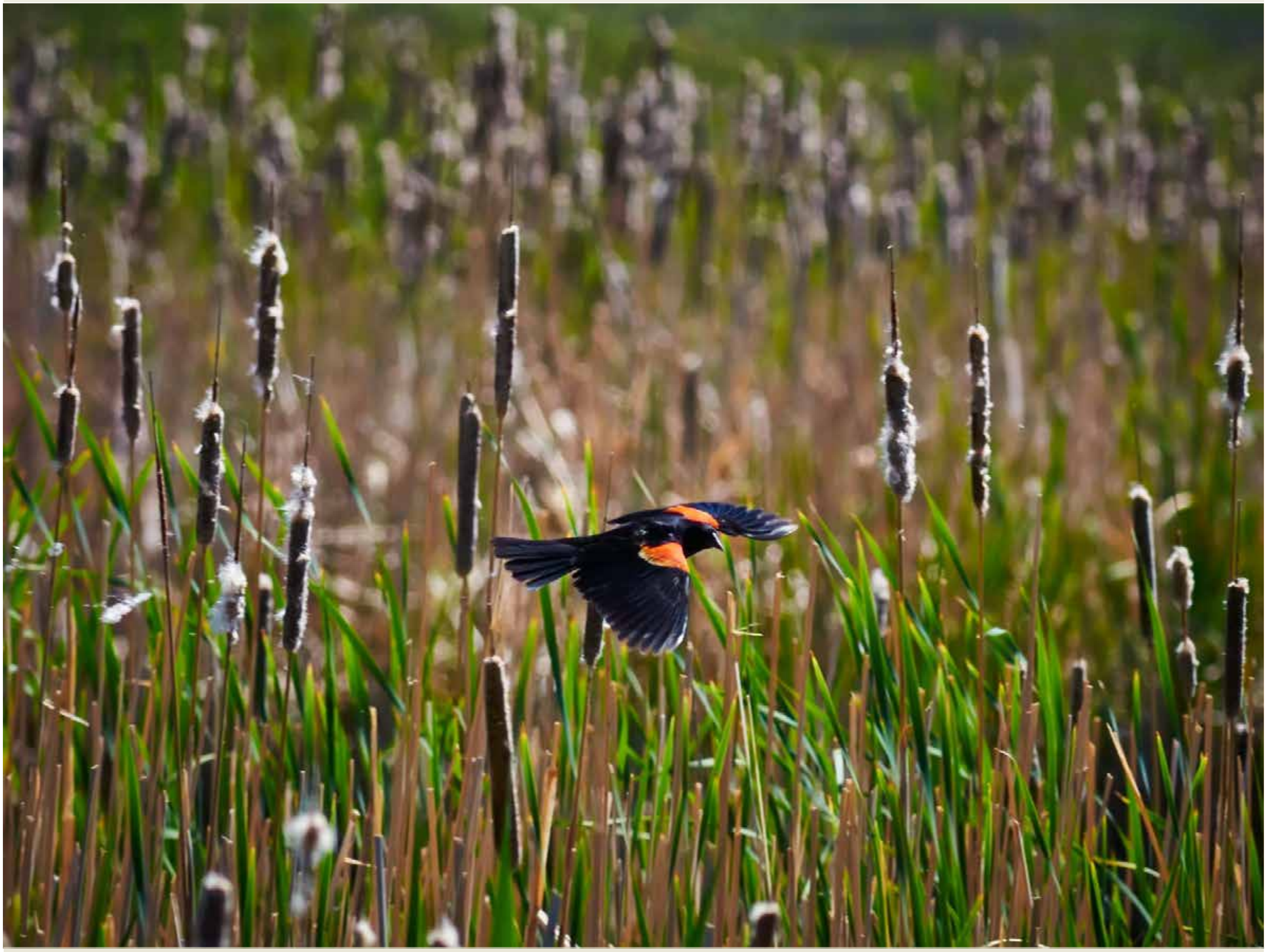
Survey and Assessment of Critical Urban Wetlands:

City and County of Denver



June 2015

WARNER COLLEGE OF Natural Resources

Colorado State University

NATURAL HERITAGE PROGRAM COLORADO

CNHP's mission is to preserve the natural diversity of life by contributing the essential scientific foundation that leads to lasting conservation of Colorado's biological wealth.

Report Prepared by:

Colorado Natural Heritage Program
Warner College of Natural Resources
Colorado State University
1475 Campus Delivery
Fort Collins, CO 80523-1475
(970) 491-1150

In collaboration with:
Kelly Uhing, City Naturalist
City and County of Denver Natural Areas

Alan Polonsky, Environmental Analyst
City and County of Denver
Dept. of Environmental Health

Report Prepared for:
City and County of Denver
Department of Environmental Health
200 W. 14th Ave.
Dept 310
Denver, CO 80204

City and County of Denver
Natural Areas Program
201 W. Colfax Ave.
Dept 601
Denver, CO 80204

U.S. Environmental Protection Agency, Region 8
1595 Wynkoop St.
Denver, CO 80202

Recommended Citation:
Smith, P. and B. Kuhn. 2015. Survey and Assessment of Critical Urban Wetlands: City and County of Denver. Colorado Natural Heritage Program, Colorado State University, Fort Collins, Colorado.

Front Cover: Red-winged Blackbird flies through cattails at Bluff Lake. © Michael Menefee, Colorado Natural Heritage Program

Survey and Assessment of Critical Urban Wetlands

City and County of Denver

Pam Smith and Bernadette Kuhn

Colorado Natural Heritage Program
Warner College of Natural Resources

Colorado State University
Fort Collins, Colorado 80523-1475

June 2015

EXECUTIVE SUMMARY

Denver County is located within the South Platte River Basin and differs significantly from the rest of the basin as it is the most highly developed and densely populated area in the region. Wetlands in dense urban centers differ from natural systems due to highly modified hydrology and increased non-native plant species, but they perform critical functions such as wildlife habitat and storm water retention. Wetland extent and condition for the County were largely unknown prior to this study. Other investigators have examined wetland condition in the region including the Cherry Creek Dam (Cooper 1989), the northern Front Range (Lemly et al. 2012), and the South Platte River basins (Lemly et al. 2014). However, none of these studies specifically examined urban wetlands in Denver County. To assess the extent and functions of wetlands in Denver County, existing National Wetland Inventory (NWI) maps were updated with new imagery and ancillary spatial data layers. To assess the condition of Denver wetlands, the Ecological Integrity Assessment (EIA) methodology was used in 40 targeted wetlands within urban Denver. Six additional wetlands were assessed in Denver Mountain Parks along Bear Creek and the South Platte River, upstream of targeted Denver County wetlands.

The wetland mapping results indicate that wetlands (including waterbodies) are uncommon in Denver County and account for 2.5% of the land area. The majority of acres mapped in the NWI are large, constructed water storage reservoirs, water conveyance canals and natural rivers that dot the landscape in Denver County. These waterbodies provide surface water storage, sediment retention, groundwater recharge, and aquatic habitat. Vegetated wetlands and small ponds represent only 0.7% of the land area, but they provide nutrient cycling, shoreline stabilization, biodiversity support, native plant community maintenance and terrestrial habitat function.

Condition assessment (EIA) results show the wetlands surveyed in urban Denver scored lower than those in Denver Mountain Parks. This was expected due to small or non-existent vegetated buffers, higher cover of non-native plant species, levels of human disturbance, and altered hydrologic processes. However, Denver's urban wetlands provided habitat for three rare plant species: sweetflag (*Acorus calamus*), broadfruit bur-reed (*Sparganium eurycarpum*) and plains ragweed (*Ambrosia linearis*) and a range of habitats for high quality native plants and wildlife.

Management efforts for protecting and improving Denver's urban wetlands should focus on protecting water quality and increasing opportunities for public education. Allowing shoreline vegetation to expand and reducing the use of herbicides, pesticides and mowed areas immediately adjacent to wetlands and lakes will help promote the growth of wetland plant species and will protect water quality. Protecting surrounding lands by limiting development, impervious surfaces, and by utilizing environmentally friendly landscaping techniques will also improve water quality and functionality of Denver's wetland resources. Reconnecting rivers to their floodplains and facilitating structural diversity in wetlands adjacent to rivers would improve or restore a variety of wetland functions to Denver wetlands. Establishment of more Natural Areas and conserving more wetlands in the watershed will promote healthier wetlands while providing opportunities for public education and outreach to improve the quality of life for Denver's residents and visitors.

SUMMARY OF FINDINGS

Wetland Mapping

- National Wetland Inventory (NWI) maps were updated using multiple sources of updated imagery for 11 USGS quadrangle maps that include Denver County.
- 2,510 acres or 2.5% of Denver County is mapped as wetlands and waterbodies.
- 43% of the mapped acres (1,070 acres) are lakes and reservoirs and 17% (425 acres) are rivers, streams and canals.
- 28% of mapped acres (714 acres) are vegetated wetlands and ponds. Of these, herbaceous wetlands and ponds were the most common.
- The remaining 12% of mapped acres (301 acres) are non-wetland riparian areas.
- Waterbodies in Denver County perform four out of ten wetland functions identified in the spatial analysis to a high level: surface water storage, ground water recharge, sediment retention and aquatic habitat.
- Vegetated wetlands and ponds support high levels of biodiversity support, native plant community maintenance and terrestrial habitat.

Wetland Condition Assessment

- Ecological Integrity Assessments (EIA) and surveys for critical biological resources were conducted at 46 targeted wetlands that collectively covered 597 acres. Forty target wetlands were surveyed in urban Denver (518 acres) and six were surveyed in Denver Mountain Parks (79 acres). Section 7 includes site descriptions for each wetland surveyed.
- A prioritized list of wetlands was created using scoring from the Ecological Integrity Assessments (EIA).
- The six wetlands assessed in Denver Mountain Parks had the highest overall EIA scores.
- Two wetlands in Denver County received overall EIA scores approaching those of wetlands in Denver Mountain Parks.
- 24 new county records for vascular plants were documented during the survey.
- 5 new occurrences for rare vascular plants, representing three different species, and one previously known occurrence were documented in Denver County.
- 1 rare animal species was documented at Denver Mountain Parks.
- Spatial and tabular data for all rare plant and animal species were entered into CNHP's Biotics database as Element Occurrences and have been provided to Denver County.
- All of the wetlands surveyed for this effort were found to provide important functions and are worthy of protection efforts because of ecological and social value to the community.
- None of the surveyed wetlands were considered to have no value or to be non-functioning wetlands.
- The quality of the surrounding buffer lands is probably the single most important factor that protects and enhances the quality of the wetlands within the County.

Management Recommendations

- Wetland condition, function, and wildlife and recreational values can be improved by allowing more natural vegetation to grow along existing waterbodies and wetlands by reducing mowing zones, bare surfaces and manicured lawns.
- Herbicide, pesticide, and fertilizer treatments in or near wetlands should be reconsidered in the context of the urban environment and include the protection of water quality.

ACKNOWLEDGEMENTS

This project was made possible by funding from the U.S. Environmental Protection Agency (EPA) Region 8. Our sincere appreciation is extended to Cynthia Gonazles, Sarah Fowler, Jill Minter, and Billy Bunch for their assistance.

The City and County of Denver staff members Kelly Uhing, Alan Polonsky and Mel Keyer provided valuable input and support for field work, and hosted stakeholder meetings.

CNHP staff members Joanna Lemly, Denise Culver and Laurie Gilligan contributed training, support and advice. Jeremy Sueltenfuss and Gabrielle Smith conducted all wetland mapping for this project. John Sovell and Adam Wagner provided zoological observations. Michael Menefee added photographic services, Jill Handwerk and Amy Greenwell provided CNHP database support. IT support was administered by Rob Fredericks. Stacey Anderson, David Leatherman, and Rich Scully donated 100 hours of volunteer support. Colorado State University students Sierra Crumbaker and Allysa Meier provided data entry and specimen labeling.

We are grateful to the following individuals for granting us access to private lands: Patricia Carmody and Chris Story. Jennifer Ackerfield assisted with specimen identification. Marika Majack provided valuable input on “pondweed”(*Potamogeton*) specimens.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

APPENDICES

1.0 INTRODUCTION

Wetlands cover only two percent of the landscape in Colorado (Dahl 1990), but are among the most biologically diverse and productive ecosystems in the state. Wetlands provide a vast array of ecosystem services including water filtration, flood protection, groundwater recharge, nutrient cycling, channel stabilization, and fish and wildlife habitat (Mitsch & Gooselink 2007: Millennium Ecosystem Assessment 2005). Despite these essential services, studies indicate that freshwater vegetated wetlands have been reduced by 50 percent across the nation (Dahl 2011). Urbanization is one of the major causes of direct loss and degradation of wetlands (McKinney 2002; EPA 1994). Urban wetlands face considerable stress from high disturbance regimes and poor water quality, but they can still provide valuable functions, especially surface water storage, ground water recharge, flood prevention and sediment retention. These functions are critical in urban areas where impervious surfaces reach levels between 75 to 100 percent. The City and County of Denver (CCD), which will be referred to in this report as either Denver County or the CCD, is the center of a large, continuously urbanized area of Colorado called the Front Range and it is the second most populated county with a total of 634,265 residents (U.S. Census Bureau 2012). However, it has the highest population density in the state (and within the entire region) with over 3,800 people per square mile. Thus, the pressure to develop on or adjacent to wetlands and the need to protect them are extremely high in Denver County.

Water quality in urban wetlands is impacted by higher concentrations of pollutants and larger areas of disturbed and impervious surfaces. Fertilizers, pesticides from residential lawns and gardens, and oil and chemicals from motor vehicles are washed into wetlands during precipitation events, degrading water quality and wetland condition. Concentrations of chlorides, nutrients, and other pollutants are typically one to two orders of magnitude higher than predevelopment conditions (Schueler 1987). Impervious surfaces can cause water temperatures in urban wetlands to be unnaturally high. As runoff moves over warmed asphalt, concrete, and other impervious surfaces common in urban settings, the water temperature rises, and dissolved oxygen levels decrease. Warmer water temperatures and decreased dissolved oxygen can cause stress and mortality to aquatic organisms (EPA 1993). Plant cover is sparse in urban areas and the associated disturbances promote the growth of non-native species in open areas and wetlands. The quantity and quality of the shoreline vegetation or buffer vegetation directly influences the ecological integrity of lakes and wetlands and is one of the most important features that protect water quality from urban impacts.

Although recent studies have focused on wetland condition along Colorado's Front Range (Lemly et al. 2012, Lemly et al. 2014), little information prior to this project was available on the status and trends of extant wetlands within Denver County. Current information on the location and condition of wetlands in dense urban areas is needed for planners, land managers, and the public across the country to prioritize effective conservation and restoration efforts. The main goal of this project was to provide the CCD with a prioritized list of wetlands that were evaluated for condition and function using metrics that had been used across the state.

1.1 Statewide Strategies for Colorado Wetlands

The Colorado Natural Heritage Program [CNHP] has been conducting wetland surveys across the state since 1992. In 2010, CNHP partnered with Colorado Parks and Wildlife [CPW] to develop *Statewide Strategies for Colorado's Wetlands* (Lemly et al. 2011). Under the guidance of these strategies, both organizations have worked together to catalogue the location, type, and condition of Colorado's wetlands through a series of river basin-scale wetland mapping and condition assessment projects. The Rio Grande Headwaters River Basin Assessment was completed in 2011 (Lemly et al. 2011); the North Platte River Basin was completed in 2012 (Lemly and Gilligan 2012); and the Lower South Platte River Basin Assessment was completed in 2014 (Lemly et al. 2015, draft). CNHP and CPW are actively working to complete wetland assessments for all of the river basins in Colorado. The survey and assessment of Denver's wetlands, while not at the basin-wide scale, contributes to the greater understanding of Colorado's often-overlooked urban wetlands. Information from completed assessments is available on the CNHP website at http://www.cnhp.colostate.edu/cwic/index.asp.

The basin-wide projects and this current study have two major components: digital wetland mapping and field-based assessments. Digital National Wetland Inventory (NWI) maps are created by digitizing existing paper maps or updating maps based on new aerial photography. These maps are then used to summarize the types, abundance, and distribution of wetlands in a defined geographic area. Field-based assessments are conducted to examine the ecological condition and stressors present at individual wetlands. These assessments can be used to provide an overall picture of wetlands across the study area. The overall goal of the basin-wide assessments, as well as this study, is to provide land managers with information to inform conservation and restoration efforts.

1.2 Project Objectives

The five primary objectives of the Survey and Assessment of Critical Urban Wetlands for the City and County of Denver are as follows:

1. Use aerial imagery to delineate newly updated NWI maps for the CCD.
2. Assess the condition of targeted wetlands within the CCD and selected Denver Mountain Parks.
3. Create a prioritized list of wetlands based on condition assessment data.
4. Provide the CCD with geospatial data on any rare species documented in the study area.
5. Create an educational brochure highlighting the importance of Denver's urban wetlands.

2.0 Study Area

2.1 Geography

The project area is located in Denver County and at selected wetland sites in the Denver Mountain Parks in Colorado (Figure 1). Denver County encompasses 401 square kilometers (155 sq. miles). Although it is the second smallest county in Colorado, it contains the largest city in Colorado (US Census Bureau 2013). Denver County is situated east of the Front Range and is part of the Southern Rocky Mountains, which run from Casper, Wyoming south to Pueblo, Colorado. The name Front Range also applies to the densely populated urban corridor along U.S. Interstate 25. The South Platte River flows through Denver County and is fed by smaller tributaries including Bear Creek, Cherry Creek, and Sand Creek.

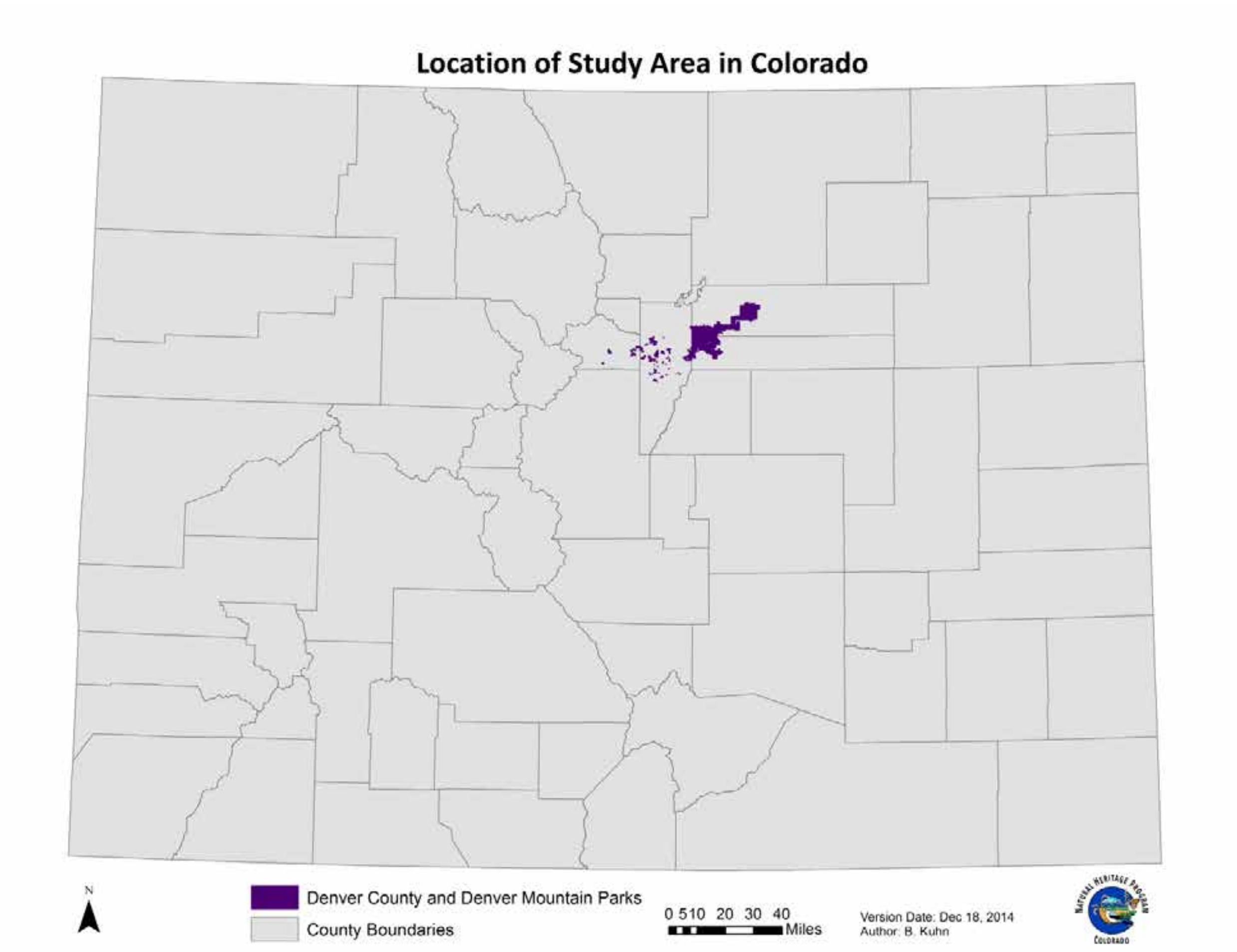


Figure 1. Location of Denver County and Denver Mountain Parks in Colorado.

2.2 Ecoregions and Vegetation

Colorado has diverse ecosystems that have been divided into areas called ecoregions (Chapman et al. 2006). Ecoregions are defined as areas of land with similar geology, vegetation, climate, soils and are designed to provide a spatial framework for environmental resource management. There are four levels of ecoregions. Level I is very coarse and Levels III and IV have finer resolutions. In the United States there are 86 Level III Ecoregions, with six found within the State of Colorado.

Denver County is located in the High Plains Level III Ecoregion, which is located in the northeastern section of Colorado (Figure 2). The High Plains Level III Ecoregion is the western edge of the Great Plains, as it juts up against the Southern Rocky Mountains. Rolling plains and tablelands are characteristic of this ecoregion and the dry arid conditions support mostly short-grass and mixed grass prairie systems (Chapman et al. 2006). Land uses range from dryland to irrigated farming and cattle ranching, though in Denver County most of the land is now highly urbanized with only small fragments of this natural ecoregion still present.

At a finer scale, the study area for the CCD contains two Level IV Ecoregions: 1) Flat to Rolling Plains in Denver County, and 2) Front Range Fans in the western portion of the study area.

The Denver Mountain Parks in Jefferson County fall within the Southern Rocky Mountains Level III Ecoregion (Figure 2). The Mountain Parks are scattered across three Level IV Ecoregions: 1) Foothills and Shrublands, 2) Crystalline Mid-Elevation Forests and Shrublands, and 3) Crystalline Subalpine Forests.

The lowest elevation sites were located at ~1,550 m (~5,000 ft) within the High Plains Level III Ecoregion; our highest sites ranged in elevation from 1830–2440 m (6,000–8,000 ft). One site fell outside this range: Echo Lake Park at 3,230m (10,600 feet). Wetlands located in the High Plains ecoregion in the eastern portion of Denver County were often urban parks owned by the City and County of Denver. Most of the native vegetation in the High Plains ecoregion has been replaced by urban development in Denver County. Existing open space is typically highly managed parks, golf courses, cemeteries and open spaces. However, there were wetlands with some native vegetation cover within the urban Denver area. Many of these were located along streams or the South Platte River. These sites were dominated by native overstory species such as coyote willow (*Salix exigua*) and plains cottonwood (*Populus deltoides*), as well as non-native species like crack willow (*Salix fragilis*), Canada thistle (*Cirsium arvense* [syn: *Breea arvense*]) and smooth brome (*Bromus inermis*). Emergent marshes in the Flat to Rolling Plains ecoregion were typically dominated by native bulrushes (*Schoenoplectus* spp.) and cattails (*Typha* spp.).

The wetland sites in the Southern Rocky Mountain Level III Ecoregion were typically located at elevations of 1830–2440 m (6,000–8,000 ft) along smaller creeks that serve as tributaries to the South Platte River. All of our surveyed wetlands in this area were designated Denver Mountain Parks. The Denver Mountain Park sites within the Southern Rocky Mountain ecoregion were dominated by native shrubs such as thin-leaf alder (*Alnus incana*), coyote willow (*Salix exigua*), and water birch (*Betula occidentalis*). Common tree species present at the sites included blue spruce (*Picea pungens*), ponderosa pine (*Pinus ponderosa*) and Douglas fir (*Pseudotsuga menziesii*). Our highest elevation site, Echo Lake (3,230 m) was located within the Crystalline Subalpine Forests ecoregion.

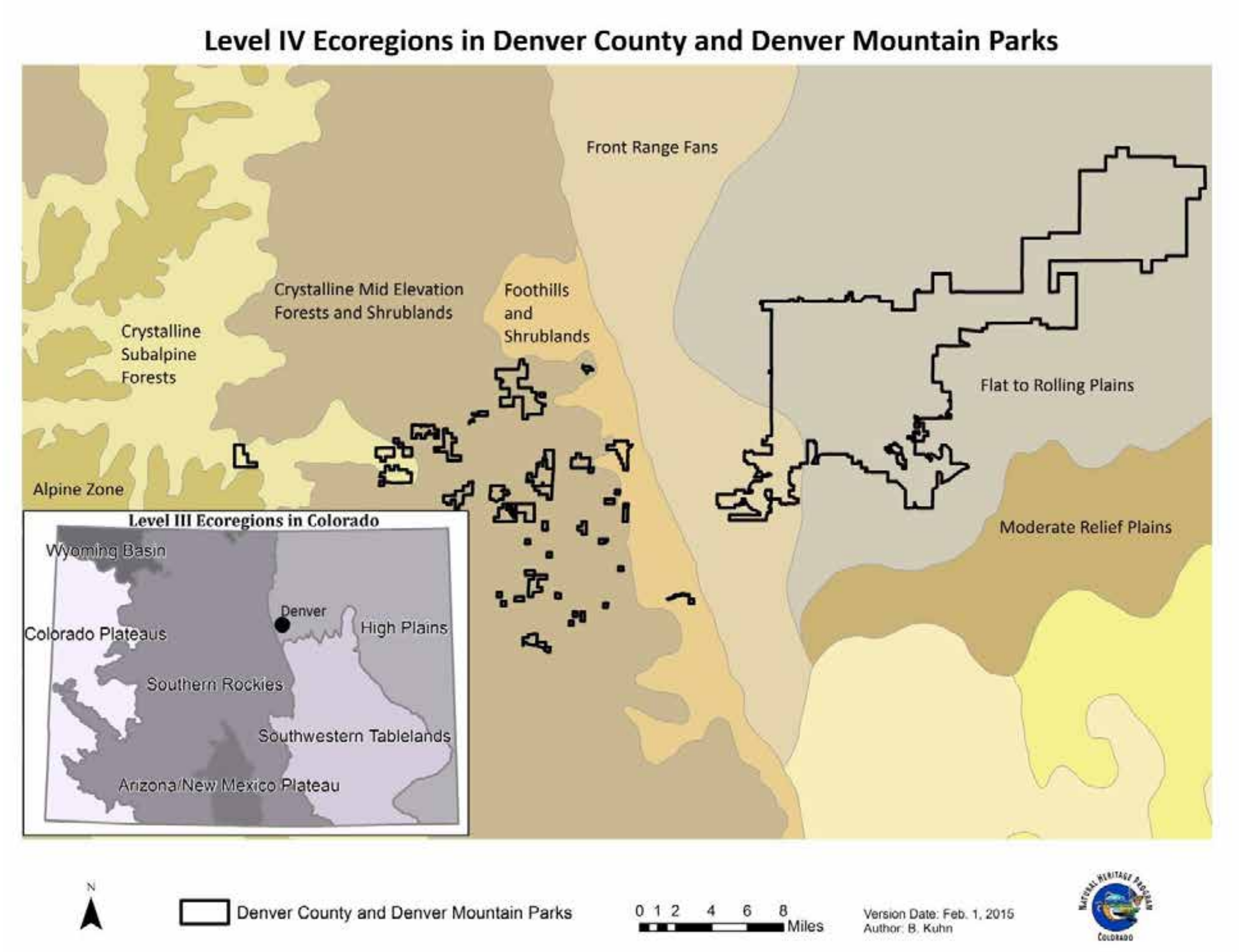


Figure 2. Level III and IV Ecoregions in the Denver Study Area in Colorado.

2.3 Climate

Denver County is located in the rain shadow of the Southern Rocky Mountains and the climate is therefore considered semi-arid. Weather station data from 1948–2013 shows an average annual precipitation of 39.17 cm or 15.42 inches (High Plains Regional Climate Center [HPRCC] 2015). Spring rains and summer thunderstorms bring most of the annual precipitation that falls in the study area. These events can cause major flooding along the South Platte River and its tributaries. During the hot summer months, the mean maximum temperature is 85°F (HPRCC 2015). Winters are typically cold and dry on the eastern side of the study area. Higher elevation sites in the Denver Mountain Parks usually receive higher amounts of snowfall during the winter.

2.4 Hydrology

Hydrology is the movement of water in relation to the landscape and is the key driver for wetlands. The United States have been divided by a hierarchy of hydrologic units and each is identified by a hydrologic unit code or HUC. Using the eight digit HUC codes, Denver County contains portions of Middle South Platte River-Cherry Creek, Upper South Platte River, and Clear Creek sub-basins. The majority of the County is located in the Middle South Platte River-Cherry Creek Watershed (Figure 3).

The South Platte River flows from south to north through the western portion of Denver County. The headwaters originate as snowmelt south and west of Denver in Park County, and flow down through the foothills of the Front Range and out onto the High Plains of Colorado. Upon entering the High Plains, the South Platte River becomes an urban river for approximately 16.9 km (10.5 miles) as it flows through the City of Denver. Sand Creek, Bear Creek, and Cherry Creek form the largest tributaries to the South Platte River in Denver County. This stretch of the South Platte River is highly channelized and impacted by urban development. Stormwater runoff is a major water source. Clear Creek, a major tributary of the South Platte River, flows through the northwest corner of the County. From Denver, the South Platte River flows to the northeastern corner of Colorado, traversing 724 km (450 miles) from its headwaters before joining the North Platte River in the City of North Platte, Nebraska.

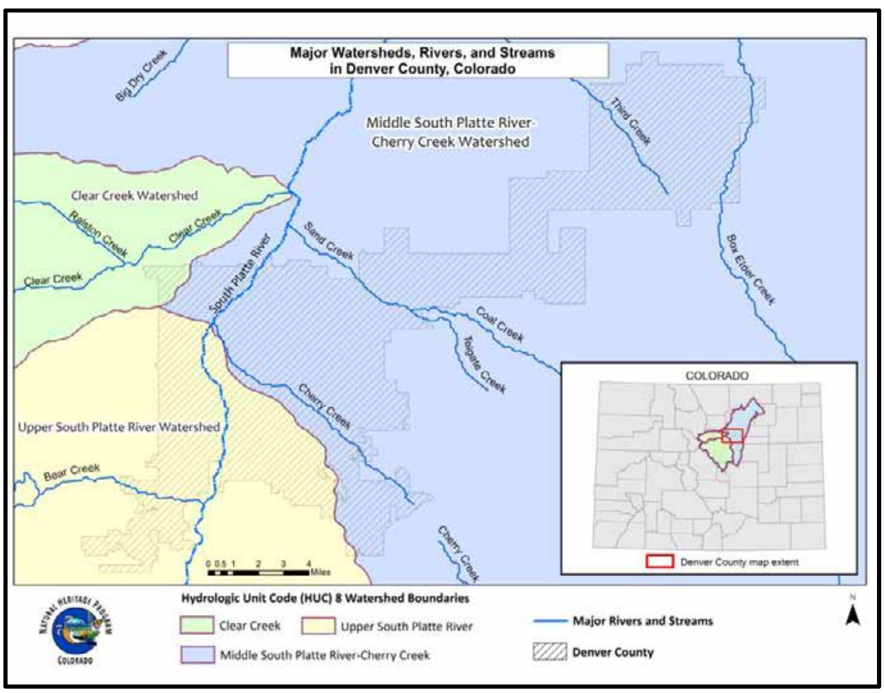


Figure 3. Map of Hydrologic Unit Code (HUC) 8 Boundaries located in Denver County (USGS 2014b).

Mean annual flow for the South Platte River gauge in Commerce City in the northeastern part of Denver is 563 cfs (USGS 2014a). Major flood events have occurred in Denver County; the most notable historical floods were in 1864, 1912, and 1965. A major flood event occurred during the first year of our study on September 9, 2013, in parts of Denver County and included 13 other counties in Colorado. Several wetlands included in our study were heavily impacted by flooding from this event.

2.5 Geology

Denver County is located in the Denver Basin, a large structural depression that extends from the Front Range to the eastern plains of Colorado, stretching from Boulder, Colorado Springs, and east to Limon (Barclay and Johnson 2004). The basin contains strata deposited during the uplift of the Rocky Mountain Front Range in the Late Cretaceous and Paleogene Period (Barclay et al. 2003; Kirkham and Ladwig 1979; Raynolds and Johnson 2002). The Denver Mountain Parks and the western edge of Denver County contain strata of Paleozoic and Mesozoic age that have been pushed up to the surface. Here, tilted rocks and rows of hogbacks alternate with low, smooth swales on the plains in the western portion of Denver County. The uppermost geologic layer is the Denver Formation. This formation is cut by the South Platte River and its tributaries (Chronic and Williams 2013).

2.6 Land Use History

The waters of the South Platte River and its tributaries have supported human occupation of Colorado's eastern plains and foothills for at least 13,000 years, but the region remained sparsely populated until the arrival of horses in the seventeenth century (Gunnerson 1987; Yohe and Bamforth 2013; Weber 1994). The introduction of the horse enabled many Native American groups to become nomadic hunters on the bison-rich plains. The Great Plains—especially the riparian zones along the South Platte and its tributaries—saw a dramatic increase in human use in this period (Hämäläinen 2009; West 2000). The Denver area likely served as hunting and overwintering grounds for the Arapaho and Cheyenne since the early eighteenth century (Fowler 1989). These tribes occupied parts of Wyoming, Kansas, Nebraska, and eastern Colorado.

In the mid-nineteenth century, white settlers moved into the area, slaughtering bison herds, and creating conflict with the Arapaho and Cheyenne tribes and others. In 1858, when gold was discovered near Denver at the confluence of Dry Creek and the South Platte River, miners, farmers, city-dwellers, and politicians streamed into the area, making nomadic lifestyles ever more difficult (Fowler 1986, West 2000). During that same year, entrepreneurs founded the towns of Auraria and Denver on opposite banks of Cherry Creek (Limerick 2012). Later, in 1869, the United States Government compelled many Arapaho and Cheyenne to abandon their territory, relocating them to a new reservation in Oklahoma. Denver County's population continued to grow, rising from 35,000 in 1880s to 649,495 in 2013 (U.S. Census Bureau 2013).

Today, the western and central portions of Denver County are characterized by urban and industrial land use. These areas support residential and commercial development dotted with open spaces and parks. The eastern and northern portions of the County contain a mix of low density residential development and a large tract of land that contains the Denver International Airport, and adjacent agricultural fields.

3.0 METHODS

3.1 Denver County Wetland Mapping

The U.S Fish and Wildlife Service National Wetland Inventory (NWI) program originally mapped wetlands and waterbodies of Denver County in the 1980s. Widespread land use changes in the last 30+ years, along with substantial increases in the quality of aerial images and changes in mapping methods, necessitated an update to the NWI maps. As part of this project, CNHP completed up-to-date wetland mapping for 11 USGS quads that overlap with the boundary of Denver County (Figure 4). To complete wetland mapping for Denver County, CNHP obtained color infra-red (CIR) and true color aerial photography flown in 2010 from Denver County. Along with this imagery, a combination of ancillary data sources were used to identify and classify wetland features in the study area, including 2009 true color images, topographic maps, political maps, Colorado Parks and Wildlife riparian polygons (generated in early 2000s) and original NWI polygons (see Appendix A for detailed mapping methodologies). Wetlands were attributed according to the NWI wetland classification system (Cowardin et al. 1979), which has become the federal standard for wetland classification. Wetland data were enhanced by including the Landscape, Landform, Water Flow Path, and Waterbody (LLWW) classification that was developed by Tiner (2003) to provide information on possible wetland functions similar to the Hydrogeomorphic classification (Brinson 1993).

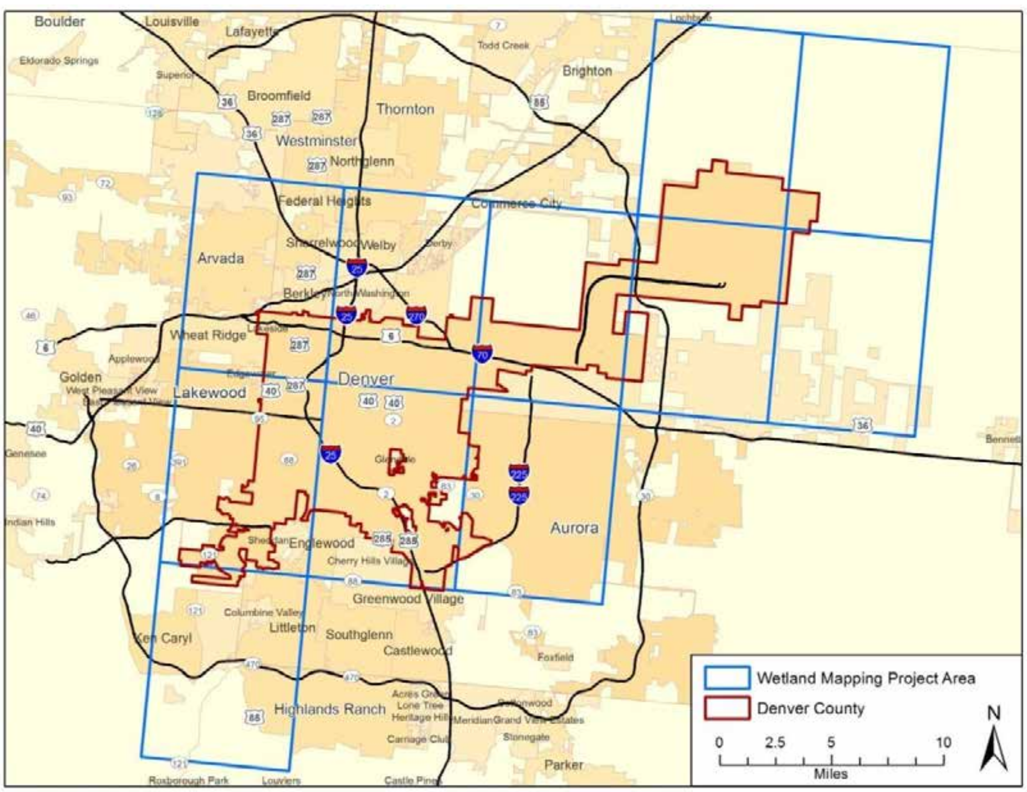


Figure 4. Denver County wetland mapping project area.

Since Denver County is the most densely populated county in Colorado, the wetland resources of the county are very different than those in the Denver Mountain Parks. In an effort to compare the wetland resources in Denver County to their natural analogs, CNHP analyzed previously created NWI mapping for the Denver Mountain Parks. Data from these areas are presented in this report for the purposes of comparison, though the data were created prior to this project and not updated for this project.

Using the imagery described above, CNHP wetland mapping specialists visually analyzed each part of the Denver County landscape to identify existing wetlands and waterbodies. Each mapped polygon was attributed with both the NWI classification as well as the LLWW classification. The NWI classification has been used extensively since its creation in 1979. The LLWW is a newer classification that, along with the NWI attribute, can be used to make generalizations about wetland functions. The electronic data that accompanies this report includes GIS layers with the updated NWI mapping for the 11 quads that include Denver County. NWI maps for Denver Mountain Parks are available online through the U.S. Fish and Wildlife Service's Wetlands Mapper: http://www.fws.gov/Wetlands/Data/Mapper.html.

NWI Classification

The NWI classification system (Cowardin et al. 1979) is based on the following definition of wetlands:

> *"Wetlands are lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water. For purposes of this classification wetlands must have one or more of the following attributes: (1) at least periodically, the land supports predominantly hydrophytes; (2) the substrate is predominantly undrained hydric soil; and (3) the substrate is nonsoil and is saturated with water or covered by shallow water at some time during the growing season of each year."*

The classification is a hierarchical system that describes wetlands and waterbodies at varying scales of specificity. All mapped polygons are attributed using the NWI hierarchy of system, subsystem, class, hydrology, and special modifiers. The result is a 4–6 character alpha-numeric code (see Appendix B for the full classification system). It is important to note that NWI data contains deep waterbodies (lakes and rivers) as well as wetlands.

LLWW Classification

The LLWW attribution scheme (Tiner 2003) utilizes the same definitions as the Cowardin classification, but attributes each polygon according to physical conditions including landscape position, landform type, water flow path, and waterbody type, each of which impact the potential functioning of a wetland. Each level of the LLWW is described using a two letter code and results in a 4-8 character LLWW alphanumeric code (see Appendix B for the full classification system). It is important to note, both for the sake of proper land management and for the understanding of LLWW codes, that wetlands and waterbodies are different. Lakes are not wetlands, though wetlands often exist along their margins.

Mapping Ecological Functions

The LLWW classification is modified from the Hydrogeomorphic (HGM) classification developed by Brinson (1993). This classification emphasizes the physical setting and characteristics of a wetland, which are strongly associated with the functions occurring in that wetland. What the LLWW system does not include, however, are the biotic components of the wetland which are also of integral importance to wetland functions. By combining the NWI attribution, which is largely based on the biotic conditions of the wetland, with the LLWW classification, assumptions can be made about the functions occurring in different types of wetlands. While some wetland types are known to function at higher rates than others, it is important to remember that every wetland provides these functions to varying degrees. The functions listed below are associated with particular NWI and LLWW codes, but are meant to represent wetlands of that type in high ecological condition. If a wetland is degraded or stressed, its ecological functioning is similarly stressed. This characterization of wetland functions aims at identifying particular wetlands that may be providing particular services of interest. It is fundamentally *not* a "value" judgement on wetlands or a means to rank which wetlands are more important than others. For example, highly stressed wetlands adjacent to urban populations may provide higher rates of needed functions compared to pristine wetlands far from that urban center. Simply because the wetland is stressed, does not mean it is not valuable.

The functions used in this analysis are largely based on reports from the Montana Natural Heritage Program (Kudray and Schemm 2008) and further informed by reports by Saint Mary's University of Minnesota (Richtman et al. 2012). Functions are separated into three primary categories: Hydrologic, Biogeochemical, and Habitat.

Functions Related to Hydrology

The delivery of clean water to downstream communities is of vital importance in the arid West. The following functions aim to address factors related to the timing of water delivery and the quantity of water delivered.

> *Groundwater Recharge* – The downward movement of surface water into the groundwater system to recharge the aquifer.
>
> *Surface Water Storage* – Storage of surface water to attenuate downstream floods during spring snow melt or following rain events.
>
> *Streamflow Maintenance* – The increase in minimum stream flow through the continual release of water into streams during droughts or late summer low flow periods.

Functions Related to Biogeochemical Processes

Along with the quantity and timing of water delivery, the delivery of clean water with low levels of nutrients and sediment is highly valuable to downstream communities. Along with delivering clean water, wetlands are known to stabilize sediment and shorelines, store carbon, and mitigate temperature fluctuations in streams for fish populations. The following functions relate to the biogeochemical processes of water quality improvement and sediment retention.

Nutrient Transformation – The conversion of nutrients into less harmful forms performed by natural biogeochemical processing within wetlands and leading to cleaner downstream water.

Sediment Retention – Filtering out previously mobilized sediment leading to a decrease in stream turbidity and increasing water quality.

Shoreline Stabilization – Decrease in shoreline erosion due to wetland plant roots holding onto the banks.

Functions Related to Habitat

Wetlands support a variety of plant and animal species and are crucial for preserving biodiversity within an otherwise urban environment like Denver County.

Terrestrial Habitat – Wetlands are a critical habitat resource for terrestrial birds and mammals.

Aquatic Habitat – Wetlands and waterbodies provide habitat for fish and amphibians.

Native Plant Community Maintenance – The ability of wetlands to provide support for native plant communities.

Biodiversity Support – Some wetlands provide more support for both native plants and animals than others. These wetlands are generally less common than the average wetland.

3.2 Wetland Condition Assessment

Wetland Assessment Framework

The Ecological Integrity Assessment (EIA) framework, developed by NatureServe (Faber-Langendoen et al. 2006; Faber-Langendoen et al. 2008), was used to conduct surveys at the selected Denver wetlands. The EIA framework evaluates wetland condition based on four biotic and abiotic categories: 1) Landscape context, 2) Biotic condition, 3) Hydrologic condition, and 4) Physiochemical condition. Each category contains three to six metrics, which are used to evaluate how far the wetland deviates from reference condition (i.e., before human disturbance). Both qualitative and quantitative criteria are used to score each metric. The metric scores are then rolled up into a category score, and category scores are rolled up into an overall EIA score and rank. Possible scores range from 1.0 to 5.0, and can be given alphabetic ranks of A, B, C or D, which correspond to different levels of alteration and represent different management opportunities (Table 1). See more about the EIA metrics and roll-up under Data Analysis below.

The EIA protocols were developed specifically for wetland types in Colorado by CNHP with funding from EPA Region 8 and Colorado Parks and Wildlife (Lemly and Rocchio 2009; Lemly et al. 2011). The EIA method can be used at varying levels of intensity. For this study, the EIA method was used as a rapid assessment to evaluate the general condition of wetlands. The field portion of the assessments took approximately 4–5 hours depending on the size of the site. In addition, a substantial amount of time was spent on data entry, quality checking, analysis, and interpretation of the results.

One of the primary goals for this study was to assist the City and County of Denver in prioritizing a list of wetlands that were evaluated for condition and function using metrics that have been applied state-wide. The EIA metrics have typically been used in Colorado to evaluate more natural wetlands, however, other studies have successfully applied condition assessment methods in urban settings (Mack and Micacchion 2007). Prior to beginning our assessment, we anticipated that very few of our urban wetland sites would score above average (~C rank). We expected most of our sites to have D ranks for the following reasons: 1) most urban wetlands are not natural features; 2) they are greatly impacted by a high percentage of impervious surfaces within their watersheds; and 3) the vegetated buffers in the landscape are either narrow or non-existent.

Table 1. Definition of Ecological Integrity Assessment ranks. Modified from Faber-Langendoen et al. 2008.

Rank Value	Description
A **(4.5-5.0)**	**Reference Condition (No or Minimal Human Impact):** Wetland functions within the bounds of natural disturbance regimes. The surrounding landscape contains natural habitats that are essentially unfragmented with little to no stressors; vegetation structure and composition are within the natural range of variation, nonnative species are essentially absent, and a comprehensive set of key species are present; soil properties and hydrological functions are intact. Management should focus on preservation and protection.
B **(3.5-4.4)**	**Slight Deviation from Reference:** Wetland predominantly functions within the bounds of natural disturbance regimes. The surrounding landscape contains largely natural habitats that are minimally fragmented with few stressors; vegetation structure and composition deviate slightly from the natural range of variation, nonnative species and noxious weeds are present in minor amounts, and most key species are present; soils properties and hydrology are only slightly altered. Management should focus on the prevention of further alteration.
C **(2.5-3.4)**	**Moderate Deviation from Reference:** Wetland has a number of unfavorable characteristics. The surrounding landscape is moderately fragmented with several stressors; the vegetation structure and composition is somewhat outside the natural range of variation, nonnative species and noxious weeds may have a sizeable presence or moderately negative impacts, and many key species are absent; soil properties and hydrology are altered. Management would be needed to maintain or restore certain ecological attributes.
D **(1.0-2.4)**	**Significant Deviation from Reference:** Wetland has severely altered characteristics. The surrounding landscape contains little natural habitat and is very fragmented; the vegetation structure and composition are well beyond their natural range of variation, nonnative species and noxious weeds exert a strong negative impact, and most key species are absent; soil properties and hydrology are severely altered. There may be little long term conservation value without restoration, and such restoration may be difficult or uncertain.

Site Selection

Target wetlands were selected using aerial imagery, topographical maps, National Wetland Inventory (NWI) maps from the 1980s, and new NWI maps generated by CNHP for this project. Additional input was contributed by a stakeholder group, which met twice during the planning phase. Using stakeholder input and map resources, a list of target wetlands was created. The targeted sites were then ranked A, B or C based on size and potential to be a natural feature and/or a functioning wetland. Target A sites were given highest priority for field survey and appeared as wetlands on at least two data sources, Target B sites appeared as wet areas on at least one data source and Target C sites were indeterminate from the air photos and were less than an acre in size. A list of Target Inventory Areas (TIAs) is included in Appendix C (provided electronically). Access was provided for areas owned by the City and County of Denver, Denver Mountain Parks and private land owners. The size (>0.5 acre), vegetation, and surrounding landscape (presence of a vegetated buffer) were also important criteria for prioritizing our target sites. Random sampling was not a part of our study design, since we were targeting the highest quality wetlands. We also did not use standard sized survey plots, but surveyed the entire wetland or at least as much of the wetland with legal access.

The initial goal was to conduct condition assessments at approximately 70–100 wetlands. However, the assessment protocol we used was developed for smaller survey sites (1.2 acre or 0.5 hectare). Due to the small number of suitable wetland sites available in our study area, we elected to assess the entire area of each target wetland, or as much of it as possible within the political boundary, instead of random plots. Therefore, the total number of field survey sites was smaller (46 sites), but the average plot size was fairly large (12 acres). Denver Mountain Park sites that were selected for an assessment included those located on major tributaries to Denver County: Bear Creek and Turkey Creek. These were surveyed to be used as a comparison to the urban wetlands in Denver because of their more natural hydrologic regimes, lower levels of disturbance, and higher plant diversity.

Field Methods

In the field, Assessment Areas (AAs) were defined as the entire wetland or portion of the wetland targeted for the condition assessment. These areas were first delineated on paper maps and/or air photos and final boundaries were confirmed with field visits. Once the AA was established, a field form was used to record data and make observations at the site (Appendix D).

Information was collected on the following attributes:

- UTM coordinates and photo points taken at four locations on the perimeter of the AA
- Elevation, slope, and aspect
- Landownership and directions to site
- Ecological System classification (see Appendix A)
- HGM classification (see Appendix B)
- Cowardin classification
- Vegetation zones within the AA
- Species list of all plants observed with qualitative cover estimate

- Incidental wildlife observations
- Description of onsite and adjacent ecological processes and land use
- Description of general site characteristics and a site drawing
- Photos to document overall characteristics of wetland
- Description of soil profile

Soil pits were used to assess and describe the soil profile at some sites. However, a number of Denver's urban wetlands were known to contain or had the potential to contain contaminated soils. In addition, many sites were located in parks with heavy recreation use. In the interest of safety, soil pits were not dug at these sites. Instead, we used soil maps, field observations of exposed soils, and photos to describe soil characteristics at these sites.

Data Analysis

Data collected in the field and gleaned from air photos and wetland mapping were used to rate each EIA metric. To calculate the overall EIA score, sub-scores were first calculated for the four ecological categories based on their component metrics (Table 2). The formulas and weights for each metric and category are provided in Appendix G. The four ecological categories were then weighted and combined to generate an overall numeric EIA score (range 1.0–5.0) and an accompanying EIA Rank (A, B, C, or D) (Appendix G – Table 2). The weights for each category are based on the relative importance of each category to overall condition and our confidence in rating the component metrics accurately.

Table 2. Ecological Integrity Assessment metrics used to evaluate wetland condition at all sites.

ECOLOGICAL CATEGORIES	KEY ECOLOGICAL ATTRIBUTES	INDICATORS & METRICS
1) Landscape Context Weight = 0.3	Landscape Composition	landscape fragmentation (all wetlands) riparian corridor continuity (riverine wetlands)
	Buffer Index	buffer extent, buffer width, buffer condition
2) Biotic Condition Weight = 0.4	Community Composition	native plant cover, noxious weed cover, aggressive native cover
	Community Structure	woody species regeneration, litter accumulation, structural complexity
3) Hydrologic Condition Weight = 0.2	Hydrological Regime	water source, hydrologic connectivity, alteration to hydroperiod (all wetlands) bank stability, beaver activity (riverine wetlands)
4) Physiochemical Condition Weight = 0.1	Chemical /Physical Processes	soil surface disturbance, water quality

Landscape Context Metrics

The Landscape Context scores were based on qualitative and quantitative metrics that reflect the quality of the landscape that surrounds the AA, including fragmentation, buffer size and buffer condition (Table 2).

Biotic Condition Metrics

Biotic Condition scores were based on the plant species data with additional information on the community structure and regeneration. Out of the four ecological categories used to generate EIA scores, the Biotic Condition category was assigned the highest weight. This was due to our high confidence in assessing plant species composition and structure.

Nested within the Biotic Condition score is the Floristic Quality Assessment (FQA), which allows for the calculation of various indices that reflect the quality of the site from the species list and cover data collected.[1] The FQA method uses the proportion of conservative plant species in a plant community to assess the degree of "naturalness" of an area (Swink and Wilhelm 1994, Wilhelm and Masters 1996). In the FQA method, every plant species in a state or regional flora is assigned a Coefficient of Conservatism, or C-value, which range from 0–10. C-values of 10 are given to the most conservative species (only found in pristine habitats) and 6–9 are indicative of high quality habitats. A value of 5 represents a species that is found in high quality areas about 50% of the time. Middle to low range values (between 1–4) represent plants that are found in disturbed habitats greater than 50% of the time. Zero is reserved for non-native species. Conservative plant species are restricted to intact ecosystems that are minimally degraded or disturbed by human stressors whereas non-conservative, or generalist species are those which have a broader ecological niche and are found in ecosystems with moderate or high levels of disturbance from human stressors. C-values for Colorado plant species were assigned by a panel of botanical experts (Rocchio 2007).

There are a number of different numeric values that can be generated from FQA data. For the EIA, the simplest FQA metric, Mean C, is incorporated into the Biotic Condition score. Mean C can be calculated for a site by averaging the C-values of all plant species found within the site. Mean C has been shown to help reflect the biotic condition of a wetland (Lemly and Rocchio 2009). FQA metrics can also incorporate biodiversity into the scoring. In addition to the Mean C metric used within the EIA score, we also evaluated the Floristic Quality Index (FQI) for sites in this survey. The FQI is calculated by taking the Mean C of all plants multiplied by the square-root of the number of all plants. FQI scores under 20 are generally indicative of lower site quality. Most wetlands with natural hydrologic functions and average disturbance levels have FQI scores ranging from 40-60 (Lemly and Gilligan, CNHP pers. comm. 2015).

Hydrologic Condition Metrics

Hydrologic condition scores are based on the water source (ground water, surface water, runoff, pipes) connectivity to other wetlands, and non-natural alterations to the hydroperiod. Water sources and other aspects of hydrology are difficult to determine in densely urbanized

[1] The FQA calculator developed by CNHPand used for this survey is available online at http://www.cnhp.colostate.edu/cwic/assessment/fqa.asp.

developments. Therefore, a lower weight (0.2) was used to calculate the Hydrologic Condition score.

Physiochemical Condition Metrics

Physiochemical condition scores are calculated based on both water quality and the soil disturbances within the AA. The Physiochemical Condition was assigned the lowest weight (0.1) of all four of the ecological categories. Water quality is difficult to determine solely from a single field observation and requires repeated observations and chemical sampling over time. The metric for this study was not meant to replicate that type of an effort. However, there are some obvious indicators of water quality that can be observed or inferred. One of the biggest indicators of water quality impacts is the percentage of impervious surfaces. Many reports indicate water quality is impacted at 10% impervious cover. In dense urban metropolitan areas, like Denver impervious surfaces typically are in the range of 75-100% (EPA 2003). Based on that information alone, the water quality in urban Denver is significantly impacted. Other observations include sedimentation, excessive algal growth, and large diameter stormwater pipes that are indicative of large volumes of stormwater inputs.

3.3 Data Management

To efficiently store and analyze data collected from wetland condition assessment projects, a Microsoft Access™ database was built by CNHP in 2008. EIA and vegetation data were entered into the database at the completion of the field season. A pre-defined species list was used for plant species entry. During data entry, unknown or ambiguous species (e.g., *Carex* sp.) were entered into the database, but not included in data analysis. Data entry was reviewed by an independent observer for quality control. All plant specimens collected during the project were deposited at Colorado State University Herbarium (CSU).

The species table from the Colorado FQA (Rocchio 2007a) was used as the pre-defined species list and to populate life history traits, wetland indicator status, and C-values in the database for each species in each plot. Species nomenclature follows Weber and Wittmann (2001), though all names are cross-referenced to the nationally accepted names in the U.S. Department of Agriculture's PLANTS Database[2]. Life history traits and cover data were used to calculate FQA metric values using Visual Basic queries programmed in the database. Calculations made by the queries were randomly checked to ensure that the queries were constructed correctly.

3.4 Natural Heritage Methodology

To determine the status of species within Colorado, CNHP gathers information on plants, animals and plant communities. Each of these elements of natural diversity is assigned a rank that indicates its relative degree of imperilment on a five-point scale (for example, 1 = extremely rare/imperiled, 5 = abundant/secure). The primary criterion for ranking elements is the number of occurrences (in other words, the number of known distinct localities or populations). These distinct populations are known as Element Occurrence (EOs). Several other factors are used to assign ranks including size of

[2] PLANTS National Database can be accessed at the following website: http://plants.usda.gov. The National nomenclature in the Colorado FQA is based on a download from the website in January 2008.

the geographic range, the number of individuals, the trends in both population and distribution, identifiable threats and the number of protected occurrences.

Element imperilment ranks are assigned both in terms of the element's degree of imperilment within Colorado (its State-rank or S-rank) and the element's imperilment over its entire range (its Global-rank or G-rank). Taken together, these two ranks indicate the degree of imperilment of an element. CNHP actively collects, maps and electronically processes specific occurrence information for animal and plant species considered extremely imperiled to vulnerable in the state (S1 - S3). Several factors, such as rarity, evolutionary distinctiveness and endemism (specificity of habitat requirements), contribute to the conservation priority of each species. Certain species are "watch listed,"meaning that specific occurrence data are collected and periodically analyzed to determine whether more active tracking is warranted. A description of each of the Natural Heritage ranks is provided in Table 3.

Table 3. Definition of Natural Heritage Imperilment Ranks.

G/S1	Critically imperiled globally/state because of rarity (5 or fewer occurrences in the world/state; or 1,000 or fewer individuals), or because some factor of its biology makes it especially vulnerable to extinction.
G/S2	Imperiled globally/state because of rarity (6 to 20 occurrences, or 1,000 to 3,000 individuals), or because other factors demonstrably make it very vulnerable to extinction throughout its range.
G/S3	Vulnerable through its range or found locally in a restricted range (21 to 100 occurrences, or 3,000 to 10,000 individuals).
G/S4	Apparently secure globally/state, though it may be quite rare in parts of its range, especially at the periphery. Usually more than 100 occurrences and 10,000 individuals.
G/S5	Demonstrably secure globally/state, though it may be quite rare in parts of its range, especially at the periphery.
G/SX	Presumed extinct globally, or extirpated within the state.
G#?	Indicates uncertainty about an assigned global rank.
G/SU	Unable to assign rank due to lack of available information.
GQ	Indicates uncertainty about taxonomic status.
G/SH	Historically known, but usually not verified for an extended period of time.
G#T#	Trinomial rank (T) is used for subspecies or varieties. These taxa are ranked on the same criteria as G1-G5.
S#B	Refers to the breeding season imperilment of elements that are not residents.
S#N	Refers to the non-breeding season imperilment of elements that are not permanent residents.
SC	Element is extant only in captivation or cultivation.
S	Migrant whose occurrences are too irregular, transitory and/or dispersed to be reliably identified, mapped and protected.
SA	Accidental in the state.
SR	Reported to occur in the state but unverified.
S?	Unranked. Some evidence that species may be imperiled, but awaiting formal rarity ranking.

Note: Where two numbers appear in a state or global rank (for example, S2S3), the actual rank of the element is uncertain, but falls within the stated range.

This single rank system works readily for all species except those that are migratory. Those animals that migrate may spend only a portion of their life cycles within the state. In these cases, it is necessary to distinguish between breeding, non-breeding and resident species. As noted in Table 3, ranks followed by a "B," for example S1B, indicate that the rank applies only to the status of breeding occurrences. Similarly, ranks followed by an "N," for example S4N, refer to non-breeding status, typically during migration and winter. Elements without this notation are believed to be year-round residents within the state.

Natural Heritage imperilment ranks should not be interpreted as legal designations. Although most species protected under state or federal endangered species laws are extremely rare, not all rare species receive legal protection. Legal status is designated by the U.S. Fish and Wildlife Service under the Endangered Species Act or the Colorado Division of Wildlife under Colorado Statutes 33-2-105 Article 2. In addition, the U.S. Forest Service recognizes some species as "Sensitive," as does the Bureau of Land Management.

Element Occurrences and their Ranking

Actual locations of elements, whether they are single organisms, populations, or plant communities are referred to as element occurrences. The element occurrence is considered the most fundamental unit of conservation interest and is at the heart of the Natural Heritage Methodology. To prioritize element occurrences for a given species, an element occurrence rank (EO-Rank) is assigned according to the ecological quality of the occurrences whenever sufficient information is available. This ranking system is designed to indicate which occurrences are the healthiest and ecologically the most viable, thus focusing conservation efforts where they will be most successful. The EO-Rank is based on three factors:

Size – a measure of the area or abundance of the element's occurrence. Takes into account factors such as area of occupancy, population abundance, population density, population fluctuation and minimum dynamic area (which is the area needed to ensure survival or re-establishment of an element after natural disturbance).

Condition/Quality – an integrated measure of the composition, structure and biotic interactions that characterize the occurrence. This includes measures such as reproduction, age structure, biological composition (such as the presence of exotic versus native species), structure (for example, canopy, understory and ground cover in a forest community) and biotic interactions (such as levels of competition, predation and disease).

Landscape Context – an integrated measure of two factors: the dominant environmental regimes and processes that establish and maintain the element and connectivity. Dominant environmental regimes and processes include herbivory, hydrologic and water chemistry regimes (surface and groundwater), geomorphic processes, climatic regimes (temperature and precipitation), fire regimes and many kinds of natural disturbances. Connectivity includes such factors as a species having access to habitats and resources needed for life cycle completion, fragmentation of ecological communities and systems and the ability of the species to respond to environmental change through dispersal, migration, or re-colonization.

Each of these factors is rated on a scale of A through D, with A representing an excellent rank or D representing a poor rank. These ranks for each factor are then averaged to determine an appropriate EO-Rank for the occurrence. If not enough information is available to rank an element occurrence, an EO-Rank of E is assigned. EO-Ranks and their definitions are summarized in Table 4.

Table 4. Element Occurrence Ranks and Definitions.

A	Excellent viability.
B	Good viability.
C	Fair viability.
D	Poor viability.
H	Historic: known from historical record, but not verified for an extended period of time.
X	Extirpated (extinct within the state).
E	Extant: the occurrence does exist but not enough information is available to rank.
F	Failed to find: the occurrence could not be relocated.

Potential Conservation Areas (PCAs)

CNHP designs Potential Conservation Areas (PCAs) to protect element occurrences of rare plants, animals and plant communities. These PCAs focus on capturing the ecological processes that are necessary to support the continued existence of a particular element occurrence of natural heritage significance. PCAs may include a single occurrence of a rare element, or a suite of rare element occurrences or significant features. PCAs are ranked according to their biodiversity significance. The ranking system is in Table 5.

Table 5. Biodiversity Ranks and Definitions

B1	Outstanding Significance (irreplaceable)
B2	Very High Significance
B3	High Significance
B4	Moderate Significance
B5	General or State-wide Biological Diversity Significance

About 40 counties in Colorado have been surveyed by the Colorado Natural Heritage Program for critical biological resources (CNHP 2015). Locations with Natural Heritage significance (where elements have been documented) are presented as Potential Conservation Areas (PCAs). The goal of delineating PCAs is to identify a land area that can provide the habitat and ecological needs upon which a particular element or suite of elements (rare plants, animals and plant communities) depends upon for their continued existence. Best available knowledge of each species' life history is used in conjunction with information about topographic, geomorphic and hydrologic features, vegetative cover, and current and potential land uses to delineate PCA boundaries. These boundaries do not confer any regulatory protection of the site, nor do they automatically recommend exclusion of all activity. The PCA boundaries represent the best professional estimate of the primary area supporting the long-term survival of the targeted species or plant communities and are presented for planning purposes. They delineate ecologically sensitive areas where land-use practices should be carefully planned and managed to ensure that activities are compatible with protection of natural heritage resources and sensitive species. Please note that these boundaries are based primarily on CNHP's understanding of the ecological systems. A thorough analysis of the human context and potential stresses was not conducted. All land within the conservation planning boundary should be considered an integral part of a complex economic, social and ecological landscape that requires wise land-use planning at all levels to achieve sustainability.

4.0 RESULTS

4.1 Mapped Wetlands of Denver County

The updated U.S. Fish and Wildlife Service National Wetland Inventory (NWI) mapping results showed that Denver County contains 2,510 acres of wetlands, waterbodies, and riparian areas (Table 6), accounting for 2.5% of the Denver County landscape. Of this total, only 714 acres were mapped as wetlands, representing 0.7% of Denver County.

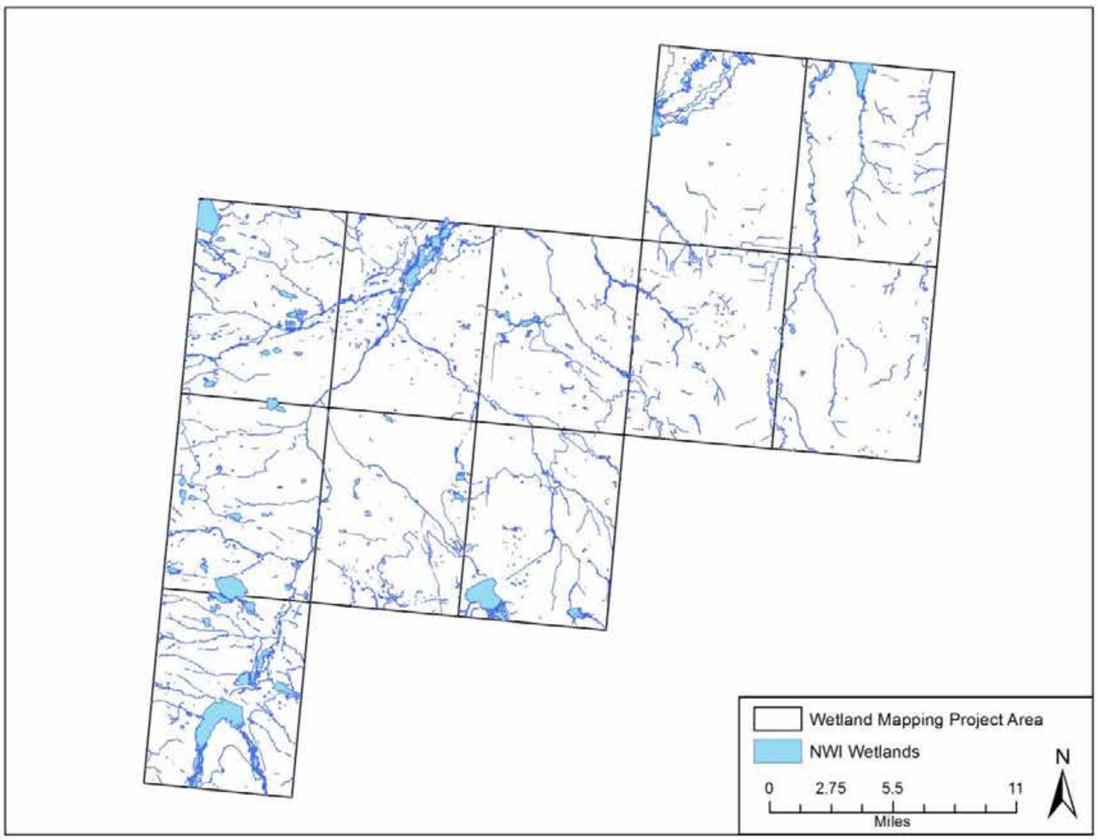


Figure 5. National Wetland Inventory (NWI) mapped features in the project area.

The NWI data shown in Figure 5 is available online at www.fws.gov/wetlands/.

Wetland Acres by General Wetland Type

Aquatic resources of Denver County are dominated by lakes and shores, which make up the largest resource type mapped at 1,070 acres, representing 43% of the total mapped acres (Table 5). Similar to rest of Colorado's Front Range, many of the lakes in the study area are artificially created reservoirs, primarily used for water storage. Rivers, streams and irrigation canals were the second largest resource type mapped at 425 acres (17% of mapped acres).

Mapped wetlands, with lakes and rivers removed, represented only 28% of all mapped acres, highlighting the large amount of waterbodies relative to wetlands. Herbaceous wetlands were the most dominant wetland type with 345 acres, making up 48% of mapped wetlands, though still only representing 14% of all mapped acres and only 0.3% of the entire county. Ponds were the second largest wetland type, with 287 mapped acres.

Table 6. National Wetland Inventory (NWI) acreage mapped in Denver County.

Wetland and Waterbody Type		*Acreage*	*% of County Acreage*	*% of NWI Acreage*	*% of Wetland Acreage*
Total Area of County		99,139	100.0%	---	---
Upland Area		96,629	97.5%	---	---
NWI Code	**Wetland Type**				
PEM	Herbaceous Wetlands	344	0.3%	14%	48%
PSS	Shrub Wetlands	52	0.1%	2%	7%
PFO	Forested Wetland	1	0.0%	0%	<1%
PAB/PUB	Pond	287	0.3%	11%	40%
----	Other	30	0.0%	1%	4%
Wetlands Only (excl. Lakes & Rivers)		**714**	**0.7%**	**28%**	**100%**
L	Lakes and Shores	1,070	1.1%	43%	---
R	Rivers, Streams, Canals	425	0.4%	17%	---
Rp	Riparian	301	0.3%	12%	---
Wetlands, Waterbodies and Riparian Areas		**2,510**	**2.5%**	**100%**	**---**

Wetland Acres by Hydrologic Regime

Permanently Flooded (H) is the most common hydrologic regime attributed to lakes and was the most prevalent wetland hydrologic regime of all NWI mapped acres in Denver County at 1,243 acres (50% of all mapped features; Table 7). The next most common hydrologic regime of all mapped features was Seasonally Flooded (12%) and Intermittently Exposed (12%). Riparian features (Rp) are not assigned a hydrologic regime.

The most prevalent hydrologic regime in wetlands specifically was 'Intermittently Exposed' at 250 acres (35% of wetlands). This is a common hydrologic regime for ponds, which are a major wetland type in the Denver County landscape.

Table 7. National Wetland Inventory (NWI) acreage mapped in Denver County by hydrologic regime code.

NWI Code	Hydrologic Regime	Acreage	% of NWI Acreage	Wetland Acreage	% of Wetland Acreage
A	Temporarily Flooded	171	7%	130	18%
C	Seasonally Flooded	311	12%	180	25%
F	Semipermanently Flooded	178	7%	149	21%
G	Intermittently Exposed	301	12%	250	35%
H	Permanently Flooded	1,243	50%	---	---
J	Intermittently Flooded	5	< 1%	5	1%
Rp	Riparian	301	12%	---	---
Total		**2,510**	**100%**	**714**	**100%**

Wetland Acres by Extent Modified

Only 42% of all NWI features in Denver County were mapped as un-modified (Table 8). Lakes primarily drive this trend with 98% of all lakes in Denver County having some modification, either excavation or impoundment. Rivers are not as modified as lakes, with only 20% of rivers excavated. It is important to note, however, that no modifiers are used to represent diversions or inputs that modify river flow. Though a river is not mapped as unmodified, most rivers throughout the Front Range have significant hydrologic modification, so these 69% unmodified rivers should not be viewed as a functional statement, only what is observable from aerial images. The majority of wetlands, without lakes and rivers, are not modified, except for ponds, which are almost all mapped as excavated.

Table 8. National Wetland Inventory (NWI) acreage mapped in Denver County by NWI modifier.

Wetland Type	Total Acreage	No Modifier		Excavated		Dammed / Impounded		Farmed	
		Acres	% of Type	Acres	% of Type	Acres	% of Type	Acres	% of Type
Herbaceous	344	310	90%	30	9%	-	-	4	1%
Shrub	52	47	90%	5	10%	-	-	-	-
Forested	1	1	100%	-	-	-	-	-	-
Ponds	287	47	16%	240	83%	-	-	-	-
Other	30	20	67%	9	30%	-	-	1	3%
Wetlands Only	**714**	**425**	**60%**	**284**	**40%**	**-**	**-**	**5**	**1%**
Lakes and Shores	1,070	26	2%	405	38%	639	60%	-	-
Rivers, Streams, Canals	425	291	69%	134	31%	-	-	-	-
Riparian	301	301	100%	-	-	-	-	-	-
Wetlands, Waterbodies and Riparian Areas	**2,510**	**1,043**	**42%**	**823**	**33%**	**639**	**25%**	**5**	**< 1%**

4.2 Mapped Wetlands of Denver Mountain Parks

Wetland Acres by General Wetland Type

Though NWI mapping was not updated for Denver Mountain Parks, the wetlands originally mapped by the NWI provide a "reference" for the types of wetlands in the Denver County area not subject to high levels of urbanization. A total of 204 acres of NWI wetlands and waterbodies were mapped by NWI in Denver Mountain Parks. Lakes and shores were the largest mapped group at 99 acres, representing 49% of the total mapped features (Table 9). Herbaceous wetlands were the next highest mapped feature with 52 acres (26% of all mapped features). Shrub wetlands accounted for 14% of all mapped features.

Vegetated wetlands, which exclude lakes and rivers, represent 45% of all mapped features, highlighting the large difference between acres mapped in Denver County (wetlands were 23% of all mapped features) and acres mapped for Denver Mountain Parks. Herbaceous wetlands were the most dominant wetland type in the Mountain Parks, making up 57% of mapped wetlands, with shrub wetlands making up 31% of mapped wetlands. Ponds are not as prevalent in the Denver Mountain Parks. The natural ecosystems that remain in the Denver Mountain Parks clearly provide a high value wetland resource adjacent to the urban landscape.

Table 9. National Wetland Inventory (NWI) acreage of originally mapped features in Denver Mountain Parks.

NWI Group	*Acreage*	*% of NWI Acreage*	*% of Wetland Acreage*
Herbaceous Wetlands	52	25%	57%
Shrub Wetlands	28	14%	31%
Forested Wetlands	8	4%	8%
Ponds	3	2%	4%
Other Wetlands	0	0%	0%
Vegetated Wetlands	**91**	**45%**	**100%**
Lakes and Shores	99	48%	-
Rivers, Streams, Canals	10	5%	-
Riparian	4	2%	-
Open Water	**113**	**55%**	**-**
Total Mapped Wetlands	**204**	**100%**	**NA**

Wetland Acres by Hydrologic Regime

Similar to Denver County, the most prevalent hydrologic regime ('Permanently Flooded') is associated with lakes (48%). 'Temporarily Flooded', 'Saturated', and 'Seasonally Flooded' are all associated with wetlands and were the next highest percentage of mapped features (Table 10). They also were the most dominant hydrologic regime among wetlands specifically. Since excavated ponds are not common in the Denver Mountain Parks, there are few acres of 'Semipermanently Flooded' and 'Intermittently Exposed'.

Table 10. Hydrologic Regime of originally mapped National Wetland Inventory (NWI) features in Denver Mountain Parks.

NWI Code	Hydrologic Regime	Acreage	% of NWI Acreage	Wetland Acreage	% of Wetland Acreage
A	Temporarily Flooded	30	15%	30	32%
B	Saturated	27	13%	27	30%
C	Seasonally Flooded	29	14%	28	31%
F	Semipermanently Flooded	4	2%	3	4%
G	Intermittently Exposed	12	6%	3	3%
H	Permanently Flooded	98	48%	---	---
Rp	Riparian	4	2%	---	---
Total		**204**	**100%**	**91**	**100%**

Wetland Acres by Extent Modified

The use of modifiers in Denver Mountain Parks is starkly different than in Denver County. Only lakes and ponds were attributed as modified, with 40% of lakes and 30% of ponds impounded (Table 11). No wetlands or waterbodies were mapped as excavated. The vast majority of mapped features (80% of total mapped features and 99% of mapped wetlands) were not modified. Though the NWI mapping does not identify condition, we would expect the ecological condition to be high in the Denver Mountain Parks.

Table 11. National Wetland Inventory (NWI) Wetland and waterbody groups mapped by modifier.

Wetland Type	Total Acres	No Modifier		Excavated		Dammed / Impounded	
		Acres	% of Type	Acres	% of Type	Acres	% of Type
Herbaceous	52	52	100%	-	-	-	-
Shrub	28	28	100%	-	-	-	-
Forested	8	8	100%	-	-	-	-
Ponds	3	2.6	78%	-	-	0.4	13%
Vegetated Wetlands	**91**	**90**	**99%**	**0**	**0%**	**<1**	**1%**
Lakes	99	59	60%	-	-	40	40%
Rivers/Streams/Canals	10	10	100%	-	-	-	-
Riparian	4	4	100%	-	-	-	-
Open Water	**113**	**73**	**65%**	**0**	**0%**	**40**	**35%**
Wetlands, Waterbodies and Riparian Areas	**204**	**163**	**80%**	**0**	**0%**	**41**	**20%**

4.3 Landscape Level Functions Provided by Denver Wetlands

Wetland Summary of LLWW Types

In order to derive functions from the mapped wetlands and waterbodies, the polygons must be attributed with LLWW descriptors, which are based on physical attributes of wetlands (Table 12). The first descriptor applied is the Waterbody Type. Waterbody Type descriptors are applied to lakes, rivers and streams (which are not considered wetlands) and also to ponds (which are considered wetlands). All polygons that are not given a Waterbody Type descriptor (the rest of the wetlands) are given Landscape Position descriptor and a Landform descriptor. Next, all polygons are attributed with a Water Flow Path descriptor, which describe the hydrodynamics and water flow direction. Lastly, modifiers from the NWI mapping are moved over to the LLWW descriptors. Based on the combination of LLWW codes and NWI codes, functions can be derived from a set of mapped wetlands.

Wetland Functional Profile for Denver County

Wetlands and waterbodies in Denver County provide high levels of functioning for four out of the ten functions highlighted by the LLWW analysis (Table 13). These four wetland functions are groundwater recharge, surface water storage, aquatic habitat, and sediment retention. These functions are associated with open water habitats, such as lakes, reservoirs, and streams. Very few acres provide the other six functions at high levels. Wetlands that are associated with high levels of biodiversity support, native plant community maintenance, and terrestrial habitat are rare in Denver County. As the majority of wetlands in most urban landscapes are modified by excavation or impoundments, the low amount of biodiversity support and native plant community maintenance provided by Denver County wetlands is expected. Stream flow maintenance, nutrient cycling, and shoreline stabilization are also not provided at a high rate by Denver County wetlands. Though shoreline stabilization is important in a landscape dominated by ponds and lakes, the large amount of unvegetated surface surrounding lakes leads to very low shoreline stabilization. Nutrient cycling and terrestrial habitat are often provided by high functioning wetlands adjacent to streams and rivers. Reconnecting rivers to their floodplains and facilitating structural diversity in wetlands adjacent to rivers would increase both of these functions across the landscape.

Table 12. Landscape Position, Landform, Water Flow Path, and Waterbody Type (LLWW) in Denver County.

Summary Parameter		Acres	% of County Acreage	% of NWI Acreage	% of Wetland Acreage
General					
	Total Area of County	99,139	100.0%	----	---
	Upland Area	96,629	97.5%	----	---
	Waterbody Area	1,495	1.5%	59.6%	---
	Wetland Area	714	0.7%	28.4%	100.0%
	Riparian Area	301	0.3%	12.0%	---
LLWW Waterbody Type					
LK	Lake	1,070	1.1%	42.6%	---
RV	River	252	0.3%	10.0%	---
St	Stream	167	0.2%	6.7%	---
PD	Pond	287	0.3%	11.4%	40.0%
LLWW Landscape Position					
LE	Lentic (assoc. with a lake)	116	0.1%	---	16.2%
LR	Lotic River (assoc. with a river)	23	< 0.1%	---	3.2%
LS	Lotic Stream (assoc. with a stream)	74	0.1%	---	10.4%
TE	Terrene (not assoc. with a waterbody)	219	0.2%	---	30.7%
LLWW Landform					
BA	Basin	318	0.3%	---	44.2%
FP	Floodplain	32	< 0.1%	---	4.5%
FR	Fringe	51	0.1%	---	7.1%
IS	Island	3	< 0.1%	---	0.4%
SL	Slope	29	< 0.1%	---	4.0%
LLWW Water Flow Path					
BI	Bi-directional	51	0.1%	2.0%	---
IC	Isolated-Complex	9	< 0.1%	0.4%	---
IN	Inflow	19	< 0.1%	0.8%	---
IS	Isolated	434	0.4%	17.3%	---
OU	Outflow	103	0.1%	4.1%	---
TH	Throughflow	1,593	1.6%	63.5%	---
LLWW Modifiers					
h	dammed/impounded	639	0.6%	25.5%	---
x	excavated	823	0.8%	32.8%	---

Table 13. Wetland functional acreage in Denver County. Only High and Moderate wetlands for each function are included, along with their percentage of Denver County and NWI acreage.

Wetland Function	*Acreage*	*% of County Acreage*	*% of Wetland and Waterbody Acreage*
Groundwater Recharge			
High	1,566.9	1.6%	70.9%
Moderate	41.6	0.0%	1.9%
Function Total (High + Moderate)	1,608.5	1.6%	**72.8%**
Surface Water Storage			
High	1,252.3	1.3%	56.7%
Moderate	239.0	0.2%	10.8%
Function Total (High + Moderate)	1,491.3	1.5%	**67.5%**
Stream Flow Maintenance			
High	17.8	0.0%	0.8%
Moderate	291.8	0.3%	13.2%
Function Total (High + Moderate)	309.6	0.3%	**14.0%**
Nutrient Cycling			
High	142.0	0.1%	6.4%
Moderate	139.1	0.1%	6.3%
Function Total (High + Moderate)	281.1	0.3%	**12.7%**
Sediment Retention			
High	54.0	0.1%	2.4%
Moderate	1,271.3	1.3%	57.5%
Function Total (High + Moderate)	1,325.3	1.3%	**60.0%**
Shoreline Stabilization			
High	37.0	0.0%	1.7%
Moderate	18.9	0.0%	0.9%
Function Total (High + Moderate)	55.9	0.1%	**2.5%**
Terrestrial Habitat			
High	30.5	0.0%	1.4%
Moderate	101.1	0.1%	4.6%
Function Total (High + Moderate)	131.6	0.1%	**6.0%**
Aquatic Habitat			
High	252.8	0.3%	11.4%
Moderate	1,259.4	1.3%	57.0%
Function Total (High + Moderate)	1,512.2	1.5%	**68.4%**
Native Plant Community Maintenance			
High	73.6	0.1%	3.3%
Moderate	31.9	0.0%	1.4%
Function Total (High + Moderate)	105.5	0.1%	**4.8%**
Biodiversity Support			
High	96.7	0.1%	4.4%
Moderate	13.7	0.0%	0.6%
Function Total (High + Moderate)	110.5	0.1%	**5.0%**

4.4 Wetland Condition Assessment Results

Forty-six wetland assessment areas (AAs) covering 597.2 acres were surveyed for wetland condition (Figure 6). Thirty-nine AAs were located within Denver County, one was located in Adams County (Figures 6, 8, and 9) and six AAs (79 acres) managed by Denver Mountain Parks were located in Jefferson County and Clear Creek counties (Figure 7). Of the 39 AAs in Denver County, four were privately owned, 35 were owned and managed by the City and County of Denver (CCD), and the Adams County AA was privately owned. The Adams County wetland data will be included in the Denver County data analyses as it is on the border of the county. The sizes of the wetland assessment areas or AAs ranged from 0.8 acres to 85.4 acres with an average size of 12.7 acres (Table 15).

Classification of Denver County Wetlands

All of the study sites were located in one of four Ecological Systems (Table 14). The most common system was the North American Arid West Emergent Marsh, followed by Western Great Plains Riparian. All sites within Denver County fell within these two systems. Four AAs located in Denver Mountain Parks were identified as Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland ecological systems. The highest elevation AA, Echo Lake, was classified as a Rocky Mountain Alpine-Montane Wet Meadow. For definitions of Ecological Systems, see Appendix E.

There were three major Hydrogeomorphic (HGM) wetland types surveyed across the study area: Depressional, Lake Fringe and Riverine. Seventeen wetlands were classified as Depressional, five sites were classified as Lake Fringe and the remaining 21 sites were classified as Riverine. Depressional wetlands were found in low lying areas often with a stream or a ditch providing water or they were located on the floodplain of a major tributary. Lake Fringe wetlands were located on waterbodies 20 acres or larger in size. Riverine wetlands were those located along streams, ditches and rivers.

Table 14. Ecological systems for the Assessment Areas (AAs) in the City and County of Denver (CCD) and Denver Mountain Parks (DMP).

Ecological System	*CCD # AAs*	*DMP #AAs*	*Common Dominant Species*
North American Arid West Emergent Marsh	23	1	Narrowleaf cattail *(Typha angustifolia)* broadleaf cattail (*Typha latifolia*)
Western Great Plains Riparian	17	0	Plains cottonwood (*Populus deltoides ssp. monilifera*) coyote willow (*Salix exigua)*
Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland	0	4	Blue spruce (*Picea pungens*) Douglas fir (*Pseudotsuga menziesii*)
Rocky Mountain Alpine-Montane Wet Meadow	0	1	Shortfruit willow (*Salix brachycarpa*) diamondleaf willow (*Salix plainfolia*)

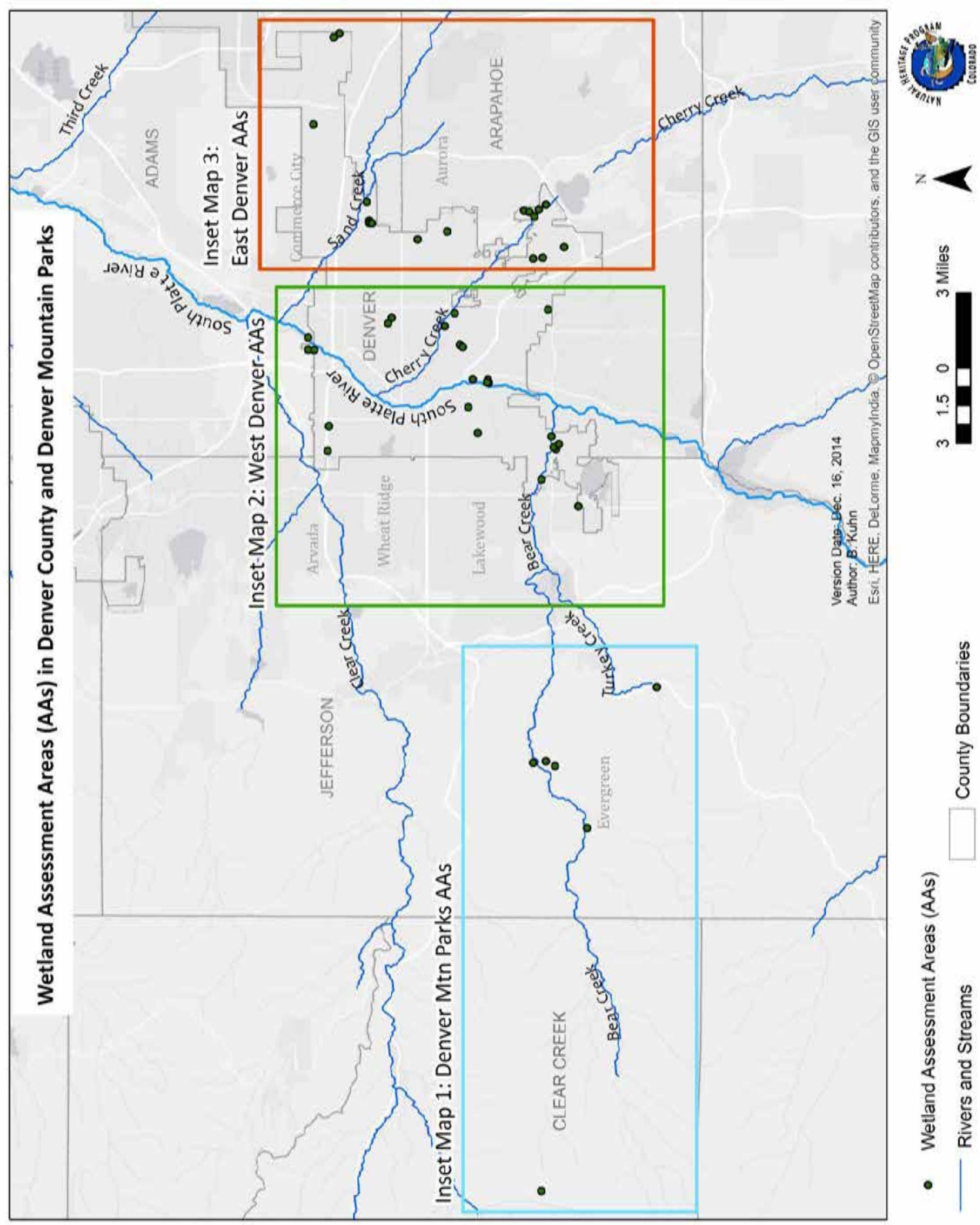


Figure 6. Location of wetland assessment areas (AAs) in Denver County and Denver Mountain Parks.

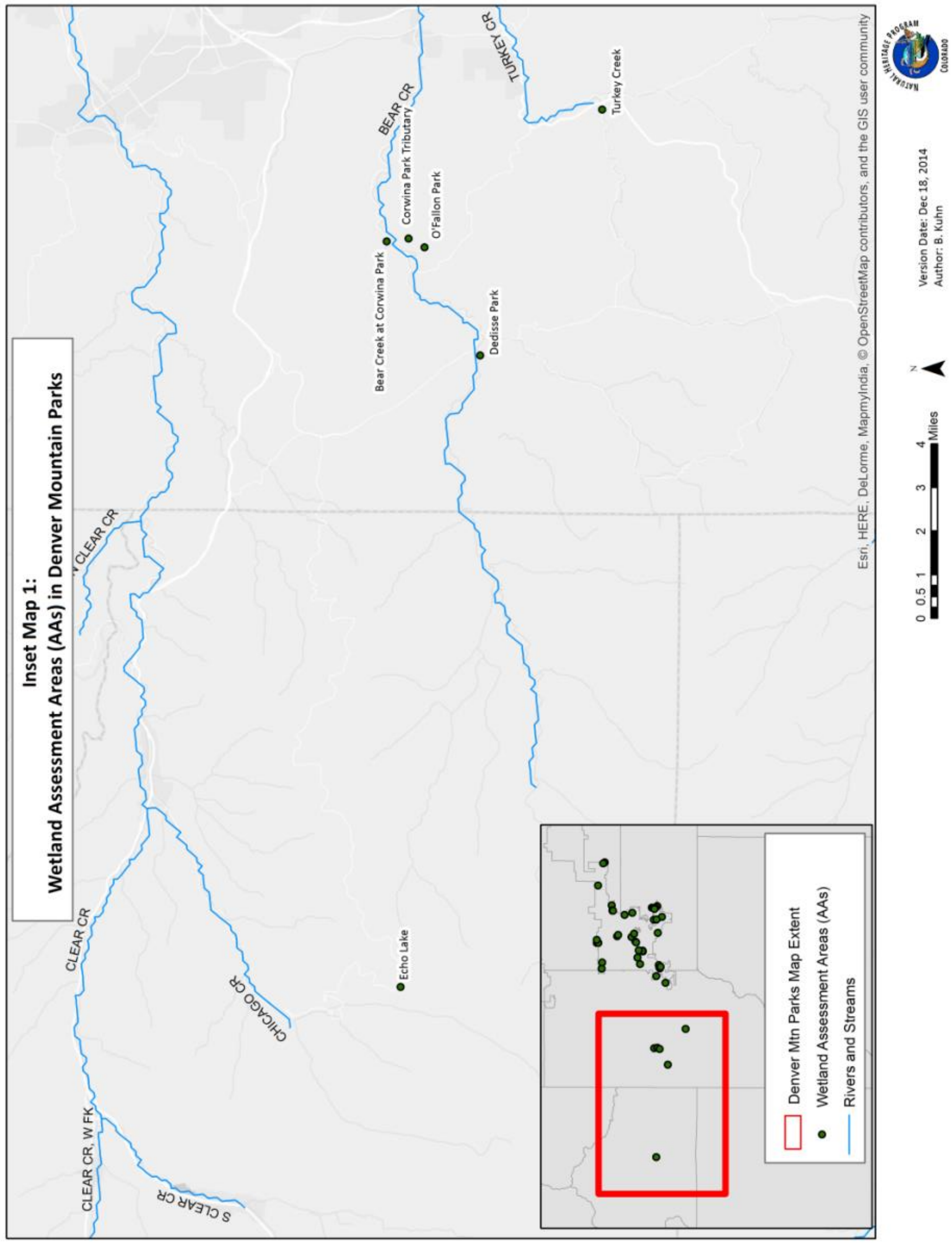


Figure 7. Location of Wetland Assessment Areas in Denver Mountain Parks.

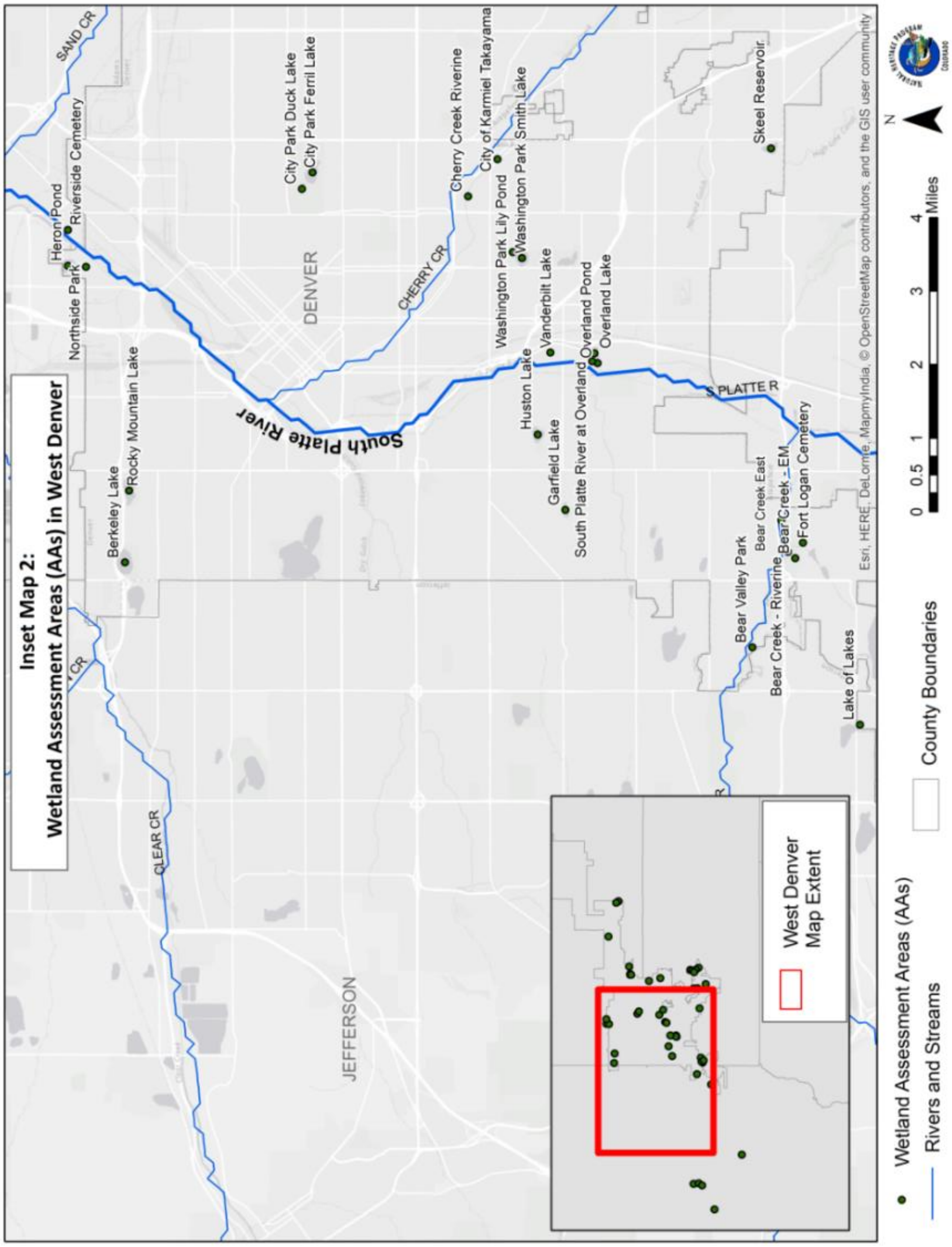


Figure 8. Wetland Assessment Areas in West Denver.

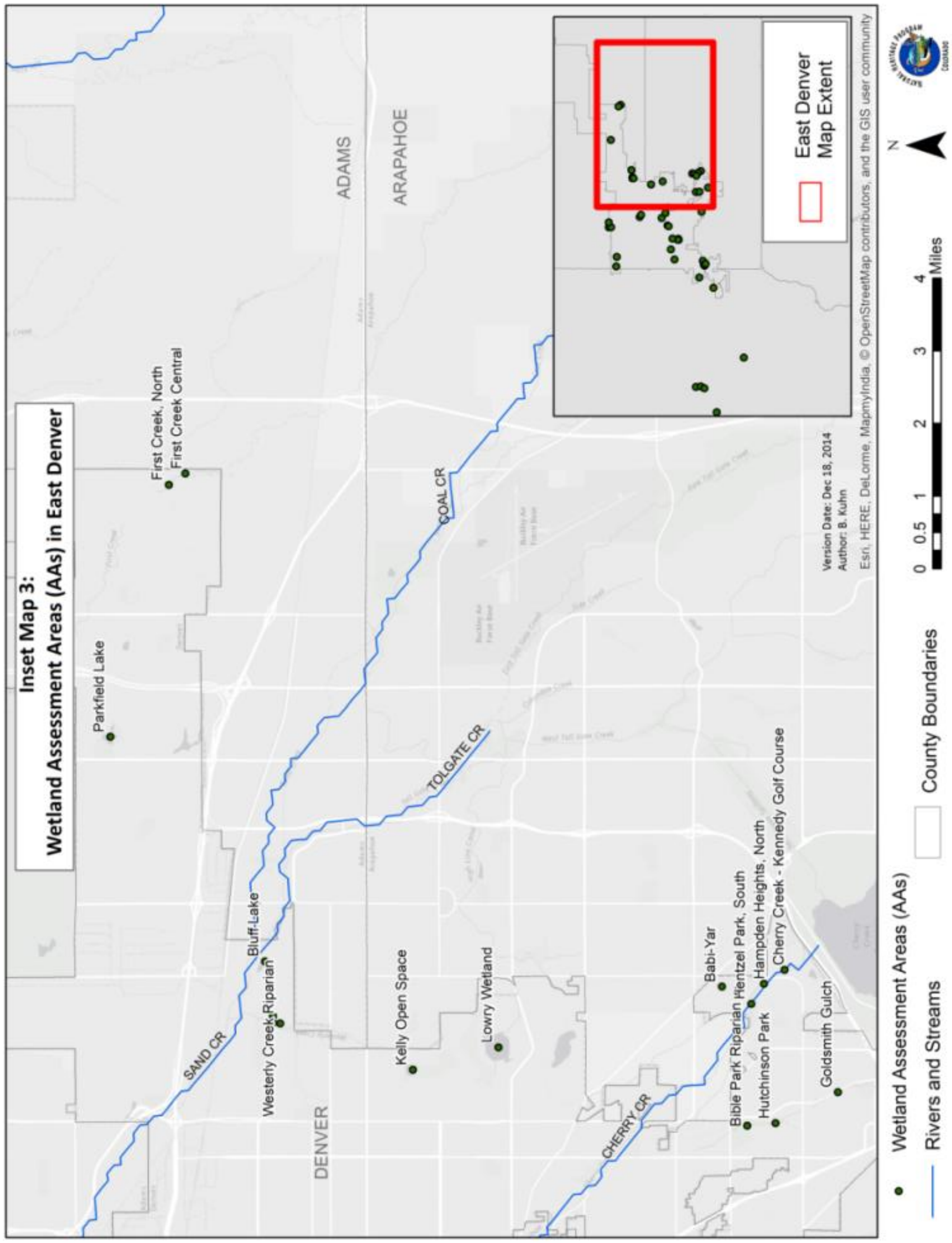


Figure 9. Wetland Assessment Areas in East Denver.

Ecological Integrity Assessment

Ecological Integrity Assessment (EIA) condition scores were calculated for the 46 assessment areas. EIA scores are translated into a 4-tiered ranking system of A,B,C, D, with each letter corresponding to a range of numeric scores (see Table 2 for more detail):

A =	4.5–5.0	Excellent - no or minimal human impact
B =	3.5–<4.5	Good - slight deviation from reference
C =	2.5–<3.5	Moderate – moderate deviation from reference
D =	1.0–<2.5	Poor –significant to severe deviation from reference

Overall EIA scores of the surveyed wetlands ranged from 1.3 to 4.2 on a 1.0–5.0 point scale (Table 15; Figure 10). The six highest EIA scores were from sites located in Denver Mountain Parks, ranging from 2.8 to 4.2. Urban wetland scores from CCD sites ranged from 1.3 to 2.8. Two Assessment Areas received B ranks for the overall EIA scores: Echo Lake and Corwina Park Tributary. These AAs are located on Denver Mountain Park property in Clear Creek and Jefferson counties, respectively (dark blue rows in Table 15). Six AAs received C ranks and included four Mountain Parks and two parks within the CCD (medium blue rows). The remaining parks received D ranks and were located in the CCD (light blue rows). Lake of Lakes, Fort Logan Cemetery, and Goldsmith Gulch received the lowest overall EIA scores.

Figure 10. Overall Environmental Integrity Assessment (EIA) Scores by Assessment Area (AA), Denver Mountain Park AAs in red and Urban Denver AAs in blue. (See Site Descriptions in Appendix K for details on each AA.)

In addition to overall EIA scores, numeric sub-scores were also calculated for the four main ecological categories (Landscape Context, Biotic Condition, Hydrologic Condition and Physiochemical Condition) for all 46 AAs (Table 16). The calculations for the EIA metric ranking criteria are provided in Appendix G.

Landscape Context Scores

These scores are based on the degree of landscape fragmentation, the extent and condition of the buffer and riparian connectivity (riverine wetlands only) within a 500 m zone surrounding an Assessment Area (AA). Lands that have more natural vegetation score higher while lands dominated by pavement, manicured lawns, highways, buildings and residential developments score lower. The surrounding landscapes play a large part in the protection of the diversity of plants and animals, water quality and overall health of the wetlands. All six of the AAs within the Mountain Parks scored in the B or C range (Table 16). Only one of the 40 wetland Assessment Areas in or near Denver County scored in the C range. Bear Creek Park – Riparian (BCP-R1), is located along a section of Bear Creek that had one of the largest surrounding areas of natural buffer cover. The three lowest scoring AAs (Lake of Lakes, Fort Logan, and Goldsmith Gulch) had no natural buffer zones (Table 15).

Biotic Condition Scores

These scores are based on the floristic data collected during the field surveys. Metrics calculated from these data utilize information on species richness, native plant cover, and structural complexity (see Appendix G). Echo Lake Park, a high elevation, sub-alpine Denver Mountain Park, received the highest overall EIA score, and was the only AA with a B rank for the Biotic Condition. Four Mountain Parks received a C rank, and one received a D rank. The D- ranked park (Bear Creek at Corwina Park CW-1) had a high cover of a non-native tree species: crack willow (*Salix fragilis*). This AA was also adjacent to a highway that likely influenced the low score because roads can introduce non-native species. Six AAs within Denver County scored within the C rank range (2.5–<3.5) for Biotic Condition and included Westerly Creek Emergent, Berkeley Lake, Huston Lake, Garfield Lake, Lily Pond and Smith Lake at Washington Park (Table 16).

Plant Species Richness

Plant species richness is the number of different plant species recorded for each of the AAs (Table 17; Figure 11). The six AAs in Denver Mountain Parks contained 89–130 taxa. O'Fallon Park AA had the highest species richness value of all 46 AAs with 130 species. The next five highest values were in Denver County AAs. The 40 sites in or near Denver County ranged from a high of 128 species at Bear Valley Park to a low of 13 different species at Overland Lake.

Relative Cover of Native Plants

The relative cover of native plants was derived from ocular estimates of cover for all species present and, unlike a plant list, provides a view of the overall cover. Native cover ranged from 5% to 98% across all 46 AAs (Table 17; Figure 12). Relative native cover was highest at five of the six Mountain Parks and ranged from 85–98%, with the exception of Bear Creek at Corwina Park AA which had a 37% relative native plant cover. For Denver County, First Creek Central, Lake of Lakes, Lowry Open Space, Ferril Lake at City Park, and Westerly Creek Emergent Marsh AAs had the highest relative cover of native plant species ranging from 80–87%. The lowest relative native cover was found at Goldsmith Gulch (5%).

Mean C

Mean C values can provide another way to look at site quality using the plant list. Each plant is assigned a value between 0-10 (a plant assigned a C value of 10 is indicative of the highest quality habitat – see methods). The scores for Denver Mountain Parks ranged between 2.99–5.74 and were higher than the other 40 AAs in or near Denver County, which had scores between 0.82–2.84. The lower scores reflect the higher number of non-native plant species, as well as native plant species that are able to tolerate high levels of disturbance which tend to have lower C values (Table 17).

The highest Mean C value was found at Echo Lake Park, which also had the highest EIA Score. The lowest Mean C (0.82) was found at Goldsmith Gulch, which had the lowest EIA score.

Floristic Quality Index (FQI)

The Floristic Quality Assessment (FQA) includes a number of indices that can be calculated to indicate ecological condition. For this assessment we used the Floristic Quality Index (detailed in the Methods section) in addition to the Mean C metric incorporated into the Biotic Condition score for the EIA. The FQI scores were highest for the six DMP AAs and the scores ranged from 26.38 (Didesse Park AA) to 52.93 (Echo Lake Park AA). The ranges for the remaining 40 AAs were 3.05 (Overland Lake) to 20.82 (Bear Valley Park) (Table 17).

Hydrologic Condition Scores

These scores are related to the water source, hydrologic connectivity, alteration to the natural hydroperiod and bank stability. Echo Lake had the only A rank for Hydrologic Condition. Three Mountain Park AAs received a B rank in this category: Corwina Park Tributary, Bear Creek at Corwina Park and O'Fallon Mountain Park AAs. The remaining two Mountain Park AAs: Didesse and Turkey Creek parks both received C ranks. Denver County AA scores ranged from 1.0 to 3.2. Thirty-two AAs scored in the D range, 8 AAs scored in the C range and 1 scored in the B range (Bear Lake Park-Riparian (Table 16). This range of Hydrologic Condition scores demonstrates how each wetland can offer a different set of functions and benefits even if it has a similar overall score to other AAs.

Physiochemical Condition Scores

Physiochemical condition scores include metrics for water quality and soil disturbances within the Assessment Areas (AAs). All of the Denver Mountain Park AAs received B or C ranks for Physiochemical Condition, while all of the AAs in Denver County received D (1.0-2.5) ranks (Table 14). The low scores for Denver County were anticipated based on the high degree of development and cover of impervious surfaces (often over 75%) throughout Denver County.

Stressors

There were four categories of stressors (landscape, vegetation, hydrological and physiochemical) that were scored corresponding to four ecological categories that comprise the EIA score (Landscape Context, Biotic Condition, Hydrologic Condition and Physiochemical Condition, respectively). The landscape and hydrological stressors were estimated from satellite imagery and well location data (GIS layer) within a 500 m zone surrounding the AAs; the vegetation and physiochemical stressors were estimated by observations made within the AAs. Roads, parking lots, buildings, and intensively managed lawns were the most common landscape stressors located within 500 m of all 46 AAs (Table 18). Recreation was the most common vegetation stressor noted within the AAs. Urban runoff was a major hydrology stressor which was reported from all 40 urban AA sites and from two Mountain Park AAs. Impacts to vegetation from stormwater flows were apparent. Erosion, soil compaction, and sedimentation were the most commonly reported physiochemical stressors observed within the AAs. All Mountain Parks surveyed had foot trails within the wetlands.

Table 15. List of Wetland Assessment Areas (AAs) ranked highest to lowest by Ecological Integrity Assessment (EIA) Scores with wetland type, size, and county.

Site Name	Site Code	County	Size (Acres)	HGM Wetland Type	Ownership*	EIA Score
Echo Lake Park	ELP-1	Clear Creek	33.2	Lake Fringe	DMP	4.2 (B)
Corwina Park Tributary	CWT-1	Jefferson	11.3	Riverine	DMP	3.6 (B)
O'Fallon Park	OFP-1	Jefferson	15.8	Riverine	DMP	3.3 (C)
Bear Creek at Corwina Park	CW-1	Jefferson	10.5	Riverine	DMP	2.9 (C)
Turkey Creek Park	TCP-1	Jefferson	0.8	Riverine	DMP	2.9 (C)
Dedisse Park	DP-1	Jefferson	7.4	Lake Fringe	DMP	2.8 (C)
Bear Creek Park-Riparian 1	BCP-R1	Denver	15.3	Riverine	CCD	2.8 (C)
Parkfield Park	PFP-1	Denver	11.9	Depressional	CCD	2.5 (C)
Westerly Creek Emergent Marsh	WC-2	Denver	6.9	Depressional	CCD	2.4 (D)
Hentzell Park 2	HEN-2	Denver	12.9	Riverine	CCD	2.4 (D)
Bear Creek Park Emergent Marsh	BC-EM1	Denver	11.7	Depressional	CCD	2.3 (D)
Bible Park Riparian	BPR-1	Denver	4.5	Riverine	CCD	2.2 (D)
Berkeley Lake Park	BLP-1	Denver	37	Lake Fringe	CCD	2.1 (D)
Riverside Cemetery	RC-1	Adams	24.3	Depressional	PVT	2.1 (D)
Bear Creek Park East	BCE-1	Denver	8.2	Riverine	CCD	2.1 (D)
Vanderbilt Park	VB-1	Denver	6.2	Depressional	CCD	2.1 (D)
Westerly Creek Riparian	WC-1	Denver	6.0	Riverine	CCD	2.1 (D)
City Park Ferril Lake	CPFL-1	Denver	24.2	Lake Fringe	CCD	2.0 (D)
Huston Lake	HL-1	Denver	14.4	Depressional	CCD	2.0 (D)
Kelly Open Space	KO-1	Denver	14.6	Depressional	CCD	2.0 (D)
Garfield Lake	GL-1	Denver	8.9	Depressional	CCD	2.0 (D)
Lily Pond (at Washington Park)	LP-1	Denver	1.4	Depressional	CCD	2.0 (D)
Bluff Lake	BL-1	Denver	27.4	Depressional	PVT	2.0 (D)

Overland Pond	OPP-1	Denver	1.9	Depressional	CCD	2.0 (D)
First Creek North	FCN-1	Denver	4.9	Riverine	CCD	2.0 (D)
Hentzell Park	HEN-1	Denver	5.3	Riverine	CCD	2.0 (D)
Smith Lake at Washington Park	WPSL-1	Denver	17.9	Depressional	CCD	1.9 (D)
Hutchinson Park	HUP-1	Denver	7.5	Depressional	CCD	1.9 (D)
Rocky Mountain Lake Park	RMLP-1	Denver	24.8	Lake Fringe	CCD	1.9 (D)
Lowry Wetlands	LO-1	Denver	85.4	Depressional	PVT	1.8 (D)
Site Name (Table 15 con't)	**Site Code**	**County**	**Size (Acres)**	**HGM Wetland Type**	**Ownership***	**EIA Score**
Bear Valley Park	BVP-1	Denver	33.4	Riverine	CCD	1.8 (D)
Hampden Heights North Park	HH-1	Denver	5.9	Riverine	CCD	1.8 (D)
Cherry Creek at Kennedy Golf Course	CC-3	Denver	6.8	Riverine	CCD	1.7 (D)
City of Karmiel and City of Takayama Park	CC-2	Denver	10.9	Riverine	CCD	1.7 (D)
First Creek Central	FCC-1	Denver	3.2	Riverine	CCD	1.7 (D)
South Platte River at Overland Pond	SPR-OPP	Denver	6.3	Riverine	CCD	1.7 (D)
Heron Pond	HEP-1	Denver	15.2	Depressional	CCD	1.6 (D)
Duck Lake at City Park	CPDL-1	Denver	5.5	Depressional	CCD	1.6 (D)
Skeel Reservoir	SR-1	Denver	14.9	Depressional	CCD/PVT	1.6 (D)
Overland Lake	OL-1	Denver	10.4	Depressional	CCD	1.6 (D)
Cherry Creek	CC-1	Denver	6.2	Riverine	CCD	1.6 (D)
Babi-Yar Park	BY-1	Denver	3.4	Riverine	CCD	1.6 (D)
Northside Park	NSP-1	Denver	1.9	Riverine	CCD	1.6 (D)
Lake of Lakes	LOL-1	Denver	4.5	Depressional	CCD	1.4 (D)
Fort Logan National Cemetery	FLC-1	Denver	3.0	Riverine	PVT	1.4 (D)
Goldsmith Gulch (near Bible Park)	GG-1	Denver	3.2	Riverine	CCD	1.3 (D)

*DMP = Denver Mountain Park, CCD = City and County of Denver , PVT= Private

Table 16. List of Wetland Assessment Areas (AAs) ranked highest to lowest by overall Ecological Integrity Assessment (EIA) scores with sub-scores for the four main ecological categories.

Site Name	Site Code	Landscape Context	Biotic Condition	Hydrologic Condition	Physiochem Condition	EIA Score
Echo Lake Park*	ELP-1	3.82 (B)	4.05 (B)	4.7 (A)	4.4 (B)	4.2 (B)
Corwina Park* Tributary	CWT-1	3.68 (B)	2.96 (C)	4.0 (B)	4.5 (B)	3.6 (B)
O'Fallon Park*	OFP-1	3.11 (C)	2.86 (C)	3.8 (B)	4.3 (B)	3.3 (C)
Bear Creek at Corwina Park*	CW-1	3.74 (B)	1.89 (D)	3.3 (C)	3.8 (B)	2.9 (C)
Turkey Creek Park*	TCP-1	2.61 (C)	3.06 (C)	2.9 (C)	3.3 (C)	2.9 (C)
Dedisse Park*	DP-1	3.13 (C)	2.79 (C)	2.4 (D)	3.5 (C)	2.8 (C)
Bear Creek Park-Riparian 1	BCP-R1	3.44 (C)	1.86 (D)	3.8 (B)	2.5 (D)	2.8 (C)
Parkfield Park	PFP-1	2.15 (D)	2.36 (D)	3.0 (C)	2.5 (D)	2.5 (C)
Westerly Creek Emergent Marsh	WC-2	1.64 (D)	2.96 (C)	2.2 (D)	2.0 (D)	2.4 (D)
Hentzell Park 2	HEN-2	2.39 (D)	2.03 (D)	3.1 (C)	2.0 (D)	2.4 (D)
Bear Creek Park Emergent Marsh	BC-EM1	2.2 (D)	2.2 (D)	3.0 (C)	1.0 (D)	2.3 (D)
Bible Park Riparian	BPR-1	0.7 (D)	2.15 (D)	3.2 (C)	2.0 (D)	2.2 (D)
Berkeley Lake Park	BLP-1	1.27 (D)	2.85 (C)	2.0 (D)	1.0 (D)	2.1 (D)
Riverside Cemetery	RC-1	1.19 (D)	2.0 (D)	3.0 (C)	2.0 (D)	2.1 (D)
Bear Creek Park East	BCE-1	1.52 (D)	1.56 (D)	3.1 (C)	2.0 (D)	2.1 (D)
Vanderbilt Park	VB-1	1.87 (D)	2.26 (D)	2.4 (D)	1.5 (D)	2.1 (D)
Westerly Creek Riparian	WC-1	1.74 (D)	2.36 (D)	2.1 (D)	1.5 (D)	2.1 (D)
City Park Ferril Lake	CPFL-1	1.0 (D)	2.5 (D)	2.0 (D)	1.5 (D)	2.0 (D)
Huston Lake	HL-1	1.0 (D)	2.6 (C)	2.0 (D)	1.5 (D)	2.0 (D)
Kelly Open Space	KO-1	2.3 (D)	1.75 (D)	2.0 (D)	2.5 (D)	2.0 (D)
Garfield Lake	GL-1	1.0 (D)	2.73 (C)	2.0 (D)	1.5 (D)	2.0 (D)
Lily Pond (at Washington Park)	LP-1	1.0 (D)	2.58 (C)	2.0 (D)	1.5 (D)	2.0 (D)
Bluff Lake	BL-1	2.54 (C)	2.23 (D)	1.4 (D)	1.5 (D)	2.0 (D)
Overland Pond	OPP-1	2.24 (D)	2.2 (D)	1.8 (D)	1.0 (D)	2.0 (D)
First Creek North	FCN-1	1.35 (D)	2.05 (D)	2.7 (C)	1.0 (D)	2.0 (D)
Hentzell Park	HEN-1	1.57 (D)	1.65 (D)	2.9 (C)	1.5 (D)	2.0 (D)
Smith Lake at Washington Park	WPSL-1	1.0 (D)	2.67 (C)	1.8 (D)	1.0 (D)	1.9 (D)
Hutchinson Park	HUP-1	1.0 (D)	2.19 (D)	2.2 (D)	2.0 (D)	1.9 (D)

(Table 16 con't) Site Name	Site Code	Landscape Context	Biotic Condition	Hydrologic Condition	Physiochem Condition	EIA Score
Rocky Mountain Lake Park	RMLP-1	1.25 (D)	2.03 (D)	2.2 (D)	1.5 (D)	1.9 (D)
Lowry Wetlands	LO-1	1.6 (D)	1.65 (D)	2.0 (D)	2.5 (D)	1.8 (D)
Bear Valley Park	BVP-1	1.6 (D)	1.66 (D)	2.0 (D)	2.0 (D)	1.8 (D)
Hampden Heights North Park	HH-1	1.98 (D)	1.65 (D)	2.2 (D)	1.0 (D)	1.8 (D)
Cherry Creek at Kennedy Golf Course	CC-3	1.0 (D)	1.60 (D)	2.4 (D)	1.0 (D)	1.7 (D)
City of Karmiel and City of Takayama Park	CC-2	1.0 (D)	1.89 (D)	2.3 (D)	1.0 (D)	1.7 (D)
First Creek Central	FCC-1	1.37 (D)	2.25 (D)	1.4 (D)	1.0 (D)	1.7 (D)
South Platte River at Overland Pond	SPR-OPP	1.55 (D)	1.76 (D)	2.0 (D)	1.0 (D)	1.7 (D)
Heron Pond	HEP-1	2.03 (D)	1.85 (D)	1.2 (D)	1.0 (D)	1.6 (D)
Duck Lake at City Park	CPDL-1	1.0 (D)	2.0 (D)	1.8 (D)	1.0 (D)	1.6 (D)
Skeel Reservoir	SR-1	1.0 (D)	1.75 (D)	2.0 (D)	1.0 (D)	1.6 (D)
Overland Lake	OL-1	1.0 (D)	1.93 (D)	1.6 (D)	1.0 (D)	1.6 (D)
Cherry Creek	CC-1	1.0 (D)	1.36 (D)	2.5 (D)	1.5 (D)	1.6 (D)
Babi-Yar Park	BY-1	2.03 (D)	1.45 (D)	1.7 (D)	1.5 (D)	1.6 (D)
Northside Park	NSP-1	1.3 (D)	2.28 (D)	1.1 (D)	1.0 (D)	1.6 (D)
Lake of Lakes	LOL-1	1.0 (D)	1.73 (D)	1.2 (D)	1.0 (D)	1.4 (D)
Fort Logan National Cemetery	FLC-1	0.9 (D)	1.25 (D)	1.6 (D)	2.0 (D)	1.4 (D)
Goldsmith Gulch (near Bible Park)	GG-1	1.0 (D)	1.67 (D)	1.0 (D)	1.0 (D)	1.3 (D)

* denotes Denver Mountain Park

Table 17. List of Wetland Assessment Areas (AAs) ranked by overall Ecological Integrity Assessment (EIA) scores with sub-scores for Species Richness, % Native Species, Mean C, Floristic Quality Index (FQI).

Site Name	Site Code	Species Richness	Relative Cover Native	Mean C 0-10	FQI 0-100	EIA Score
Echo Lake Park	ELP-1	91	98	5.74	52.93	4.2 (B)
Corwina Park Tributary	CWT-1	93	91	4.49	40.94	3.6 (B)
O'Fallon Park	OFP-1	130	92	4.33	46.44	3.3 (C)
Bear Creek at Corwina Park	CW-1	89	37	3.33	30.55	2.9 (C)
Turkey Creek Park	TCP-1	89	91	4.22	34.47	2.9 (C)
Dedisse Park	DP-1	87	85	2.99	26.38	2.8 (C)
Bear Creek Park-Riparian 1	BCP-R1	98	54	1.67	16.06	2.8 (C)
Parkfield Park	PFP-1	109	68	2.02	20.20	2.5 (C)
Westerly Creek Emergent Marsh	WC-2	39	84	2.29	13.52	2.4 (D)
Hentzell Park 2	HEN-2	118	41	1.68	16.93	2.4 (D)
Bear Creek Park Emergent Marsh	BC-EM1	74	67	2.28	19.23	2.3 (D)
Bible Park Riparian	BPR-1	49	55	1.77	11.76	2.2 (D)
Berkeley Lake Park	BLP-1	45	75	2.26	14.66	2.1 (D)
Riverside Cemetery	RC-1	70	55	1.97	15.62	2.1 (D)
Bear Creek Park East	BCE-1	77	34	1.69	14.24	2.1 (D)
Vanderbilt Park	VB-1	35	64	1.42	8.18	2.1 (D)
Westerly Creek Riparian	WC-1	89	83	2.00	18.00	2.1 (D)
City Park Ferril Lake	CPFL-1	20	85	2.84	12.39	2.0 (D)
Huston Lake	HL-1	49	60	2.07	13.57	2.0 (D)
Kelly Open Space	KO-1	72	62	1.47	11.94	2.0 (D)
Garfield Lake	GL-1	54	79	2.10	15.12	2.0 (D)
Lily Pond (at Washington Park)	LP-1	19	81	2.46	8.88	2.0 (D)
Bluff Lake	BL-1	89	69	1.98	18.33	2.0 (D)
Overland Pond	OPP-1	40	70	2.31	13.83	2.0 (D)
First Creek North	FCN-1	67	80	1.98	14.83	2.0 (D)
Hentzell Park	HEN-1	52	50	1.30	8.85	2.0 (D)
Smith Lake at Washington Park	WPSL-1	22	74	2.33	9.90	1.9 (D)
Hutchinson Park	HUP-1	62	69	1.66	12.09	1.9 (D)
Rocky Mountain Lake Park	RMLP-1	35	75	1.94	11.32	1.9 (D)

Site Name (Table 17 con't)	Site Code	Species Richness	Relative Cover Native	Mean C 0-10	FQI 0-100	EIA Score
Lowry Wetlands	LO-1	67	85	1.40	10.84	1.8 (D)
Bear Valley Park	BVP-1	128	48	1.89	20.82	1.8 (D)
Hampden Heights North Park	HH-1	100	52	1.30	12.30	1.8 (D)
Cherry Creek at Kennedy Golf Course	CC-3	85	59	1.68	14.83	1.7 (D)
City of Karmiel and City of Takayama Park	CC-2	85	46	1.32	11.47	1.7 (D)
First Creek Central	FCC-1	44	80	2.24	14.50	1.7 (D)
South Platte River at Overland Pond	SPR-OPP	24	49	1.52	6.98	1.7 (D)
Heron Pond	HEP-1	69	65	1.89	14.99	1.6 (D)
Duck Lake at City Park	CPDL-1	20	50	1.75	7.83	1.6 (D)
Skeel Reservoir	SR-1	36	36	1.55	8.36	1.6 (D)
Overland Lake	OL-1	13	29	0.85	3.05	1.6 (D)
Cherry Creek	CC-1	82	23	1.45	12.44	1.6 (D)
Babi-Yar Park	BY-1	92	57	2.04	18.33	1.6 (D)
Northside Park	NSP-1	82	84	2.17	19.14	1.6 (D)
Lake of Lakes	LOL-1	58	87	1.59	11.70	1.4 (D)
Fort Logan National Cemetery	FLC-1	91	40	1.81	16.58	1.4 (D)
Goldsmith Gulch (near Bible Park)	GG-1	29	5	0.82	4.35	1.3 (D)

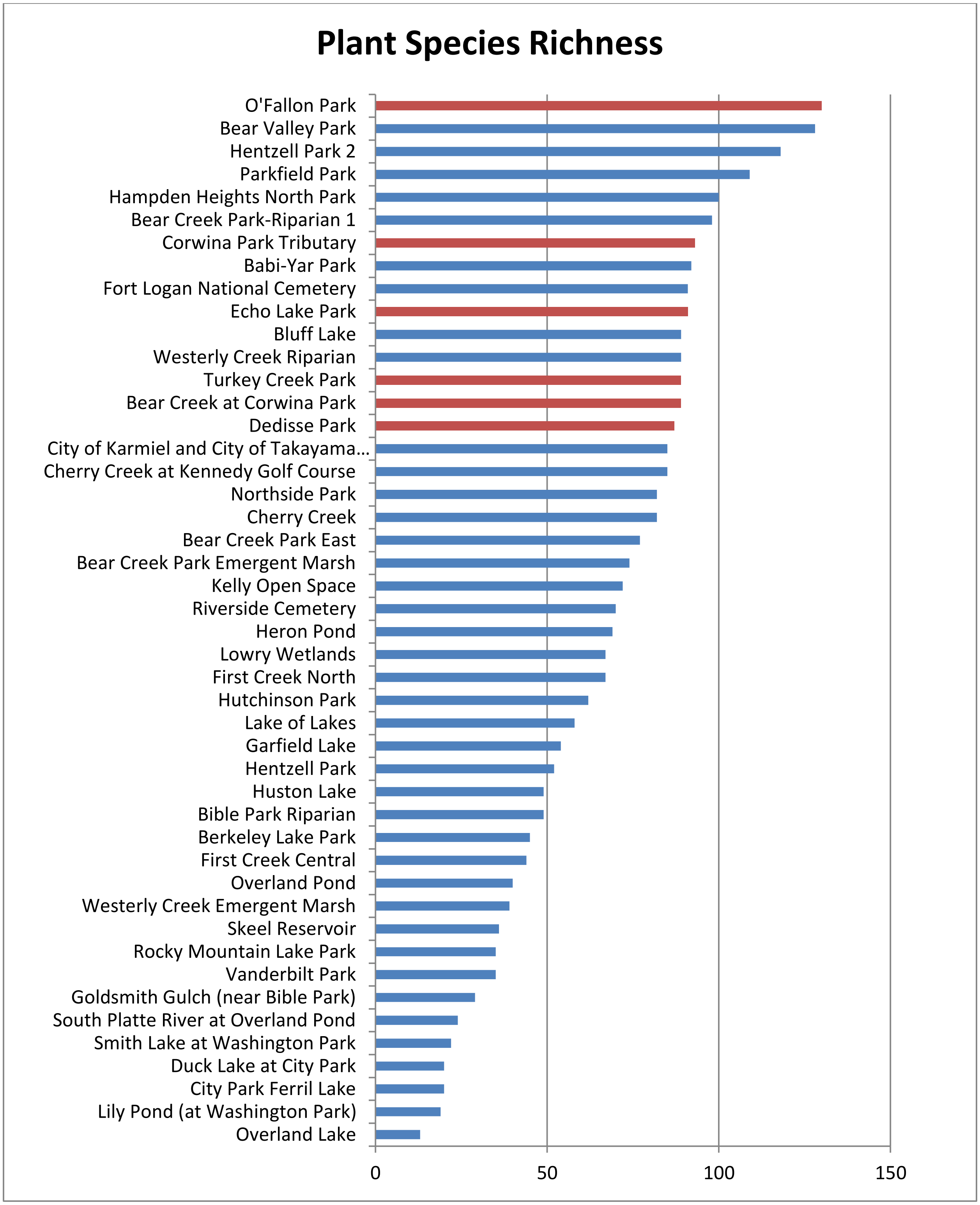


Figure 11. Plant Species Richness at 46 wetland assessment areas (AAs) located in the City and County of Denver (shown in blue) and Denver Mountain Parks (shown in red).

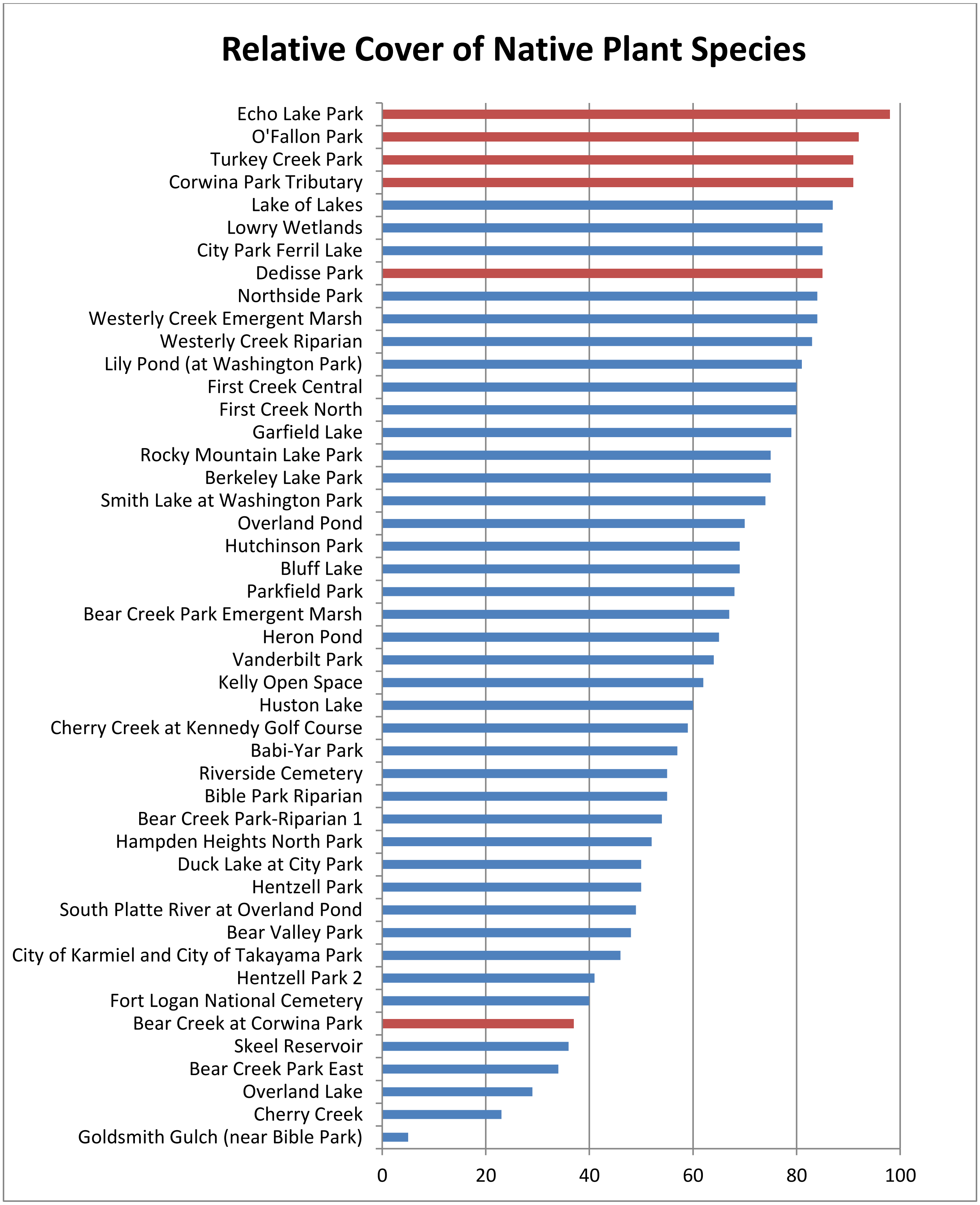


Figure 12. Relative Cover of Native Plant Species at 46 wetland assessment areas (AAs) located in the City and County of Denver (shown in blue) and Denver Mountain Parks (shown in red).

Table 18. Common Wetland Stressors in a 500 meter area surrounding the AAs in Denver County and Denver Mountain Parks.

Common Stressors surrounding the AAs	Denver County (% AAs)	Denver Mountain Parks (% AAs)
Landscape Stressors in 500 m Envelope Surrounding AA		
Paved roads, parking lots, railroad tracks	100%	67%
Domestic or commercially developed buildings	100%	83%
Intensively managed golf courses, sports fields, urban parks, expansive lawns	93%	17%
Unpaved roads (e.g., driveway, tractor trail, 4-wheel drive roads)	68%	83%
Intense recreation or human visitation (ATV use / camping / popular fishing spot, etc.)	35%	0%
Hydrology Stressors in 500 m Envelope Surrounding AA		
Observed or potential urban runoff	100%	33%
Engineered inlet or outlet channel (e.g., riprap)	73%	33%
Berms, dikes, levees that hold water in the wetland	55%	33%
Pumps, diversions, ditches that move water into the wetland	73%	0%

Table 19. Common Stressors within the AAs in Denver County and Denver Mountain Parks.

Common Stressors within the AAs	Denver County (n=40)	Denver Mountain Parks (n=6)
Physiochemical Stressors within AA		
Erosion	60%	83%
Compaction and soil disturbance by human use (trails, ORV use, camping)	60%	33%
Sedimentation	58%	50%
Vegetation Stressors within AA		
Intense recreation or human visitation (ATV use / camping / popular fishing spot, etc.)	55%	0%
Light recreation or human visitation (low-use trail)	48%	33%
Moderate recreation or human visitation (high-use trail)	43%	67%
Unpaved Roads (e.g., driveway, tractor trail, 4-wheel drive roads)	28%	33%

4.5 Natural Heritage Results

Rare Plant and Animal Species

Prior to the 2012–2014 surveys, the CNHP database contained eight Element Occurrence Records (EORs) for five animal and three plant species within the Denver County study area (Table 20). For a detailed explanation of CNHP EORs see Section 3.4 of this report. All of the occurrences are considered to be either extirpated or have not been observed in Denver County since the turn of the 20th century. Four of the five animal element occurrence records (EORs) were for the black-footed ferret (*Mustela nigripes*) at four different sites around Denver County, with the last sighting reported by the US Fish & Wildlife Service in 1988. This was the last known wild occurrence of this species in the state. Black-footed ferrets are now considered extirpated (X Rank) in Colorado. The other animal EOR was for Preble's Meadow Jumping Mouse (PMJM) (*Zapus hudsonius preblei*) last observed in 1885 in Denver County. It is currently listed in the CNHP database as an historical occurrence (H Rank), meaning it has not been observed at that location in more than 20 years (in this case, more than 120 years). It is unlikely there is adequate habitat for the PMJM in Denver County as they do not thrive with human disturbances (pers.comm. John Sovell CNHP December 2014). The three plant EORs in the CNHP database prior to this survey included three prairie species: dwarf milkweed (*Asclepia uncialis* ssp. *uncialis*), prairie violet (*Viola pedatifida*) and the Platte River milkvetch (*Astragalus plattensis*). The dwarf milkweed is thought to be extirpated from Denver County and the prairie violet and the Platte River milkvetch have not been observed since 1893 and 1916, respectively, and are ranked as historical records.

A list of target plant and animal species was compiled using existing records, herbarium searches and the potential for records based on nearby occurrences of rare plants, plant communities and animals (Appendix C). A total of seven Element Occurrence Records (EORs) for rare species were documented during this survey. Three rare plant species (six separate occurrences) were documented in Denver County AAs. Sweet flag (*Acorus calamus*), a tall perennial wetland monocot, occurred in four AAs. It was typically found growing among cattails along the margins of ponds and emergent wetlands. Broadfruit bur-reed (*Sparganium eurycarpum*) was also found growing in a pond margin in a dense patch of sweet flag. Plains ragweed (*Ambrosia linearis*) was found growing on the banks of a canal among dense stands of smooth brome (*Bromus inermis*). No CNHP tracked plant communities or animal species were documented at the 40 urban AA sites during the survey. One rare CNHP tracked animal species, Barrow's Goldeneye (*Bucephala islandica*), was documented in the Mountain Parks at the Echo Lake AA in Clear Creek County (Table 20).

Potential Conservation Areas

CNHP designs Potential Conservation Areas (PCAs) to protect element occurrences of rare plants, animals and plant communities (see methodology Section 3.4). There were two PCAs that included AAs, one in Denver County and one in Clear Creek County. The South Platte River PCA crosses through Denver County and encompasses the mainstem of the South Platte River, as well as associated large reservoirs and major drainages (Figure 13). This large PCA (248,266 acres) is ranked as a B-4 (Moderate Significance) because it supports multiple nesting occurrences of the state rare (G5/S1B) Bald Eagle (*Haliaeetus leucocephalus*). The boundary was drawn primarily for the Bald Eagle so that it would include large reservoirs with trees in proximity to the South Platte

River and its major drainages (Sovell and Smith 2012). Seven of the AAs that are included within PCAs include: Riverside Cemetery, Northside Park, Heron Pond, Overland Pond, Vanderbilt Lake, South Platte River at Overland Park and Overland Lake. The Echo Lake AA is located within the Echo Lake PCA. This PCA is approximately 1,700 acres and includes Echo Lake, as well as the bristlecone pine/ juniper forest to the east of the lake, and areas along Mt. Evans Road. Several species of rare moonworts (*Botrychium* spp.) have been documented within the Echo Lake PCA. The complete reports for South Platte River and Echo Lake PCAs are located in Appendix H and Appendix I, respectively.

Table 20. List of Element Occurrence Records (EORs) for Denver County in the CNHP database. Blue highlight indicates species documented in 2012-2014.

Species Name	*Common Name*	*Global/State Rank**	*Last Observation*	*EO Rank**
Total Vascular Plant Element Occurrences				**9**
Acorus calamus	Sweet flag	G4?/ S1	2013	C
Acorus calamus	Sweet flag	G4?/ S1	2013	D
Acorus calamus	Sweet flag	G4?/ S1	2014	C
Acorus calamus	Sweet flag	G4?/ S1	2013	D
Ambrosia linearis	Plains ragweed	G3/S3	2014	D
Asclepias uncialis ssp. *uncialis*	Dwarf milkweed	G3G4T2T3/T2S2	1895	X?
Astragalus plattensis	Platte River Milkvetch	G5/S1	1916	H
Sparganium eurycarpum	Broadfruit bur-reed	G5 /S2	2013	D
Viola pedatifida	Prairie violet	G5/S2	1893	H
Total Animal Element Occurrences				**5**
Bucephala islandica	Barrow's Goldeneye	G5/S2B	2014	Not yet ranked
Mustela nigripes	Black-footed Ferret	G1/S1	1988	X
Mustela nigripes	Black-footed Ferret	G1/S1	1984	X
Mustela nigripes	Black-footed Ferret	G1/S1	1972	X
Mustela nigripes	Black-footed Ferret	G1/S1	1972	X
Zapus hudsonius preblei	Preble's Meadow Jumping Mouse	G5T2/S1	1885	H
Total Element Occurrences				**14**

*See Section 3.4 for full explanation of CNHP global and state ranks and CNHP spatial data provided in a GIS format to Denver County.

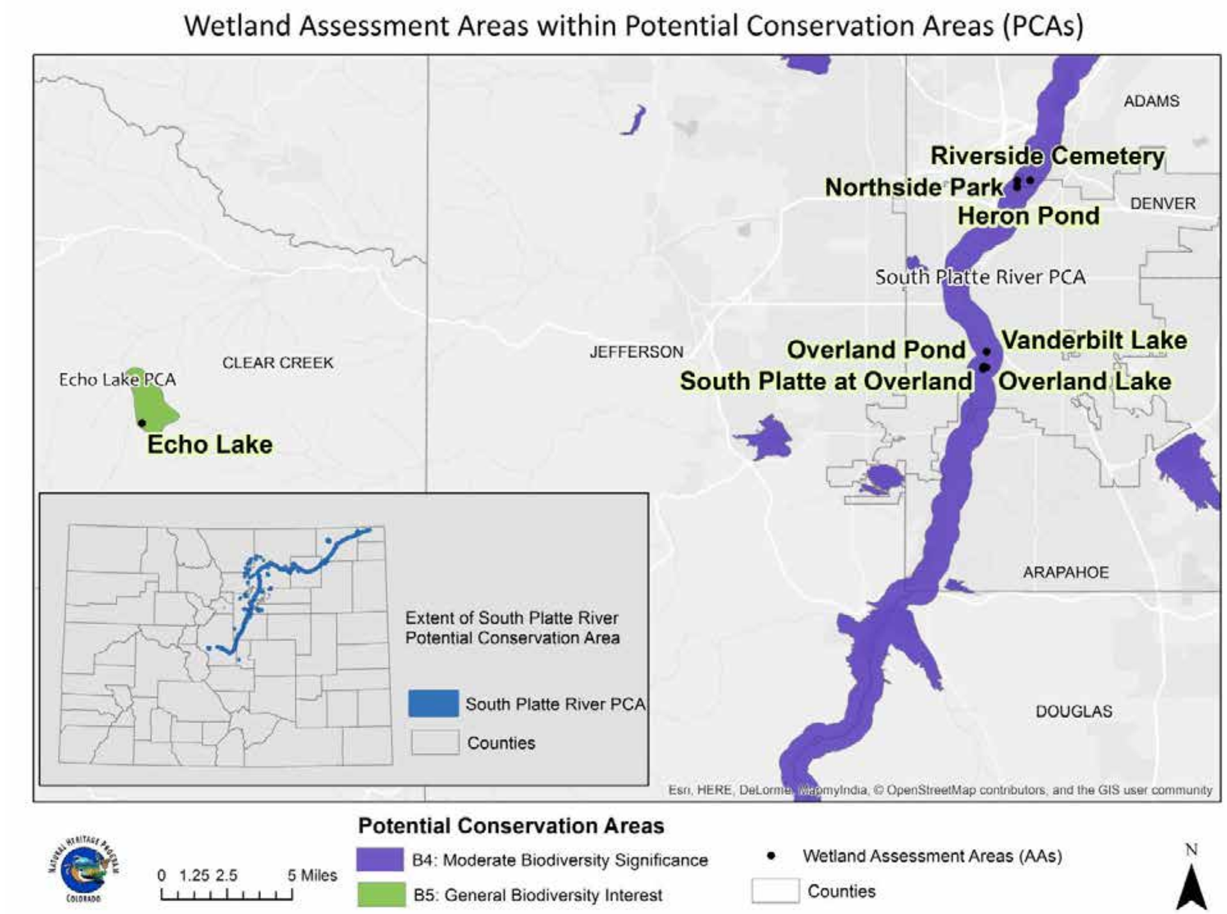


Figure 13. Location and Biodiversity Significance of the South Platte River and Echo Lake Potential Conservation Areas (PCAs) in Denver County and Denver Mountain Parks.

4.6 Vegetation Composition

A total of 545 plant species were found in the 46 Assessment Areas (399 different species in urban Denver AAs and 286 different species in the six Mountain Park AAs – see Appendix J). Denver Mountain Park AAs ranged from 87-130 different species with an average of 97 plants per AA. The AAs in Denver County ranged from 19-128 plants per AA with an average of 62 plants per AA.

Canada thistle (*Cirsium arvense* [syn: *Breea arvense*]) and coyote willow (*Salix exigua*) were the most commonly encountered species, occurring at 43 and 42 of our sites, respectively. Smooth brome (*Bromus inermis* [syn: *Bromopsis inermis*]) and plains cottonwood (*Populus deltoides*) were found at 38 sites. Showy milkweed (*Asclepias speciosa*) was present at 34 sites (Table 21).

Noxious Weeds

The Colorado Department of Agriculture Noxious Weed Program and the Colorado Weed Management Association provide lists of noxious weeds. List A plants are required to be eradicated as designated by the State Commissioner. List B plants are treated based on management plans with local governments. List C plants are also treated based on management strategies with local governments and private land holders, with an emphasis on integrated management techniques. Watch List species are suspected of being a potential invasive species. The list used for this survey was updated in 2014.

There were four List A noxious weed species observed in eight occurrences in the Denver County AAs and no List A species in Mountain Park AAs (see Appendix K for individual AAs). There were 24 species of List B noxious weeds with was a total of 203 occurrences. Only 12 List B species were recorded in Denver Mountain Parks. There were 11 List C noxious weeds with 132 occurrences, 9 in Denver Mountain Parks, and 11 different species in Denver County. There were three different species of Watch Listed Noxious weeds with 12 occurrences in Denver County and no Watch Listed species in Denver Mountain Park AAs (Table 22). The average percent cover of non-native plant species was 29% across all AAs.

Denver County Records

Twenty-four vascular plant species were documented during the wetland assessment surveys that had not been previously reported for Denver County (Table 23). This list includes 20 native and five non-native plant species. Of the native plant species, two are tracked by CNHP and two non-native species are on the State List of noxious weeds (Table 21). Some of the species are known from the County, like Eurasian watermilfoil, a List B noxious weed, but a specimen had not been deposited in an herbarium. All specimens listed in Table 21 were deposited at the Colorado State University herbarium with duplicates sent to the University of Colorado herbarium. County records were verified using the following data sources: USDA Plants, SEINet, and University of Colorado Herbarium (CU).

4.7 Site Descriptions

Detailed site descriptions for each of the 46 wetland sites with EIA scores, site photos, maps, and information on plant species composition and wetland condition are provided in Appendix K.

Table 21. Twenty most commonly encountered plants in the City and County of Denver and Denver Mountain Parks (Bolded = only in Denver County).

Scientific Name	Common Name	# of AAs	Wetland Indicator Status[1]	Native Status	C-Value
Cirsium arvense	Canada thistle	43	FACU	List B noxious weed	0
Salix exigua	Narrowleaf willow	42	FACW	Native	3
Populus deltoides	Cottonwood	38	FAC	Native	3
Bromus inermis	Smooth brome	38	FACU	Non-native	0
Asclepias speciosa	Showy milkweed	34	FAC	Native	3
Convolvulus arvensis	Field bindweed	32	UPL	List C noxious weed	0
Rumex crispus	**Curly dock**	**32**	**FAC**	**Non-native**	**0**
Taraxacum officinale	Dandelion	32	FACU	Non-native	0
Elymus repens	Quack grass	32	FACU	List B noxious weed	0
Plantago major	Plantain	31	FAC	Non-native	0
Lactuca serriola	Prickly lettuce	29	FAC	Non-native	0
Phalaris arundinacea	Reed canarygrass	28	FACW	Native	2
Poa pratensis	Kentucky bluegrass	28	FACU	Non-native	0
Ulmus pumila	Siberian elm	27	UPL	Non-native	0
Fraxinus pensylvanica	**Green ash**	**26**	**FACW**	**Native**	**na**
Salix fragilis	Crack willow	24	FAC	Non-native	0
Melilotus officinale	Yellow sweet clover	24	FACU	Non-native	0
Ambrosia psilostachya	Cuman ragweed	24	FACU	Native	3
Schoenoplectus pungens	**Common threesquare**	**24**	**OBL**	**Native**	**4**
Oenothera villosa	Hairy evening primrose	23	FAC	Native	4

[1] Wetland Indicator Status based on the 2013 National Wetland Plant List for the Great Plains region. OBL = obligate wetland species, found in wetlands 99% of the time; FACW = facultative wetland species, found in wetlands 67–99% of the time; FAC = facultative species, found in wetlands 34–66% of the time; FACU = facultative upland species, found in uplands 67–99% of the time; UPL = obligate upland species, found in uplands 99% of the time.

[2] *Distichlis stricta* is a wetland indicator species in the Great Plains, but not in the Arid West region (FAC). *Pascopyrum smithii* is a FAC species in the Arid West region. Random sites were located in both regions, though more of the study area is located in the Great Plains region.

Table 22. List of Noxious Weeds found in 46 AAs in the City and County of Denver and Denver Mountain Parks. (Bolded = only in Denver County).

Species Name and Authority	Common Name	Colorado Noxious Weed Status	Number of Sites
***Epilobium hirsutum* L.**	**hairy willowherb**	**List A**	**8**
***Euphorbia myrsinites* L.**	**myrtle spurge**	**List A**	**1**
***Lythrum salicaria* L.**	**purple loosestrife**	**List A**	**6**
***Polygonum cuspidatum* Siebold & Zucc.**	**Japanese knotweed**	**List A**	**1**
Acroptilon repens (L.) DC.	hardheads	List B	1
***Cardaria draba* (L.) Desv.**	**whitetop**	**List B**	**4**
Carduus nutans L.	nodding plumeless thistle	List B	13
Centaurea diffusa Lam.	diffuse knapweed	List B	7
***Centaurea stoebe* L. ssp. *micranthos* (Gugler) Hayek**	**spotted knapweed**	**List B**	**1**
Cirsium arvense (L.) Scop.	Canada thistle	List B	43
Cirsium vulgare (Savi) Ten.	bull thistle	List B	4
Cynoglossum officinale L.	gypsy flower	List B	8
***Dipsacus fullonum* L.**	**Fuller's teasel**	**List B**	**4**
***Dipsacus laciniatus* L.**	**cutleaf teasel**	**List B**	**4**
***Elaeagnus angustifolia* L.**	**Russian-olive**	**List B**	**22**
Euphorbia esula L. var. *esula*	leafy spurge	List B	14
Euphorbia esula L. var. *uralensis* (Fisch. ex Link) Dorn	Russian leafy spurge	List B	5
***Lepidium latifolium* L.**	**broadleaved pepperweed**	**List B**	**11**
Leucanthemum vulgare Lam.	oxeye daisy	List B	1
Linaria dalmatica* (L.) Mill. ssp. *dalmatica	**Dalmatian toadflax**	**List B**	**1**
Linaria vulgaris Mill.	butter and eggs	List B	5
***Myriophyllum spicatum* L.**	**Eurasian milfoil**	**List B**	**1**
***Onopordum acanthium* L.**	**Scotch cottonthistle**	**List B**	**11**
***Potentilla recta* L.**	**sulphur cinquefoil**	**List B**	**1**
Saponaria officinalis L.	bouncingbet	List B	7
***Tamarix ramosissima* Ledeb.**	**saltcedar**	**List B**	**1**
***Tripleurospermum perforatum* (Mérat) M. Lainz**	**scentless false mayweed**	**List B**	**1**
***Arctium minus* Bernh.**	**lesser burdock**	**List C**	**9**
***Bromus tectorum* L.**	**cheatgrass**	**List C**	**20**
***Cichorium intybus* L.**	**chicory**	**List C**	**7**
***Conium maculatum* L.**	**poison hemlock**	**List C**	**18**
Convolvulus arvensis L.	field bindweed	List C	32
Elymus repens (L.) Gould	quackgrass	List C	32
***Erodium cicutarium* (L.) L'Hér. ex Aiton**	**redstem stork's bill**	**List C**	**11**
Hypericum perforatum L.	common St Johnswort	List C	1
Sonchus arvensis L.	field sowthistle	List C	5

Sonchus arvensis L. ssp. *uliginosus* (M. Bieb.) Nyman	moist sowthistle	List C	4
***Tribulus terrestris* L.**	**puncturevince**	**List C**	**5**
Verbascum thapsus L.	common mullein	List C	20
Iris pseudacorus L.	yellow flag	Watch List	2
***Phragmites australis* (Cav.) Trin. ex Steud.**	**common reed**	**Watch List**	**2**

Table 22. List of Plant Species not previously reported for Denver County based on herbarium search records.

Species Name	Common Name	Specimen Number	Native Status
Carex foenea (C. siccata)	Dry spike sedge	D-2013-111	Native
Carex utriculata	Northwest territory sedge	D-2013-107	Native
Chenopodium simplex	Mapleleaf goosefoot	D-2013-175; D-2013-176; D-2013-179	Native
Crataegus macracantha var. *occidentalis*	Fleshy hawthorn	D-2013-62	Native
Cyperus odoratus	Fragrant flatsedge	D-2013-101	Native
Eleocharis rostellata	Beaked spikerush	D-2013-191; D-2013-192	Native
Elymus repens	Quackgrass	D-2013-180	List C noxious weed
Eragrostis lutescens	Sixweeks lovegrass	D-2013-139	Native
Eragrostis spectabilis	Purple lovegrass	D-2013-141	Native
Forestiera pubescens	Stretchberry	D-2013-80; D-2013-44	Native
Frangula alnus [*Rhamnus frangula*]	Glossy buckthorn	D-2013-60	Non-native
Froelichia floridana var. *campestris*	Plains snakecotton	D-2013-s.n.	Native
Glyceria striata	Fowl mannagrass	D-2013-133; D-2013-134; D-2013-160	Native
Kochia [*Bassia*] *hyssopifolia*	Fivehorn smotherweed	D-2013-77	Non-native
Lemna miniscula [*L. minuta*]	Least duckweed	D-2013-85; D-2013-94	Native
Lycopus uniflorus	Northern bugleweed	D-2013-73	Native
Myriophyllum spicatum	Eurasian watermilfoil	D-2013-86	List B noxious weed
Najas guadalupensis	Southern waternymph	D-2013-83	Native
Persicaria amphibia	Water smartweed	D-2013-142	Native
Potamogeton pusillus	Small pondweed	D-2013-91	Native
Rumex densiflorus	Denseflowered dock	D-2013-145	Native
Sparganium eurycarpum	Broadfruit bur-reed	D-2013-04	Native CNHP tracked
Thinopyrum intermedium	Intermediate wheatgrass	D-2013-40	Non-native
Wolffia columbiana	Columbian watermeal	D-2013-88	Native

5.0 DISCUSSION

Wetlands in highly urbanized watersheds, though impacted by development, still provide essential services, including flood control by absorbing excess runoff; erosion control through vegetation stabilization; and water quality improvement by removing excess nutrient runoff, pollutants, and microbial contaminants from non-point sources (Mack and Micacchion 2007; Jennette et al. 2014). All of the wetlands surveyed for this effort are worthy of protection and offer significant benefits to the community. None of the surveyed wetlands in Denver were considered to have no value, be unrestorable, or were on the brink of not functioning as wetlands. Even the lowest scoring wetlands provided services and some harbored rare plant species.

Ecosystem functions, such as soil drainage, evaporation, and heat dispersal, may be significantly altered in urban wetlands (Pavao-Zuckerman 2008). Additionally, urban wetlands can be stressed by highly centralized sources of pollutants, significant air pollution, and urban runoff from impervious surfaces. This is compounded by the fact that urban wetlands are typically constructed features or modifications of existing wetland areas. The watersheds surrounding Denver's urban wetlands are highly developed and contribute low quality water. Often, Denver's lakes and reservoirs had highly developed shorelines. Since natural shoreline vegetation has a direct influence on the ecological integrity of a lake by providing shade, leaf litter, woody debris, protection from erosion and wildlife habitat, improving and protecting natural shoreline vegetation is important for urban wetland management (Nasselli-Flores 2008). The role of aquatic plants, algae, buffer zones and non-native plants in urban environments needs to be integrated into management plans to protect and improve urban wetland resources and the ecosystem functions they provide (see Management Recommendations below).

Two urban wetland AAs, Parkfield Park and Bear Creek Park Riparian, received C ranks or fair condition scores of 2.5 and 2.8, respectively. These wetlands, unlike the other 38 urban sites that had scores in the D rank range, contained large, vegetated buffers and high plant species diversity. Every effort should be made to protect not only the wetlands but the buffer lands that protect them. No examples of good (B rank) or excellent (A rank) sites were found in the urban environment due to high levels of landscape, biotic, physiochemical, and hydrologic stressors.

For a statewide comparison, wetland condition ranks have been documented for the South Platte River Basin (Lemly et al. 2014), northern Front Range (Lemly et al. 2013), North Platte River Basin (Lemly and Gilligan 2012), and Rio Grande Headwaters River Basin (Lemly et al. 2011). The North Platte and Rio Grand Basins are large and include much less developed landscapes and mountainous topography. These basins had numerous A ranked wetlands. The South Platte River Basin, of which Denver County is a small portion, had no A ranked wetlands and only 2% B ranked, reflecting much of the agricultural lands on the northeastern plains of Colorado. The northern Front Range study was similar to the South Platte, with no A ranked sites, few B ranked sites, and largely C ranks (Figures 14 & 15). Denver County scores are expected as it is the most intensely developed section of the South Platte River Basin.

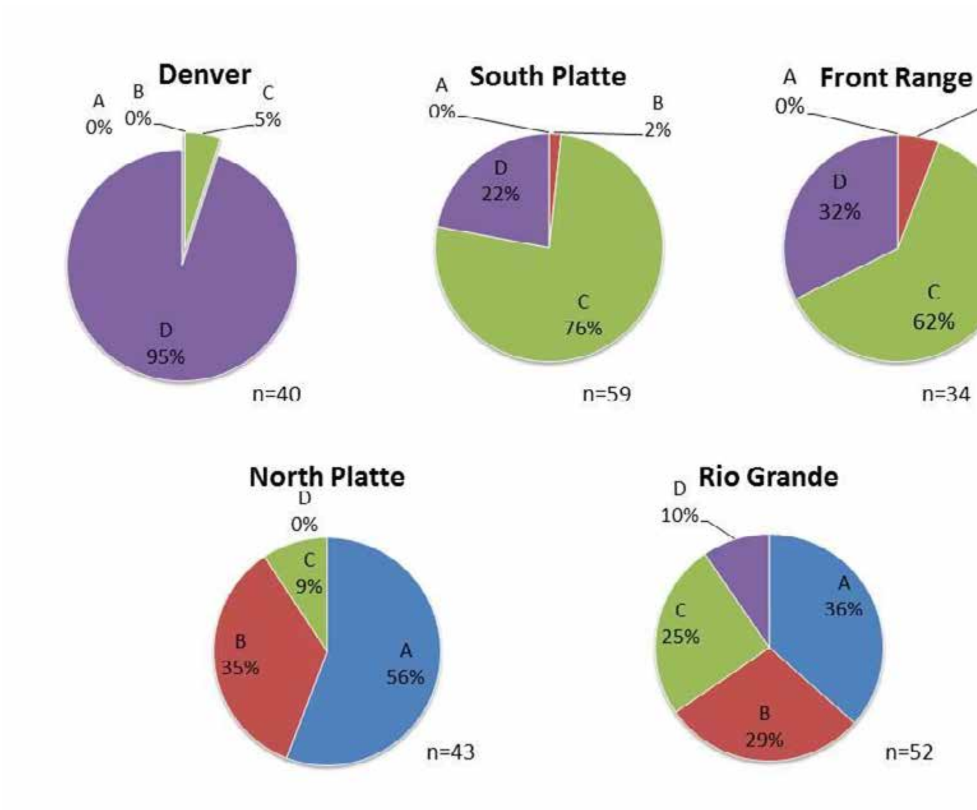


Figure 14. Comparison of Denver County Wetland Condition Ranks using Ecological Integrity Assessment methods. Wetlands condition ranks are as follows: A = Excellent; B = Good; C = Fair; D = Poor.

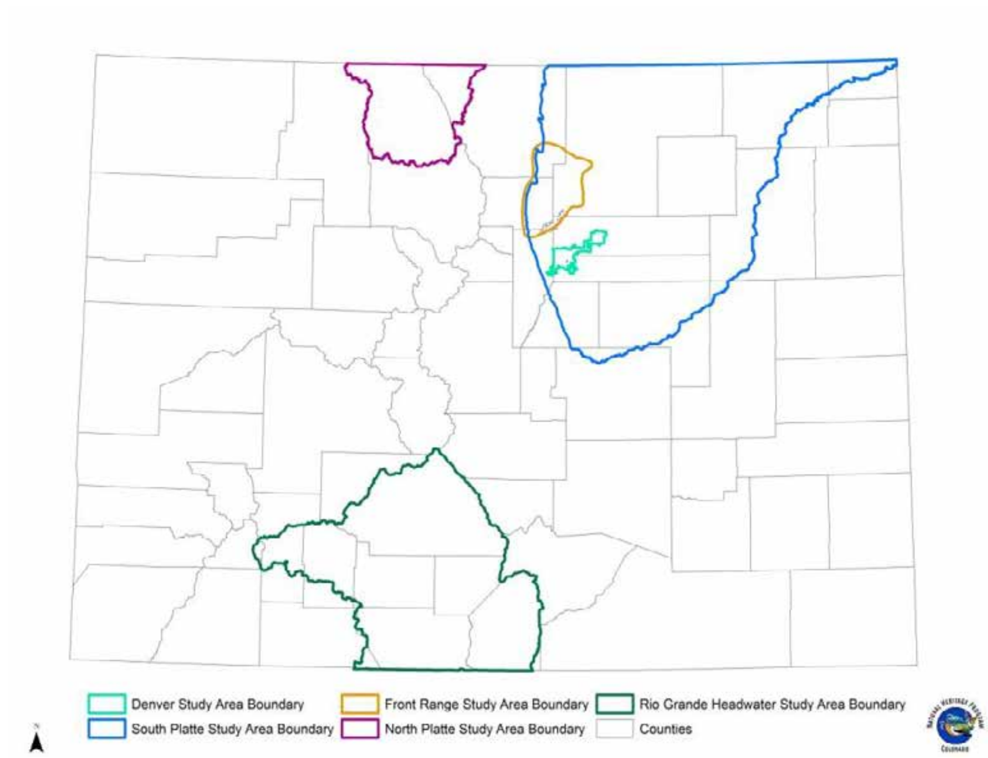


Figure 15. Location of wetland condition assessment study areas in Colorado.

Condition assessments were also conducted at six wetlands located within Denver Mountain Parks (DMPs) as part of the Denver County wetland study. The DMP sites have comparatively lower levels of development, fragmentation, and hydrologic alteration and have a distant upstream connection to some of the surveyed sites in urban Denver. The Mountain Park sites were similar to the types of sites to which an EIA type of an assessment has been used in the past, and served as a reference to verify the metrics in the EIA scores. As expected, the DMP sites all ranked higher (B and C ranks) than the sites located within Denver County. Interestingly, however, one of the western Denver County sites (Bear Creek Park Riparian) had the same score as one of the Mountain Park AAs (Didesse Park). Wetland sites in the Mountain Parks were often buffered by large expanses of forests and meadows dominated by native plant species. In addition, DMP sites were characterized by more natural hydrologic regimes than Denver County sites. Water sources, hydrologic connectivity, and hydroperiod for DMP sites, unlike urban Denver sites, were largely natural. While the DMP sites largely contained higher quality wetlands than most of the Denver County sites, all of the Mountain Park wetlands have been impacted by human development. Major highways were located in close proximity to all six DMP sites, all with residential developments in the vicinity.

The importance of the wetlands in Denver County from a wildlife perspective cannot be understated. All urban Denver wetlands are located along the Central Flyway, a north/south migratory pathway centered on the North American Great Plains (Johnsgard 2012). Almost half of the NWI mapped wetlands and waterbodies were lakes that are permanently flooded throughout the year. While these are not natural features, they provide vital habitat for birds migrating along the Central Flyway. Incidental wildlife observations at both the urban and Denver Mountain Park AAs demonstrate that wildlife, including migratory birds, are utilizing both the urban and mountain sites (see Site Descriptions for wildlife observations). The wetlands in Denver that support the best habitat were those which provided 10 of the functions measured by the LLWW analysis (see Section 4.3). These wetlands are the ones that have vegetated wetlands versus reservoir type wetlands with narrow rings of vegetation and no macrophyte or emergent plant growth. These wetlands provide the most benefits, are the least common and warrant special protection. The vegetated zones of many of Denver's wet areas are being suppressed by mowing and could easily be increased by allowing the vegetation to flourish around wetlands.

Urban wetlands also offer recreational and educational opportunities. While our study did not attempt to quantify social values provided by wetland sites, they are well documented and greatly enhance the quality of life for the community. As Robert Pyle (1993) describes in his book "The Thunder Tree", which is about his childhood memories growing up near the Highline Canal:

" Even if they don't know my ditch…they have a ditch somewhere". Pyle goes on to describe that we need these places where the "earth gets under our nails and a sense of place gets under our skin" and that even the damaged lands provide a place for people to make a connection with nature. Many of the urban wetland sites we visited were public parks that received high levels of recreation and visitation (Figure 16). People need these places and the more diverse they are in terms of native plants and animals, the more resistant they are to mosquito and geese imbalances that occur in more traditionally managed parks.

Figure 16. A father and son enjoy fishing at Smith Lake at Washington Park, Denver County.

Rare Plant and Animal Occurrences

Since many uncommon or rare species tend to inhabit areas of low human disturbance, we did not anticipate documenting rare species during our survey. Surprisingly, six occurrences of rare plants tracked by CNHP were documented in Denver County (Table 19). There were four occurrences of sweet flag (*Acorus calamus*), and one each of prairie ragweed (*Ambrosia linearis*) and broadfruit bur-reed (*Sparganium eurycarpum*).

Another interesting plant sighting was reported to CNHP by Denver County employee John Vickery at a section of Sanderson Gulch. The sighting was of the only known occurrence of a native orchid species (*Platanthera* sp.) ever reported for Denver County that was not planted in a garden. The orchid is not a rare CNHP tracked species, but it is an exciting find for metro Denver. It was documented along Sanderson Gulch within a couple of inches of the unmowed corridor. This is a nice example that although the urban wetlands are impacted, they are worthy of protection as they do harbor rare plants and likely have the potential to also harbor rare or other important animal species.

The natural regeneration we observed in some wetlands was an important indicator that restoration is highly likely even with minimal human intervention along the wetlands. These wetlands also provide many important ecological, hydrological and esthetic benefits, despite what might be considered a low EIA score. This data also supports recent efforts proposed by Urban Drainage Flood Control District to reduce mowing along the canals and drainage ways in Denver. From our observations, this not only would save money, it would likely enhance these types of occurrences, improve water quality, and provide other ecological services that are not afforded by manicured and mowed borders.

Prairie ragweed (*Ambrosia linearis*), a rare plant tracked by CNHP, was documented at Goldsmith Gulch (Figure 17). It was reported originally in 2004 by biologist Rick Brune from that location and verified by CNHP in 2014. Prairie ragweed, a globally and state vulnerable (G3/S3) species is an endemic known only from the plains of eastern Colorado. This species occurs in intermittent streams and around playa margins. This population might represent a relictual population that was protected in the gulch buffer (which was not mowed at the time of the survey) that has managed to survive in this urban environment. This is particularly interesting because this site received the lowest overall EIA score of all of the AAs surveyed.

Figure 17. Prairie ragweed (left), a rare prairie plant is tucked into a dense smooth brome dominated shore of Goldsmith Gulch. Photo: P. Smith June 17, 2014.

Sweet flag is considered to be both native and/or introduced depending on the taxonomic source consulted. CNHP follows the treatment of Kartez (1999) who looked at plant material characters from the two recognized species that overlap (*Acorus calamus* and *A. americanus*) and thus noted both these species are likely native to North America. In the CNHP database, sweet flag is considered to be apparently globally secure (can be rare in parts of its range), but state critically imperiled (G4?/S1). Four occurrences of sweet flag were documented in the entire state before this survey. A single occurrence from Boulder County was extirpated (X rank), another two herbarium specimens from Larimer County were historical and have not been observed in the last 30 years (H rank), and a recent record documented in 2011 by the City of Fort Collins was the only extant population. Sweet flag, which does not produce seeds and only spreads by rhizomes or underground stems, was documented by CNHP in 2013 and 2014 at four locations in Denver County (Garfield Lake, Rocky Mountain Lake, Ferril Lake and Westerly Creek) within AAs. The only other Denver County Record before this survey was a specimen collected from a planting at the Denver Botanical Gardens from their "Plains Garden" in 1990. It is an interesting species known for its wide range of medicinal properties and sweet fragrance (Figure 18).

Wetland plants tend to regenerate more easily than prairie plants when given the opportunity (pers. comm. Renee Rondeau July 2014) and this is demonstrated in many of the urban parks including City Park (Figure 18). Two excavated lakes at City Park include Ferril and Duck Lakes. They are totally surrounded by manicured areas and paved trails, and even paved shoreline in some areas in a very densely developed metro park area. In the small areas where the wetland plants are allowed to flourish along the lakeshore, there is a high quality very narrow vegetated buffer of tall native herbaceous plants that has developed around the shoreline that contains a population of the rare CNHP tracked plant, sweet flag (*Acorus calamus*). Many of the man-made features in Denver have been lakes or ponds for over 100 years (Dudley 2004) and have developed wetland vegetation around them or maintain wetland plantings well, with Berkeley and Rocky Mountain Lakes being two examples. Both of these lakes had some native plant occurrences including some rare and uncommon plants: duck meat (*Spirodela polyrhiza*), sweet flag (*Acorus calamus*), and broadfruit bur-reed (*Sparganium eurycarpum*).

Figure 18. Ferril Lake at City Park with very small wetland fringes along shoreline that include sweet flag. Native wetland plants are visible trying to grow in the mowed zone. This is a great example where reducing mowing alone would improve the plant zone on the lakeshore and would protect the lake's water quality while reducing maintenance costs.

5.1 Management Implications

Vegetated Buffer Zones

The single most important factor that can protect and enhance the quality of the wetlands in Denver County is the vegetated areas or buffer lands that border them. Conserving natural areas in the watershed and around waterbodies is an important way to protect water quality. The natural shoreline vegetation directly influences the ecological integrity of the wetland (Nasselli-Flores, 2008). The more natural state the surrounding buffer lands are in, the more benefits they provide. This was reflected by the EIA scores for the AAs in Denver County. While they are better than bare soil or paved surfaces, mowed areas, especially manicured parks and residential lawns, do not provide good wetland buffers. In fact, pesticide, herbicide and insecticide residue from these lawns is a major source of contamination to urban streams in the United States (USGS, 1999, Gilliom 2007). These pollutants can cause impacts to human health, as well as the health of wildlife species (Gilliom 2007). The best buffers to enhance water quality would include non-treated and non-mowed strips of wetland plants along the edges of wetlands. Every foot of tall wetland vegetation provides filtration, reduction of surface runoff speeds, cooling and shade, and provides wildlife habitat. Non-native species also provide these services. The Lake Management and Protection Plan for Denver states… "Denver wants to manage and protect their urban lake resources for the benefit of the citizens and the environment" (Dudley 2004). Other goals included in the plan are to restore natural, ecologically balanced lake shoreline and shoreland habitat and to target causes to reverse water quality impacts (Dudley 2004). One of the easiest and cost efficient ways to accomplish this is to protect and encourage a natural vegetation layer that covers at least half of the shoreline area around a lake, and is unmowed and untreated. Smith, Ferril and Duck Lakes have very high nutrient levels (personal communication, Al Polonsky, November 2103) and are surrounded by acres of treated manicured lawns. Reuse water is a large water input for all of these lakes. Allowing more of a vegetated buffer to develop around these lakes and reducing mowing, pesticides and fertilizers and allowing for some aquatic plant growth to return would improve the water quality by providing extra filtration from the plants. It would also increase the esthetic experiences of visitors, reduce Canadian geese visitation and maintenance costs. This would also increase the acreage of the most highly functioning wetland types in the County.

Aquatic plants

There are two major types of plants found within the waterbodies in Denver's streams, rivers, lakes and reservoirs. The large plants that are submerged, floating, or that grow along the water's edge are referred to as aquatic macrophytes. These aquatic plants are an extremely important part of healthy wetlands (Figure 19). However, the benefits and values of these plants are misunderstood and therefore not highly valued. For example, many wildlife species are a welcome sight in the urban wetlands but aquatic plants are not. Many people do not realize that aquatic plants are a necessary food source and provide homes and cover for many fish, birds, reptiles, amphibians and land animals.

> "In moderation, aquatic plants are aesthetically pleasing and desirable environmentally. Their presence is natural and normal in lakes, and in fact they are an important link in a lake's life system. In large quantities, plants can interfere with some water uses and may be seen as a problem" (State of Washington 2014).

Figure 19. Biologists Jill Handwerk and Marika Majack show a specimen of *Potamogeton praelongus*, an uncommon native pondweed, at Echo Lake Mountain Park. Inset shows submerged plants. Photo: P.Smith July 09, 2014).

The other major group of plants that are misunderstood include the algae. The individual plants for most species are microscopic and give lake water a green color. They can also form dense mats, cause odors and even produce toxins when the balance between aquatic macrophyte and algae in the lake are disrupted. The goal for lake managers should be to achieve a balance between algae and the aquatic macrophytes for healthy systems (State of Washington 2014). Aquatic plants help maintain good water quality by settling sediments and absorbing pollutants. They also decrease flow velocity and prevent erosion and flooding during storm events. They also help maintain healthy oxygen levels and keep algae from dominating. The role wetland plants play in erosion control and nutrient cycling is also extremely important. A common reaction when aquatic plants and algae get dense is to remove all of them. However, unintended impacts to fish and wildlife are not considered. Once a lake's ecosystem is disturbed, a new balance must be achieved. Almost all methods of plant control have direct effects on plant life and organisms other than the targets of the control program (State of Washington 2014).

Nutrients and sediments that enter Denver’s wetlands influence the presence and growth of macrophytes and algae. One of the best ways to keep the aquatic plant growth at a healthy level is to reduce the flow of nutrients and sediments into the wetland. Much of the aquatic growth is also determined by sediment loads and not the water column. One of the best ways to address problems with aquatic plant and algae growth is from a watershed level approach that includes stormwater treatments and public involvement and education. Dredging and chemical herbicides to treat wetlands and the surrounding landscapes are not recommended because they are only short term fixes that promote more stress, have mixed results and do not recover water quality (Naselli-Flores, 2008). Protection of buffer lands, reducing mow zones around wetlands and reducing chemical fertilizers and pesticides will help reduce nutrient loads and improve water quality for the longer term. Conservation of *natural areas* anywhere within the urban watershed would be a significant contribution to enhancing water quality and the public's experiences (Naselli-Flores 2008).

Non-native Plant Species in Urban Denver

Non-native species are typically defined as non-indigenous or species occurring in an area where they have not evolved since the last Ice Age and whose introduction was incited by human activities. Disturbance by human activities is very different from natural disturbances in natural settings. Anthropogenic disturbances are directly linked to species composition. In dense metropolitan areas it is typical to have about 40% cover of non-native species (Kowarik 2008). At each of the AAs in urban Denver, the cover and the number of non-native species ranged between 30 to 72% of the individual plant lists for each site. Efforts to control non-native species, including noxious weeds, need to be considered carefully in urban settings. The removal of all non-native species and noxious weeds in an area that no longer naturally supports native plants is a difficult and unnecessary task. A non-native plant still performs the same functions of native species in terms of shoreline stabilization, structure and food for wildlife, filtration of runoff and provides buffer lands. Non-native species have a tendency to decrease overtime without treatment (Kowarik 2008). Weed treatments can be a form of disturbance, causing habitats to stay in an ecological successional (disturbance) stage that favors the establishment of weeds. In most cases where a species is targeted for elimination, treatment only temporarily removes the species, or it is replaced by a different weedy species.

Herbicide Use

Chemicals such as herbicides, pesticides, and insecticides are applied to lawns as fertilizers, or to kill weeds and insects. The majority of urban waters in the U.S are contaminated from runoff from residential landscapes (Gan et al. 2003a). All of these chemicals have secondary unintended effects and in addition, large amounts of applied chemicals (>99%) do not even reach the intended targets and are released into the environment (Silver and Riley 2001, Gan et al. 2003b). Herbicide use is common, but it can have many hidden costs because the resulting contamination poses risks to soil microorganisms, insects, plants, fish and birds. Contrary to common misconceptions, herbicides are even more problematic because of the large volumes in which they are now being applied (Silver and Riley 2001). Herbicide treatments in Denver wetlands are not recommended for two main reasons: 1) the coverage of noxious weeds was found to be low and alternative methods should be considered especially in or near wetlands and 2) the wetlands already receive a very high load of contaminants from the surrounding landscapes. Observations of herbicide drift were noted in several AAs including Parkfield Park and Westerly Creek. The drift impacts observed included bare ground, curled tree leaves and non-target tree mortality.

The treatment of Canada thistle (*Breea arvensis* or *Cirsium arvense*), a class B noxious weed that managers are obligated to treat, is an example of how chemical weed control might not be the first choice. In a long-term weed study in Colorado (Rondeau & Lavender 2012), it was found that if a non-native grass species, smooth brome (*Bromus inermis*) was present, the herbicide treatments used for Canada thistle resulted in a increased cover of smooth brome. Additionally, the treatments also resulted in the disappearance of native shrubs thought to be weakened by the herbicide. The result was an area dominated by a single species of a non-native grass species that possesses all the characters of a noxious weed with the exception of the legal designation. Native shrubs that offered complex vegetation structure for wildlife habitat were eliminated, as well as the floral resources that are offered by Canada thistle for pollinators. Overall, the herbicide treatments resulted in a reduction in biodiversity. A better treatment course would be to consider mechanical removal of flowering heads rather than chemical applications that could weaken surrounding plants and give smooth brome an advantage. This study is of particular importance to Denver County land management practices because almost every site had large populations of smooth brome in the AA or the surrounding buffer lands, and Canada thistle was one of the most common plants observed.

Fertilizers and Turf Maintenance

Fertilizer use is common in Denver County due to the high percentage of lawns and cropland. Landowners apply fertilizers to promote the growth of turfgrass and agricultural crops. However, the nitrogen and phosphorus contained in these fertilizers can negatively affect ground and surface water quality (Rosen and White 1999; Biello 2008). In urban Denver, these fertilizers enter streams and rivers during stormwater runoff events, causing excessive levels of nitrogen and phosphorus in our surface and ground water. This nutrient pollution can result in the rapid growth of algae. Significant increases in algal growth can harm water quality and aquatic plant habitats, as well as decrease oxygen levels that fish and other aquatic organisms rely on to survive.

For Denver County, using sustainable landscaping that does not require chemical fertilizers in city parks, cemeteries and golf courses would improve water quality in the cities' streams, lakes, and wetlands. This change would also result in reduced costs for chemical fertilizers. Land managers and reduction of highly manicured lawns would also benefit resource managers economically because treatments for excess plant growth would be reduced, as would costs for lawn chemicals. Other cities in Colorado, including Durango and Boulder, are experimenting with using compost as lawn fertilizer, instead of synthetic fertilizers. Additionally, lands owned by the City of Denver could be evalutated to determine if they are suitable for restoration or conversion to shortgrass prairie or more natural habitats. These converted areas could contain more deep-rooted native plant species, which would help filter stormwater runoff more efficiently than shallow-rooted turfgrass lawns. In turn, this would lead to improved water quality in Denver wetlands. This has been achieved in wetlands at Parkfield Park and along Bear Creek, where the surrounding natural landscapes have promoted higher water quality scores.

Educating the public about the use of safer lawn-care would also increase awareness and promote better water quality throughout Denver County. Sources for safe lawn care include the Coalition to educate the public about how to promote safer lawn care:
http://www.beyondpesticides.org/pesticidefreelawns/

Tips for chemical free lawn maintenance from the National Wildlife Federation can be found here: http://www.nwf.org/How-to-Help/Garden-for-Wildlife/Gardening-Tips/How-to-Maintain-a-Chemical-Free-Lawn.aspx

5.2 Recommendations

1) Protect all existing wetlands within Denver County and any surrounding buffer lands from development (See Site Descriptions Section 7.0 for individual Assessment Areas).
2) Expand the coverage of existing wetlands by eliminating or reducing the acreage of manicured and mowed landscaping around edges of all wetlands including streams and lakes. Leave vegetated buffers several feet wide or more where possible to enhance water quality.
3) Conserve natural areas in the urban watershed to enhance water quality and the public's experiences.
4) Promote environmentally friendly landscaping with no or low use of chemical herbicides, pesticides, and fertilizers in wetlands and associated buffer lands.
5) Encourage environmentally friendly landscape management in the parks and throughout the watershed to the public through education and incentives.
6) Revegetate bare ground around shorelines to provide protection from erosion and to slow runoff and pollutant entry into lakes and streams.
7) Avoid paving or adding impervious surfaces to areas near wetlands and in buffer lands.
8) Retain aquatic macrophytes and algae in a balance.
9) Refrain from sediment dredging and removal to avoid additional stresses to wetland functions.
10) Implement stormwater treatment where possible (e.g. infiltration trenches, porous pavements, surface filters (sand and organic) to improve water quality.
11) Reconnect rivers to their floodplains and facilitate structural diversity in wetlands adjacent to rivers to increase watershed functionality.

6.0 References

Barclay, R.S., K.R. Johnson, W.J. Betterton, and D.L. Dilcher. 2003. Stratigraphy and Megaflora of a K-T Boundary Section in the Eastern Denver Basin, Colorado: *Rocky Mountain Geology*, v. 38, no. 1, p. 45-71.

Barclay, R.S. and K.R. Johnson. 2004. West Bijou Site Cretaceous-Tertiary boundary, Denver Basin, Colorado in *Field Trips in the Southern Rocky Mountains*, USA, eds. E. Nelson and E. Erslev. *Geological Society of America*, Field Guide 5, p. 59-68.

Biello, D. 2008. Fertilizer Runoff Overwhelms Streams and Rivers-Creating Vast "Dead Zones" Scientific American. March 14, 2008 http://www.scientificamerican.com/article/fertilizer-runoff-overwhelms-streams/

Brinson, M.M. 1993. A hydrogeomorphic classification for wetlands, Technical Report WRP–DE–4, U.S. Army Corps of Engineer Waterways Experiment Station, Vicksburg, MS.

Chapman, S.S., Griffith, G.E., Omernik, J.M., Price, A.B., Freeouf, J., and Schrupp, D.L., 2006, Ecoregions of Colorado (color poster with map, descriptive text, summary tables, and photographs): Reston, Virginia, U.S. Geological Survey (map scale 1:1,200,000).

Chronic, H. and F. Williams 2013. Roadside Geology of Colorado 3rd Edition. Mountain Press Publishing Company, Missoula, Missouri.

CNHP 2013. Biodiversity Tracking and Conservation System (BIOTICS). Colorado Natural Heritage Program, Colorado State University Fort Collins, CO.

Cooper, D.J. 1989. An ecological characterization and functional evaluation of wetlands in the Cherry Creek Basin: Cherry Creek Reservoir upstream to Franktown. U.S. Environ. Protection Agency, Denver, CO, 3 Vols.

Cowardin, L. M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979 Classification of wetlands and deepwater habitats of the United States. U.S. Fish and Wildlife Services, Office of Biological Services, Washington DC.

Dahl, T.E. (1990) Wetlands losses in the United States 1780s to 1980s. U.S. Department of the Interior, Fish and Wildlife Service, Washington D.C.

Dahl, T.E. 2011. Status and trends of wetlands in the conterminous United States 2004 to 2009. U.S. Department of the Interior; Fish and Wildlife Service, Washington, D.C. 108 pp.

Dudley, M. 2004. Lake Management and Protection Plan, City and County of Denver pp. 1-68.

EPA 2003. US Environmental Protection Agency *Urban Nonpoint Source Fact Sheet* EPA 841-FF-03-003 February 2003 http://water.epa.gov/polwaste/nps/urban_facts.cfm Accessed 12-2014.

Faber-Langendoen, D. et al. (2006) Ecological Integrity Assessment and performance measures for wetland mitigation. NatureServe, Arlington, Virginia.

Faber-Langendoen, D., G. Kudray, C. Nordman, L. Sneddon, L. Vance, E. Byers, J. Rocchio, S. Gawler, G. Kittel, S. Menard, P. Comer, E. Muldavin, M. Schafale, T. Foti, C. Josse, J. Christy. (2008) Ecological performance standards for wetland mitigation: an approach based on Ecological Integrity Assessments. NatureServe, Arlington, VA. Online: http://www.natureserve.org/publications/epaWetlandMitigation.jsp.

Fowler, L. 1989. *The Arapaho*. New York: Chelsea House Publishers. 128 p.

Gan, J., C. Wilen and D. Pittenger 2003b. Landscape Herbicides: What Happens after Application? Proceedings of the California Weed Science Society (Volume 55) pp. 94-97.

Gan, J., Y. Zhu, C. Wilen, D. Pittneger and D. Crowley. 2003a. Effect of Planting Covers on Herbicide Persistence in Landscape Soils. Environ. Sci. Technol. 2003, 37, 2775-2779.

Gilliom, Robert J. 2007. Pesticides in U.S. Streams and Groundwater. American Chemical Society, Environmental Science & Technology 3409. PP. 3408-3413 .http://pubs.acs.org/doi/pdf/10.1021/es072531u

Gunnerson, J.H. 1987. Archaeology of the High Plains. Cultural Resource Series 29. Denver: Bureau of Land Management.

Hämäläinen, Pekka. 2009. *Comanche Empire.* Yale University Press. 512 p.

HPRCC 2014. High Plains Regional Climate Center data from automated weather stations operated in Colorado. University of Nebraska, Lincoln NE. http://www.hprcc.unl.edu/ Accessed December 2014.

Jennette, M.A., L. Haaf, A.B. Rogerson, A.M. Howard, D. Kreeger, A. Padeletti, K. Cheng, and J. Buckner. 2014. Condition of Wetlands in the Christiana River Watershed. Delaware Department of Natural Resources and Environmental Control, Watershed Assessment and Management Section, Dover, DE and the Partnership for the Delaware Estuary, Wilmington, DE.

Johnsgard, P. 2012. Wings over the Great Plains: Bird Migrations in the Central Flyway. Zea Books, Lincoln, NE. 249 pg.

Kartez, J. T. 1999. A synonomized checklist and atlas with biological attributes for the vascular flora of the United States, Canada, Greenland. 3rd edition. CD-ROM. North Carolina Botanical Garden, Chapel Hill, NC.

Kirkham, R.M., and L.R. Ladwig. 1979. Coal resources of the Denver and Cheyenne Basins, Colorado: Colorado Geological Survey, Resource Series 5, 70 p., 5 plates. SD-7 1980, Energy resources of the Denver and Cheyenne Basins, Colorado: Colorado Geological Survey, Environmental Geology 12, 258 p., 2 plates.

Kowarik, I. 2008. On the Role of Alien Species in Urban Flora and Vegetation. Urban Ecology 2008, pp. 321-338. © Springer 2008

Kudray, G.M. and T. Schemm. 2008. Wetlands of the Bitterroot Valley: Change and ecological functions., Report to the Montana Department of Environmental Quality. Montana Natural Heritage Program, Helena, Montana. 32 pp. plus appendices.

Lemly, J. and J. Rocchio. (2009) Field testing of the subalpine-montane riparian shrublands Ecological Integrity Assessment (EIA) in the Blue River watershed, Colorado. Colorado Natural Heritage Program, Colorado State University, Fort Collins, CO.

Lemly, J., L. Gilligan, and M. Fink. 2011. Statewide strategies to improve effectiveness in protecting and restoring Colorado's wetland resource including the Rio Grande Headwaters pilot wetland condition assessment. Colorado Natural Heritage Program Report to Colorado Parks and Wildlife Wetland Wildlife Conservation Program. Fort Collins, Colorado.

Lemly, J. and L. Gilligan, B. Sullivan, G. Wilcox, J.Runge, J. Hoeting, E. Schleip. 2012. North Platte River Basin Wetland profile and Condition Assessment. Prepared for Colorado parks and Wildlife, Fort Collins, CO and US Environmental Protection Agency, Denver, CO. Colorado Natural Heritage Program. Colorado State University, Fort Collins CO.

Lemly, J., L. Gilligan, and G. Smith. 2014. Lower South Platte River Basin Wetland Profile and Condition Assessment. Colorado Natural Heritage Program, Colorado State University, Fort Collins, Colorado.

Limerick, P. 2012. A Ditch in Time: The City, the West and Water. Fulcrum Publishing. 352 pg.

Mack, J. J., & Micacchion, M. 2007. *An ecological and functional assessment of urban wetlands in central Ohio. Volume 1: condition of urban wetlands using rapid (level 2) and intensive (level 3) assessment methods*. Ohio EPA Technical Report WET/2007-3A. Ohio Environmental Protection Agency, Wetland Ecology Group, Division of Surface Water, Columbus, Ohio.

McKinney, M. 2002. Urbanization, Biodiversity and Conservation. BioScience Vol. 52. No. 10. Pp. 883-890.

Millennium Ecosystem Assessment (2005). Ecosystems and Human Well-Being: Wetlands and Water Synthesis. World Resources Institute, Washington DC.

Mitsch, W.J. and J.G. Gooselink (2007) *Wetlands. Fourth Edition.* John Wiley & Sons, Inc. Hoboken, New Jersey.

Naselli-Flores, L. 2008. Urban Lakes: Ecosystems at Risk, Worthy of Best Care. Proceedings of Taal2007: The 12th World Lake Conference: 1333-1337.

Pavao-Zuckerman. 2008. The Nature of Urban Soils and Their Role in Ecological Restoration in Cities. *Restoration Ecology* 16 (4): 642-649.

Pyle, R.P. 1993. The Thunder Tree: Lessons from an Urban Wildland. Houghton Mifflin CO., Boston & New York. 220 pp.

Raynolds, R. G., and Johnson, K. R., 2002, Drilling of the Kiowa Core, Elbert County, Colorado: *Rocky Mountain Geology*, v. 37, p. 105–109.

Richtman, C.M., J.C. Anderson, A.G. Robertson, and D.D. Rokus. 2012. Description of existing wetland resources in the St. Croix River Headwaters Watershed. Saint Mary's University of Minnesota.

Rocchio, J. 2007. Floristic Quality Assessment Indices of Colorado Plant Communities. Unpublished report prepared for Colorado Department of Natural Resources, and U.S. Environmental Protection Agency, Region VIII. Colorado Natural Heritage Program, Colorado State University, Fort Collins, CO.

Rondeau, R. and A. Lavender 2012. Noxious Weed Monitoring at the U.S. Air Force Academy – Year 7 Results. Unpublished report prepared for U.S. Air Force Academy Department of Natural Resources. Colorado Natural Heritage Program, Colorado State University, Fort Collins, CO http://www.cnhp.colostate.edu/download/documents/2012/Noxious_Weed_Monitoring_at_the_US_Air_Force_Academy-_7th_year_results.pdf

Rosen, C. J. and D.B. White. 1999. "Preventing Pollution Problems from Lawn and Garden Fertilizers." University of Minnesota Extension Service.

Rosen, C. J. and D. B. White. 1999. Preventing Pollution Problems from Lawn and Garden Fertilizers. University of Minnesota Extension Service. http://www.extension.umn.edu/distribution/horticulture/DG2923.html

Schueler, T. 1987. Controlling Urban Runoff: a Practical Manual for Planning and Designing Urban Best Management Practices. Metropolitan Washington Council of Governments. Washington, D.C.

Silver, J. and B. Riley.2001. Environmental Impact of Pesticides Commonly Used on Urban Landscapes. Northwest Coalition for Alternatives to Pesticides or NCAP.

State of Washington. 2014. Native Freshwater Plants: Aquatic Plants and Lakes. Access Washington Department of Ecology,: http://www.ecy.wa.gov/programs/wq/plants/native/uses.html accessed November 2014.

Sovell, J. and P. Smith 2012. Critical Biological Resources Inventory for Jefferson County Colorado 2010-2011. Colorado Natural Heritage Program, Colorado State University, Fort Collins, CO.

Swink F. and G. Wilhelm. 1979. Plants of the Chicago Region. Revised and expanded edition with keys. The Morton Arboretum, Lisle, IL.

Tiner, R.W. 2003. Correlating enhanced National Wetlands Inventory data with wetland functions for watershed assessments: a rationale for northeastern U.S. wetlands. U.S. Fish and Wildlife Service, National Wetlands Inventory Program, Region 5, Hadley, MA. 26pp.

U.S. Census Bureau 2012 http://quickfacts.census.gov/qfd/states/08/08031.html Accessed November 2014.

U.S. Census Bureau 2013 http://quickfacts.census.gov/qfd/states/08/08031.html Accessed December 2014.

U.S. Census Bureau 2014 http://quickfacts.census.gov/qfd/states/08/08031.html Accessed December 2014.

U.S. Geological Survey. 1998. National Water Quality Assessment. Pesticide National Synthesis Project. Pesticides in surface and ground water of the United States; Summary of results of the National Water Quality Assessment program. http://water.wr.usgs.gov/pnsp/allsum/

USGS. 2014a. National Water Information System. Web Interface. Available online at http://waterdata.usgs.gov/nwis. Accessed December 2014.

USGS. 2014b. Hydrologic Unit Codes: http://water.usgs.gov/GIS/huc.html Accessed December 2014.

Weber, D.J. 1994. *The Spanish Frontier in North America*. Yale University Press, 602 p.

West, Elliot. 2000. *The Contested Plains: Indians, Goldseekers, and the Rush to Colorado*. University Press of Kansas. 422 p.

Weber, W.A. & Wittmann, R.C. 2001. *Colorado Flora: Eastern Slope, Third Edition*. University Press of Colorado, Boulder, Colorado.

Wilhelm, G. and L. Masters. 1996. Floristic Quality Assessment in the Chicago Region. The Morton Arboretum, Lisle, IL.

Yohe, R.M. and D.B. Bamforth. 2013. Late Pleistocene protein residues from the Mahaffy Cache, Colorado. *Journal of Archaeological Science* 40: 2337-2343.

APPENDICES

Survey and Assessment of Critical Urban Wetlands

City and County of Denver

Prepared by:

Colorado Natural Heritage Program
Colorado State University
254 General Services Building
Fort Collins, CO 80523
(970) 491-2127

APPENDIX A: COLORADO NATURAL HERITAGE PROGRAM

WETLAND MAPPING PROCEDURES

Version Date: March 29, 2013

Scope of Document

This document was prepared by the Colorado Natural Heritage Program (CNHP), a research unit of the Warner College of Natural Resources and Colorado State University. It describes procedures used by CNHP to map wetlands in Colorado. All wetland mapping conducted by CNHP is in collaboration with the U.S. Fish and Wildlife Service (USFWS)'s National Wetlands Inventory (NWI) Program and follows the Federal Geographic Data Committee (FGDC)'s most recent standards for wetland mapping (FGDC 2009).

There are two primary types of wetland mapping carried out by CNHP:

1) Conversion of original NWI paper maps to digital polygonal data. The original NWI paper maps were produced in the 1970s and 1980s and are currently available as either hard copy paper maps or scanned images, but are not available as digital polygonal data. CNHP works in partnership with the NWI program to convert these hard copy maps to geo-referenced digital polygonal data. Polygons and attributes are not updated or corrected in this process, except in cases where the original attribute is now considered an invalid code. When converting original NWI mapping, CNHP is responsible for the accurate representation of the original mapping in a digital form, but not for the accuracy of how well the data represent wetlands on the ground.

2) Creation of new, updated digital NWI maps delineated in ArcGIS and based on the most recent aerial photography available. When delineating newly updated NWI maps, CNHP is responsible for all aspects of accuracy and precision.

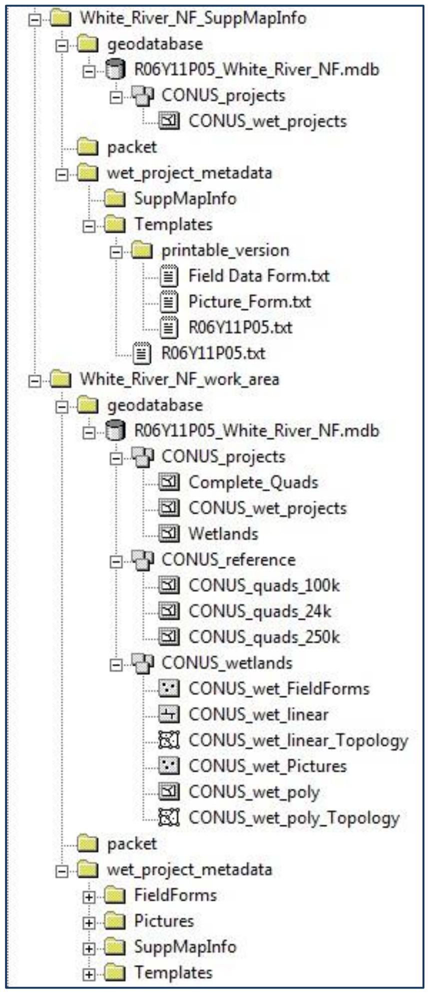
This document is primarily intended as an internal communication tool for CNHP's Wetland Mapping Specialists. Certain sections, therefore, may lack background information of interest to external readers. More information is available upon request.

Funding for CNHP's wetland mapping projects has come from a variety of partners, including U.S. Environmental Protection Agency (EPA), U.S. Forest Service (USFS), Bureau of Land Management (BLM), and National Academy of Science (NAS)'s Transportation Research Board (TRB). Non-Federal matching support has come from Colorado Parks and Wildlife (CPW), Great Outdoor Colorado (GOCO), Colorado Department of Transportation (CDOT), and Colorado Water Conservation Board (CWCB).

Table of Contents

A. Project Check-out/Prep Work

1. ***Checkout Project Area from NWI:*** Choose the quads in the project area. Merge and dissolve into a single polygon shape. Submit to Regional NWI Coordinator Kevin Bon (Kevin_Bon@fws.gov). Kevin will reply with a "Checkout Packet" which will include documentation, a database with the checkout area, any existing wetland shapes and supplemental layers. Below is a view of the file structure in ArcCatalog.



2. ***Identifying Priorities/Intermediate Deadlines:*** These must be known early in the planning stages before mapping begins. Once the project area is divided into sets (see below) it can be very confusing to split sets or complete single quads for an intermediate data request. If priority areas or intermediate deadline exist (i.e., if the sponsor requests a certain set of the data before the entire project is complete) these should be flagged and the project area should be divided accordingly.

3. ***Aerial Imagery for New Mapping Updates:*** New mapping updates will be based on the most current digital aerial photography available. In most cases, this imagery will be obtained from the USDA Farm Service Agency, Aerial Photography Field Office in Salt Lake

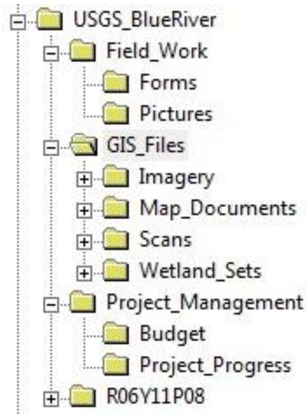
City, Utah (http://www.apfo.usda.gov). In special circumstances, imagery may be provided by a project sponsor for a specific project area. The imagery used must be color infra-red (CIR) and must meet all requirements stated in the FGDC standard for wetland mapping (FGDC 2009). The minimum imagery needed to perform new mapping updates is CIR imagery for the year the wetland mapping is being updated to, and CIR imagery for one other year. Two or more additional years is preferable, as having multiple years available (such as a drought year and wet year) supports more accurate water regime determination.

4. ***Tracking Project Progress:*** Progress on each mapping project is tracked in an Excel spreadsheet. Several template versions are located on the CNHP Server at P:\Wetland_Mapping\SupportFiles\Project_Progress_Templates. Three types exist: 1) Double_Scan_Quads, 2) Single_Scan_Quads and 3) New_Mapping_Updates. Slightly different intermediate steps warrant multiple versions. Projects with quads in more than one of these statuses should have the quads broken up and worked on separately and progress recorded in each respective spreadsheet. An additional, Full_Project_Progress spreadsheet should be created to track overall progress.

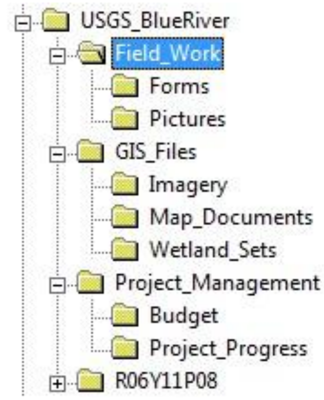
5. ***Dividing Project Area:*** It is usually not feasible to work continuously on a single feature class for a project area; therefore, the quads within the project area are divided into "sets".
   a. When converting original NWI maps to digital polygons, blocks can be made up of four quads in a 2x2 square. A 4x1 linear set can also be created. There is no difference between the two and often the overall project area will determine the correct set structure. Working with more than 4 quads can be very cumbersome and more densely populated quads may want to be divided into smaller sets.
   b. When delineating new wetland features, quads should be dealt with singularly.

6. ***Naming Conventions/File Structure:*** The standard file structure below shows an Old-Digital Conversion project and a New Mapping Update project. The only difference between these two structures is the addition of a "GIS_Files/Scans" folder to hold rasters of NWI maps, if available.

Old-Digital Conversion



New Mapping Update



Daily work should be complete on a local drive (C:\temp) and copied back to the proper location on the P:\ drive at the end of the day. Additional daily or AT LEAST weekly backups should be completed to a third (external) drive. Backup files should be named explicitly with a date (e.g., "Backup\USGS_BlueRiver\7_17_2011"). Naming conventions for the wetland files produced during the procedure:

"ProjectCode"_Set_"#"_wetlands_pre_attribution.shp (after Step 3)
"ProjectCode"_Set_"#"_wetlands_post_attribution.shp
"ProjectCode"_Set_"#"_wetlands_qaqced.shp (ready to be merged)
"Project"_merged_wetlands (post merging)
"Project"_checked_wetlands (after topology and script run)

" " are values that change with the set or project.

B. Overview of CNHP ArcGIS Method for Digital Conversion

CNHP uses the ArcScan extension for ArcGIS 10.x to convert rasters (scanned data) into digital vector data. The steps below represent the conceptual process taken to convert raster NWI data into vector data. More detail on each step is spelled out in the following section.

1. Project rasters into NAD83: Albers projection. Extract the data within each individual quad and mosaic 4 to 6 quads worth of data into a set.
2. Use the ArcScan extension to generate vector lines on all the visible lines on the mosaicked raster.
3. Inspect lines that represent linear features (rivers and streams) and merge line segments into complete continuous lines that accurately represent linear wetland features.
4. Attribute the linear features with their NWI wetland code, and populate a field with buffer distance values that correspond to the desired width of linear features.
5. Convert all enclosed features into polygons.
6. Buffer the linear features using the values in the Buffer Distance field.
7. Copy the buffered lines into the feature class created in step 5.
8. Attribute all features with NWI wetland codes.
9. Run topology and QAQC tests as described in Section F and make necessary changes.

C. Work Flow for Digital Conversion of Original NWI Mapping, using ArcScan extension

1. Copy the GDB "Wetlands_Domain.gdb" from P:\Wetland_Mapping > SupportFiles into the appropriate set folder.

2. Load quad TIFFs for the defined set to your map document.

3. For each TIFF:

    - Project in Albers (Data Management Tools > Projections and Transformations > Raster > Project Raster) with the output landing in the geodatabase in the set folder mentioned in step 1.

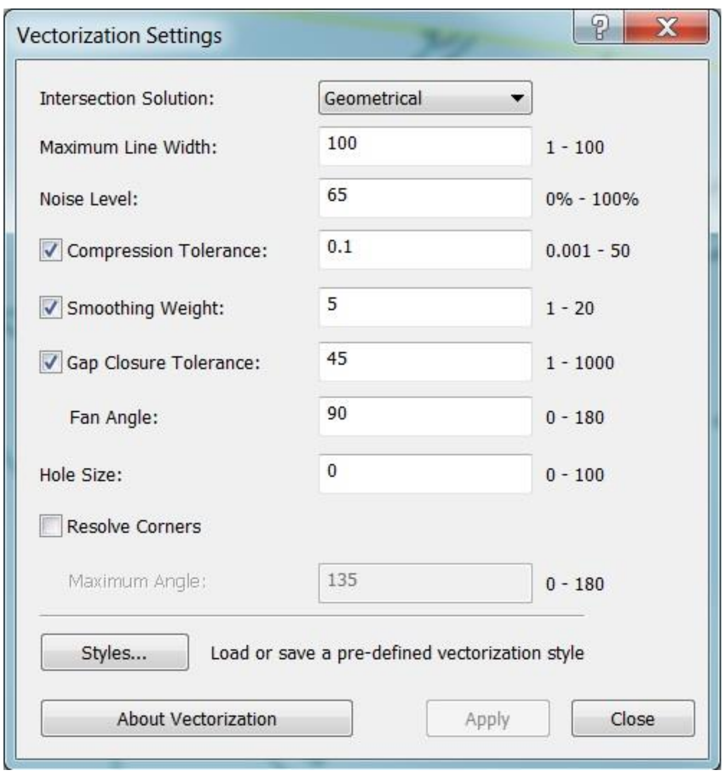
    - Extract each Tiff individually by highlight the quad boundary and extracting by mask (Spatial Analyst Tools > Extraction > Extract by mask).

4. Mosaic rasters together (Data Management > Raster > Raster Dataset > Mosaic to New Raster). Output location should be the GDB in the set folder. Number of bands = 1.

5. Add the 'Lines' blank linear feature class from the GDB to the map.

6. Start an editing session on the linear feature class created in the previous step.

7. Enter the following "vectorization settings" In the ArcScan toolbar drop down menu:



8. Select "Generate Features" under the Vectorization dropdown. Uncheck the box that says "Generate polygons where the maximum line width setting is exceeded." Make sure the mosaic raster is in the ArcScan Raster selection.

9. Examine all linear features to ensure they are smooth and continuous. Manually draw or correct any linears missed or misrepresented during automated processing and merge necessary segments. Once a linear is merged and correct, enter the corresponding code into the "Attribute" attribute field.

10. Close any open polygon lines within the feature class or along the edges.

11. Once you are confident the feature line work is correct, use it to create polygons (Data Management > Features > FeaturetoPolygon). Save the feature class as "ProjectCode_set_XX_pre_attribution" in the GDB.

12. Export all attributed linears to the GDB. Name the output "linears_for_buff_set_X".

13. Enter the correct buffer width for the following categories in the "Buff_Dist" field:
    - Palustrines = 3m (6m)
    - Riverine Perennial (R2/3) = 4m (8m)
    - Riverine Intermittent (R4) = 3m (6m)
    - Lacustrine = 4m (8m)

14. Buffer the "linears_for_buff_set_X" using the "Buffer_Width" field (Analysis > Proximity > Buffer). Name the output 'Linears_Buffered_set_X'.

15. Copy and paste 'linears_buffered_set_X' into the 'ProjectCode_set_XX_pre_attribution' feature class.

16. Add, merge, and correct all polygons.

17. After saving edits and closing your map document, copy your geodatabase to the appropriate folder in P:Wetland_Mapping and name it (ex. 'SRLCC_set_28_wetlands_pre_attribution')

18. In ArcCatalog, apply the domain "Attribute" to the "ProjectCode_set_XX_pre_attribution" feature class. If you notice any common attributes that exist in the current set but are not included in the attribute domain, add those values to the domain.

19. Attribute polygons.

20. QAQC data as outlined in Section F.

D. Process for Attributing Digitally Converted Data

CNHP often uses the help of student work studies, interns and volunteers to attribute the digitally converted original NWI data. The following steps should be taken to ensure correct attribution.

1. Navigate the map document (.mxd) that has been prepared for you and open it. In the table of contents, locate the shapefile you will be editing. It will be named something similar to: "SP_set_32_pre_attribution.shp"

2. Check to make sure the attribution table of this item is ready to edited. Depending on the project you are working on, you will need either a field named Attribute (text, 20 characters) or Old_Code (text, 20 characters). If the field you need is not in the shapefile's table, you can add it by clicking "Adding Field" in the table window's dropdown list.

3. Click on the editor toolbar dropdown list and choose "Start Editing." The next dialog box prompts you to indicate which layer you will be editing, choose the shapefile identified in step 1. If the editor toolbar is not already displayed in your ArcMap, you can add it using Customize > Toolbars > Editor.

4. Check to be sure that snapping is turned on for the layer you are editing. (Editor > Snapping > Snapping window). You may need to check the "use old style snapping" in the editor options if the snapping window is not an available choice.

5. Make sure your display properties are set up to make editing easy. You want the field you are editing to be the displayed label field, and layer visibility should be at about 35% transparency so you can see the raster layer underneath the shapefile you are editing. For symbology I usually go with "Lake" colored because the outline provides nice contrast.

6. Start filling in the "Attribute" (or Old_Code) field. You can type this into the table directly, or open the attributing window by clicking "Attribute" on the editor toolbar. You can use the wetland code handout to understand what the codes mean. All codes are letters, with the exception that riverine and lacustrine systems have a number after their first letter (ie R4SBC).

7. An important rule of wetland mapping is that **no two features with the same attribute can touch each other**. Sometimes a single feature will be incorrectly split by the automated processes that we use to create them – in that case the appropriate solution is to merge the pieces. I set my merge function to Insert as a hotkey, but it can be set to any key, or choosen from the editor dropdown menu. Sometimes the solution to this problem is not so simple – perhaps a linear feature splits a polygon, but that linear feature was overlooked.

   **When in doubt, just attribute a polygon with "??" so it can be reviewed later.

8. Reshape polygons that do not accurately represent the shape on the CONUS scan vectors.

9. When done attributing a shapefile, save edits and stop editing. Save and close the map document, and let me know that set is done.

D. Work Flow for New Mapping Updates

1. Prepare ¼ quad images with mosaic method of choice.

2. Create a line shapefile to add features to.

3. Map smaller streams, channel, canals and linear features, then buffer to the appropriate amount.

4. Create a polygon shapefile to add features to.

5. Begin mapping large water bodies and rivers.

6. Attribute NWI wetland codes (Cowardin et al., 1979) as you go, keeping the following in mind:

    - Map to the image, not historic or predicted.
    - Be conscious of mowing changing the intensity of vegetation signatures.
    - Be conscious of haying changing the texture and color.
    - "Farmed" modifier describes tiled agriculture, not pastureland or mowed areas.

7. Use the Montana Natural Heritage Program's method of applying LLWW descriptors in a semi-automated fashion to areas of 8-12 quads at a time. The application of LLWW descriptors will be done in a manner consistent with Ralph Tiner's 2003 Dichotomous Keys and *Mapping Codes for Wetland Landscape Position, Landform, Water Flow Path, and Waterbody Type Descriptors* (Tiner, 2003).

8. Once finished, save as quad name, copy to the project folder on P: and turn over to other mapper for QAQC'ing.

9. Important things to keep in mind:

    - Examine the wetlands for consistent alignment with features on the imagery.
    - Examine for correct System/Subsystem (mostly lakes and rivers).
    - Examine for correct Class (look for shadows denoting trees and shrubs, look carefully at smaller ponds for aquatic vegetation, and larger lakes for rings of aquatic vegetation).
    - Examine for correct Water Regime (use several dates if possible) compare with reference sites of field visits.
    - Examine for correct Modifiers (only put modifier if confident).
    - Look at large riparian systems carefully for matrix and isolated wetland pockets.

E. Riparian Classification Information Sheet

Riparian Features – Riparian features are mapped at the same time as wetland features. The USFWS defines riparian features as "contiguous to and affected by… lotic and lentic water bodies (rivers, streams, lakes or drainage ways)". The have either distinctly different vegetation (species) or significantly more robust growth. These areas are transitional between uplands and wetlands and can be considered to have a less predictable flooding regime and is often drier than an "A" water regime from NWI.

It is important to consider subsurface flow as well. Sandy washes, wooded draws, etc are affected by collection of water during storm events and/or water tables closer to the surface.

Residential areas can be trickier, as runoff from lawn watering, impervious surfaces, etc often elevate water tables in these areas. Look at the type of tree and proximity to water feature. Golf courses contain many trees and well watered vegetation but are not likely Rp.

Coding: Class is defined by the tallest life form that composes at least 30% of the area. No modifiers are applied to the riparian code. Tilled fields, even those close to rivers and streams are not mapped as riparian.

System	**Rp** (Riparian)		
SubSystem	**1** (lotic-flowing)	**2** (lentic – standing)	
Class	**EM** (emergent)	**SS** (scrub-shrub)	**FO** (forested)

Examples: Rp1FO, Rp1SS, Rp2FO

Common settings: *Rp1SS* – shrubby draw or drainage, often interrupted with drier herbaceous patches or by locations of incision. Shrubs can be dense or not. Often very narrow and linear in appearance. These will often be mapped as a linear feature then buffered out to the appropriate width.

Rp1EM – often along larger R4's with terraces. Often the same type of vegetation as the surround area, but much more robust. Channel scars and swales will usually be and NWI wetland code PEMA or PEMC, so one needs to look broadly.

Rp1EM/Rp1FO – matrix of herb/tree pockets in a larger floodplain. Look closely at denser pockets and the overall % cover to decide a class. Must choose one, DO NOT USE MIXED CODE.

Rp2FO – a ring of trees along a lake with a waterlevel that appears to fluctuate. Look closely at the understory (if visible) to determine if it's really Rp or NWI code PFOA.

F. QA/QC Procedures

CNHP uses the Wetland Data Verification Toolset developed by the U.S. Fish and Wildlife Service National Wetlands Inventory. The tool and its supporting document is available at: http://www.fws.gov/wetlands/Data/Tools-Forms.html

This toolset contains an ArcGIS 10 toolbox with 6 QAQC tests, a geodatabase containing a complete list of all currently valid NWI wetland codes and a PDF set of instructions. All data must clear these tests (or have justifications provided for records that get flagged as errors but are in fact correct) to be accepted by the NWI.

F1. QAQC Work Flow for All Mapping Projects

1. **Run topology (rule: features must not overlap), correct all errors**

2. **Run the "NWI Wetlands Data Verification Toolset version 1206, database version 1110" tool in a custom toolbox:**
   http://www.fws.gov/wetlands/Data/tools/Wetlands-Data-Verification-Toolset-Installation-Instructions-and-User-Information.pdf

3. **QAQC Code description:** Shows up in the form "NNNNNN". "N" means no error.
   C – incorrect wetland code
   U – sliver uplands*
   A – adjacent polygons with same attribute, this test also catches multipart features
   S – sliver wetlands, less than 0.1 acres *
   L – L1 or L2 < 20 acres *
   P – PUB or PAB > 20 acres *
   O – overlapping polygons (topology should render this test moot)

   ** indicates this test is "optional" in the sense that there can be polygons that are correct but not slivers, there can be Lakes less than 20 acres, etc.*

4. **Visual Scan -** new mapping only, see following section F5 for procedure.

F2. Description of the Verification Tests

A brief description of each of the verification functions is provided below.

Code "C" - Incorrect Wetland Codes: This model identifies wetland polygons with incorrect wetland codes, or null or blank values in the 'attribute' field. Bad wetland code and wetland code synonym summary tables are created and stored with your wetlands file geodatabase. The model changes the first character of QAQC_Code = 'C' if the wetland code is bad.

Code "U" - Sliver Uplands: This model identifies upland islands or holes in wetlands that are less than 0.01 acres. These may be actual upland features but are identified as errors as they are typically errors in wetland delineation. The model changes the fourth character of QAQC_Code = 'U', in wetland polygons adjacent to the upland sliver.

Code "A" - Adjacent Wetlands: This model identifies wetland polygons that are adjacent to other wetland polygons with the same 'attribute' and changes the second character of QAQC_Code = 'A'. Adjacent wetlands with the same attribute are not allowed and need to be corrected. This test also highlights multi-part features, which need to be corrected.

Code "S" Sliver Wetlands: This model identifies wetland polygons less than 0.01 acres and changes the third character of QAQC_Code = 'S'. These wetland features exceed the minimum mapping standard for wetlands and should be reviewed. Actual wetland features flagged as sliver wetlands can be justified as correct in the comments field of the QAQC_Summary table.

Code "L" or" P" - Lake and Pond Size: This model identifies Lakes that are less than 20 acres in size and Ponds that are greater or equal to 20 acres in size. It changes the fifth character of QAQC_Code ='L' for small lakes or 'P' for large ponds. These may or may not be errors and can be justified based on water depth of the identified waterbody or small lake portions on the edge of the mapping project area. Comments can be added to the 'comments' field of the QAQC_Summary table for those wetland features flagged that are valid based on depth requirements outlined in the wetlands mapping standards.

Code "O" - Overlapping Wetlands: This model identifies overlapping wetland polygons and changes the sixth character of QAQC_Code = 'O'. The overlapping portions of these polygons are stored in your wetlands file geodatabase as an Overlapping_Polygons feature class to assist in locating these features. This model does not validate topology of the wetlands file geodatabase. The CONUS_wet_poly_Topology layer in your wetlands file geodatabase can be validated using the topology toolbar in ArcMap and also to view the errors. This model and the wet_poly_topology identify the same errors and either can be used. Overlapping wetland features are not allowed in the dataset.

F3. Code Updates

Some wetland codes were used in the original NWI maps that are no longer considered valid. These out of date codes are found on Colorado NWI maps uncommonly, but often enough that CNHP developed a standardized method for conversion. Codes can be checked for validity using the Wetland Code Interpreter available here: http://www.fws.gov/wetlands/Data/Wetland-Codes.html

The following rules have been used to update these out of date codes to valid codes:

Old Classes:

- OW = UB
- BB or FL = US

Old Water Regimes

- D = C
- W = A
- Y = B, C, or A (usually C)
- Z = G, H (P usually gets G, L usually gets H)

F4. QAQC Notes

Water Regimes Available for Each Class (red = default for P systems):

EM – Emergent	Water Regimes = A, B, C, F, G, H, or J
SS – Shrub/Scrub	Water Regimes = A, B, C, F, G, H, or J
FO – Forested	Water Regimes = A, B, C, F, G, H, or J
UB – Unconsolidated Bottom	Water Regimes = H, G, or F
AB – Aquatic Bed	Water Regimes = H, G, F or C
US – Unconsolidated Shore	Water Regimes = C, B, A or J

PAB/PUB and LAB/LUB: Ensure that only lakes and ponds with "apparent" aquatic vegetation are labeled as PAB. Be aware that flooded shrubs can look like aquatic vegetation. Be sure to examine both 2005 and 2009 images.

PEMC/PEMF: Can be confusing in that some PEMF (especially bulrush) can look pale. Examine 2005 true color image. PEMF's are usually very dark.

Rp1SS/PSSA: PSSA needs to be wet and should be in proximity to other wet areas. Along streams Rp1SS is most common unless back channels, etc. suggest wetter conditions.

CANALS: Be aware of the 10m minimum distance. Larger canals can be labeled R4SB but smaller ones not. If a canal is shallow and significantly vegetated at a swath of 10m and appears to be significantly wet, it could be labeled as a PEM.

DONUTS: Be aware for areas where wetlands form inset, concentric circles to ensure that the inner polygon is "clipped" to remove that area from the larger polygon when analysis is completed.

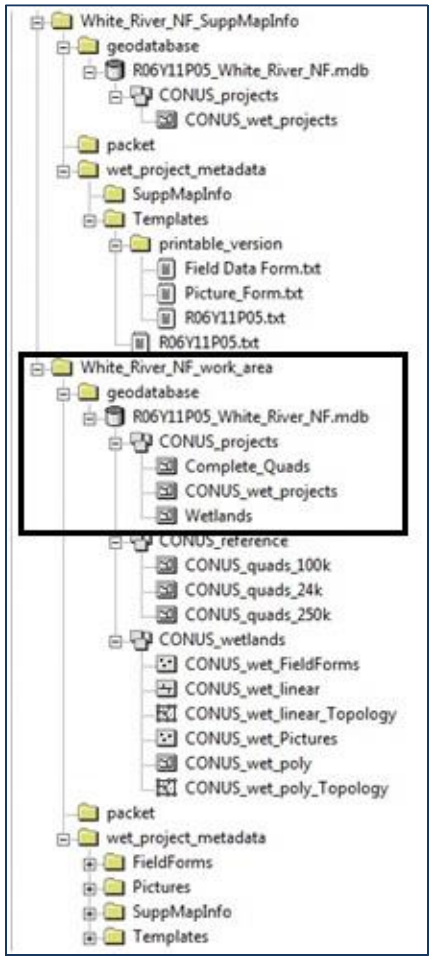
F5. QA/QC Procedures: Visual Inspection on New Mapping

Goal: 100% of features visually inspected by a wetland mapper who did not create the dataset.

1. Examine the wetlands for consistent alignment with features on the imagery.
2. Examine for correct System/Subsystem (mostly lakes and rivers).
3. Examine for correct Class (look for shadows denoting trees and shrubs, look carefully at smaller ponds for aquatic vegetation, and larger lakes for rings of aquatic vegetation).
4. Examine for correct Regime (use several dates if possible) compare with reference sites of field visits.
5. Examine for correct Modifiers (only put modifier if confident).
6. Look at large riparian systems carefully for matrix and isolated wetland pockets.

G. Project Check-in/Data Storage

1. ***Check in Project Area to NWI*** – Import the files properly into the geodatabase provided in the materials originally received from the NWI. The created data should be submitted in the part of the file structure indicated below by the black box. "Complete_Quads" indicates the actually area that was mapped as a feature class of the quads. "Wetlands" is the feature class that contains the attributed wetland polygons. A third feature class could be added for New Mapping Updates if riparian features were mapped. This would be called "Riparian" and be located in the same subfolder.



2. ***Internal CNHP Wetlands Database*** – For data sharing on relevant projects, an internal geodatabase of wetlands for the State of Colorado will be maintained. After wetland mapping projects are delivered to the client and delivered to the NWI, they will be imported into the Colorado_Wetlands.gdb. The imported wetlands will need to be merged with the existing wetlands. If the imported data is an update, any existing wetland polygons should be clipped by quad boundary and exported with a logical file name. We do not want to delete older mapping, but it should not be included in the internally distributed layer. This dataset will be located at G:\Colorado\Wetlands. The date will be in the file or folder name

such that the most current data can be accessed. No more than 3 copies will exist at any given time in the folder, older copies will be deleted.

H. References

Tiner, R.W. 2003. Dichotomous Keys and Mapping Codes for Wetland Landscape Position, Landform, Water Flow Path, and Waterbody Type Descriptors. U.S. Fish and Wildlife Service, National Wetlands Inventory Program, Northeast Region, Hadley, MA. 44 pp.

Cowardin et al. 1979. Classification of Wetlands and Deepwater Habitats of the United States. U.S. Fish and Wildlife Service, Washington D.C.

APPENDIX B:

NWI and LLWW Classifications

National Wetlands Inventory (NWI) Classification

System is the primary division in the classification and divides mapped features into a handful of aquatic resource types and is followed (when appropriate) by a numeric subsystem code. The four systems used for Colorado NWI mapping are Riverine (rivers), Lacustrine (lakes), Palustrine (vegetated wetlands) and Riparian (non-wetland vegetated areas adjacent to waterbodies) (Table B1). The Riparian system was developed following the initial mapping in the 70s and 80s. As the majority of the study area was digitally converted from 1980's NWI mapping, only those areas with updated mapping include riparian features.

After system and subsystem, class identifies the dominate substrate or vegetation structure present and is represented by a two letter code (Table B2). Hydrologic regimes describe the duration and timing of flooding and is represented by a single letter character (Table B3). Duration increases from A-H, though B sites are rarely flooded, but have water at or very near the surface consistently. Areas mapped as Riparian do not receive a hydrologic regime code. The final component of the code is an optional special modifier, represented by a lowercase letter. Many modifiers are possible, though only a handful of codes were applied in the study area (Table B4). To facilitate generalizations about the mapping data, Cowardin codes were combined into eight broad groups (Table B5), of which five are considered true wetlands and the remaining three are lakes, rivers/streams and riparian.

Table B1: NWI Cowardin system and subsystem codes and interpretation.

System	*Subsystem*	*Code*	*Interpretation*
Riverine		**R**	**Rivers and streams**
	Lower Perennial	2	low gradient, slow moving channels
	Upper Perennial	3	steep, fast moving channels
	Intermittent	4	channels that do not flow year round, including manmade ditches
Lacustrine		**L**	**Lakes (water bodies >20 acres and/or > 2 m deep)**
	Limnetic	1	lake water > 2 m deep
	Littoral	2	lake water < 2 m deep along lake margins
Palustrine		**P**	**Vegetated wetlands (marshes, swamps, bogs, etc.) even if associated with rivers or lakes**
Riparian		**Rp**	**Non-wetland areas adjacent to waterbodies with vegetation distinct from surrounding uplands**

Table B2: NWI Cowardin class codes and interpretation.

Class	*Code*	*Interpretation*
Aquatic Bed	AB	aquatic rooted or floating vegetation
Emergent	EM	herbaceous, non-woody vegetation
Scrub-shrub	SS	low woody vegetation
Forested	FO	trees
Unconsolidated Bottom	UB	habitats with at least 25% cover of particles smaller than stones and less than 30% areal cover of vegetation
Unconsolidated Shore	US	unconsolidated substrates with less than 75% areal cover of stones, boulders or bedrock and less than 30% areal cover of vegetation
Stream Bed	SB	unvegetated surfaces with variable substrate sizes within stream channels

Table B3: NWI Cowardin hydrologic regime codes and interpretation.

Code	*Interpretation*
A	temporarily flooded
B	saturated
C	seasonally flooded
F	semi-permanently flooded
G	intermittently exposed
H	permanently flooded
K	artificially flooded

Table B4: NWI Cowardin special modifier codes and interpretation.

Code	*Interpretation*
x	Excavated
h	Dammed/impounded
b	Beaver

Table B5: NWI attribute groups for summary tables.

NWI Group	*Codes*	*Interpretation*
Herbaceous Wetlands	PEM*	all herbaceous wetlands (e.g., marshes, wet meadows, playas, etc.)
Shrub Wetlands	PSS*	shrub dominated wetlands (e.g. willow stands)
Forested Wetlands	PFO*	tree dominated wetlands (e.g., wet cottonwood stands)
Ponds	PAB*/PUB*	ponds of all kinds, either vegetated or not, but with open water < 2 m (e.g. beaver ponds, stock ponds, golf ponds, etc.)
Other Wetlands	PUS*/Pf	misc. other classes, primarily unvegetated surface (i.e. sparsely vegetated salt flats) and some farmed wetlands (used only rarely)
Lakes and Lakeshores	L*	all lakes and unvegetated lake shores
Rivers / Streams / Canals	R*	all river and stream channels, including manmade ditches, and their associated unvegetated shores (i.e., unvegetated sandbars)
Riparian	Rp*	Non-wetland areas adjacent to waterbodies with vegetation distinct from surrounding uplands

Landscape, Landform, Waterbody, Water Flow Path Classification (LLWW)

The LLWW attribution scheme utilizes the same wetland definition as the Cowardin classification, but it attributes each wetland polygon with its landscape position, landform type, water flow path, and waterbody type. Landscape position describes a features location along a stream, river, or lake, or its location as geographically isolated (Table B6). Landforms describe a features geomorphic setting, including slope, basin, floodplain, fringe, or island (Table B7). Flowpaths describe how water flows through the wetland or waterbody, including inflow, outflow, throughflow, bidirectional, and isolated (Table B8). Waterbody is the classification for open water systems, including lakes, ponds, rivers, and streams (Table B9). Similar to the NWI classification, modifiers are included in the LLWW to describe features as modified by excavation, impoundment, or influences by beavers. Each level of the LLWW is described using a two letter code and results in a 4-8 character LLWW alphanumeric code.

Table B6: LLWW Landscape Position codes and interpretation.

Landscape	*Gradient*	*Code*	*Interpretation*
Lotic River		**LR**	**Wetlands along a river**
	Lower Perennial	2	low gradient, slow moving channels
	Upper Perennial	3	steep, fast moving channels
	Intermittent	4	channels that do not flow year round, including manmade ditches
Lotic Stream		**LS**	**Wetland along a stream**
	Lower Perennial	2	low gradient, slow moving channels
	Upper Perennial	3	steep, fast moving channels
	Intermittent	4	channels that do not flow year round, including manmade ditches
Lentic		**LE**	**Wetlands in or along a lake or reservoir**
Terrene		**TE**	**Wetlands not along rivers, streams, or lakes, OR wetlands along these features but *not* subject to frequent overflows**

Table B7: LLWW Landform codes and interpretation.

Landform	*Code*	*Interpretation*
Basin	BA	Wetland exists in a distinct depression
Fringe	FR	Wetland occurs within the banks of a river or stream, or along the shores of a pond or lake
Island	IS	Wetland forms an island
Floodplain	FP	Wetland occurs on an active floodplain
Slope	SL	Wetlands occur on a noticeable slope

Table B8: LLWW Water Flow Path codes and interpretation.

Water Flow Path	*Code*	*Interpretation*
Inflow	IN	Wetland receives water from a wetland or waterbody at a higher elevation, but has no observable outflow to a wetland or waterbody at lower elevations
Outflow	OU	Wetland discharges water to a wetland or waterbody at a lower elevation, but has no observable inflow from a wetland or waterbody at higher elevations
Throughflow	TH	Wetland receives water from another wetland or waterbody, and delivers water to another wetland or waterbody at a lower elevation
Isolated	IS	Wetland has no inflow from a wetland or waterbody nor delivers water to a wetland or waterbody at a lower elevation
Bidirectional	BI	Water levels fluctuate due to lake influences

Table B9: LLWW Waterbody codes and interpretation.

Waterbody Type	*Gradient*	*Code*	*Interpretation*
River		**RV**	**River/stream features that are polygons on 1:24,000 USGS topographic map**
	Lower Perennial	2	low gradient, slow moving channels
	Upper Perennial	3	steep, fast moving channels
	Intermittent	4	channels that do not flow year round, including manmade ditches
Stream		**ST**	**River/stream features that are lines on 1:24,000 USGS topographic map**
	Lower Perennial	2	low gradient, slow moving channels
	Upper Perennial	3	steep, fast moving channels
	Intermittent	4	channels that do not flow year round, including manmade ditches
Lake		**LK**	**Large waterbody >20 acres**
Pond		**PD**	**Small waterbody <20 acres**

APPENDIX C: Animal, Plant, and Plant Community Target Lists for Denver County and Denver Mountain Parks

Animal Species Target List						
Scientific Name	Common Name	Global Rank	State Rank	U.S. ESA Status	USFS/BLM Status	Comments
AMPHIBIANS						
Lithobates pipiens	**Northern Leopard Frog**	G5	S1			creeks rivers, ponds wth shoreline grasses
Anaxyrus boreas	Boreal Toad (pop 1)	G4	S3			Mountain wetlands
BIRDS					FS/BLM	
Accipiter gentilis	**Northern Goshawk**	G5	S3B			aspen, ponderosa pine. Lodgepool pine
Catharus fuscescens	Veery	G5	S3B, SZN			riparian thickets-willow, dogwood, cottonwood saplings; hillside brush near streams
Cypseloides niger	Black Swift	G4	S3B		FS	cliffs with waterfalls
Empidonax traillii	Willow Flycatcher	G5	S4B, S4N			riparian willow/alder thickets etc.
Falco mexicanus	Prairie Falcon	G5	S4B, S4N			moutainous grasslands, nests in pot hole of cliffs
Falco peregrinus anatum	American Peregrine Falcon	G4T4	S2B		FS	high open cliff faces that dominate the surrounding area
Haliaeetus leucocephalus	Bald Eagle	G5	S1B,S3N			rivers and reservoirs and near Pdog towns in winter
Loxia leucoptera	**White-winged Crossbill**	**G5**	**S1B,SZN**			spruce-fir forests, but also all types of coniferous forests
Numenius americanus	Long-billed Curlew	G5	S2B		FS/BLM	shortgrass prairie, usually near water
Seiurus aurocapillus	**Ovenbird**	G5	S2B			foothill riparian thickets, aspen or ponderosa pine with Gambel oak or other shrubs
Tympanuchus phasianellus jamesi	Plains Sharp-tailed Grouse	G4T4	S1			gambel oak and other shrublands lacking conifers
Melanerpis lewis	Lewis's Woodpecker	G4	S3			lowland riparian forests of cottonwood, ponderosa pine
FISH						
Gila robusta	Roundtail Chub	G3	S2		BLM	slow moving waters adjacent to faster water, river eddies and irrigation ditches
Oncorhynchus clarki stomias	Greenback Cutthroat Trout	G4T2T3	S2	LT		well-oxygenated headwaters of mountain streams, pools, backwaters and pockets
LEPIDOPTERA						
Agapema homogena	Rocky Mountain Agapema	G4	S2			forests above 4400 feet; hostplants - California coffeeberry (Rhamnus californica ursina), sandbar willow (Salix exigua), and wax currant (Ribes cereum); nocturnal

Atrytone arogos	Arogos Skipper	G3	S2			undisturbed moist, but sloping prairie meadows at up to 6200'; bluestem
Callophrys mossii schryveri	Moss's Elfin	G4T3	S2S3			steep, rocky, brushy foothill ravines and sagebrush hillsides; stonecrop
Celastrina humulus	**Hops Feeding Azure**	G2G3	S2			mountain canyons and valleys that contain permanent water, common hops & lupine
Cicindela nebraskana	Tiger Beetle	G4	S1?			Open ground and trails in woodland areas; Ponderosa Pine-bunchgrass association
Coloradia luski	Lusk's Pinemoth	G4	S1?			Pine forests at 6000-7500 feet., use ponderosa pine and other pines as hosts
Doa ampla	Moth	GNR	S1			
Erynnis martialis	Mottled Dusky Wing	G3	S2S3			Shrubby foothills with stands of Cercocarpus and Ceanothus from 5800' to 8200', open woods and thickets; Ceanothus americanus, herbaceous (=ovatus), fendleri
Hesperia leonardus montana	**Pawnee Montane Skipper**	G4T1	S1	LT		Ponderosa pine forest with blue gramma; blue gramma
Hesperia ottoe	**Ottoe Skipper**	G3G4	S2		USFS	Moist shortgrass prairies, especially gently sloping meadows below 6300'; bluestem
Pachysphinx modesta	Modest Sphinx	G4G5	S3?			Riparian areas and moist mountainsides; Poplar, aspen, and cottonwood
Paratrytone snowi	Snow's Skipper	G4	S3			upper edge of ponderosa pine, riparian habitats in pine forests; Blepharoneuron tricholepis (pine dropseed)
Polites origenes	Cross-line Skipper	G5	S3			Grasslands, canyon openings near plains, wales and grassy meadows adjoining rocky mountain foothills from 5400'-7600'; big bluestem
Polites rhesus	Rhesus Skipper	G4	S2S3			Shortgrass and mixed grass prairie; blue grama
Proserpinus juanita	Juanita Sphinx	G4G5	S3S4			Forest edges, prairie valleys and hills, and weedy roadsides; evening primrose family (Onagraceae)
Pyrgus ruralis	Two-banded Checkered-skipper	G5	S3			Forest clearings and small meadows along streams; Rosaceae including Potentilla drummondii and Horkelia fusca
Pyrgus xanthus	Mountain Checkered-skipper	G3G4	S3			High mountain clearings from 8000 to 10,500 feet in elevation; Potentilla species in the rose family (Rosaceae)

Speyeria idalia	**Regal Fritillary**	G3	S1		USFS	Found in wet meadows and undisturbed prairie lands near marshes; Hostplant: Herb Violaceae including Viola pedatifida, papilionacea, lanceolata, pedata
Sphinx drupiferarum	Wild Cherry Sphinx Moth	G4	S3			A wide variety of wooded habitats; Wild cherry and plum (Prunus species) lilac (Syringa vulgaris), hackberry (Celtis occidentalis), and apple (Malus sylvestris)
Sphinx perelegans	Elegant Sphinx Moth	G4G5	S1?			Oak woodlands and mountains; Snowberries (Symphoricarpos), apple and plum (Prunus), manzanita (Arctostaphylos), and mountain mahogany (Cercocarpus betuloides)
Stinga morrisoni	Morrison's Skipper	G4G5	S3S4			Open pinyon, ponderosa pine, pine-juniper or oak-juniper woodland; not reported
Grammia sp. 1	Tiger Moth	G2G3	SNR			
MAMMALS						
Corynorhinus townsendii pallescens	**Townsend's big-eared bat**	G4T4	S2		BLM	Roosts in caves and shaft mines in semidesert shrublands, pinon-juniper woodlands, and open montane forests
Cynomys gunnisoni	Gunnison's prairie dog	G5	S5			High mountain valleys and plateaus at elevations of 1,830-3,660 meters
Cynomys ludovicianus	Black-tailed Prairie Dog	G4	S3			Habitat consists of dry, flat or gently sloping, open grasslands with low, relatively sparse vegetation
Myotis thysanodes	Fringed Myotis	G4G5	S3			Conifer woodlands and desert scrub; individuals roost in crevies, caves, mines or buildings
Sorex nanus	Dwarf Shrew	G4	S2		FS	Forests (unbroken and partially cleared). Open woodland, rocky, shrubby foothill slopes. Also alpine and sub alpine rockslides
Sorex preblei	0	G4	S1			arid and semiarid shrub-grass associations, openings in montane coniferous forests dominated by sagebrush (Washington), willow-fringed creeks, marshes (Oregon), bunchgrass associations, sagebrush-aspen associations (California), sagebrush-grass associations (Nevada), alkaline shrubland (Utah)
Vulpes velox	Swift Fox	G3	S3	PS, LE	FS	open prairie and grasslands, shortgrass or midgrass prairie in relatively flat areas

Zapus hudsonius preblei	**Meadow Jumping Mouse Subsp**	G5T2	S1	LT, PDL		moist shrubby riparian vegetation, usually Salix exigua, Amorpha fruticosa, or Symphoricarpus occidentalis
MOLLUSCS						
Acroloxus coloradensis	Rocky Mountain Capshell	G3	S1		FS	High lakes and ponds on the undersurfaces of the rocks
Pygnodon grandis	Giant Floater	G5	S2			inhabits permanent ponds, lakes, and rivers of various sizes, usually on mud
Ferrissia fragilis	Fragile Ancylid	G5	S1			Inhabits the littoral zone of oligotrophic and mesotrophic mountain lakes from 8,800 to 9,800 feet in elevation
Promenetus umbilicatellus	Umbilicate Sprite	G4	S3			Platte River drainage at high altitude lakes, creeks, ditches, and sloughs
ODONATA						
Hesperagrion heterodoxum	Painted Damsel	G5	S1			Permanent and ephemeral creeks and streams with moderate emergent vegetation. March-Nov
Plathemis subornata	Desert Whitetail	G4	S4			Desert pools, ponds, springs, and slow streams with thick emergent vegetation and mud bottoms. Mid-April to mid-Oct
Somatochlora ensigera	Plains Emerald	G4	S1			Small woodland streams & ditches, eggs deposited on damp clay at water's edge. Mid-June to mid-Aug
Stylurus intricatus	Brimstone Clubtail	G4	S2			Slow flowing, open, desert streams and rivers. June to mid-Oct
Sympetrum costiferum	Safron-winged Meadowhawk	G5	S1?			Ponds, especially marsh bordered, barren sandy or gravelly ponds in the open.
REPTILES						
Eumeces multivirgatus multivirgatus	Many-lined Skink	G5T5	S4			Loose, sandy soil in eastern Colorado; along rivers (South Platte) and streams within grassland, steep slopes above streams and PJ along streams in the mountains. <5500
Phrynosoma hernandesi	Short-horned Lizard	G5	S5			Semiarid plains to high mountains in open, shrubby, or openly wooded areas with sparse vegetation. Ranges to at least 8500.
Tropidoclonion lineatum	Lined Snake	G5	S3			Plains grasslands, canyon bottom grasslands at dusk. During daylight hours they hide under rocks, wood, or debris on the ground. Active after spring and summer rains. <6000

Plant Species Target List

Scientific Name	Common Name	Rank	Habitat
Acorus calamus	sweet flag	G4?/SH	wetlands-piedmont valleys
Agastache foeniculum	lavender hyssop	G5/S1	canyons
Ambrosia linearis	plains ragweed	G3/S3	seasonally moist - playas
Amorpha nana	dwarf wild indigo	G5/S2S3	prairie
Apios americana	American groundnut	G5/S1	mesic woods, ditch banks, streambanks, ponds
Aquilegia chrysantha v. rydbergii	golden columbine	G4T1Q/S1	streamsides, rocky ravines
Argyrochosoma fendleri	Fendler cloak-fern	G3/S3	granite/basalt cliffs
Aristida basiramea	forktip three-awn	G5/S1	barren/sandy soil, sandstone outcrops & hogbacks
Asclepias stenophylla	narrow-leaved milkweed	G4G5/S2	dry prairies, bluffs, outwash mesas
Asclepias uncialis	wheel milkweed	G3G4T2T3/S2	shortgrass prairie, sandstone soils, gravelly, rocky
Asplenium adiantum-nigrum	black spleenwort	G5/S1	sandstone, shaded cracks, crevices, ledges dry S & E face cliffs
Astragalus plattensis	Platte River milkvetch	G5/S1	woods, prairies, rocky slopes, gullys, bluffs
Astragalus sparsiflorus	Front Range milkvetch	G3?S3?	rocky slopes, wet meadows,river floodplains, granite, PIPO duff
Botrychium campestre	prairie moonwort	G3G4/S1	native unplowed prairie
Callitriche heterophylla	large water-starwort	G5/S1	aquatic, water with little movement, drying mud
Campanula aparinoides	marsh bellflower	G5/SH	wet meadows, streambanks
Carex conoidea	openfield sedge	G5/S1	wet meadows, prairies
Carex crawei	Crawe sedge	G5/S1	wet gravel, sand, streams, pond margins, flow dist.
Carex diandra	lesser panicled sedge	G5/S1	wet meadows, fens, floating mats
Carex lasiocarpa	slender sedge	G5/S1	fens, bogs, lakeshores
Carex oreocharis	sedge	G3/S1	dry slopes, granitic soils
Carex peckii	Peck sedge	G4G5/S1	cool shaded gulches, riparian alluvium soils, foothills

Carex sartwellii	Sartwell's sedge	G4G5/S1	marshes, fens, streams
Carex saximontana	Rocky Mountain sedge	G5/S1	pine forests, thickets of outer foothills
Carex sprengelii	Sprengel's sedge	G5?/S2S3	dry to mesic deciduous forests, floodplain forests with calcium
Carex sychnocephala	many-headed sedge	G4/S1	wet areas, at least seasonally, open, sandy, silty or peaty shores, banks, on limestone
Carex torreyi	Torrey sedge	G4/S1	dry & moist woodlands, meadows, gulches, outer foothills
Cheilanthes eatonii	Eaton's lip fern	G5?/S1S2	slopes and ledges, limestone and granite
Claytonia rubra	miners lettuce	G5/S1	gambell oak, cut banks near streams, sand, tree fall
Crassula aquatica	water pygmyweed	G5/SH	muddy pondshores, annual w/fleshy leaves fls wht/grn
Crataegus chrysocarpa	yellow hawthorne	G5/S1	north slopes, riparian
Crocanthemum bicknellii	frostweed	G5/S2	grassy forest opening

Plant Community Target List		
Plains/Low Elevation Communities (CCD)	**RANK**	**Common Name**
Andropogon gerardii-Schizachyrium scoparium Western Great Plains Herbaceous Vegetation	G2?S2	Big bluestem-little bluestem
Andropogon gerardii-Sorghastrum nutans Western Great Plains Herbaceous Vegetation	G2S1S2	Big bluestem-indiangrass
Andropogon gerardii-Sporobolus heterolepis Western Great Plains Herbaceous Vegetation	G2S1S2	Big bluestem-prairie dropseed
Carex diandra Wet Meadow Herbaceous Vegetation	GNRSU	Lesser panicled sedge
Carex lasiocarpa Herbaceous Vegetation	G4?S1	Woollyfruit sedge
Carex nebrascensis Herbaceous Vegetation	G4S3	Nebraska sedge
Carex utriculata Herbaceous Vegetation	G5S4	Northwest territory sedge
Danthonia parryi Herbaceous Vegetation	G3S3	Parry's oatgrass
Distichlis spicata Herbaceous Vegetation	G5S3	Saltgrass

Eleocharis rostellata Herbaceous Vegetation	G3S2	Beaked spikerush
Festuca arizonica-Muhlenbergia filiculmis Herbaceous Vegetation	GUS3	Arizona fescue-slimstem muhly
Festuca arizonica-Muhlenbergia montana Herbaceous Vegetation	G3S2	Arizona fescue-mountain muhly
Hesperostipa comata Colorado Front Range Herbaceous Vegetation	G1G2S1S2	Needle-n-thread grass
Hesperostipa comata-Bouteloua gracilis-Carex filifolia Herbaceous Vegetation	G5S2S3	Needle-n-thread grass-blue grama
Hesperostipa neomexicana Herbaceous Vegetation	G3S3	New Mexican feathergrass
Muhlenbergia montana-Hesperostipa comata Herbaceous Vegetation	G1G2S1S2	Mountain muhly-Needle-n-Thread
Populus angustifolia/Prunus virginiana Woodland	G2QS1	Narrowleaf cottonwood/chokecherry
Populus angustifolia/Salix exigua Woodland	G4S4	Narrowleaf cottonwood/sandbar willow
Populus deltoides ssp. monilifera/Prunus virginiana Woodland	GUSU	Plains cottonwood/chokecherry
Populus deltoides/Symphoricarpos occidentalis Woodland	G2G3S2	Plains cottonwood/snowberry
Potomogeton natans Herbaceous Vegetation	G5?S1	Floating pondweed
Ribes cereum/Leymus ambiguus Shrubland	G2S2?	Wax current/Colorado wildrye
Salix drummondiana/Mesic Forbs Shrubland	G4S4	Drummond willow
Salix geyeriana-Salix monitcola/Mesic Forbes	G3S3	Geyer willow
Salix ligulifolia Shrubland	G2G3S2S3	Strapleaf willow
Salix monticola/Calamagrostis canadensis Shrubland	G3S3	Rocky Mountain willow/Canada bluejoint
Salix monticola/Mesic Forbs Shrubland	G4S3	Rocky Mountain willow
Salix monticola/Mesic Graminoids Shrubland	G3S3	Rocky Mountain willow
Sparganium angustifolium Herbaceous Vegetation	G4/SU (PT)	Floating submergent palustrine wetlands
Spartina pectinata Western Herbaceous Vegetation	G3?/S3	Prairie slough grass
Spartina pectinata-Shoenoplectus pungens Herbaceous Vegetation	G3/NNR	Prairie cordgrass-bulrush
Spartina pectinata-Carex spp. Herbaceous Vegetation	G3?/NNR	Prairie cordgrass sedge wet meadow
Suaeda (calceoliformis) moquini Herbaceous Vegetation	G5/S2	Seablite

Typha (latifolia, angustifolia) Western Herbaceous Vegetation	G5S4 (NT)	Cattail
Foothills, Montane and Subalpine Communities (DMP)	**RANK**	
Abies lasiocarpa-Picea engelmanii/Mertensia ciliata Forest	G5S5	Subalpine fir-Engelmann spruce/tall fringed bluebells
Alnus incana - Salix drummndiana Shrubland	G3S3	Thinleaf alder-Drummond willow
Alnus incana/Equisetum arvense Shrubland	G3S3	Thinleaf alder- field horsetail
Alnus incana/Mesic Forbs Shrubland	G3S3	Thinleaf alder
Alnus incana/Mesic Graminoids Shrubland	G3S3	Thinleaf alder
Betula occidentalis/Cornus sericea Shrubland	G3S1S2	River birch/red-osier dogwood
Betula occidentalis/Maianthemum stellatum Shrubland	G4?S2	River birch/starry false Solomon's seal
Betula occidentalis/Mesic Graminoids Shrubland	G3S2	River birch
Glyceria borealis Herbaceous Vegetation	G4S3	Small floating mannagrass
Picea pungens/Alnus incana Woodland	G3S3	Blue spruce/thinleaf alder
Picea pungens/Alnus incana-Corylus cornuta Woodland	GUSU	Blue spruce/thinleaf alder-beaked hazelnut
Picea pungens/Betula occidentalis Woodland	G2S2	Blue spruce/river birch
Pinus ponderosa/Alnus incana Woodland	G2S2	Ponderosa pine/river birch
Pinus ponderosa/Carex rossii Forest	G4G5S3S4	Ponderosa pine/Ross' sedge
Populus angustifolia/Alnus incana Woodland	G4G5S2S3	Ponderosa pine/mountain muhly
Populus angustifolia/Betula occidentalis Woodland	G3S3	Narrowleaf cottonwood/thinleaf alder
Populus tremuloides/Betula occidentalis Forest	G3S3	Aspen/river birch
Populus tremuloides/Corylus cornuta Forest	G3S2	Aspen/beaked hazelnut
Pseudotsuga menziesii/Betula occidentalis Woodland	G3S1	Douglas fir/river birch
Pseudotsuga menziesii/Carex geyeri Forest	G3?S3	Douglas fir/Geyer sedge
Pseudotsuga menziesii/Jamesia americana Forest	G4?S3	Douglas fir/waxflower
Salix bebbiana Shrubland	G3G4	Bebb willow
Salix planifolia/Carex aquatilis Shrubland	G3?S2	Planeleaf willow/water sedge

QC_________

APPENDIX D: 2013 WETLAND CONDITION ASSESSMENT FIELD FORM

LOCATION AND GENERAL INFORMATION

Point Code: ____________________ Site Name: ____ ☐ Level 2.5 OR ☐ Level 3

Date: _________________________ Surveyors: ____ ☐ Team A OR ☐ Team B

General Location: ____ County: ____________________________________

General Ownership: _____________________ Specific Ownership: ____

Directions to Point:

Access Comments (note permit requirement or difficulties accessing the site):

GPS COORDINATES OF TARGET POINT AND ASSESSMENT AREA (NAD 83 UTM Zone ________)

Point WP #: __________ UTM E: ___ ___ ___ ___ ___ ___ UTM N: ___ ___ ___ ___ ___ ___ ___ Error (+/-): ______________

Dimensions of AA:	
____40 m radius circle	Elevation (m):
____Rectangle, width________ length:_________	Slope (deg):
____Freeform, describe and take a GPS Track	Aspect (deg):

AA-Center (Circle AAs Only) WP #: __________ UTM E: ___ ___ ___ ___ ___ ___ UTM N: ___ ___ ___ ___ ___ ___ ___ Error (+/-): ______________

AA-1 WP #: __________ UTM E: ___ ___ ___ ___ ___ ___ UTM N: ___ ___ ___ ___ ___ ___ ___ Error (+/-): ______________

AA-2 WP #: __________ UTM E: ___ ___ ___ ___ ___ ___ UTM N: ___ ___ ___ ___ ___ ___ ___ Error (+/-): ______________

AA-3 WP #: __________ UTM E: ___ ___ ___ ___ ___ ___ UTM N: ___ ___ ___ ___ ___ ___ ___ Error (+/-): ______________

AA-4 WP #: __________ UTM E: ___ ___ ___ ___ ___ ___ UTM N: ___ ___ ___ ___ ___ ___ ___ Error (+/-): ______________

AA-Track Track Name: ____ Area: ____

AA Placement and Dimensions Comments (if AA is moved from original point, note why):

PHOTOS OF ASSESSMENT AREA (Taken at four points on edge of AA looking in. Record WPs of each photo in table above.)

AA-1 Photo #: _____________ Aspect: _____________ AA-2 Photo #: _____________ Aspect: _____________ AA-3 Photo #: _____________ Aspect: _____________ AA-4 Photo #: _____________ Aspect: _____________	Additional AA Photo Range: Comments: (Note range of photo numbers and explain particular photos of interest)

ENVIRONMENTAL DESCRIPTION AND CLASSIFICATION OF ASSESSMENT AREA

Wetland vs. riparian / non-target inclusions _________ % AA with true wetland _________ % AA with non-wetland riparian area _________ % AA with > 1m standing water _________ % AA with upland inclusions	Wetland origin *(if known)* ____ Natural feature with minimal alteration ____ Natural feature, but altered or augmented by modification ____ Non-natural feature created by passive or active management ____ Unknown

Ecological System: (see manual for key and rules on inclusions and pick the *best match*) Fidelity: High Med Low

Cowardin Classification Fidelity: High Med Low (see manual and pick *one each* of System, Class, Water Regime, and optional Modifier for dominant type)	HGM Class (pick *only one*) Fidelity: High Med Low ____Riverine* ____Lacustrine Fringe ____Depressional ____ Slope ____ Flats ____ Novel (Irrigation-Fed) **Specific classification and metrics apply to the Riverine HGM Class*

***RIVERINE SPECIFIC* CLASSIFICATION OF THE ASSESSMENT AREA**

Confined vs. Unconfined Valley Setting ______ Confined Valley Setting (valley width < 2x bankfull width) ______ Unconfined Valley Setting (valley width ≥ 2x bankfull width) Stream Flow Duration ______ Perennial ______ Intermittent ______ Ephemeral	AA Proximity to Channel ______ AA includes the channel and both banks ______ AA is adjacent to or near the channel (< 50 m) and evaluation includes one or both banks ______ AA is > 50 m from the channel and banks were not evaluated Stream Depth at Time of Survey (if evaluated) ______ Wadeable ______ Non-wadeable

MAJOR ZONES WITHIN THE ASSESSMENT AREA (See manual for rules and definitions. Mark each zone on the site sketch.)

Zone 1 Description _____________________________ Dom spp: ____ % of AA: ___________

Zone 2 Description _____________________________ Dom spp: ____ % of AA: ___________

Zone 3 Description _____________________________ Dom spp: ____ % of AA: ___________

Zone 4 Description _____________________________ Dom spp: ____ % of AA: ___________

Zone 5 Description _____________________________ Dom spp: ____ % of AA: ___________

ENVIRONMENTAL AND CLASSIFICATION COMMENTS

Classification Issues (important for sites with low fidelity to one or more classification systems):

AA REPRESENTATIVENESS

Is AA the entire wetland/riparian area? ___ Yes ___ No

If no, is AA representative of larger wetland/riparian area? ___ Yes ___ No

Provide comments:

ASSESSMENT AREA DRAWING

Add north arrow and approx. scale bar. Document **habitat features** and **biotic and abiotic zones** (particularly open water), inflows and outflows, and indicate direction of drainage. Include sketch of vegetation plot and soil pit placement. If appropriate, add a **cross-sectional diagram** and indicate slope of side.

ASSESSMENT AREA DESCRIPTION AND COMMENTS

General Description:
Optional Note wildlife species observed:

Point Code__________________ QC_________

Vegetation Plot Species Table: For four out of five plots, list all species within and overhanging the plot and estimate percent cover for the plot. For the fifth plot, list any *additional* species in the residual "R" column and estimate percent cover for the entire AA.

LEVEL 3 VEGETATION AND SOIL DATA COLLECTION

VEGETATION PLOT SPECIES TABLE												
Plot →											**R**	
Presence / Cover →			**P**	**C**	**P**	**C**	**P**	**C**	**P**	**C**	**P**	**C**
Cover Classes 1: trace **2:** <1% **3:** 1–<2% **4:** 2–<5% **5:** 5–<10% **6:** 10–<25% **7:** 25–<50% **8:** 50–<75% **9:** 75–<95% **10:** >95%												
Scientific Name or Pseudonym (If repeated/common pseudonym, mark with *)	**Coll #**	**Photos**										

Point Code__________________ QC_________

VEGETATION PLOT SPECIES TABLE												
Plot →											R	
Presence / Cover →			P	C	P	C	P	C	P	C	P	C
Cover Classes 1: trace 2: <1% 3: 1–<2% 4: 2–<5% 5: 5–<10% 6: 10–<25% 7: 25–<50% 8: 50–<75% 9: 75–<95% 10: >95%												
Scientific Name or Pseudonym (If repeated/common pseudonym, mark with *)	**Coll #**	**Photos**										

Point Code__________________ QC_________

VEGETATION PLOT SPECIES TABLE												
Plot →											R	
Presence / Cover →			P	C	P	C	P	C	P	C	P	C
Cover Classes 1: trace 2: <1% 3: 1–<2% 4: 2–<5% 5: 5–<10% 6: 10–<25% 7: 25–<50% 8: 50–<75% 9: 75–<95% 10: >95%												
Scientific Name or Pseudonym (If repeated/common pseudonym, mark with *)	Coll #	Photos										

VEGETATION PLOT GROUND COVER AND VERTICAL STRATA					
Plot →					**R**
Cover Classes 1: trace 2: <1% 3: 1–<2% 4: 2–<5% 5: 5–<10% 6: 10–<25% 7: 25–<50% 8: 50–<75% 9: 75–<95% 10: >95%					
Cover Class (unless otherwise noted) →	**C**	**C**	**C**	**C**	**C**
Ground Cover					
Cover of water (any depth, vegetated or not, standing or flowing)					
Predominant depth of water					
Min depth of water					
Max depth of water					
Cover of exposed bare ground* – soil / sand / sediment					
Cover of exposed bare ground* – gravel / cobble (~2–250 mm)					
Cover of exposed bare ground* – bedrock / rock / boulder (>250 mm)					
Cover of litter (all cover, including under water or vegetation)					
Depth of litter (cm) – average of four non-trampled locations where litter occurs					
Predominant litter type (C = coniferous, E = broadleaf evergreen, D = deciduous, S = sod/thatch, F = forb)					
Cover of standing dead trees (>5 cm diameter at breast height)					
Cover of standing dead shrubs or small trees (<5 cm diameter at breast height)					
Cover of downed coarse woody debris (fallen trees, rotting logs, >5 cm diameter)					
Cover of downed fine woody debris (<5 cm diameter)					
Cover bryophytes (all cover, including under water, vegetation or litter cover)					
Cover lichens (all cover, including under water, vegetation or litter cover)					
Cover algae (all cover, including under water, vegetation or litter cover)					

*Bare ground has no vegetation/litter/water cover, but may have some algae cover. The three categories of bare ground are mutually exclusive and should total ≤100%.

Height Classes 1: <0.5 m 2: 0.5–1m 3: 1–2 m 4: 2–5 m 5: 5–10 m 6: 10–15 m 7: 15–20 m 8: 20–35 m 9: 35–50 m 10: >50 m										
Vertical Vegetation Strata (live or very recently dead) **Cover / Height →**	**C**	**H**	**C**	**H**	**C**	**H**	**C**	**H**	**C**	**H**
(T1) Dominant canopy trees (>5 m and > 30% cover)										
(T2) Sub-canopy trees (> 5m but < dominant canopy height) or trees with sparse cover										
(S1) Tall shrubs or older tree saplings (2–5 m)										
(S2) Short shrubs or young tree saplings (>2 m)										
(HT) Herbaceous total										
(H1) Graminoids (grass and grass-like plants)										
(H2) Forbs (all non-graminoids)										
(H3) Ferns and fern allies										
(AQ) Submergent or floating aquatics										

SOIL PROFILE DESCRIPTION – SOIL PIT 1 ☐ **Representative Pit?** **Photo #s** _____________ **GPS Waypoint** ______________ **(mark on site sketch)**

Depth to saturated soil (cm): ____________ Depth to free water (cm): _____________ ☐ Not observed, if so: ☐ Pit is filling slowly OR ☐ Pit appears dry Settling Time: ___________

Horizon (optional)	Depth (cm)	Matrix Color (moist)	Dominant Redox Features Color (moist)	Dominant Redox Features %	Secondary Redox Features Color (moist)	Secondary Redox Features %	Texture	Remarks

Hydric Soil Indicators: See field manual for descriptions and check all that apply to pit.

____Histosol (A1)
____Histic Epipedon (A2/A3)
____Mucky Mineral (S1/F1)
____Hydrogen Sulfide Odor (A4)
____Gleyed Matrix (S4/F2)
____Depleted Matrix (A11/A12/F3)
____Redox Concentrations (S5/F6/F8)
____Redox Depletions (S6/F7)

Comments:

If representative pit:
____Histosol
____Histic Epipedon
____Clayey/Loamy
____Sandy

SOIL PROFILE DESCRIPTION – SOIL PIT 2 ☐ **Representative Pit?** **Photo #s** _____________ **GPS Waypoint** ______________ **(mark on site sketch)**

Depth to saturated soil (cm): ____________ Depth to free water (cm): _____________ ☐ Not observed, if so: ☐ Pit is filling slowly OR ☐ Pit appears dry Settling Time: ___________

Horizon (optional)	Depth (cm)	Matrix Color (moist)	Dominant Redox Features Color (moist)	Dominant Redox Features %	Secondary Redox Features Color (moist)	Secondary Redox Features %	Texture	Remarks

Hydric Soil Indicators: See field manual for descriptions and check all that apply to pit.

____Histosol (A1)
____Histic Epipedon (A2/A3)
____Mucky Mineral (S1/F1)
____Hydrogen Sulfide Odor (A4)
____Gleyed Matrix (S4/F2)
____Depleted Matrix (A11/A12/F3)
____Redox Concentrations (S5/F6/F8)
____Redox Depletions (S6/F7)

Comments:

If representative pit:
____Histosol
____Histic Epipedon
____Clayey/Loamy
____Sandy

SOIL PROFILE DESCRIPTION – SOIL PIT 3 ☐ **Representative Pit?** **Photo #s _____________ GPS Waypoint ______________ (mark on site sketch)**

Depth to saturated soil (cm): ____________ Depth to free water (cm): _____________ ☐ Not observed, if so: ☐ Pit is filling slowly OR ☐ Pit appears dry Settling Time: ___________

Horizon (optional)	Depth (cm)	Matrix Color (moist)	Dominant Redox Features Color (moist)	Dominant Redox Features %	Secondary Redox Features Color (moist)	Secondary Redox Features %	Texture	Remarks
________	_______	______________	______________	________	_____________	________	______________	____
________	_______	______________	______________	________	_____________	________	______________	____
________	_______	______________	______________	________	_____________	________	______________	____
________	_______	______________	______________	________	_____________	________	______________	____
________	_______	______________	______________	________	_____________	________	______________	____

Hydric Soil Indicators: See field manual for descriptions and check all that apply to pit.

____Histosol (A1)
____Histic Epipedon (A2/A3)
____Mucky Mineral (S1/F1)
____Hydrogen Sulfide Odor (A4)
____Gleyed Matrix (S4/F2)
____Depleted Matrix (A11/A12/F3)
____Redox Concentrations (S5/F6/F8)
____Redox Depletions (S6/F7)

Comments:

If representative pit:
____Histosol
____Histic Epipedon
____Clayey/Loamy
____Sandy

WATER CHEMISTRY - PH, EC, AND TEMPERATE MEASUREMENTS

Take pH, EC, and water temperature recording at up to four locations within the AA and circle the appropriate characteristics. Take measurements within each habitat feature with open water. Take measurements in soil pits if in a fen. Take GPS Waypoints at each location.

	GPS WP#	Location	Depth (cm)	Surface OR Ground	Standing OR Flowing	Shallow OR Deep	Clear OR Turbid	Open OR Shade	pH	EC	Temp
Site 1				Surface / Ground	Standing / Flowing	Shallow / Deep	Clear / Turbid	Open / Shade			
Site 2				Surface / Ground	Standing / Flowing	Shallow / Deep	Clear / Turbid	Open / Shade			
Site 3				Surface / Ground	Standing / Flowing	Shallow / Deep	Clear / Turbid	Open / Shade			
Site 4				Surface / Ground	Standing / Flowing	Shallow / Deep	Clear / Turbid	Open / Shade			

Water chemistry measurement comments:

LEVEL 2 ECOLOGICAL INTEGRITY ASSESSMENT FOR COLORADO WETLANDS

1. LANDSCAPE CONTEXT METRICS – Circle the applicable letter.

1a. LANDSCAPE FRAGMENTATION		
Select the statement that best describes the **landscape fragmentation** within a 500 m envelope surrounding the AA. To determine, identify the largest unfragmented block *that includes the AA* within the 500 m envelope and estimate its percent of the total envelope. Well-traveled dirt roads and major canals count as fragmentation, but hiking trails, hayfields, low fences and small ditches can be included in unfragmented blocks (see definitions).	Intact: AA embedded in >90–100% unfragmented, natural landscape.	**A**
	Variegated: AA embedded in >60–90% unfragmented, natural landscape.	**B**
	Fragmented: AA embedded in >20–60% unfragmented, natural landscape.	**C**
	Relictual: AA embedded in ≤20% unfragmented, natural landscape.	**D**
1b. RIPARIAN CORRIDOR CONTINUITY *(RIVERINE WETLANDS ONLY)*		
For riverine wetlands, select the statement that best describes the **riparian corridor continuity** within 500 m upstream and downstream of the AA. To determine, identify any non-buffer patches (see definitions) within the potential riparian corridor (natural geomorphic floodplain) both upstream and downstream of the AA. Estimate the percentage of the riparian corridor they occupy. *For AAs on one side of a very large river channel,* only consider the riparian corridor on the side of the channel the AA is located.	Intact: >95–100% natural habitat within the riparian corridor both upstream and downstream.	**A**
	Variegated: >80–95% natural within the riparian corridor both upstream and downstream.	**B**
	Fragmented: >50–80% natural habitat within the riparian corridor both upstream and downstream.	**C**
	Relictual: ≤50% natural habitat within the riparian corridor both upstream and downstream.	**D**
Landscape fragmentation and riparian corridor continuity comments:		

1c. BUFFER EXTENT		
Select the statement that best describes the **extent of buffer land cover** surrounding the AA. To determine, estimate the percent of the AA surrounded by buffer land covers (see definitions). Each segment must be ≥ 5 m wide and extend along ≥ 10 m of the AA perimeter.	Buffer land covers surround 100% of the AA.	**A**
	Buffer land covers surround >75–<100% of the AA.	**A-**
	Buffer land covers surround >50–75% of the AA.	**B**
	Buffer land covers surround >25–50% of the AA.	**C**
	Buffer land covers surround ≤25% of the AA.	**D**
1d. BUFFER WIDTH		
Select the statement that best describes the **buffer width**. To determine, estimate buffer width (up to 200 m from AA) along eight lines radiating out from the AA at the cardinal and ordinal directions (N, NE, E, SE, S, SW, W, NW).		
1: _____________ 5: _____________	Average buffer width is >200 m	**A**
2: _____________ 6: _____________	Average buffer width is >100–200 m	**A-**
3: _____________ 7: _____________	Average buffer width is >50–100 m	**B**
4: _____________ 8: _____________	Average buffer width is >25–50 m	**C**
Average width: _________________________	Average buffer width is ≤25 m OR no buffer exists	**D**

1e. BUFFER CONDITION

Select the statement that best describes the **buffer condition**. Select one statement per column. Only consider the actual buffer measured in metrics 1c and 1d.

Abundant (≥95%) relative cover native vegetation and little or no (<5%) cover of non-native plants.	**A**	Intact soils, little or no trash or refuse, and no evidence of human visitation.	**A**
Substantial (≥75–95%) relative cover of native vegetation and low (5–25%) cover of non-native plants.	**B**	Intact or moderately disrupted soils, moderate or lesser amounts of trash, OR minor intensity of human visitation or recreation.	**B**
Moderate (≥50–75%) relative cover of native vegetation.	**C**	Moderate or extensive soil disruption, moderate or greater amounts of trash, OR moderate intensity of human use.	**C**
Low (<50%) relative cover of native vegetation OR no buffer exists.	**D**	Barren ground and highly compacted or otherwise disrupted soils, moderate or greater amounts of trash, moderate or greater intensity of human use, OR no buffer exists.	**D**

Buffer comments:

1f. NATURAL COVER WITHIN A 100 M ENVELOPE (SUPPLEMENTAL METRIC)

Using the table below, estimate the percent cover of each **natural cover type within a 100 m envelope** of the AA. Natural cover includes both *native and non-native vegetation*. This measure applies to the entire 100 m envelope and not just buffer land covers. Estimate the total combined cover and wetland and upland cover separately.

Natural Cover Type	*Total % Cover*	*Upland % Cover*	*Wetland % Cover*
Total non-natural land use (development, roads, row crops, feed lots, etc.).			
Total natural cover (breakdown by type below)			
A. Deciduous forest			
B. Coniferous forest			
C. Mixed forest type (neither deciduous nor coniferous trees dominate)			
D. Shrubland			
E. Perennial herbaceous (includes hay fields and CRP lands)			
F. Annual herbaceous or disturbed bare (generally weedy)			
G. Naturally bare (open water, rock, snow/ice)			

Natural cover comments (and note the dominant species from above):

A.

B.

C.

D.

E.

F.

G.

LANDSCAPE STRESSORS

Using the table below, estimate the independent and cumulative percent of each **landscape stressor / land use within a 500 m envelope** of the AA. Stressors can overlap and do not need to total 100% (e.g., light grazing and moderate recreation can both be counted in the same portion of the envelope). ***Scope rating: 1 = 1–10%, 2 = >10–25%, 3 = >25–50%, 4 = >50–75%, 5 = >75%.***

Landscape stressor/ Land use categories	*Scope*
Paved roads, parking lots, railroad tracks	
Unpaved roads (e.g., driveway, tractor trail, 4-wheel drive roads)	
Domestic or commercially developed buildings	
Intensively managed golf courses, sports fields, urban parks, expansive lawns	
Gravel pit operation, open pit mining, strip mining	
Mining (other than gravel, open pit, and strip mining), abandoned mines	
Resource extraction (oil and gas wells and surrounding footprint)	
Dam sites and flood disturbed shorelines around water storage reservoirs	
Agriculture – tilled crop production	
Agriculture – permanent crop (hay pasture, vineyard, orchard, tree plantation)	
Vegetation conversion (chaining, cabling, rotochopping, or clear-cutting of woody veg)	
Logging or tree removal with 50-75% of trees removed	
Selective logging or tree removal with <50% of trees removed	
Heavy grazing/browse by livestock or native ungulates	
Moderate grazing/browse by livestock or native ungulates	
Light grazing/browse by livestock or native ungulates	
Intense recreation or human visitation (ATV use / camping / popular fishing spot, etc.)	
Moderate recreation or human visitation (high-use trail)	
Light recreation or human visitation (low-use trail)	
Recent old fields and other fallow lands dominated by *non-native* species (weeds or hay)	
CRP lands (grasslands planted with a mix of *native* and *non-native* species)	
Haying of *native* grassland (*not* dominated by non-native hay grasses)	
Beetle-killed conifers	
Evidence of recent fire (<5 years old, still very apparent on vegetation, little regrowth)	
Other:	
Other:	
Other:	

Landscape stressor comments:

2. VEGETATION CONDITION METRICS – *Circle the applicable letter.*

2a-d. VEGETATION COMPOSITION

Vegetation composition metrics can be calculated out of the field based on the species list and cover values. To aid data interpretation, provide comments on composition and **list noxious species identified in field.**

2e. REGENERATION OF NATIVE WOODY SPECIES

Select the statement that best describes the **regeneration of native woody species** within the AA.	
Woody species are naturally uncommon or absent.	**N/A**
All age classes of desirable (native) woody riparian species present.	**A**
Age classes restricted to mature individuals and young sprouts. Middle age groups absent.	**B**
Stand comprised of mainly mature species OR mainly evenly aged young sprouts that choke out other vegetation.	**C**
Woody species predominantly consist of decadent or dying individuals OR >25% of the canopy cover is Russian Olive and/or Salt Cedar.	**D**

Regeneration comments and photo #'s:

2f. COARSE AND FINE WOODY DEBRIS

Select the statement that best describes **coarse and fine woody debris** within the AA.	
There are no obvious inputs of woody debris.	**N/A**
AA characterized by moderate amount of coarse and fine woody debris, relative to expected conditions. For riverine wetlands, debris is sufficient to trap sediment, but does not inhibit stream flow. For non-riverine wetlands, woody debris provides structural complexity, but does not overwhelm the site.	**AB**
AA characterized by small amounts of woody debris OR debris is somewhat excessive. For riverine wetlands, lack of debris may affect stream temperatures and reduce available habitat.	**C**
AA lacks woody debris, even though inputs are available.	**D**

Woody debris comments and photo #'s:

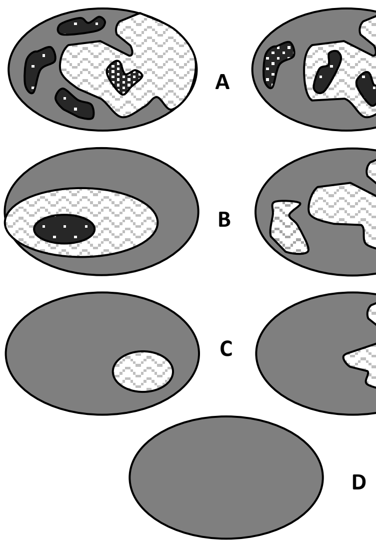
2g. HERBACEOUS / DECIDUOUS LEAF LITTER ACCUMULATION

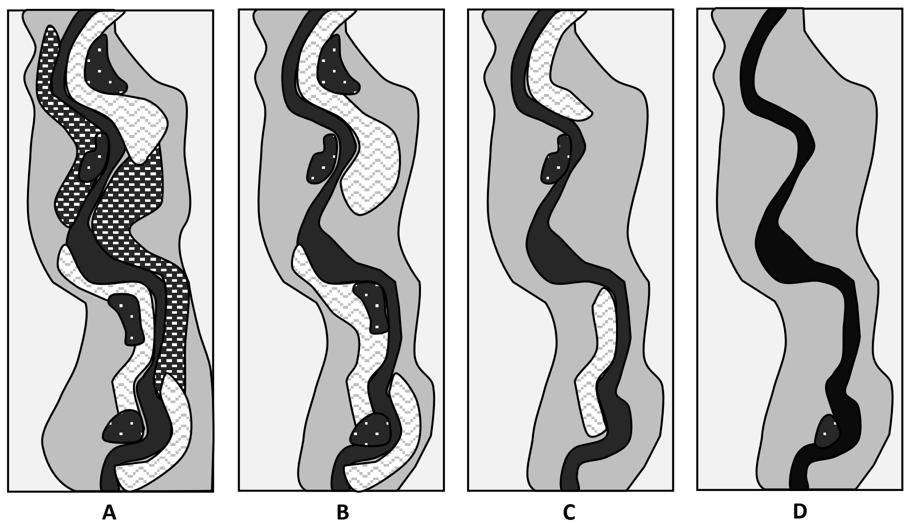
Select the statement that best describes **herbaceous and/or deciduous leaf litter accumulation** within the AA.	
AA characterized by moderate amount of herbaceous and/or deciduous leaf litter. New growth is more prevalent than previous years'. Litter and duff layers in pools and topographic lows are thin. Organic matter is neither lacking nor excessive.	**AB**
AA characterized by small amounts of litter with little plant recruitment OR litter is somewhat excessive.	**C**
AA lacks litter OR litter is extensive and limiting new growth.	**D**

Herbaceous / deciduous litter accumulation comments and photo #'s:

2h. HORIZONTAL INTERSPERSION OF BIOTIC AND ABIOTIC ZONES

Refer to diagrams below and select the statement that best describes the **horizontal interspersion of biotic and abiotic zones** within the AA. Rules for defining zones are in the field manual. Include zones of open water when evaluating interspersion.	High degree of horizontal interspersion: AA characterized by a very complex array of nested or interspersed zones with no single dominant zone.	**A**
	Moderate degree of horizontal interspersion: AA characterized by a moderate array of nested or interspersed zones with no single dominant zone.	**B**
	Low degree of horizontal interspersion: AA characterized by a simple array of nested or interspersed zones. One zone may dominate others.	**C**
	No horizontal interspersion: AA characterized by one dominant zone.	**D**





Horizontal interspersion comments (note if lack of interspersion is not related to wetland integrity such as in *Carex*-dominated fens):

VEGETATION STRESSORS WITHN THE AA

Using the table below, estimate the independent scope of each vegetation stressor within the AA. Independent scopes can overlap (e.g., light grazing can occur along with moderate recreation). ***Scope rating: 1 = 1–10%, 2 = >10–25%, 3 = >25–50%, 4 = >50–75%, 5 = >75%.***

Vegetation stressor categories	*Scope*
Unpaved Roads (e.g., driveway, tractor trail, 4-wheel drive roads)	
Vegetation conversion (chaining, cabling, rotochopping, clearcut)	
Logging or tree removal with 50-75% of trees removed	
Selective logging or tree removal with <50% of trees removed	
Heavy grazing/browse by livestock or native ungulates	
Moderate grazing/browse by livestock or native ungulates	
Light grazing/browse by livestock or native ungulates	
Intense recreation or human visitation (ATV use / camping / popular fishing spot, etc.)	
Moderate recreation or human visitation (high-use trail)	
Light recreation or human visitation (low-use trail)	
Recent old fields and other fallow lands dominated by *non-native* species (weeds or hay)	
Haying of *native* grassland (*not* dominated by non-native hay grasses)	
Beetle-killed conifers	
Evidence of recent fire (<5 years old)	
Other:	
Other:	

Vegetation stressor comments and photo #'s:

3. HYDROLOGY METRICS – *Circle the applicable letter.*

4a. WATER SOURCES / INPUTS	
Select the statement below that best describes the **water sources** feeding the AA during the growing season. Check off all *major* water sources in the table to the right. If the dominant water source is evident, mark it with a star (*).	_____ Overbank flooding _____ Alluvial aquifer _____ Groundwater discharge _____ Natural surface flow _____ Precipitation _____ Snowmelt _____ Irrigation via direct application _____ Irrigation via seepage _____ Irrigation via tail water run-off _____ Urban run-off / culverts _____ Pipes (directly feeding wetland) _____ Other:

Water sources are precipitation, groundwater, natural runoff, or natural flow from an adjacent freshwater body. The system may naturally lack water at times, such as in the growing season. There is no indication of direct artificial water sources, either point sources or non-point sources. Land use in the local watershed is primarily open space or low density, passive use with little irrigation.	**A**
Water sources are mostly natural, but also include occasional or small amounts of inflow from anthropogenic sources. Indications of anthropogenic sources include developed land or irrigated agriculture that comprises < 20% of the immediate drainage basin, the presence of a few small storm drains or scattered homes with septic system. No large point sources control the overall hydrology.	**B**
Water sources are moderately impacted by anthropogenic sources, but are still a mix of natural and non-natural sources. Indications of moderate contribution from anthropogenic sources include developed land or irrigated agriculture that comprises 20–60% of the immediate drainage basin or the presence of a many small storm drains or a few large ones. The key factor to consider is whether the wetland is located in a landscape position supported wetland before development and whether the wetland is still connected to its natural water source (e.g., modified ponds on a floodplain that are still connected to alluvial aquifers, natural stream channels that now receive substantial irrigation return flows).	**C**
Water sources are primarily from anthropogenic sources (e.g., urban runoff, direct irrigation, pumped water, artificially impounded water, or another artificial hydrology). Indications of substantial artificial hydrology include developed or irrigated agricultural land that comprises > 60% of the immediate drainage basin of the AA, or the presence of major drainage point source discharges that obviously control the hydrology of the AA. The key factor to consider is whether the wetland is located in a landscape position that likely never supported a wetland prior to human development. The reason the wetland exists is because of direct irrigation, irrigation seepage, irrigation return flows, urban storm water runoff, or direct pumping.	**C-**
Natural sources have been **eliminated** based on the following indicators: impoundment of all wet season inflows, diversions of all dry-season inflows, predominance of xeric vegetation, etc. The wetland is in steady decline and may not be a wetland in the near future.	**D**

4b. HYDROPERIOD	
Select the statement below that best describes the **hydroperiod** within the AA (extent and duration of inundation and/or saturation). Search the AA and 500 m envelope for hydrologic stressors (see list below). Use best professional judgment to determine the overall condition of the hydroperiod. For some wetlands, this may mean that water is being channelized or diverted away from the wetland. For others, water may be concentrated or increased.	
Hydroperiod is characterized by natural patterns of filling or inundation and drying or drawdowns. There are no major hydrologic stressors that impact the natural hydroperiod.	**A**
Hydroperiod filling or inundation patterns deviate slightly from natural conditions due to presence of stressors such as: small ditches or diversions; berms or roads at/near grade; minor pugging by livestock; or minor flow additions. Outlets may be slightly constricted. Playas are not significantly impacted pitted or dissected. *If wetland is artificially controlled,* the management regime closely mimics a natural analogue (it is very unusual for a purely artificial wetland to be rated in this category).	**B**
Hydroperiod filling or inundation and drying patterns deviate moderately from natural conditions due to presence of stressors such as: ditches or diversions 1–3 ft. deep; two lane roads; culverts adequate for base stream flow but not flood flow; moderate pugging by livestock that could channelize or divert water; shallow pits within playas; or moderate flow additions. Outlets may be moderately constricted, but flow is still possible. *If wetland is artificially controlled,* the management regime approaches a natural analogue. Site may be passively managed, meaning that the hydroperiod is still connected to and influenced by natural high flows timed with seasonal water levels.	**C**
Hydroperiod filling or inundation and drawdown of the AA deviate substantially from natural conditions from high intensity alterations such as: a 4-lane highway; large dikes impounding water; diversions > 3ft. deep that withdraw a significant portion of flow, deep pits in playas; large amounts of fill; significant artificial groundwater pumping; or heavy flow additions. Outlets may be significantly constricted, blocking most flow. *If wetland is artificially controlled,* the site is actively managed and not connected to any natural season fluctuations, but the hydroperiod supports natural functioning of the wetland.	**C-**
Hydroperiod is dramatically different from natural. Upstream diversions severely stress the wetland. Riverine wetlands may run dry during critical times. *If wetland is artificially controlled,* hydroperiod does not mimic natural seasonality. Site is actively managed for filling or drawing down without regard for natural wetland functioning.	**D**
Water source and Hydroperiod comments:	

4c. HYDROLOGIC CONNECTIVITY

Select the statement below that best describes the **hydrologic connectivity**.

Rising water has unrestricted access to adjacent areas without levees or other obstructions to the lateral movement of flood waters. Channel, if present, is not entrenched and is still connected to the floodplain (see entrenchment ratio in optional riverine metrics).	**A**
Unnatural features such as levees or road grades limit the amount of adjacent transition zone or the lateral movement of floodwaters, relative to what is expected for the setting, but limitations exist for <50% of the AA boundary. Restrictions may be intermittent along the margins of the AA, or they may occur only along one bank or shore. Channel, if present, is somewhat entrenched. If playa, surrounding vegetation does not interrupt surface flow.	**B**
The amount of adjacent transition zone or the lateral movement of flood waters to and from the AA is limited, relative to what is expected for the setting, by unnatural features for 50–90% of the boundary of the AA. Features may include levees or road grades. Flood flows may exceed the obstructions, but drainage out of the AA is probably obstructed. Channel, if present, may be moderately entrenched and disconnected from the floodplain except in large floods. If playa, surrounding vegetation may interrupt surface flow.	**C**
The amount of adjacent transition zone or the lateral movement of flood waters is limited, relative to what is expected for the setting, by unnatural features for >90% of the boundary of the AA. Channel, if present, is severely entrenched and entirely disconnected from the floodplain. If playa, surrounding vegetation may dramatically restrict surface flow.	**D**

Hydrologic connectivity comments:

HYDROLOGY STRESSORS WITHIN A 500 M ENVELOPE AND BEYOND

Using the table below, mark the presence of each **hydrology stressor within at least the 500 m envelope of the AA, if not beyond**. Mark whether the stressor is present upstream/slope or downstream/slope of the AA. If known alteration occurs further upstream than 500 m, please explain in comments below.

Hydrology stressor categories	*Within AA*	*Upstream / Upslope*	*Downstream / Downslope*
Dam / reservoir			
Impoundment / stock pond			
Spring box diverting water from wetland			
Extensive groundwater wells in the surrounding area			
Pumps, diversions, ditches that move water *out of* the wetland			
Pumps, diversions, ditches that move water *into* the wetland			
Berms, dikes, levees that hold water in the wetland			
Deeply dug pits for holding water			
Weir or drop structure that impounds water and controls energy of flow			
Observed or potential agricultural runoff			
Observed or potential urban runoff			
Flow obstructions into or out of wetland (roads without culverts)			
Dredged inlet or outlet channel			
Engineered inlet or outlet channel (e.g., riprap)			
Other:			
Other:			

Hydrology stressor comments:

4. PHYSIOCHEMICAL METRICS – Circle the applicable letter.

3a. WATER QUALITY - SURFACE WATER TURBIDITY / POLLUTANTS	
Select the statement that best describes the **turbidity or evidence or pollutants** in surface water within the AA.	
No open water in AA	**NA**
No visual evidence of degraded water quality. No visual evidence of turbidity or other pollutants.	**A**
Some negative water quality indicators are present, but limited to small and localized areas within the wetland. Water is slightly cloudy, but there is no obvious source of sedimentation or other pollutants.	**B**
Water is cloudy or has unnatural oil sheen, but the bottom is still visible. Sources of water quality degradation are apparent (identify in comments below). *Note: If the sheen breaks apart when you run your finger through it, it is a natural bacterial process and not water pollution.*	**C**
Water is milky and/or muddy or has unnatural oil sheen. The bottom is difficult to see. There are obvious sources of water quality degradation (identify in comments below). *Note: If the sheen breaks apart when you run your finger through it, it is a natural bacterial process and not water pollution.*	**D**
Surface water turbidity / pollutants comments and photo #'s:	
Turbidity may be natural depending on recent weather patterns and flow timing (i.e., higher flows are often more turbid). Natural turbidity is generally in the A to B range; the C to D range is for unusual amounts of turbidity or other pollutants in the water. Make sure to include good notes if turbidity appears natural.	

3b. WATER QUALITY - ALGAL GROWTH	
Select the statement that best describes **algal growth** within surface water in the AA.	
No open water in AA or evidence of open water.	**NA**
Water is clear with minimal algal growth.	**A**
Algal growth is limited to small and localized areas of the wetland. Water may have a greenish tint or cloudiness.	**B**
Algal growth occurs in moderate to large patches throughout the AA. Water may have a moderate greenish tint or sheen. Sources of water quality degradation are apparent (identify in comments below).	**C**
Algal mats are extensive, blocking light to the bottom. Water may have a strong greenish tint and the bottom is difficult to see. There are obvious sources of water quality degradation (identify in comments below).	**D**
Algal growth comments and photo #'s:	
Algal growth may be natural and not necessarily indicative of poor water quality. Natural algal growth is generally in the A to B range; the C to D range is for unusual amounts of algal growth in the water. Make sure to include good notes if algal growth appears natural.	

3c. SUBSTRATE / SOIL DISTURBANCE

Select the statement below that best describes disturbance to the substrate or soil within the AA. For playas, the most significant substrate disturbance is sedimentation or unnaturally filling, which prevents the system's ability to pond after heavy rains. For other wetland types, disturbances may lead to bare or exposed soil and may increase ponding or channelization where it is not normally. For any wetland type, consider the disturbance relative to what is expected for the system.

No soil disturbance within AA. Little bare soil OR bare soil areas are limited to naturally caused disturbances such as flood deposition or game trails OR soil is naturally bare (e.g., playas). No pugging, soil compaction, or sedimentation.	
Minimal soil disturbance within AA. Some amount of bare soil, pugging, compaction, or sedimentation present due to human causes, but the extent and impact are minimal. The depth of disturbance is limited to only a few inches and does not show evidence of altering hydrology. Any disturbance is likely to recover within a few years after the disturbance is removed.	
Moderate soil disturbance within AA. Bare soil areas due to human causes are common and will be slow to recover. There may be pugging due to livestock resulting in several inches of soil disturbance. ORVs or other machinery may have left some shallow ruts. Sedimentation may be filling the wetland. Damage is obvious, but not excessive. The site could recover to potential with the removal of degrading human influences and moderate recovery times.	
Substantial soil disturbance within AA. Bare soil areas substantially degrade the site and have led to altered hydrology or other long-lasting impacts. Deep ruts from ORVs or machinery may be present, or livestock pugging and/or trails are widespread. Sedimentation may have severely impacted the hydrology. The site will not recover without active restoration and/or long recovery times.	

Substrate / soil comments and photo #'s:

PHYSIOCHEMICAL STRESSORS WITHIN THE AA

Using the table below, estimate the independent scope of each physiochemical stressor within the AA. Independent scopes can overlap (e.g., soil compaction can occur with trash or refuse). ***Scope rating: 1 = 1–10%, 2 = >10–25%, 3 = >25–50%, 4 = >50–75%, 5 = >75%.***

Physiochemical stressor categories	*Scope*
Erosion	
Sedimentation	
Current plowing or disking	
Historic plowing or disking (evident by abrupt A horizon boundary at plow depth)	
Substrate removal (excavation)	
Filling or dumping of sediment	
Trash or refuse dumping	
Compaction and soil disturbance by livestock or native ungulates	
Compaction and soil disturbance by human use (trails, ORV use, camping)	
Mining activities, current or historic	
Obvious point source of water pollutants (discharge from waste water plants, factories)	
Agricultural runoff (drain tiles, excess irrigation)	
Direct application of agricultural chemicals	
Discharge or runoff from feedlots	
Obvious excess salinity (dead or stressed plants, salt encrustations)	
Other:	
Other:	

Physiochemical stressor comments:

5. SIZE METRICS – Circle the applicable letter.

5a. RELATIVE SIZE		
Estimate the potential size of the Ecological System containing the assessment area and compare this to the actual size. Wetland and riparian areas can be lost due to human disturbance such as roads, impoundments, development, ditching, draining, mining, flooding for reservoirs, etc. Estimate using best available information (maps, air photography, etc.).	Wetland/riparian area ≈ onsite abiotic potential; <5% of wetland has been reduced.	**A**
	Wetland/riparian area < abiotic potential; 5–25% of wetland has been reduced.	**B**
	Wetland/riparian area < abiotic potential; 25–50% of wetland has been reduced.	**C**
	Wetland/riparian area < abiotic potential; >50% of wetland has been reduced.	**D**
Relative size comments:		

5b. ABSOLUTE SIZE
Absolute size of the wetland will be determined in GIS. To aid data interpretation, please describe any **significant boundaries** to the targeted **Ecological System** that are not evident from aerial photography, such as break in hydrologic flow, change in soil type, or land use changes since aerial photography was flown.

6. OPTIONAL RIVERINE HYDROLOGY METRICS (use when channel is within ~50 m)

6a. RIVERINE CHANNEL AND BANK STABILITY

Select the statement below that best describes **channel and bank stability** within or near the AA. To determine, visually survey the AA for field indicators of channel equilibrium, aggradation or degradation listed in the table below. Check “Y” for all that apply and “N” for those not observed. Use best professional judgment to determine the overall channel and bank stability.

Condition	Y	N	*Field Indicators*
Indicators of Channel Equilibrium / Natural Dynamism	☐	☐	The channel (or multiple channels in braided systems) has a well-defined usual high water line or bankfull stage that is clearly indicated by an obvious floodplain, topographic bench that represents an abrupt change in the cross-sectional profile of the channel throughout *most* of the site.
	☐	☐	The usual high water line or bank full stage corresponds to the lower limit of riparian vascular vegetation.
	☐	☐	Leaf litter, thatch, wrack, and/or mosses exist in most pools.
	☐	☐	The channel contains embedded woody debris of the size and amount consistent with what is available in the riparian area.
	☐	☐	Active undercutting of banks or burial of riparian vegetation is limited to localized areas and not throughout site.
	☐	☐	There is little evidence of recent deposition of *cobble* or *very coarse gravel* on the floodplain, although recent sandy deposits may be evident.
	☐	☐	There are no densely vegetated mid-channel bars and/or point bars, indicating flooding at regular intervals.
	☐	☐	The spacing between pools in the channel tends to be 5-7 channel widths, if appropriate.
	☐	☐	The larger bed material supports abundant periphyton.
Indicators of Active Aggradation / Excessive Sediment	☐	☐	The channel through the site lacks a well-defined usual high water line.
	☐	☐	There is an active floodplain with fresh splays of sediment covering older soils or recent vegetation.
	☐	☐	There are partially buried tree trunks or shrubs.
	☐	☐	Cobbles and/or coarse gravels have recently been deposited on the floodplain.
	☐	☐	There is a lack of in-channel pools, their spacing is greater than 5-7 channel widths, or many pools seem to be filling with sediment.
	☐	☐	There are partially buried, or sediment-choked, culverts.
	☐	☐	Transitional or upland vegetation is encroaching into the channel throughout most of the site.
	☐	☐	The bed material is loose and mostly devoid of periphyton.
Indicators of Active Degradation / Excessive Erosion	☐	☐	The channel through the site is characterized by deeply undercut banks with exposed living roots of trees or shrubs.
	☐	☐	There are abundant bank slides or slumps, or the banks are uniformly scoured and unvegetated.
	☐	☐	Riparian vegetation declining in stature or vigor, and/or riparian trees and shrubs may be falling into channel.
	☐	☐	Abundant organic debris has accumulated on what seems to be the historical floodplain, indicating that flows no longer reach the floodplain.
	☐	☐	The channel bed appears scoured to bedrock or dense clay.
	☐	☐	The channel bed lacks fine-grained sediment.
	☐	☐	Recently active flow pathways appear to have coalesced into one channel (i.e. a previously braided system is no longer braided).
	☐	☐	There are one or more nick points along the channel, indicating headward erosion of the channel bed.

RATING CRITERIA FOR ALL RIVERINE WETLANDS	
Most of the channel within or near the AA is characterized by naturally dynamic equilibrium conditions, with little evidence of excessive aggradation or degradation.	
Most of the channel within or near the AA is characterized by some aggradation or degradation, none of which is severe, and the channel seems to be approaching an equilibrium form.	
There is evidence of severe aggradation or degradation of most of the channel within or near the AA or the channel is artificially hardened through less than half of the AA.	
The channel is concrete or otherwise artificially hardened through most of the AA.	

Channel stability comments (note if channel is unstable due to beaver or recent natural disturbances):

6b. RIVERINE ENTRENCHMENT RATIO (optional guide for if stream may be entrenched)

Using the following worksheet, calculate the average **entrenchment ratio** for the channel. The steps should be conducted for each of three cross sections located in or adjacent to the AA at the approximate mid-points along straight riffles or glides, away from deep pools or meander bends. *Do not attempt to measure this for non-wadeable streams!*

Steps	*Replicate cross-sections* →	*1*	*2*	*3*
1. Estimate bankfull width.	If the stream is entrenched, the height of bankfull flow is identified as a scour line, narrow bench, or the top of active point bars well below the top of apparent channel banks. If the stream is not entrenched, bankfull stage can correspond to the elevation of a broader floodplain with indicative riparian vegetation. Estimate or measure the distance between the right and left bankfull contours.			
2. Estimate max bankfull depth.	Imagine a line between right and left bankfull contours. Estimate or measure the height of the line above the thalweg (the deepest part of the channel).			
3. Estimate flood prone height.	Double the estimate of maximum bankfull depth from Step 2.			
4. Estimate flood prone width.	Imagine a level line having a height equal to the flood prone depth from Step 3. Note the location of the new height on the channel bank. Estimate the width of the channel at the flood prone height.			
5. Calculate entrenchment.	Divide the flood prone width (Step 4) by the max bankfull width (Step 1).			
6. Calculate average entrenchment	Average the results of Step 5 for all three cross-sections and enter it here.			

RATING CRITERIA FOR CONFINED RIVERINE WETLANDS		**RATING CRITERIA FOR UNCONFINED RIVERINE WETLANDS**	
Entrenchment ratio >1.8.		Entrenchment ratio >2.2.	
Entrenchment ratio 1.6–1.8.		Entrenchment ratio 1.9–2.2.	
Entrenchment ratio 1.2–1.5.		Entrenchment ratio 1.5–1.8.	
Entrenchment ratio <1.2.		Entrenchment ratio <1.5.	

Entrenchment ratio comments:

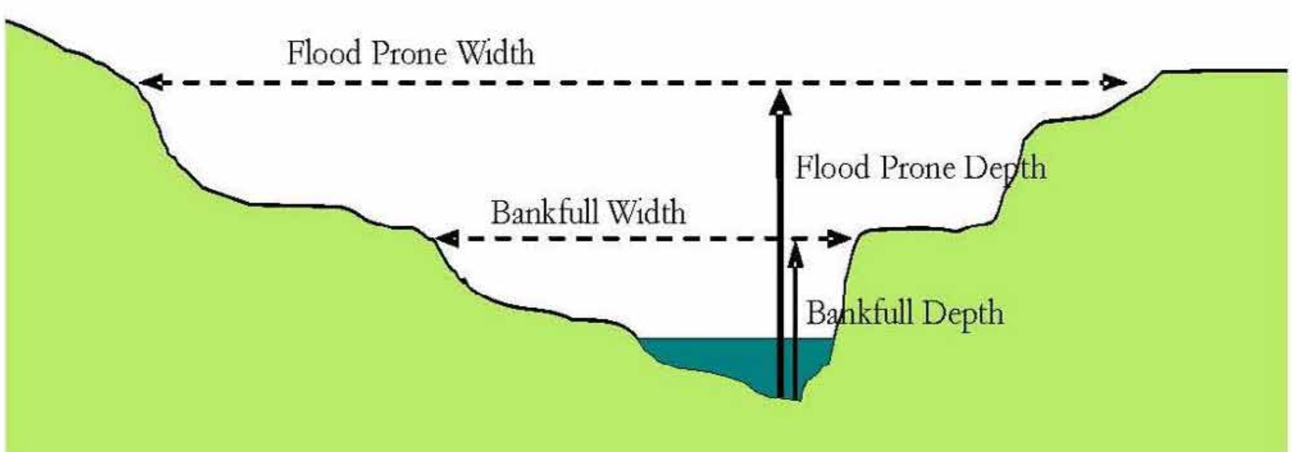


Illustration from Collins *et al.* 2008. California Rapid Assessment Method for Wetlands v 5.0.2

Point Code__________________ QC_________

2013 WETLAND CONDITION ASSESSMENT FIELD FORM – HABITAT METRICS

HABITAT TYPES WITHIN THE ASSESSMENT AREA (See manual for rules and definitions. Mark features on the site sketch.)					
Habitat type	*% AA*	*Photos*	*Additional riparian structural patches*	*% AA*	*Photos*
1.			Bank slumps or undercut banks		
2.			Active beaver dam		
3.			Beaver canal		
4.			Debris jams / woody debris in channel		
5.			Pools in stream		

DOMINANT VEGETATION BY HABITAT TYPE					
Check one box per by habitat type **Habitat Type →**	**1**	**2**	**3**	**4**	**5**
1. Robust wetland herbs (cattail, bulrush, reedgrass, etc.)					
2. Tall sedges, rushes (>50 cm)					
3. Low sedges, rushes (<50 cm)					
4. Tall grasses (>50 cm)					
5. Low grasses (<50 cm)					
6. Annual forbs					
7. Aquatic vegetation (submergent, floating leaves, algae)					
8. Open willows / shrubs					
9. Dense willows / shrubs					
10. Open canopy trees					
11. Closed canopy trees					
12. Other:					

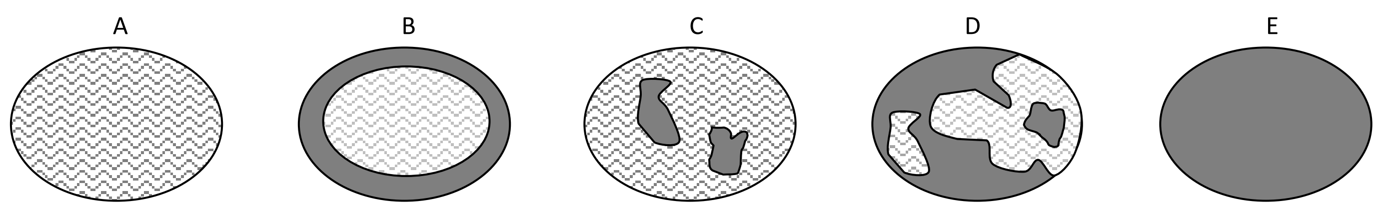
DOMINANT SPECIES BY HABITAT TYPE										
List top four dominant species by habitat type **Dominant / Cover →**	**D**	**C**	**D**	**C**	**D**	**C**	**D**	**C**	**D**	**C**
Scientific Name or Pseudonym										

Point Code__________________ QC_________

DUCK FOOD BY HABITAT TYPE					
Estimate cover class of all high or med value duck foods **Habitat Type →**	**1**	**2**	**3**	**4**	**5**
High quality duck foods					
Medium quality duck foods					

VERTICAL STRATA BY HABITAT TYPE										
Estimate cover of each stratum **Cover / Height →**	**C**	**H**	**C**	**H**	**C**	**H**	**C**	**H**	**C**	**H**
Height Classes 1: <0.5 m 2: 0.5–1m 3: 1–2 m 4: 2–5 m 5: 5–10 m 6: 10–15 m 7: 15–20 m 8: 20–35 m 9: 35–50 m 10: >50 m										
Canopy cover > 2m **(all woody vegetation > 2m)**										
Shrub and sub-canopy cover **(all woody vegetation < 2m)**										
Total herbaceous cover **(all herbaceous vegetation)**										
% of herbaceous vegetation that is too coarse/dense for animal movement										

GROUND COVER BY HABITAT TYPE					
Actual cover of water (any depth, vegetated or not, standing or flowing)					
Actual cover of water with emergent vegetation					
Actual cover of water with submergent / floating vegetation					
Actual predominant depth of water					
Actual min depth of water					
Actual max depth of water					
Potential cover of water at ordinary high water					
Potential predominant depth at ordinary high water					
Cover of litter (all cover, including under water or vegetation)					
Cover of exposed bare ground – soil / sand / sediment / gravel (can have algae cover)					
Cover of downed coarse woody debris (fallen trees, rotting logs, >5 cm diameter)					
SHALLOW WATER WITH SUNLIGHT BY HABITAT TYPE					
Percent of shallow water (up to 1 m) with the potential for open sunlight					
INTERSPERSION BY HABITAT TYPE					
Interspersion of vegetation and water at time of sampling *(if applicable)**					
Interspersion of vegetation and water at ordinary high water					



A: Open Water	Habitat is essentially not vegetated and covered exclusively by open water
B: Fringe	Habitat has vegetation around the perimeter of the wetland with central open water
C: Partially interspersed	Habitat contains a few vegetation patches in the central portion
D: Complex	Habitat contains vegetation interspersed in many patches
E: Closed	Habitat has few or no areas of open water

**Note: If site is dry, put NA for interspersion.*

COMMENTS BY HABITAT TYPE

Habitat 1

Does the feature extend beyond the AA? ____Yes ____No

Is the portion of the habitat feature within the AA representative of the larger feature? ____Yes ____No

Is the overall size of the feature evident form aerial images? ____Yes ____No

Comments:

Habitat 2

Does the feature extend beyond the AA? ____Yes ____No

Is the portion of the habitat feature within the AA representative of the larger feature? ____Yes ____No

Is the overall size of the feature evident form aerial images? ____Yes ____No

Comments:

Habitat 3

Does the feature extend beyond the AA? ____Yes ____No

Is the portion of the habitat feature within the AA representative of the larger feature? ____Yes ____No

Is the overall size of the feature evident form aerial images? ____Yes ____No

Comments:

Habitat 4

Does the feature extend beyond the AA? ____Yes ____No

Is the portion of the habitat feature within the AA representative of the larger feature? ____Yes ____No

Is the overall size of the feature evident form aerial images? ____Yes ____No

Comments:

Habitat 5

Does the feature extend beyond the AA? ____Yes ____No

Is the portion of the habitat feature within the AA representative of the larger feature? ____Yes ____No

Is the overall size of the feature evident form aerial images? ____Yes ____No

Comments:

APPENDIX E: FIELD KEY TO WETLAND AND RIPARIAN ECOLOGICAL SYSTEMS OF THE LOWER SOUTH PLATTE RIVER BASIN, COLORADO

Last Updated May 24, 2013

How to Use This Key:

Ecological systems are dynamic assemblages or complexes of plant communities that 1) occur together on the landscape; 2) are tied together by similar ecological processes, underlying abiotic environmental factors or gradients; and 3) form a readily identifiable unit on the ground. These systems provide a coarser level unit than plant associations and alliances as defined under the International Vegetation Classification standard, and are more easily identified on the ground and through vegetation mapping. Ecological systems include both native, natural vegetation and non-native, human influenced vegetation. All wetland and riparian areas encountered in the Lower South Platte should fit within the key. If a wetland or riparian area is clearly manipulated, created, or otherwise does not fit a description, attempt to fit it in one of the ecological systems and take note of how and why it differs from the description given. Within this version of the key, comments specific to the Lower South Platte River Basin are noted *[in brackets and italics].*

The scale at which ecological systems are delineated is important. Within the context of CNHP's wetland condition assessment projects, an assessment area (AA) could represent the entire extent of an ecological system or just part of one. If the occurrence of an ecological system is larger than the AA, all aspects of the system should be considered in the key, not just those within the AA. Make sure to look at the larger landscape when using this key. A mosaic of herbaceous and shrubby vegetation patches does not necessarily mean multiple ecological systems. Changes in dominant soil type, however, can mean multiple ecological systems. Pay close attention to the size thresholds in the key when determining the ecological system or systems present. Percent cover thresholds are guidelines for the *footprint of an entire stratum*, not the percent cover of individual species, and are determined for the overall ecological system rather than the confines of the specific AA.

1a. Wetland water source is dominated by *natural* groundwater, hydrology is fairly stable, and the wetland is generally *not* located within the active floodplain of a river system. These wetlands generally occur on the landscape where there is a break in slope, seeps or springs, and/or near stream headwaters. The water table is generally at or near the surface and they typically lack prolonged standing water. Most wetlands within this couplet are predominantly natural in origin. *[In the Lower South Platte Basin, these wetlands will most likely occur along the western and southern edge of study area, where there is more pronounced topography and the potential for groundwater discharge from slopes.]*..**2**

1b. Wetland water source is not dominated by natural groundwater and does not have stable hydrology. *If wetland receives significant groundwater input,* it is located in a floodplain and standing water is typically deep (i.e., warm water sloughs) *or* groundwater inputs are associated with irrigation runoff, return flows, or seepage from irrigation ditches. Be sure to look at the larger landscape context. **3**

2a. Wetland defined by groundwater inflows and organic (peat) soil accumulation of at least 40 cm within the upper 80 cm. Vegetation can be woody or herbaceous. If the wetland occurs within a mosaic of non-peat forming wetlands, then the patch must be at least **0.1 hectares (0.25 acres)** to be classified as this system. If the wetland occurs as an isolated patch surrounded by upland, then there is no minimum size criteria. *[Fens are uncommon in the Lower South Platte Basin, but if peat soil is encountered, consider the criteria here.]*..
.... **Rocky Mountain Subalpine-Montane Fen**

2b. Wetland does not have at least 40 cm of organic (peat) soil accumulation within the upper 80- cm or occupies an area less than 0.1 hectares (0.25 acres) within a mosaic of other non-peat forming wetlands. *[Natural wet meadows will generally be* *restricted to the western edge of the Lower South Platte study area. If a wet meadow is encountered within the South Platte floodplain, look for signs of irrigation influence, as mentioned in #1b of this key.]* **Rocky Mountain Alpine-Montane Wet Meadow**

3a. Low stature shrublands dominated by species such as *Sarcobatus vermiculatus, Atriplex* spp., *Ericameria nauseosa*, *Artemisia cana*, and *Artemisia tridentata.* Vegetation may be sparse and soils may be saline. Sites may be located on flats or in washes, but typically not associated with river and stream floodplains. *[It is not clear how common either of these ecological systems will be in the Lower South Platte River Basin, but they are included in case they are encountered. If they are encountered, they may not be considered true wetlands]*............**4**

3b. Wetland is not a low stature shrubland in saline wash or flat. **5**

4a. Shrublands with >10% total vegetation cover, located on flats or in temporarily or intermittently flooded drainages, and dominated by *Sarcobatus vermiculatus* and *Atriplex* spp. with inclusions of *Sporobolus airoides, Pascopyrum smithii, Distichlis spicata, Puccinellia nuttalliana,* and *Eleocharis palustris* herbaceous vegetation. ....**Inter-Mountain Basins Greasewood Flat**

4b. Sites with < 10% total vegetation cover and restricted to temporarily or intermittently flooded drainages with a variety of sparse or patchy vegetation including *Sarcobatus vermiculatus*, *Ericameria nauseosa*, *Artemisia cana*, *Artemisia tridentata*, *Grayia spinosa*, *Distichlis spicata*, and *Sporobolus airoides.* .... **Inter-Mountain Basins Wash**

5a. Sites located within the floodplain or immediate riparian zone of a river or stream. Vegetation may be entirely herbaceous or may contain tall stature woody species, such as *Populus* spp. or *Salix* spp. Water levels variable. Woody vegetation that occurs along reservoir edges can also be included here. **6**

5b. Herbaceous wetlands of the Western Great Plains that are isolated or partially isolated from floodplains and riparian zones, often depressional with or without an outlet. **11**

6a. Herbaceous wetlands within the floodplain with standing water at or above the surface throughout the growing season, except in drought years. Water levels are often high at some point during the growing season, but managed systems may be drawn down at any point depending on water management regimes. Vegetation typically dominated by species of *Typha, Scirpus, Schoenoplectus*, *Carex*, *Eleocharis*, *Juncus*, and floating genera such as *Potamogeton*, *Sagittaria*, and *Ceratophyllum*. If located within a matrix of vegetation communities, the portion of the wetland meeting these characteristics must be at least **0.1 hectares (0.25 acres)** to be classified here (i.e., a small puddle with a few cattails does not count). The floodplain expression of this system is located on the floodplain, but may be disconnected from flooding regimes. The hydrology may be entirely managed. Water may be brackish or not. Soils are highly variable. This system includes natural warm water sloughs and other natural floodplain marshes as well as a variety of managed wetlands on the floodplain (e.g., recharge ponds, moist soil units, shallow gravel pits, etc.) ....**Western North American Emergent Marsh**

6b. Not as above. Wetland and riparian vegetation that typically lacks extensive standing water. Vegetation may be herbaceous or woody. Management regimes variable **7**

7a. Large herbaceous wetlands (generally > 0.5 ha) within the floodplain that receive surface or subsurface irrigation waters. Sites typically lack prolonged standing water. Vegetation is dominated by native or non-native herbaceous species; graminoids have the highest canopy cover. May be intentionally managed for hay production or may be the result of unintentional return flows, runoff or seepage. Patches of emergent marsh vegetation and standing water are less than 0.1 ha in size and not the predominant vegetation. ....**Irrigation-Influenced Wet Meadow (not an official Ecological System)**

7b. Predominantly natural vegetation (though may be weedy and altered) within the floodplain or immediate riparian zone of a river or stream, dominated by either woody or herbaceous species. Not obviously controlled by irrigation, though may receive some irrigation runoff or seepage...**8**

8a. Riparian woodlands and shrublands of the Rocky Mountain foothills. Woodlands are dominated by *Populus* spp. (*Populus angustifolia*, *P. deltoides,* or the hybrid *P. acuminata*). Common native shrub species include *Salix* spp., *Alnus incana*, *Betula occidentalis, Cornus sericea*, and *Crataegus* spp. Exotic shrub species include *Tamarix spp.* and *Elaeagnus angustifolia.* Sites are most often associated with a stream channel, including ephemeral, intermittent, or perennial streams (Riverine HGM Class). This system can also occur on slopes, lakeshores, or around ponds where the vegetation is associated with groundwater discharge or a subsurface connection to lake or pond water, and may experience overland flow but no channel formation (Slope, Lacustrine, or Depressional HGM Classes). It is also typically found in backwater channels and other perennially wet but less scoured sites, such as floodplain swales and irrigation ditches. *[For the Lower South Platte Basin, this type is confined to the foothills on the edge of the Front Range Fans Level 4 Ecoregion.]*..
....**Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland**

8b. Riparian woodlands, shrublands and meadows of Colorado's Western Great Plains. Dominant native species include *Populus deltoides*, *Salix fragilis, Salix amygdaloides, Salix exigua, Acer negundo, Fraxinus* spp., and *Ulmus* spp. Dominant non-native species include *Tamarix* spp., *Elaeagnus angustifolia,* and other introduced woody species Site may lack woody vegetation and be entirely herbaceous. **9**

9a. Woodlands, shrublands, and meadows of draws and ravines associated with steep north-facing slopes or canyon bottoms that do not experience prolonged flooding. Common tree species include *Acer negundo, Populus tremuloides*, *Fraxinus* spp., and *Ulmus* spp. Important shrub species include *Crataegus* spp., *Prunus virginiana*, *Rhus* spp., *Rosa woodsii*, *Symphoricarpos occidentalis*, and *Shepherdia argentea. [It is uncertain how common this type will be in the Lower South Platte River Basin. This type is more common on the plains to the north and east of Colorado (Wyoming, Nebraska, and South Dakota), where there is more relief to the landscape. If found, this type may be too narrow to fit the target assessment area width and will be primarily non-wetland riparian vegetation.]*....**Western Great Plains Wooded Draw and Ravine**

9b. Woodlands, shrublands, and meadows of small to large streams and rivers of the Western Great Plains. Overall vegetation is lusher than above and includes more wetland indicator species...**10**

10a. Riparian woodlands, shrublands, and meadows along medium and small rivers and streams. Sites have less floodplain development and flashier hydrology than the next, and all streamflow may drawdown completely for some portion of the year. Water sources include snowmelt runoff (streams closer to the Rocky Mountain front), groundwater (prairie streams), and summer rainfall. Dominant species include *Populus deltoides, Salix* spp., *Fraxinus pennsylvanica, Artemisia cana* ssp. *cana, Carex* spp., *Pascopyrum smithii, Panicum virgatum, Panicum obtusum, Sporobolus cryptandrus,* and *Schizachyrium scoparium. Tamarix* spp., *Elaeagnus angustifolia,* and less desirable grasses and forbs can invade degraded examples. Groundwater depletion, lack of fire, heavy grazing, and/or agriculture have resulted in species and hydroperiod changes. *[For the Lower South Platte Basin, this system applies to all streams and rivers outside the South Platte floodplain from Greeley west. Irrigation ditches lined with woody vegetation will fall into this system.]* ....**Western Great Plains Riparian**

10b. Woodlands, shrublands, and meadows along large rivers with extensive floodplain development and periodic flooding that is more associated with snowmelt and seasonal dynamics in the mountains than with local precipitation events. Dominant communities within this system range from floodplain forests to wet meadow patches, to gravel/sand flats dominated by early successional herbs and annuals; however, they are <u>linked by underlying soils and the flooding regime</u>. Dominant species include *Populus deltoides* and *Salix* spp., *Carex* spp., *Panicum virgatum*, and *Andropogon gerardii. Tamarix* spp., *Elaeagnus angustifolia,* and non-native grasses have invaded degraded areas within the floodplains, which are subjected to heavy grazing and/or agriculture. Groundwater depletion and lack of fire have created additional alterations in species composition and hydroperiod. In most cases, the majority of the native wet meadow and prairie communities may be extremely degraded or extirpated from examples of this system. Large (> 0.5 ha), irrigation-influenced wet meadows within the floodplain are keyed out separately (see #7 above). *[For the Lower South Platte project, this system applies to the South Platte floodplain from Greeley east.]*. **Western Great Plains Floodplain**

11a. Natural shallow depressional wetlands in the Western Great Plains with an impermeable soil layer, such as dense hardpan clay, that causes periodic ponding after heavy rains. Sites generally have closed contour topography and are surrounded by upland vegetation. Hydrology is typically tied to precipitation and runoff and lacks a groundwater connection. Ponding is often ephemeral and sites may be dry throughout the entire growing season during dry years. Species composition depends on soil salinity, may fluctuate depending on seasonal moisture availability, and many persistent species may be upland species. *[Within the Lower South Platte basin, wetlands within this group are collectively referred to* ***playas or playa lakes****. Ecological systems listed below separate playas based on the level of salinity and total cover of vegetation.]* **12**

11b. Herbaceous wetlands in the Western Great Plains not associated with hardpan clay soils. Sites may or may not be depressional and may or may not be natural..**13**

12a. Shallow depressional wetlands with less saline soils than the next. Dominant species are typically not salt-tolerant. Sites may have obvious vegetation zonation of tied to water levels, with the most hydrophytic species occurring in the wetland center where ponding lasts the longest. Common native species include *Pascopyrum smithii, Buchloe dactyloides, Eleocharis* spp., *Oenothera canescens, Ratibida tagetes, Plantago* spp., *Polygonum* spp., and *Phyla cuneifolia.* Non-native species are very common in these sites, including *Salsola australis, Bassia sieversiana, Verbena bracteata,* and *Conyza canadensis.* Sites have often been disturbed by agriculture and heavy grazing. Many have been dug out or "pitted" to increase water retention and to tap shallow groundwater. *[Most of the playas within the Lower South Platte River will likely fit within this ecological system.]* ....**Western Great Plains Closed Depression Wetland**

12b. Shallow depressional herbaceous wetlands with saline soils. Salt encrustations can occur on the surface. Species are typically salt-tolerant, including *Distichlis spicata*, *Puccinellia* spp., *Salicornia* spp., *Schoenoplectus maritimus. Sporobolus airoides,* and *Hordeum jubatum.* Other commonly occurring taxa include *Puccinellia nuttalliana, Salicornia rubra, Schoenoplectus maritimus, Schoenoplectus americanus, Suaeda calceoliformis, Spartina* spp., *Triglochin maritima,* and occasional shrubs such as *Sarcobatus vermiculatus* and *Krascheninnikovia lanata.* (Note: Low stature shrub-dominant wetlands key in the flats and wash systems in #4 above.)...............**Western Great Plains Saline Depression Wetland**

13a. Herbaceous wetlands with standing water at or above the surface throughout the growing season, except in drought years. Water levels are often high at some point during the growing season, but managed systems may be drawn down at any point depending on water management regimes. Vegetation typically dominated by species of *Typha, Scirpus, Schoenoplectus*, *Carex*, *Eleocharis*, *Juncus*, and floating genera such as *Potamogeton*, *Sagittaria*, and *Ceratophyllum*. The isolated expression of this system can occur around ponds, as fringes around lakes, and at any impoundment of water, including irrigation run-off. The hydrology may be entirely managed or artificial. Water may be brackish or not. Soils are highly variable. ... .**Western North American Emergent Marsh**

13b. Herbaceous wetlands associated with a high water table that is controlled by artificial overland flow (irrigation runoff or return flow) or artificial groundwater seepage (including from leaky irrigation ditches). Sites typically lack prolonged standing water. Vegetation is dominated by native or non-native herbaceous species; graminoids have the highest canopy cover. Species composition may be dominated by non-native hay grasses. Patches of emergent marsh vegetation and standing water are less than 0.1 ha in size and not the predominant vegetation....................................**Irrigation-Influenced Wet Meadow (not an official Ecological System)**

APPENDIX F: FIELD KEY TO THE HYDROGEOMORPHIC (HGM) CLASSES OF WETLANDS IN COLORADO'S ROCKY MOUNTAINS AND PLAINS

1a. Entire wetland unit is flat and precipitation is the primary source (>90%) of water. Groundwater and surface water runoff are not significant sources of water to the unit. **NOTE:** *Flat wetlands are very uncommon in Colorado.* .... **Flats HGM Class**

1b. Wetland does not meet the above criteria; primary water sources include groundwater and/or surface water **2**

2a. Entire wetland unit meets ***all*** of the following criteria: a) the vegetated portion of the wetland is on the shores of a permanent open water body at least 8 ha (20 acres) in size; b) at least 30% of the open water area is deeper than 2 m (6.6 ft); c) vegetation in the wetland experiences bidirectional flow as the result of vertical fluctuations of water levels due to rising and falling lake levels. .... **Lacustrine Fringe HGM Class**

2b. Wetland does not meet the above criteria; wetland is not found on the shore of a water body, water body is either smaller or shallower, OR vegetation is not effected by lake water levels **3**

3a. Entire wetland unit meets ***all*** of the following criteria: a) wetland unit is in a valley, floodplain, or along a stream channel where it is inundated by overbank flooding from that stream or river; b) overbank flooding occurs at least once every five years; and c) wetland does not receive significant inputs from groundwater. **NOTE:** *Riverine wetlands can contain depressions that are filled with water when the river is not flooding such as oxbows and beaver ponds. However, depressions on the floodplain that are not strongly influenced by flooding would be classified as true depressions. These include depressions disconnected due to modified hydrology and channel entrenchment, and impounded managed wetlands.* .... **Riverine HGM Class**

3b. Wetland does not meet the above criteria; if the wetland is located within a valley, floodplain, or along a stream channel, it is outside of the influence of overbank flooding or receives significant hydrologic inputs from groundwater or managed hydrology................ **4**

4a. Entire wetland unit is located in a topographic depression in which water ponds or is saturated to the surface at some time during the year. **NOTE:** *Any outlet, if present, is higher than the interior of the wetland.*.....**Depressional HGM Class**

4b. Wetland does not meet the above criteria. There is no significant ponding except at times of very high water......**5**

5a. Wetland unit meets the following criteria: a) wetland is on a slope (slope can be very gradual or nearly flat); b) *natural* groundwater is the primary hydrologic input; c) water, if present, flows through the wetland in one direction and usually comes from seeps or springs; and d) water leaves the wetland without being impounded. **NOTE:** *Small channels can form within slope wetlands, but are not subject to overbank flooding. Surface water does not pond in these types of wetlands, except occasionally in very small and shallow depressions or behind hummocks (depressions are usually < 3ft diameter and less than 1 foot deep)*..........**Slope HGM Class**

5b. Wetland water source, when surface water flow or subsurface groundwater expression, is largely connected to irrigation water, either through direct application or seepage from fields or ditches**Novel Irrigation-Fed HGM Class**

APPENDIX G: SCORING FORMULAS FOR ECOLOGICAL INTEGRITY ASSESSMENT (EIA) AND FLORISTIC QUALITY INDEX (FQI)

ECOLOGICAL INTEGRITY ASSESSMENT (EIA) METRIC RATING CRITERIA AND SCORING FORMULAS

	Key Ecological Attribute	Indicator / Metric	Metric Rating Criteria				
		Rank / Score	A / 5	B / 4	C / 3	D / 1 –OR– D / 2 and E / 1	
		Interpretation	**Reference (No or Minimal Human Impact)**	**Slight Deviation from Reference**	**Moderate Deviation from Reference**	**Significant Deviation from Reference**	
LANDSCAPE CONTEXT	**Landscape Connectivity**	*1a. Landscape Fragmentation within 500 m*	Embedded in >90% unfragmented, natural landscape.	Embedded in >60–90% unfragmented, natural landscape.	Embedded in >20–60% unfragmented, natural landscape.	Embedded in ≤20% unfragmented, natural landscape.	
		1b. Riparian Corridor Continuity within 500 m[1] *RIVERINE ONLY*	>90% natural habitat upstream and downstream	>60–90% natural habitat upstream and downstream	>20–60% natural habitat upstream and downstream	≤20 natural habitat upstream and down-stream	
	Buffer	*1c. Buffer Extent*	Buffer at least 5 m wide surrounds 100% of AA	Buffer at least 5 m wide surrounds >75–<100% of AA	Buffer at least 5 m wide surrounds >50–75% of AA	Buffer at least 5 m wide surrounds >25–50% of AA	Buffer at least 5 m wide surrounds ≤25% of AA
		1d. Buffer Width	Average buffer width is >200 m	Average buffer width is >100–200 m	Average buffer width is >50–100 m	Average buffer width is ≤50 m or no buffer exists	
		1e. Buffer Condition – Vegetation	Abundant (>95%) cover native vegetation, little or no (<5%) cover of non-native plants, intact soils.	Substantial (75–95%) cover of native vegetation, low (5–25%) cover of non-native plants.	Moderate (25–50%) cover of non-native plants.	Dominant (>50%) cover of non-native plants.	
		1f. Buffer Condition – Soils	Intact soils with little-no trash, negligible intensity of human use.	Intact or moderately disrupted soils, moderate –lesser trash, OR minor intensity of human use.	Moderate-extensive soil disruption, moderate of greater amounts of trash, OR moderate intensity of human use.	Barren ground and highly compacted or disrupted soils, moderate-greater amounts of trash, moderate-greater intensity of human use, OR no buffer.	

[1] Metric used for Riverine HGM wetlands only

BIOTIC CONDITION

Key Ecological Attribute	Indicator / Metric	Metric Rating Criteria				
	Rank / Score	**A / 5**	**B / 4**	**C / 3**	**D / 1 –OR– D / 2 and E / 1**	
	Interpretation	**Reference (No or Minimal Human Impact)**	**Slight Deviation from Reference**	**Moderate Deviation from Reference**	**Significant or Severe Deviation from Reference**	
Community Composition[1]	*2a. Relative Cover Native Plant Species*	Relative cover native plants > 99%	Relative cover native plants >95-99%	Relative cover native plants >80-95%	Relative cover native plants >50-80%	Relative cover native plants ≤50%
	2b. Absolute Cover Noxious Weeds	Absolute cover noxious weeds = 0%	Absolute cover noxious weeds >0-3%	Absolute cover noxious weeds >3-10%	Absolute cover noxious weeds >10% noxious	
	2c. Absolute Cover Aggressive Native Species	<10% cattail or <5% reed canary grass or giant reed grass	10-25% cattail or 5-10% reed canary grass or giant reed grass	>25-50% cattail or 10-25% reed canary grass or giant reed grass	>50% cattail or >25% reed canary grass or giant reed grass	
	2d. Mean C	Mean C > 6.0	Mean C > 5.5-6.0	Mean C >5.0-5.5	Mean C >4.0-5.0	Mean C ≤ 4.0
Community Structure	*2e. Regeneration of Native Woody Species* [2]	All age classes present (N/A if woody sp. naturally uncommon/absent)	No middle age groups, others present	No young-middle age groups, mature present	Woody sp. mainly decadent and dying or >5% cover Tamarisk or Russian Olive	
	2f. Litter Accumulation	Moderate litter and duff and organic matter, neither lacking nor excessive.		Small amounts of litter with little plant recruitment, or excessive litter.	AA lacks litter completely, or excessive litter that limits new growth.	
	2g. Structural Complexity	Horizontal structure consists of a very complex array of nested and/or interspersed, irregular biotic and abiotic patches with no single dominant patch type.	Horizontal structure consists of a moderate array of biotic and abiotic patches with no single dominant patch type.	Horizontal structure consists of a simple array of biotic and abiotic patches.	Horizontal structure consists of one dominant patch type and thus has relatively no interspersion.	

[1] All community composition metrics calculated from the vegetation data not derived from field for rank scores. Final thresholds are different from those shown on the field form.

[2] Only applied to sites with where woody species are naturally common.

HYDROLOGIC CONDITION[1]	Indicator / Metric	Metric Rating Criteria			
	Rank / Score	**A / 5**	**B / 4**	**C / 3**	**D / 1**
	Interpretation	**Reference (No or Minimal Human Impact)**	**Slight Deviation from Reference**	**Moderate Deviation from Reference**	**Significant Deviation from Reference**
	3a. Water Source	Sources are precipitation, groundwater, natural runoff, or natural flow from an adjacent freshwater body, or the AA naturally lacks water in the growing season. There is no indication that growing season conditions are controlled by artificial water sources.	Sources are mostly natural, but also obviously include occasional or small effects of modified hydrology (e.g., developed land or irrigated agricultural land that comprises less than 20% of the immediate drainage basin within about 2 km upstream of the AA, presence of a few small storm drains or scattered homes with septic systems). No large point sources or dams control the overall hydrology.	Sources are primarily from anthropogenic sources (e.g., urban runoff, direct irrigation, pumped water, artificially impounded water, or another artificial hydrology). Indications of artificial hydrology include developed or irrigated agricultural land that comprises more than 20% of the immediate drainage basin within about 2 km upstream of the AA, or the presence of major drainage point source discharges that obviously control the hydrology.	Natural sources have been eliminated based on the following indicators: impoundment of all wet season inflows, diversions of all dry-season inflows, predominance of xeric vegetation, etc.
	3b. Hydrologic Connectivity	Rising water has unrestricted access to adjacent areas without levees or other obstructions to the lateral movement of flood waters, if stream present, not entrenched.	Unnatural features such as levees or road grades limit the lateral movement of floodwaters, relative to what is expected for the setting, but limitations exist for <50% of the AA boundary. Restrictions may be intermittent along the margins of the AA, or they may occur only along one bank or shore. If stream present, slightly entrenched.	The lateral movement of flood waters to and from the AA is limited, relative to what is expected for the setting, by unnatural features such as levees or road grades, for 50–90% of the boundary of the AA. Flood flows may exceed the obstructions, but drainage out of the AA is probably obstructed. If stream present, moderately entrenched.	The lateral movement of flood waters is limited, relative to what is expected for the setting, by unnatural features such as levees or road grades, for >90% of the boundary of the AA. If stream present, very entrenched.
	3c. Alteration to Hydroperiod *NON-RIVERINE ONLY*	Hydroperiod is characterized by natural patterns of filling or inundation and drying or drawdowns with no alterations.	Filling and drying patterns deviate slightly from natural conditions due to presence of stressors such as small ditches or diversions, berms or roads at/near grade, pugging, or minor flow additions.	Filling and drying patterns deviate moderately from natural conditions due to presence of stressors such as 1-3ft deep ditches or diversions, two lane roads, roads with culverts adequate for stream flow, moderate pugging, or moderate flow additions.	Filling and drying patterns deviate substantially from natural conditions due to high intensity alterations such as a 4-lane highway, large dikes, > 3ft diversions or ditches capable of lowering water table, large amount of fill, artificial groundwater pumping, or heavy flow additions.
	3d. Upstream Water Retention *RIVERINE ONLY*	<5% of watershed drains to water storage facility.	5–20% of watershed drains to water storage facility.	20–50% of watershed drains to water storage facility.	>50% of watershed drains to water storage facility.

[1] Hydrology metrics are different for Riverine HGM and Non-Riverine HGM wetlands.

HYDROLOGIC CONDITION[1]	*3e. Water Diversions and/or Additions* *RIVERINE ONLY*	No upstream or onsite water diversions or additions present.	Few diversions/additions present or impacts minor relative to contributing watershed size. Minor impact to local hydrology.	Many diversions/additions present or impact moderate relative to contributing watershed size. Major impact to local hydrology.	Diversions/additions very numerous or impacts high relative to contributing watershed size. Local hydrology drastically altered.
	3f. Bank Stability *RIVERINE ONLY*	Most of the channel through the AA is characterized by equilibrium conditions, with little evidence of aggradation or degradation. Streambanks dominated (>90% cover) by stabilizing plant species, including trees, shrubs, herbs.	Most of the channel through the AA is characterized by some aggradation or degradation, none of which is severe, and the channel seems to be approaching an equilibrium form. Streambanks have 70–90% cover of stabilizing plant species.	There is evidence of severe aggradation or degradation of most of the channel through the AA or the channel is artificially hardened through less than half of the AA. Streambanks have 50–70% cover of stabilizing plant species.	The channel is concrete or otherwise artificially hardened through most of the AA. Streambanks have <50% cover of stabilizing plant species.
	3g. Beaver Activity[2] *RIVERINE ONLY*	Active or recent beaver sign present. Beaver currently active within the area.	Only old beaver sign present. No evidence of recent or new beaver activity despite available food resources and habitat. (Score = 3)		No beaver sign present.

[1] Hydrology metrics are different for Riverine HGM and Non-Riverine HGM wetlands.

[2] Only applied to sites with where beaver activity is expected.

PHYSIOCHEMICAL CONDITION	*4a. Water Quality*	No visual evidence of degraded water quality. No visual evidence of turbidity or other pollutants.	Some negative water quality indicators are present, but limited to small and localized areas within the wetland. Water is slightly cloudy, but there is no obvious source of sedimentation or other pollutants.	Water is cloudy or has unnatural oil sheen (natural bacterial sheens break apart upon contact), but the bottom is still visible. Sources of water quality degradation are apparent.	Water is milky and/or muddy or has unnatural oil sheen (natural bacterial sheens break apart upon contact). The bottom is difficult to see and there are obvious sources of water quality degradation.
	4b. Algal Growth	Water is clear with minimal algal growth.	Algal growth is limited to small and localized areas of the wetland. Water may have a greenish tint or cloudiness.	Algal growth occurs in moderate to large patches throughout the AA. Water may have a moderate greenish tint or sheen. Sources of water quality degradation are apparent.	Algal mats are extensive, blocking light to the bottom. Water may have a strong greenish tint and the bottom is difficult to see. There are obvious sources of water quality degradation.
	4c. Substrate / Soil Disturbance	No apparent modifications.	Past modifications, but recovered; OR recent but minor modifications.	Recovering OR recent and moderate modifications.	Recent and severe modifications.

EIA Scoring Formulas:

Non-Riverine HGM Wetlands

Landscape Context Score: (1a * 0.4) + ([(1c*1d)$^{1/2}$ * (1e + 1f)/2]$^{1/2}$ * 0.6)

Biotic Condition Score: (2a * 0.2) + ([2b OR 2c[1]] * 0.2) + (2d * 0.4) + (2e[2] * 0.1) + (2f[2] * [0.05 OR 0.1]) + (2g[2] * [0.05 OR 0.1])

Hydrologic Condition Score: (3a * 0.2) + (3b * 0.2) + (3c * 0.6)

Physiochemistry Condition Score: (4a * 0.25) + (4b * 0.25) + (4c * 0.5)

Riverine HGM Wetlands

Landscape Context Score: (1a * 0.1) + (1b * 0.3) + ([(1c*1d)$^{1/2}$ * (1e + 1f)/2]$^{1/2}$ * 0.6)

Biotic Condition Score: (2a * 0.2) + ([2b OR 2c[1]] * 0.2) + (2d * 0.4) + (2e[2] * 0.1) + (2f[2] * [0.05 OR 0.1]) + (2g[2] * [0.05 OR 0.1])

Hydrologic Condition Score: (3a * 0.2) + (3b * 0.2) + ([3d*3e]$^{1/2}$ * 0.4) + (3f[3] *[0.1 OR 0.2]) + (3g[3] * 0.1)

Physiochemistry Condition Score: (4a * 0.25) + (4b * 0.25) + (4c * 0.5)

Overall EIA Score

(Landscape Context Score * 0.2) + (Biotic Condition Score * 0.4) + (Hydrologic Condition Score * 0.3) + (Hydrologic Condition Score * 0.1)

[1] Lowest value from 2b or 2c is used.

[2] If 2e is NA, use 0.1 for 2f and 2g weights.

[3] If 3g is NA, use 0.2 for 3f weight.

Overall Score to Rank Conversion:

A = 4.5 – 5.0   C=2.5 - < 3.5

B = 3.5 – <4.5   D=1.0 - < 2.5

TERMINOLOGY, DESCRIPTION AND CALCULATION OF FLORISTIC QUALITY ASSESSMENT (FQA) INDICES

N_n = count of native species, N_a = count of all species, N_e = count of non-native species, C_i = index of conservatism for the i^{th} species, x_i = percent cover for the i^{th} species.

Indices	Description	Calculation
Species richness	Number of plant species observed	N_a
Native species richness	Number of native plant species observed	N_n
Non-native species richness	Number of non-native plants	N_e
Percent non-native species	Number of native plants divided by the number of all plants multiplied by 100	$(N_n/N_a)(100)$
Mean C	Average C-value of all plants	$\sum_{i=1}^{n} C_i \Big/ N_a$
Mean C_{nat}	Average C-value of only the native plants	$\sum_{i=1}^{n} C_i \Big/ N_n$
Cover-weighted Mean C	Sum of each species C-value multiplied by its cover values, then divided by the sum of cover values for all species	$\sum_{i=1}^{n} x_i C_i \Big/ \sum_{i=1}^{n} x_i$
Cover-weighted Mean C_{nat}	Sum of each native species C-value multiplied by its cover values, then divided by the sum of cover values for native species	$\sum_{i=1}^{n} x_i C_i \Big/ \sum_{i=1}^{n} x_i$
FQI	Mean C of all plants multiplied by the square-root of number of all plants	$\left(\sum_{i=1}^{n} C_i \Big/ N_a\right)\sqrt{N_a}$

FQI_{nat}	Mean C of native plants multiplied by the square-root of number of native plants	$\left(\sum_{i=1}^{n} C_i \middle/ N_n\right)\sqrt{N_n}$
Cover-weighted FQI	Cover-weighted Mean C for all species multiplied by the square-root of all species	$\left(\sum_{i=1}^{n} x_i C_i \middle/ \sum_{i=1}^{n} x_i\right)\sqrt{N_a}$
Cover-weighted FQI_{nat}	Cover-weighted Mean C for native plants multiplied by the square-root of native plants	$\left(\sum_{i=1}^{n} x_i C_i \middle/ \sum_{i=1}^{n} x_i\right)\sqrt{N_n}$
Adjusted FQI	Mean C of native plants divided by 10 multiplied by square-root of native plants divided by the square-root of number of all plants multiplied by 100	$\frac{\left(\sum_{i=1}^{n} C_i \middle/ N_n\right)}{10} \frac{\sqrt{N_n}}{\sqrt{N_a}}(100)$
Adjusted cover-weighted FQI	Cover-weighted Mean C for native plants divided by 10 multiplied by square-root of native plants divided by the square-root of number of all plants multiplied by 100	$\frac{\left(\sum_{i=1}^{n} x_i C_i \middle/ \sum_{i=1}^{n} x_i\right)}{10} \frac{\sqrt{N_n}}{\sqrt{N_a}}(100)$

Appendix H: Potential Conservation Area Reports for Echo Lake and South Platte River Sites

Conservation Site Report

2/11/2015

Echo Lake

Site Code BCD S.USCOHP*350

IDENTIFIERS

Site Code BCD S.USCOHP*350

Site Class Standard site

Old Site Code USCOHP*350

Conservation_Site_ID 553

Shape_ID 34580

Site Alias

Network of Conservation Areas (NCA)

NCA Site ID	NCA Site Code BCD	NCA Site Name

Defining Managed Area

Site Relations

- ccA.'foR 8

Nation United States

State/Province Colorado

Site Responsibility Colorado

Latitude 394009N

Longitude 1053551W

South North East West

County	State/Province	Quad Code	Quad Name	Watershed Code	Watershed Name
Clear Creek	Colorado	39105-F5	Idaho Springs	10190002	Upper South Platte
				10190004	Clear

Township/Range/Section

TownRange	Section	Meridian	Note
004S073W	33	6P	
004S073W	31	6P	
004S073W	30	6P	
004S074W	24	6P	
004S073W	32	6P	
004S073W	19	6P	
004S073W	29	6P	

Directions

SITE DESCRIPTION

Minimum Elevation: Feet Meters

Maximum Elevation: Feet Meters

Site Description The site includes the forest area to the east of Echo Lake and along the Mt. Evans Road.

Key Environmental Factors

Climate Description

Land Use History

Cultural Features

SITE DESIGN

Conservation Site Report

Echo Lake

Site Code BCD S.USCOHP*350

Site Mapped P - Partial

Mapped Date 09/12/1994

Designer Pague, C.A.

Boundary Justification

The boundary includes the known occurrences and a buffer into adjacent forested habitat.

Primary and Secondary Area		Acres		Hectares
Primary Area	1,759.27	Acres	711.95	Hectares
Trade Land Area		Acres		Hectares

Site Comments

Shelf Note

SITE SIGNIFICANCE

Old Site Rating

Old Site Rating Comments

Biodiversity Significance B5: General Biodiversity Interest

Biodiversity Significance Comment!

This site supports a breeding occurrence of the state imperiled (G5/S2B) Barrow's Goldeneye *(Bucephala islandica).* This occurrence is in fair (C-ranked) condition. There is also a good (B-ranked) occurrence of the unranked (GU/SU) *Pinus aristata IJuniperus communis* plant community.

Other Values

Other Values Comments

Reflected moonwort *(Botrychium* echo), a species on CNHP's watch list, occurs in the site. *Botrychium* populations occur near the road. These species are known to favor slightly disturbed conditions; however, future management may be required iftrampling begins to threaten.

Protection Urgency P5: No Action to be Taken on this Site

Protection Urgency Comments

Site is on USFS and Denver Mountain Parks lands.

Management Urgency M3: Needed within 5 Years to Maintain Quality

Management Urgency Comments

Water quality has likely been impacted by human disturbances. A highway (CO 103) that is very busy in the spring, summer and fall forms the north shore boundary. Shoreline vegetation restoration is on-going. In addition, the area is heavily used by hikers, dog walkers, fishermen. One of the biggest threats is potential fire suppression efforts in the surrounding spruce forest which could destroy or damage the current nesting area for these ducks and other forest inhabitants observed including a Sawwhet Owl. Forest management activities in the vicinity of the lake should retain large trees with cavities, if such trees do not pose an imminent hazard to recreationsits. If in the future specific nest trees used by the ducks are identified, they should be protected.

REAL ESTATE/PROTECTION

Conservation Intentions

Number of Tracts

Estimated Protection Cost

Designation

Protection Comments

MANAGEMENT

Land Use Comments

Conservation Site Report

2/11/2015

Echo Lake

Site Code BCD S.USCOHP*350

Natural Hazard Comments

Exotics Comments

Offsite

Information Needs

Management Needs

Managed Area Relations

ELEMENT occlJIU iE:Ncks

ELCode	EO#	Scientific Name	Common Name	GRNK	SRNK	EORNK	DRVNG	OCC. TYPE	ECOSCALE
Bucephala islandica									
ABNJB18020	22	*Bucephala islandica*	Barrow's Goldeneye	G5	S2B	E	y	Principal	INTERMEDIATE
Pinus aristata / Juniperus communis Woodland									
CEGL002894	3	*Pinus aristata I Juniperus communis Woodland*	Montane Woodlands	GU	SU	B	N	Principal	COARSE

REFERENCES

Reference Code   Full Citation

VERSION/QC

Additional Topics

Version Tracking

Lead Responsibility   CNHP-Zoology Team

Version Date   12/17/2014

Version Author   Kuhn, B.

Manual File Note

Mapping

Paper Mapping By   Paper Mapping Date   9/12/1994 12:00:00.

Mapped Date   9/12/1994 12:00:00A

Digital Mapping By   JEH   Digital Mapping Date   12/17/2014

Digitizing Scale   1:100,000 Quad - Paper

Old Methodology: No

Old Methodology Marked but Not Verified: No

Sensitive Site: No

Exception to B-rank Rules: No

Comments Justifying Exception to B-rank Rules

Quality Control

Data QC Status   Data QC By

Map QC Status   Map QC By

Comments   B rank revised 2014-12-17 to reflect change in driving eo G rank.

South Platte River

Biodiversity Rank - B4: Moderate Biodiversity Significance
Protection Urgency Rank - P?: Unknown
Management Urgency Rank - M?: Unknown

U.S.G.S. 7.5-minute quadrangles: Proctor, Johnstown, Sedgwick, Hackett Mountain, Fort Logan, Golden, Arvada, Spinney Mountain, North Sterling Reservoir, Crook, Galien, Barnesville, Sunken Lake, Platteville, Carter Lake Reservoir, Sulphur Mountain, Deckers, Cheesman Lake, Parker, Sterling North, Hygiene, Sterling South, Dearfield, Kassler, Wrights Reservoir, Marks Butte, Severance, Greeley, Masters, Weldona, Garo, Westcreek, Guffey NW, Iliff, Gowanda, Milton Reservoir, Milliken, Brush West, Merino SW, Tarryall, Morrison, Englewood, Louisville, Mile High Lakes, Horse Creek, Loveland, Windsor, Kersey, Merino, Omar, Atwood, Berthoud, Hardin, Orchard, Fort Morgan, Platte Canyon, Littleton, Fitzsimons, Brighton, Commerce City, Antero Reservoir, Timnath, Longmont, Brush East, Julesburg Reservoir, Julesburg, Eastlake, Erie, Keenesburg, Elevenmile Canyon, Tamarack Ranch, Messex, La Salle, Ovid, Green Mountain, Ralston Buttes, Fort Lupton, Lake George

Size: 248,267 acres (100,470 ha)   Elevation: 3,511 - 8,940 ft. (1,070 - 2,725 m)

General Description: The site is open water and shorelines and includes the mainstem of the South Platte River and surrounding large lakes and reservoirs. The river has been altered by water diversion, development and agriculture. Mature cottonwood trees are present. In addition to Bald Eagles, the aquatic resources of the site support Snowy Egret, White Pelican, and Preble's meadow jumping mouse. At mid-elevations towards the west end of the site there are populations of the endangered Pawnee montane skipper butterfly. Within one reservoir there is a historical occurrence of the umbilicate sprite, an uncommon snail. Plains cottonwood riparian woodland (*Populus deltoides* ssp. *monilifera / Symphoricarpos occidentalis*), sandbar willow / bare ground (*Salix exigua* / bare ground), narrow-leaf cattail marsh (*Typha angustifolia - Typha latifolia*), Great Plains marsh (sandhills bullrush marsh), and montane riparian woodland (*Picea pungens / Betula occidentalis*) are some of the riparian and wetland communities present in the area. Wild black currant (*Ribes americanum*), ebony spleenwort (*Asplenium platyneuron*), and pale blue-eyed grass (*Sisyrinchium pallidum*) are state rare plants found within the site.

Biodiversity Significance Rank Comments (B4): This site supports multiple occurrences of the state rare (G5/S1B) Bald Eagle (*Haliaeetus leucocephalus*), including one in good condition (B-ranked).

Natural Heritage element occurrences at the South Platte River PCA.

Major Group	State Scientific Name	State Common Name	Global Rank	State Rank	Federal Status	State Status	Fed Sens	EO Rank	Last Obs Date
Birds	Haliaeetus leucocephalus	Bald Eagle	G5	S1B,S3N		ST	BLM/USFS	H	1980-03-24
Birds	Haliaeetus leucocephalus	Bald Eagle	G5	S1B,S3N		ST	BLM/USFS	H	9999-99-99
Birds	Haliaeetus leucocephalus	Bald Eagle	G5	S1B,S3N		ST	BLM/USFS	D	1994-06-10
Birds	Haliaeetus leucocephalus	Bald Eagle	G5	S1B,S3N		ST	BLM/USFS	E	1995-99-99
Birds	Haliaeetus leucocephalus	Bald Eagle	G5	S1B,S3N		ST	BLM/USFS	E	1993-99-99
Birds	Haliaeetus leucocephalus	Bald Eagle	G5	S1B,S3N		ST	BLM/USFS	E	2011-99-99
Birds	Haliaeetus leucocephalus	Bald Eagle	G5	S1B,S3N		ST	BLM/USFS	H	1979-12-99
Birds	Haliaeetus leucocephalus	Bald Eagle	G5	S1B,S3N		ST	BLM/USFS	B	2005-01-23
Birds	Haliaeetus leucocephalus	Bald Eagle	G5	S1B,S3N		ST	BLM/USFS	H	1979-99-99

** The records above are sorted in the following order 1) Major Group 2) Global Rank and 3) Scientific name.

Boundary Justification: The boundary was drawn primarily for Bald Eagles to include large reservoirs with trees in proximity to the South Platte River and its major drainages. The river was buffered 1/2 mile. In addition, all lakes and reservoirs 100 acres or larger, within 15 miles of the river, were included. This site does not include contiguous land between the river and the lakes and reservoirs.

Protection Urgency Rank Comments (P??): The site is approximately 73% private land, 16% State land, 11% USFS land with trace amounts of BLM land.

Management Urgency Rank Comments (M?): Maintain cottonwood trees and reduce disturbance from boating, fishing and ORV use on shorelines during nesting season. Should include adequate nesting, roosting and foraging sites which are all affected by disturbance (CSP Bird Working Group 2004).

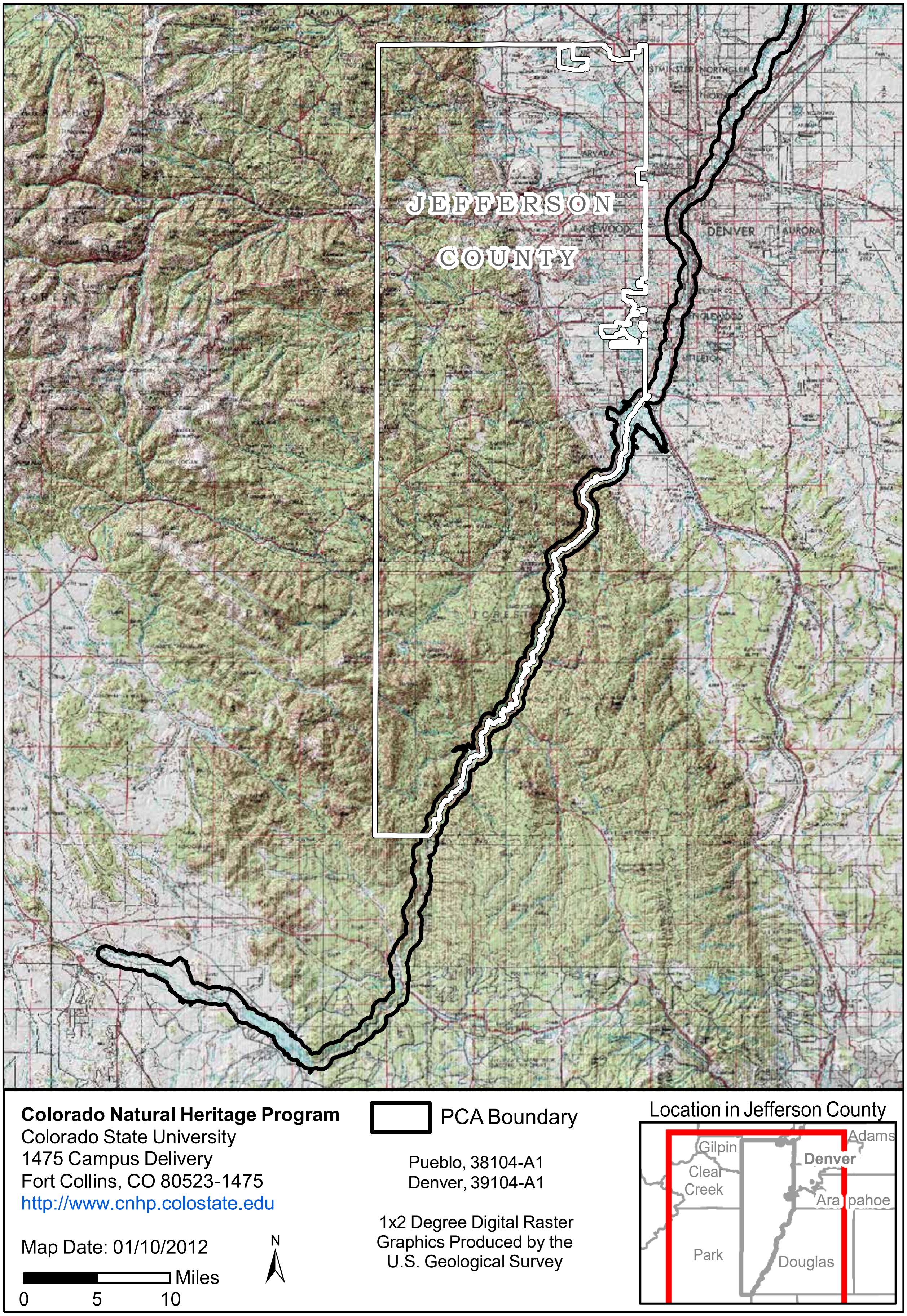
References

Central Shortgrass Prairie Bird Working Group. 2004. Meeting held on July 29, 2004 at CSU. Participants included personnel from CNHP, Rocky Mountain Bird Observatory, Colorado Division of Wildlife and Playa Lakes Joint Venture.

Sovell, J., P. Smith, D. Culver, S. Panjabi and J. Stevens. 2012. CNHP Final Report: Survey of Critical Biological Resources in Jefferson County, Colorado. Colorado Natural Heritage Program, Fort Collins, CO.

Version Author: Sovell, J.R.

Version Date: 01/06/2012



Map 37. South Platte River Potential Conservation Area, B4: Moderate Biodiversity Significance

APPENDIX I:

Bird List and Report for Echo Lake Ecological Survey

By David Leatherman

BIRD LIST FOR ECHO LAKE PARK
CLEAR CREEK COUNTY, CO
9JULY2014
OBSERVER: DAVID LEATHERMAN

Bird species are listed in order of detection, starting at the Echo Lake Park parking lot northwest of the lake and going around the lake in counter clockwise fashion from about 10am to 2pm. Birds preceded by an * likely bred in the Echo Lake area.

*Pine Siskin
*American Robin
*Yellow-rumped Warbler (Audubon's form)
*Cordilleran Flycatcher
*Hairy Woodpecker
*Broad-tailed Hummingbird
*Hermit Thrush
*Mountain Chickadee
*Lincoln's Sparrow
*Steller's Jay
*Barrow's Goldeneye
*Mallard
*Wilson's Warbler
*Ruby-crowned Kinglet
*Clark's Nutcracker
*Red Crossbill (type 2)
*Common Raven
*Northern Saw-whet Owl (juvenile)
*Violet-green Swallow
*Pine Grosbeak
*Gray Jay
*Red-breasted Nuthatch
*White-crowned Sparrow (mountain form)
*Dark-eyed Junco (gray-headed form)
<u>American Crow</u>
25 species

<u>Misses (species seen in area recently or that should be in the area based on habitat):</u>

*Band-tailed Pigeon
*Brown Creeper
*Golden-crowned Kinglet
*Red-naped and/or Williamson's Sapsucker
*American Three-toed Woodpecker
Rufous Hummingbird
Calliope Hummingbird
*Cassin's Finch
*Fox Sparrow (dusky form)

FURTHER OBSERVATIONS FROM 9JULY2014 VISIT TO ECHO LAKE PARK

Dave Leatherman
Forest Entomologist/Birder/Naturalist
Fort Collins, CO

A briefly annotated bird checklist from this visit was provided separately.

Perhaps the most noteworthy birds seen on 9July 2014 were an adult female and 2 juvenile Barrow's Goldeneyes. These ducks, which apparently bred on-site, constitute a feather in the cap of Echo Lake and Denver Parks. Their somewhat surprising presence is perhaps best explained by the site's meeting of their basic needs for cover, food, and water.

This is normally a cavity-nesting duck, with nest trees being live or dead, at water's edge, or up to 2km away. These ducks sometimes use other nest sites, such as under tree stumps or even large mammal burrows. I do not know where these birds nested but to sustain the presence of these "quality", high mountain forest ducks, forest management activities in the vicinity of the lake should retain large trees with cavities, if such trees do not pose an imminent hazard to recreationists. If in the future specific nest trees used by the ducks are identified, they should be protected. I would also recommend keeping the southeast corner of the lake closed permanently, so as to give waterfowl such as the goldeneyes at least partial relief from the heavy human and dog traffic the lake sustains (and to allow all plants and animal species a place to develop naturally, free from excessive disturbance).

As for meeting Barrow's Goldeneye food requirements, 3 items mentioned in the literature as being central to their diets are abundant at Echo Lake: damselfly adults/nymphs (the Northern/Boreal Bluet (*Enallagma annexum/boreale*), pondweed seeds (*Potamogeton praelongus*), and perhaps an abundant crustacean that lives among the submerged leaves/stems of the pondweed (the scud *Gammaris locusta*). Given that all these items are present in high numbers in a lake that is far from pristine (pH of 10, no doubt impacted by human and dog pollution, etc.), not much is probably needed in the way of altered management to have them continue at levels which contribute to sustained

Barrow's Goldeneye breeding. Nutritional studies estimate that recently hatched duckling goldeneyes require 175 typical food items per day, with adults requiring 1500.

From this, then, the key to Barrow's Goldeneye breeding at this site in the future will be the presence of large trees with cavities in which they can nest. If this habitat feature can be addressed, the southeastern shore and its vegetation continue closed to serve as an area of "cover"/refuge, and the food situation remains the same, the ducks have a chance of continuing at this site.

Juvenile Barrow's Goldeneye on Echo Lake

Another "quality" bird species discovered during the survey within 100 meters of the lake shore was a juvenile Northern Saw-whet Owl. Being a young bird, local breeding is strongly suspected. This is another cavity-nester and yet another reason to stress retention of trees with holes, both coniferous and deciduous (mostly spruce and aspen) on-site. That is to say, hazard reduction, fire fuels reduction, and bark beetle prevention work in the form of thinning should not be so zealous as to remove all snags and other trees with holes or potential for cavity-nesting. At a minimum, 10 dead and/or cavity-bearing trees should be retained per acre.

Juvenile Northern Saw-whet in a Lodgepole Pine south of Echo Lake

Insects observed and/or collected during the visit (all specimens deposited in Colorado State University's C. P. Gillette Museum of Arthropod Diversity in Fort Collins):

Enallagma annexum/boreale (these two blue damselfly species, the Northern Bluet and the Boreal Bluet, are very difficult to tell apart and for the purposes of this report the identity of exactly which one is present is probably unnecessary. Both are common in general and whichever species was present on this date was abundant. In fact I would say it was the dominant insect near the lake, with 10s of thousands being present in a ten-foot diameter ring of shore around the lake. They were seen on every piece of vegetation and rock.

Two blue male and one green female bluet damselflies, north shore of Echo Lake

Libellula quadrimaculata (4-spotted skimmer) – a very few of this common mountain dragonfly seen.

Four-spotted Skimmer adult

Small assortment of flies associated with moist shoreline vegetation (undetermined, perhaps 10 individuals deposited with CSU).

Dendroctonus rufipennis (Spruce Beetle) – major killer of large-diameter Engelmann and, to a lesser extent, Colorado Blue Spruce in the Western U.S. Adults removed from under the bark of a downed stem which failed due to basal decay fungi. One also adult was flying and collected, indicating normal seasonal emergence is on-going. Not a lot of mortality from this bark beetle noted in the area, although much of Colorado's High County is experiencing an epidemic of this beetle at present.

Adult Spruce Beetle (actual length about ¼ inch).

Polygraphus rufipennis (Four-eyed Spruce Beetle) – small series of this secondary bark beetle collected from the same tree mentioned above. This beetle is of no economic consequence.

Egg galleries of the Four-eyed Spruce Beetle
from just under the bark of a fallen Engelmann Spruce, Echo Lake

Pityophthorus sp. (a so-called "twig beetle") – one specimen collected from under the bark of the same fallen tree mentioned above. Of no consequence.

Reddish ovoid galls on the leaves of willows (species?) caused by *Pontania* sp. (a type of sawfly) are evident in the wet meadow along the east side of the lake.

Sawfly galls on willow, similar to those seen at Echo Lake

Other forest issues noted:

A needlecast fungus was collected from red needles of Lodgepole Pines. This was identified by Dr. Ned Tisserat of CSU as being caused by *Davisomycella*. It is a minor aesthetic issue.

A basal canker of large-diameter Engelmann Spruce was noted in the forest south of the lake, cause undetermined.

Many Lodgepole Pines growing in the wetland east of the lake show dead branch tips. Most of this is concentrated in the upper parts of tree crowns and is consistent with "winter burn", a condition where by portions of conifers growing above the snow level are subjected to desiccating winter winds. Under winter conditions that freeze soil water and prevent its uptake to replace water lost thru needle stomates, terminal sections of needles and branches die.

A fruiting body or conk of a decay fungus, probably *Phellinus pini*, was collected from the tree mentioned above with basal decay that fell over and was colonized by various bark beetles. This fungus, if widespread (and it did <u>not</u> appear to be), could be a cause of tree-fall hazard in recreation areas such as the picnic area nw of the lake.

Endocronartium harknessii (Western Gall-Rust of Hard Pines) noted in Lodgepole Pines along the west and south sides of the lake. Since this forest is not being managed for commercial timber purposes, its presence is not a major issue except for being a potential cause of stem failure when it infects trunks and leads to so-called "hip" cankers. During thinning operations, if the choice for tree removal involves a tree with gall-rust vs. one that does not, the gall-rust tree might be a better choice for removal.

Miscellaneous observations:

Besides humans and dogs, *Tamiasciurus hudsonicus* (Red Squirrel) is perhaps the most conspicuous mammal at Echo Lake. Their chattering, cone hording, and general movements are prominent northwest, west and south of the lake.

Red Squirrel at Echo Lake

In the category of interesting biology, I visited Echo Lake on 27July2014. While observing a harried male Ruby-crowned Kinglet feed its brood of recently-fledged 5-6 young, two Gray Jays came close. I believe the intent of the jays, among other things, was to catch and eat the young kinglets. The presence of my friends and I perhaps prevented this predation. Moving on to other things, one jay was seen going down to the ground and wiping its bill thru a patch of white material. Upon close examination this material was a type of fungus. More specifically, it was a slime mold which goes by the descriptive name of "Dog Vomit Slime Mold " (*Fuligo septica*). It is a known food item within the remarkably broad plant and animal diet of Gray Jays.

Dog Vomit Slime Mold at Echo Lake (photo by Janeal Thompson) and Gray Jay

A lot of coniferous tree stems have been cut in the forest south of the lake. I am not sure what the purpose of this cutting was, but in many cases the stumps are higher than would be considered a "best management practice" for such silviculture. Perhaps it was done while the area had snow cover, but this is still not a valid excuse. Injury to forest visitors tripping on these stems is possible, particularly in areas where foot traffic is allowed.

It would appear litter is a continuous issue at Echo Lake and whatever means can be employed to prevent/minimize/eliminate this should be encouraged. Hard to believe people can consider a place a target destination, presumably because of its beauty, and then trash it up.

Bilingual signs explaining both giardia and the fact dogs can be a common source of e coli bacteria in water systems might be advisable at various places around the lake. Cases of people letting their kids and dogs play in the water, sometimes together, while eating food and obviously oblivious to the potential hazards to them, their pets, and others, were common.

APPENDIX J: List of Plant Taxa Documented In Denver County

Plant Species Name and Authority
Acer glabrum Torr.
Acer negundo L. var. *interius* (Britton) Sarg.
Acer negundo L. var. *negundo*
Acer saccharinum L.
Achillea millefolium L. var. *occidentalis* DC.
Achnatherum hymenoides (Roem. & Schult.) Barkworth
Acorus calamus L.
Acroptilon repens (L.) DC.
Agrimonia striata Michx.
Agropyron cristatum (L.) Gaertn.
Agrostis gigantea Roth
Agrostis scabra Willd.
Agrostis stolonifera L.
Ailanthus altissima (Mill.) Swingle
Alliaria petiolata (M. Bieb.) Cavara & Grande
Alnus incana (L.) Moench ssp. *tenuifolia* (Nutt.) Breitung
Alopecurus aequalis Sobol.
Alopecurus arundinaceus Poir.
Alopecurus pratensis L.
Alyssum alyssoides (L.) L.
Alyssum simplex Rudolphi
Amaranthus sp. L.
Amaranthus albus L.
Amaranthus blitoides S. Watson
Amaranthus hybridus L.
Amaranthus palmeri S. Watson
Amaranthus powellii S. Watson
Amaranthus retroflexus L.
Ambrosia linearis (Rydb.) Payne
Ambrosia psilostachya DC.
Ambrosia trifida L.
Amorpha fruticosa L.
Androsace septentrionalis L.
Anemone canadensis L.
Anemopsis californica (Nutt.) Hook. & Arn.
Antennaria sp. Gaertn.

Antennaria rosea Greene
Antennaria umbrinella Rydb.
Anthoxanthum odoratum L.
Apocynum androsaemifolium L.
Apocynum cannabinum L.
Arabis glabra (L.) Bernh.
Aralia nudicaulis L.
Arctium minus Bernh.
Arctium tomentosum Mill.
Arctostaphylos uva-ursi (L.) Spreng.
Argemone sp. L.
Argemone polyanthemos (Fedde) G.B. Ownbey
Argentina anserina (L.) Rydb.
Aristida purpurea Nutt.
Arnica cordifolia Hook.
Artemisia campestris L. ssp. *borealis* (Pall.) H.M. Hall & Clem. var. *scouleriana* (Hook.) Cronquist
Artemisia dracunculus L.
Artemisia dracunculus L.
Artemisia frigida Willd.
Artemisia ludoviciana Nutt.
Asclepias incarnata L.
Asclepias speciosa Torr.
Asparagus officinalis L.
Aster sp. L.
Atriplex sp. L.
Atriplex canescens (Pursh) Nutt.
Atriplex micrantha Ledeb.
Atriplex patula L.
Bassia hyssopifolia (Pall.) Kuntz
Bassia scoparia (L.) A.J. Scott
Beckmannia syzigachne (Steud.) Fernald
Berteroa incana (L.) DC.
Berula erecta (Huds.) Coville
Betula occidentalis Hook.
Bidens sp. L.
Bidens cernua L.
Bidens frondosa L.
Bouteloua curtipendula (Michx.) Torr.
Bouteloua dactyloides (Nutt.) J.T. Columbus
Bouteloua gracilis (Willd. ex Kunth) Lag. ex Griffiths
Brickellia grandiflora (Hook.) Nutt.

Bromus sp. L.
Bromus arvensis L.
Bromus carinatus Hook. & Arn.
Bromus inermis Leyss. ssp. inermis var. *inermis*
Bromus lanatipes (Shear) Rydb.
Bromus tectorum L.
Calamagrostis canadensis (Michx.) P. Beauv.
Calamagrostis purpurascens R. Br.
Calamovilfa longifolia (Hook.) Scribn.
Callitriche heterophylla Pursh
Callitriche palustris L.
Caltha leptosepala DC. ssp. *leptosepala* var. *leptosepala*
Calystegia sepium (L.) R. Br. ssp. *angulata* Brummitt
Camelina microcarpa Andrz. ex DC.
Campanula rapunculoides L.
Campanula rotundifolia L.
Capsella bursa-pastoris (L.) Medik.
Cardaria draba (L.) Desv.
Cardaria pubescens (C.A. Mey.) Jarmolenko
Carduus nutans L.
Carex sp. L.
Carex aquatilis Wahlenb.
Carex athrostachya Olney
Carex aurea Nutt.
Carex bebbii Olney ex Fernald
Carex bella L.H. Bailey
Carex canescens L.
Carex deweyana Schwein.
Carex douglasii Boott
Carex emoryi Dewey
Carex gravida L.H. Bailey var. *lunelliana* (Mack.) F.J. Herm.
Carex microptera Mack.
Carex nebrascensis Dewey
Carex occidentalis L.H. Bailey
Carex pellita Muhl. ex Willd.
Carex praegracilis W. Boott
Carex scoparia Schkuhr ex Willd.
Carex siccata Dewey
Carex simulata Mack.
Carex stipata Muhl. ex Willd.
Carex utriculata Boott

Carex vulpinoidea Michx.
Carex xerantica L.H. Bailey
Castilleja sulphurea Rydb.
Celtis laevigata Willd. var. *reticulata* (Torr.) L.D. Benson
Cenchrus longispinus (Hack.) Fernald
Centaurea diffusa Lam.
Centaurea stoebe L. ssp. *micranthos* (Gugler) Hayek
Cerastium arvense L. ssp. *strictum* (L.) Ugborogho
Cerastium fontanum Baumg.
Ceratophyllum demersum L.
Chamaesyce sp. Gray
Chamaesyce glyptosperma (Engelm.) Small
Chamaesyce maculata (L.) Small
Chamaesyce serpyllifolia (Pers.) Small
Chamerion angustifolium (L.) Holub ssp. *circumvagum* (Mosquin) Hoch
Chenopodium sp. L.
Chenopodium album L.
Chenopodium atrovirens Rydb.
Chenopodium berlandieri Moq.
Chenopodium glaucum L.
Chenopodium rubrum L.
Chenopodium simplex (Torr.) Raf.
Cichorium intybus L.
Cicuta douglasii (DC.) J.M. Coult. & Rose
Cirsium arvense (L.) Scop.
Cirsium ochrocentrum A. Gray
Cirsium vulgare (Savi) Ten.
Clematis sp. L.
Cleome serrulata Pursh
Conium maculatum L.
Convolvulus arvensis L.
Conyza canadensis (L.) Cronquist
Coreopsis sp. L.
Cornus sericea L. ssp. *sericea*
Corylus cornuta Marsh.
Crataegus erythropoda Ashe
Crataegus monogyna Jacq.
Crataegus succulenta Schrad. ex Link
Croton texensis (Klotzsch) Müll. Arg.
Cucurbita foetidissima Kunth
Cyclachaena xanthifolia (Nutt.) Fresen.

Cynoglossum officinale L.
Cyperus sp. L.
Cyperus acuminatus Torr. & Hook. ex Torr.
Cyperus erythrorhizos Muhl.
Cyperus odoratus L.
Cyperus squarrosus L.
Cystopteris fragilis (L.) Bernh.
Dactylis glomerata L.
Dasiphora fruticosa (L.) Rydb. ssp. *floribunda* (Pursh) Kartesz
Datura stramonium L.
Daucus carota L.
Deschampsia cespitosa (L.) P. Beauv.
Descurainia sp. Webb & Bethel.
Descurainia incana (Bernh. ex Fisch. & C.A. Mey.) Dorn ssp. *incisa* (Engelm. ex A. Gray) Kartesz &
Descurainia pinnata (Walter) Britton
Descurainia sophia (L.) Webb ex Prantl
Dipsacus sp. L.
Dipsacus fullonum L.
Dipsacus laciniatus L.
Distichlis spicata (L.) Greene
Dodecatheon pulchellum (Raf.) Merr.
Draba streptocarpa A. Gray
Echinochloa crus-galli (L.) P. Beauv.
Echinocystis lobata (Michx.) Torr. & A. Gray
Elaeagnus angustifolia L.
Eleocharis sp. R. Br.
Eleocharis acicularis (L.) Roem. & Schult.
Eleocharis macrostachya Britton
Eleocharis quinqueflora (Hartmann) O. Schwarz
Eleocharis rostellata (Torr.) Torr.
Ellisia nyctelea (L.) L.
Elodea canadensis Michx.
Elymus canadensis L.
Elymus elymoides (Raf.) Swezey
Elymus repens (L.) Gould
Elymus trachycaulus (Link) Gould ex Shinners ssp. *trachycaulus*
Epilobium sp. L.
Epilobium brachycarpum C. Presl
Epilobium ciliatum Raf.
Epilobium hirsutum L.
Equisetum arvense L.

Equisetum hyemale L. var. *affine* (Engelm.) A.A. Eaton
Equisetum laevigatum A. Braun
Eragrostis sp. von Wolf
Eragrostis cilianensis (All.) Vign. ex Janchen
Eragrostis lutescens Scribn.
Eragrostis pectinacea (Michx.) Nees ex Steud.
Eragrostis pilosa (L.) P. Beauv.
Eragrostis spectabilis (Pursh) Steud.
Ericameria nauseosa (Pall. ex Pursh) G.L. Nesom & Baird ssp. *nauseosa* var. *nauseosa*
Erigeron sp. L.
Erigeron divergens Torr. & A. Gray
Erigeron flagellaris A. Gray
Erigeron pumilus Nutt.
Erigeron speciosus (Lindl.) DC.
Eriogonum flavum Nutt.
Eriogonum umbellatum Torr.
Erodium cicutarium (L.) L'Hér. ex Aiton
Euphorbia dentata Michx. var. *dentata*
Euphorbia esula L. var. *esula*
Euphorbia esula L. var. *uralensis* (Fisch. ex Link) Dorn
Euphorbia myrsinites L.
Euthamia occidentalis Nutt.
Forestiera pubescens Nutt.
Fragaria sp. L.
Fragaria virginiana Duchesne ssp. *glauca* (S. Watson) Staudt
Frangula alnus Mill.
Fraxinus pennsylvanica Marsh.
Froelichia floridana (Nutt.) Moq. var. *campestris* (Small) Fernald
Gaillardia pulchella Foug.
Galium aparine L.
Galium boreale L.
Gaura coccinea Nutt. ex Pursh
Gaura mollis James
Gentianella amarella (L.) Böerner ssp. *acuta* (Michx.) J.M. Gillett
Geranium sp. L.
Geranium caespitosum James
Geranium richardsonii Fisch. & Trautv.
Geum aleppicum Jacq.
Geum macrophyllum Willd. var. *perincisum* (Rydb.) Raup
Geum rossii (R. Br.) Ser. var. *turbinatum* (Rydb.) C.L. Hitchc.
Gleditsia triacanthos L.

Glyceria grandis S. Watson
Glyceria striata (Lam.) Hitchc.
Glycyrrhiza lepidota Pursh
Grindelia sp. Willd.
Grindelia squarrosa (Pursh) Dunal
Hackelia floribunda (Lehm.) I.M. Johnst.
Helianthus annuus L.
Helianthus nuttallii Torr. & A. Gray
Heracleum maximum Bartram
Hesperostipa comata (Trin. & Rupr.) Barkworth
Heterotheca villosa (Pursh) Shinners
Heterotheca villosa (Pursh) Shinners var. *foliosa* (Nutt.) V.L. Harms
Heuchera bracteata (Torr.) Ser.
Holodiscus discolor (Pursh) Maxim.
Hordeum jubatum L. ssp. *jubatum*
Hordeum murinum L. ssp. *glaucum* (Steud.) Tzvelev
Hydrophyllum fendleri (A. Gray) A. Heller
Hypericum formosum Kunth [excluded]
Hypericum perforatum L.
Iris sp. L.
Iris pseudacorus L.
Jamesia americana Torr. & A. Gray
Juncus sp. L.
Juncus arcticus Willd. ssp. *littoralis* (Engelm.) Hultén
Juncus articulatus L.
Juncus compressus Jacq.
Juncus drummondii E. Mey.
Juncus effusus L.
Juncus ensifolius Wikstr.
Juncus gerardii Loisel.
Juncus interior Wiegand
Juncus longistylis Torr.
Juncus nodosus L.
Juncus tenuis Willd.
Juncus torreyi Coville
Juniperus sp. L.
Juniperus communis L. var. *saxatilis* Pall.
Koeleria macrantha (Ledeb.) Schult.
Lactuca serriola L.
Lactuca tatarica (L.) C.A. Mey. var. *pulchella* (Pursh) Breitung
Leersia oryzoides (L.) Sw.

Lemna minor L.
Lemna minuta Kunth
Leonurus cardiaca L.
Lepidium campestre (L.) W.T. Aiton
Lepidium densiflorum Schrad.
Lepidium latifolium L.
Leptochloa fusca (L.) Kunth ssp. *fascicularis* (Lam.) N. Snow
Leucanthemum vulgare Lam.
Ligusticum porteri J.M. Coult. & Rose
Ligustrum sp. L.
Ligustrum vulgare L.
Limosella aquatica L.
Linaria dalmatica (L.) Mill. ssp. *dalmatica*
Linaria vulgaris Mill.
Linum lewisii Pursh var. *lewisii*
Lolium perenne L. ssp. *multiflorum* (Lam.) Husnot
Lonicera involucrata (Richardson) Banks ex Spreng. var. *involucrata*
Lonicera tatarica L.
Lupinus argenteus Pursh
Luzula parviflora (Ehrh.) Desv.
Lycopus americanus Muhl. ex W. Bartram
Lycopus asper Greene
Lycopus uniflorus Michx.
Lysimachia ciliata L.
Lythrum alatum Pursh
Lythrum salicaria L.
Machaeranthera bigelovii (A. Gray) Greene
Mahonia repens (Lindl.) G. Don
Maianthemum racemosum (L.) Link ssp. *amplexicaule* (Nutt.) LaFrankie
Maianthemum stellatum (L.) Link
Malus sp. Mill.
Malva neglecta Wallr.
Matricaria discoidea DC.
Medicago lupulina L.
Medicago sativa L.
Melilotus sp. Mill.
Melilotus officinalis (L.) Lam.
Mentha sp. L.
Mentha arvensis L.
Mentha spicata L.
Mentzelia sp. L.

Mentzelia nuda (Pursh) Torr. & A. Gray var. *nuda*
Mertensia ciliata (James ex Torr.) G. Don
Mimulus glabratus Kunth
Mirabilis nyctaginea (Michx.) MacMill.
Mollugo verticillata L.
Monarda fistulosa L. ssp. *fistulosa* var. *menthifolia* (Graham) Fernald
Monarda pectinata Nutt.
Muhlenbergia asperifolia (Nees & Meyen ex Trin.) Parodi
Muhlenbergia minutissima (Steud.) Swallen
Muhlenbergia pungens Thurb.
Munroa squarrosa (Nutt.) Torr.
Myriophyllum sibiricum Kom.
Myriophyllum spicatum L.
Nassella viridula (Trin.) Barkworth
Nasturtium officinale W.T. Aiton
Nepeta cataria L.
Nymphaea sp. L.
Nymphaea odorata Aiton
Oenothera coronopifolia Torr. & A. Gray
Oenothera latifolia (Rydb.) Munz
Oenothera villosa Thunb. ssp. *strigosa* (Rydb.) W. Dietr. & P.H. Raven
Onopordum acanthium L.
Onosmodium bejariense DC. ex A. DC. var. *occidentale* (Mack.) B.L. Turner
Opuntia sp. Mill.
Opuntia fragilis (Nutt.) Haw.
Opuntia macrorhiza Engelm.
Opuntia polyacantha Haw.
Osmorhiza sp. Raf.
Oxalis sp. L.
Oxalis stricta L.
Packera dimorphophylla (Greene) W.A. Weber & A. Löve
Packera fendleri (A. Gray) W.A. Weber & A. Löve
Panicum sp. L.
Panicum capillare L.
Panicum virgatum L.
Parietaria pensylvanica Muhl. ex Willd.
Parthenocissus sp. Planch.
Parthenocissus quinquefolia (L.) Planch.
Parthenocissus vitacea (Knerr) Hitchc.
Pascopyrum smithii (Rydb.) A. Löve
Pedicularis groenlandica Retz.

Pedicularis parryi A. Gray
Pedicularis sudetica Willd. ssp. *scopulorum* (A. Gray) Hultén
Penstemon sp. Schmidel
Penstemon whippleanus A. Gray
Petasites frigidus (L.) Fr. var. *sagittatus* (Banks ex Pursh) Cherniawsky
Phacelia hastata Douglas ex Lehm.
Phalaris arundinacea L.
Phleum alpinum L.
Phleum pratense L.
Phragmites australis (Cav.) Trin. ex Steud.
Physalis hederifolia A. Gray var. *comata* (Rydb.) Waterf.
Physalis virginiana Mill.
Physocarpus monogynus (Torr.) J.M. Coult.
Picea engelmannii Parry ex Engelm.
Picea pungens Engelm.
Pinus ponderosa C. Lawson var. *scopulorum* Engelm.
Plantago lanceolata L.
Plantago major L.
Platanthera hyperborea (L.) Lindl.
Poa alpina L.
Poa compressa L.
Poa nemoralis L. ssp. *interior* (Rydb.) W.A. Weber
Poa palustris L.
Polanisia dodecandra (L.) DC.
Polygonum sp. L.
Polygonum achoreum S.F. Blake
Polygonum amphibium L. var. *emersum* Michx.
Polygonum aviculare L.
Polygonum bellardii All.
Polygonum bistortoides Pursh
Polygonum convolvulus L. var. *convolvulus*
Polygonum cuspidatum Siebold & Zucc.
Polygonum hydropiper L.
Polygonum lapathifolium L.
Polygonum pensylvanicum L.
Polygonum persicaria L.
Polygonum ramosissimum Michx.
Polygonum viviparum L.
Polypogon monspeliensis (L.) Desf.
Populus sp. L.
Populus × *acuminata* Rydb. (pro sp.)

Populus angustifolia James
Populus deltoides Bartram ex Marsh. ssp. *monilifera* (Aiton) Eckenwalder
Populus tremuloides Michx.
Portulaca oleracea L.
Potamogeton sp. L.
Potamogeton crispus L.
Potamogeton foliosus Raf.
Potamogeton nodosus Poir.
Potamogeton praelongus Wulfen
Potamogeton pusillus L.
Potentilla sp. L.
Potentilla diversifolia Lehm.
Potentilla fissa Nutt.
Potentilla hippiana Lehm.
Potentilla norvegica L.
Potentilla paradoxa Nutt.
Potentilla pulcherrima Lehm.
Potentilla recta L.
Potentilla subjuga Rydb.
Prunella vulgaris L.
Prunus sp. L.
Prunus americana Marsh.
Prunus virginiana L. var. *melanocarpa* (A. Nelson) Sarg.
Psathyrostachys juncea (Fisch.) Nevski
Pseudocymopterus montanus (A. Gray) J.M. Coult. & Rose
Pseudotsuga menziesii (Mirb.) Franco
Psoralidium lanceolatum (Pursh) Rydb.
Pyrola asarifolia Michx. ssp. *asarifolia*
Pyrola chlorantha Sw.
Pyrola minor L.
Quercus sp. L.
Quercus gambelii Nutt.
Ranunculus sp. L.
Ranunculus cymbalaria Pursh
Ranunculus hyperboreus Rottb.
Ranunculus macounii Britton
Ranunculus repens L.
Ranunculus sceleratus L. var. *sceleratus*
Ratibida columnifera (Nutt.) Woot. & Standl.
Rhamnus cathartica L.
Rhodiola sp. L.

Rhodiola integrifolia Raf. Ssp. *integrifolia*
Rhodiola rhodantha (A. Gray) H. Jacobsen
Rhus trilobata Nutt. var. *pilosissima* Engelm.
Rhus trilobata Nutt. var. *trilobata*
Ribes aureum Pursh
Ribes cereum Douglas
Ribes inerme Rydb.
Robinia neomexicana A. Gray
Rorippa sp. Scop.
Rorippa palustris (L.) Besser
Rorippa sinuata (Nutt.) Hitchc.
Rosa sp. L.
Rosa arkansana Porter
Rosa woodsii Lindl.
Rubus sp. L.
Rubus deliciosus Torr.
Rubus idaeus L. ssp. *strigosus* (Michx.) Focke
Rudbeckia hirta L.
Rudbeckia laciniata L. var. *ampla* (A. Nelson) Cronquist
Rumex sp. L.
Rumex acetosella L.
Rumex aquaticus L. var. *fenestratus* (Greene) Dorn
Rumex crispus L.
Rumex densiflorus Osterh.
Rumex obtusifolius L.
Rumex salicifolius Weinm. var. *mexicanus* (Meisn.) C.L. Hitchc.
Rumex stenophyllus Ledeb.
Sagina sp. L.
Sagittaria sp. L.
Sagittaria latifolia Willd.
Salix alba L.
Salix amygdaloides Andersson
Salix bebbiana Sarg.
Salix brachycarpa Nutt.
Salix drummondiana Barratt ex Hook.
Salix eriocephala Michx.
Salix exigua Nutt.
Salix fragilis L.
Salix glauca L. ssp. *glauca* var. *villosa* (D. Don ex Hook.) Andersson
Salix irrorata Andersson
Salix monticola Bebb

Salix planifolia Pursh
Salix scouleriana Barratt ex Hook.
Salsola collina Pall.
Salsola tragus L.
Salvia × *sylvestris* L. (pro sp.)
Sambucus sp. L.
Sanicula marilandica L.
Saponaria officinalis L.
Saxifraga bronchialis L. ssp. *austromontana* (Wiegand) Piper
Saxifraga rhomboidea Greene
Schedonorus phoenix (Scop.) Holub
Schizachyrium scoparium (Michx.) Nash
Schoenoplectus acutus (Muhl. ex Bigelow) A. Löve & D. Löve var. *acutus*
Schoenoplectus maritimus (L.) Lye
Schoenoplectus pungens (Vahl) Palla
Schoenoplectus tabernaemontani (C.C. Gmel.) Palla
Scirpus sp. L.
Scirpus microcarpus J. Presl & C. Presl
Scirpus pallidus (Britton) Fernald
Scorzonera laciniata L.
Scrophularia lanceolata Pursh
Securigera varia (L.) Lassen
Sedum sp. L.
Sedum lanceolatum Torr. ssp. *lanceolatum*
Senecio pudicus Greene
Senecio riddellii Torr. & A. Gray
Senecio vulgaris L.
Setaria pumila (Poir.) Roem. & Schult. ssp. *pumila*
Sidalcea sp. A. Gray
Silene dioica (L.) Clairville
Sisymbrium altissimum L.
Solanum dulcamara L.
Solanum ptycanthum Dunal
Solanum rostratum Dunal
Solidago canadensis L.
Solidago gigantea Aiton
Solidago simplex Kunth ssp. *simplex* var. *simplex*
Sonchus arvensis L.
Sonchus arvensis L. ssp. *uliginosus* (M. Bieb.) Nyman
Sonchus asper (L.) Hill
Sorbus sp. L.

Sorghastrum nutans (L.) Nash
Sparganium eurycarpum Engelm.
Spartina pectinata Bosc ex Link
Spergula arvensis L.
Spergularia maritima (All.) Chiov.
Spergularia rubra (L.) J. Presl & C. Presl
Spirodela polyrrhiza (L.) Schleid.
Sporobolus airoides (Torr.) Torr.
Sporobolus cryptandrus (Torr.) A. Gray
Stellaria longipes Goldie
Stuckenia filiformis (Pers.) Böerner ssp. *filiformis*
Stuckenia pectinata (L.) Böerner
Symphoricarpos sp. Duham.
Symphoricarpos albus (L.) S.F. Blake
Symphoricarpos occidentalis Hook.
Symphyotrichum sp. Nees
Symphyotrichum ascendens (Lindl.) G.L. Nesom
Symphyotrichum ciliatum (Ledeb.) G.L. Nesom
Symphyotrichum ericoides (L.) G.L. Nesom var. *ericoides*
Symphyotrichum falcatum (Lindl.) G.L. Nesom var. *falcatum*
Symphyotrichum foliaceum (Lindl. ex DC.) G.L. Nesom var. *foliaceum*
Symphyotrichum laeve (L.) A. Löve & D. Löve var. *geyeri* (A. Gray) G.L. Nesom
Symphyotrichum lanceolatum (Willd.) G.L. Nesom ssp. *hesperium* (A. Gray) G.L. Nesom var. *hesperium*
Symphyotrichum novae-angliae (L.) G.L. Nesom
Symphyotrichum porteri (A. Gray) G.L. Nesom
Tamarix sp. L.
Tamarix ramosissima Ledeb.
Taraxacum officinale F.H. Wigg.
Thalictrum fendleri Engelm. ex A. Gray
Thelesperma megapotamicum (Spreng.) Kuntze
Thermopsis divaricarpa A. Nelson
Thermopsis montana Nutt.
Thinopyrum intermedium (Host) Barkworth & D.R. Dewey
Thinopyrum ponticum (Podp.) Z.-W. Liu & R.-C. Wang
Thlaspi arvense L.
Toxicodendron rydbergii (Small ex Rydb.) Greene
Tragopogon dubius Scop.
Tragopogon lamottei Rouy
Tribulus terrestris L.
Trifolium sp. L.
Trifolium fragiferum L.

Trifolium hybridum L.
Trifolium pratense L.
Trifolium repens L.
Triglochin maritima L.
Tripleurospermum perforatum (Mérat) M. Lainz
Trisetum spicatum (L.) K. Richt.
Triticum sp. L.
Triticum aestivum L.
Typha sp. L.
Typha angustifolia L.
Typha latifolia L.
Ulmus pumila L.
Ulmus rubra Muhl.
Urtica dioica L. ssp. *gracilis* (Aiton) Seland.
Valeriana edulis Nutt. ex Torr. & A. Gray
Verbascum thapsus L.
Verbena bracteata Cav. ex Lag. & Rodr.
Verbena hastata L.
Verbesina encelioides (Cav.) Benth. & Hook. f. ex A. Gray ssp. *encelioides*
Veronica americana Schwein. ex Benth.
Veronica anagallis-aquatica L.
Veronica peregrina L. ssp. *xalapensis* (Kunth) Pennell
Veronica wormskjoldii Roem. & Schult. var. *wormskjoldii*
Viburnum sp. L.
Viburnum edule (Michx.) Raf.
Viburnum lantana L.
Viburnum opulus L.
Viola sp. L.
Viola biflora L.
Viola canadensis L. var. *rugulosa* (Greene) C.L. Hitchc.
Vitis riparia Michx.
Wolffia columbiana Karst.
Woodsia scopulina D.C. Eaton
Xanthium strumarium L.
Yucca sp. L.
Yucca glauca Nutt.
Zannichellia palustris L.
Zinnia sp. L.

Appendix K: Site Descriptions for Wetland Assessment Areas

Bear Creek East (BCE_1)

EIA Overall Rank: 2.1 D

Biotic Condition: 1.56 D **Hydrologic Condition: 3.10 C**

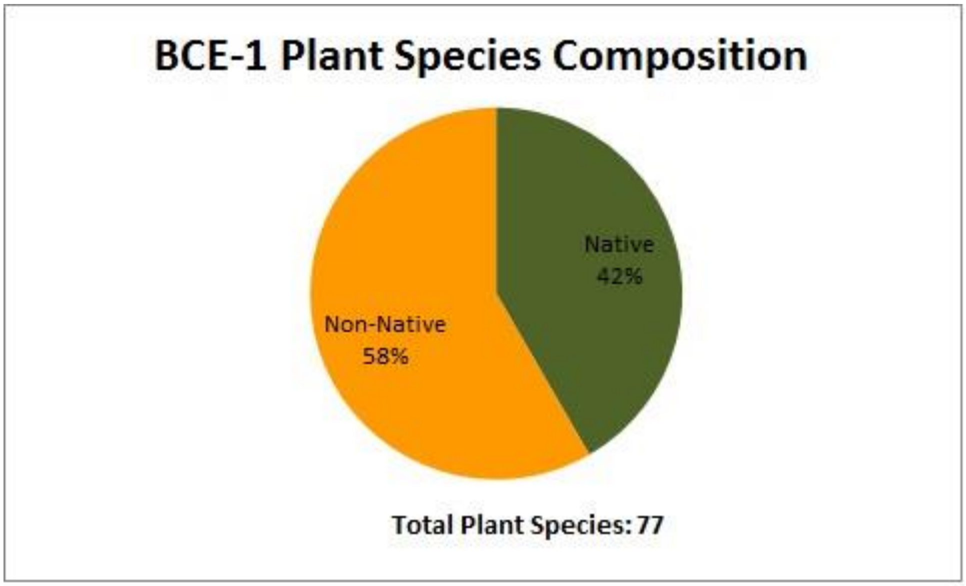
Landscape Context: 1.52 D **Physiochemical Condition: 2.00 D**

Ecological System: Western Great Plains Riparian

Size of Assessment Area: 8.2 acres **Elevation**: 1361-1632 m

General Description: The Bear Creek East AA includes a one mile stretch of Bear Creek that flows between the east side of Bear Creek Park to South Lowell Boulevard. The northern section of the river is bounded by Highway 285 (S. Hampden Boulevard). Dense urban development surrounds the assessment area and includes residences, paved roads, highways, schools, ball fields and a cemetery. This section of the river has a very thick forested overstory with shrub and herbaceous layers. The forested wetlands supported along this riverine wetland are uncommon in Denver County. Plains cottonwood *(Populus deltoides* ssp. *monilifera*) and lanceleaf cottonwood (*Populus x acuminata*) are two important native overstory species while crack willow (*Salix fragilis*), green ash (*Fraxinus pensylvanica*), and Siberian elm (*Ulmus pumila*) are common non-native overstory species. A number of cultivated woody plants were also observed in the understory. These are garden escapes that are growing on the riverbanks: catalpa (*Catalpa speciosa*), tree of heaven (*Ailanthus altissima*), silver maple (*Acer saccharinum*), honey locust (*Gleditisia tricanthos*), linden (*Tilia* sp.), and common buckthorn (*Rhamnus cathartica*).

Floristic Composition:

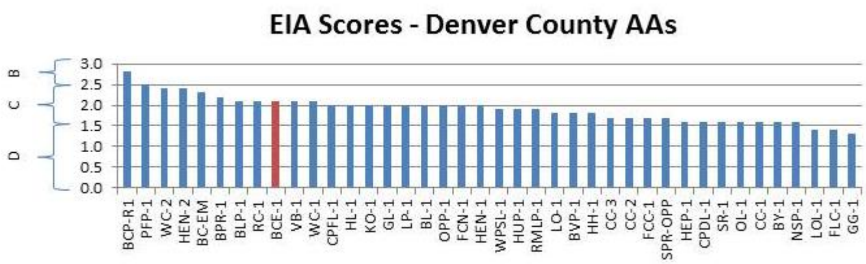


Mean C: 1.69 (CCD Range 0.82-2.84) **FQI: 14.24** (CCD ranges 3.05-20.82)

This AA has moderate plant diversity, with 77 different species. Native plants make up 42% of the list and the relative cover of native plants was relatively low at 34% (City and County of Denver (CCD) range is 5-70% relative native cover). The Mean C is moderate reflecting the mix of native and non-native species within the AA.

Key Environmental Factors: The continuity of the AA, which includes a section of Bear Creek, to healthy stretches of the river both to the east and west side of the study site is a very important environmental attribute. Although Bear Creek is dam controlled, the stream appears to have somewhat natural hydroperiods with peak flows occurring in May and June (Colorado Department of Water Resources 2015). Well-developed mature vegetation on the stream sides sets this AA apart from many of the other urban wetlands. The location of the site on the west side of Denver County in an area that is not quite as highly developed as the interior of the County is significant. The flows more closely resemble a natural system compared to other AAs in the county. The dense mature vegetation with complex layer structure that is included within the AA helps mitigate anthropogenic impacts, especially runoff from the surrounding dense urban development, upstream impoundments, culverts, trails (paved and unpaved), and highways. The complex structure of the forest provides shade and cover for wildlife. One of the most important key environmental factors is that approximately 30-40% of the 100 m buffer surrounding the AA is not covered with pavement and other impervious surfaces.

Land Use History: Bear Creek Dam lies upstream of Denver County and was constructed in 1982 at the confluence of Bear Creek and Turkey Creek in Lakewood for flood prevention. The lake behind the dam drains 236 square miles that eventually will flow through Bear Creek in Denver County (USACOE 2014).



Rank Comments: This survey area was ranked 2.1 for the overall EIA score. For Denver County, the overall EIA ranks ranged from a high of 2.8 (C) to 1.3 (D). Of the 40 sites in Denver County there was a range of 13 different numerical scores. Five other sites scored a 2.1 overall EIA, placing the Bear Creek East AA at number 6 out of the 13 possible scores (medium range). The connectivity of the river and the development of forested banks add greatly to the quality of this site and account for a higher Hydrological Condition score in the C range. Because this area is on the west side of the County, the development is not quite as extreme as it is further east. The forested overstory helps cool the water which is important for many wildlife species as is the structure provided by the trees, shrubs and herbs for feeding, nesting, and predator and prey relationships. The vegetated zone along this stretch of river is significant here and helps filter pollutants from surrounding urban runoff. This AA also has a higher buffer score because some of the surrounding land within 100 meters of the site is not paved, the average width of buffer provided by vegetation (manicured lawns are not included) averages about 34 meters which is excellent in this densely developed urban area. The plant biodiversity was moderate with 77 different species present within the AA. These factors contributed to the score and are indicative of good hydrological functioning of this area and potential for restoration and regeneration of a more highly functioning system.

Protection Urgency Comments: Based on our analysis, this is one of the most important areas to protect from further development. It is of very high quality within the County and provides more aesthetic and environmental benefits to the community than lower quality areas. It is uncommon to have natural wetlands within the urban corridor with an intact hydrology and a buffer.

Colorado 2014 Noxious Weed List: Eight List B: Canada thistle (*Cirsium arvense* <5%), Russian-olive (*Elaeagnus angustifolia* <2%) and leafy spurge (*Euphorbia esula* <1%, *Euphorbia uralensis*<2%); yellow toadflax (*Linaria vugaris* <1%); diffuse knapweed

(*Acosta diffusa* <1%), bouncingbet (*Saponaria officinalis* <1%); broad-leaved peppergrass (*Lepidium latifolium* <1%) and cutleaf teasel (*Dipsacus lanciniatus* <1%); five List C: quack grass (*Elymus repens* <5%), poison hemlock (*Conium maculatum* <1%); chickory (*Chicorum intybus* <1%), burdock (*Arctium minus* <1%) and field bindweed (*Convolvulus arvensis* <1%); were observed within the AA, all of them with 5% or less cover. Herbicides are being used to treat poison hemlock (*Conium maculatum*) at the site. In addition, two A List species have been reported at this site: Hairy willowherb (*Epilobium hirsutum*) and purple loosestrife (*Lythrum salicaria*) (pers.comm. Kelly Uhing 2015).

Wildlife Comments: Two dead muskrats were observed within the AA on the north side between the highway and the river. Trees that have beaver chew marks and beaver stumps were also observed within the assessment area. Mallard ducks (inset photo above) and dragonflies were observed in the river corridor.

Recommendations: This is one of the AAs that provide many benefits to the Denver community because of the quality of the forested zone and its connectivity to intact upstream sites. To increase and protect existing resources we recommend reducing cover of mowed lawns where possible in the park area. Carefully consider any chemical applications in the riparian zone to protect the water quality and existing native species. (See section in Discussion on native-non-native plants in urban settings.)

Smooth brome, a non-native perennial grass, is a major component of the understory covering 25% of the site. Although smooth brome is not a listed noxious weed it is an aggressive weed in riparian systems especially when herbicides are used to control other weeds (Rondeau and Lavender 2012). Therefore, removing or clipping the tops of the listed weeds before they go to seed rather than herbicide treatments are preferable. Since these plants are located directly on the stream bank in close proximity to water, avoiding the use of herbicides will also help protect water quality. The presence of smooth brome in the understory is the most compelling reason to avoid the use of herbicide treatments at the Bear Creek East AA.

References:

Colorado Division of Water Resources. 2015. Annual Water Discharge for Bear Creek at Sheridan. Available Online at http://www.dwr.state.co.us/SurfaceWater/data/detail_graph.aspx?ID=BCRSHECO.

Colorado Natural Heritage Program Field Surveys. September 5, 2013. Field Forms on File at CNHP, Fort Collins, CO.

Rondeau, R. and A. Lavender 2012. Noxious Weed Monitoring at the U.S. Air Force Academy – Year 7 Results April 2012. Colorado Natural Heritage Program www.cnhp.colostate.edu

US Army Corps of Engineers. 2014. Description of Bear Creek Dam. http://www.nwo.usace.army.mil/Missions/DamandLakeProjects/TriLakesProjects/BearCreekDam.aspx

BEAR CREEK PARK EMERGENT MARSH (BC_EM)

EIA Overall Rank: 2.3 D

Biotic Condition: 2.20 D **Physiochemical Condition: 1.00 D**

Landscape Context: 2.20 D **Hydrologic Condition: 3.00 C**

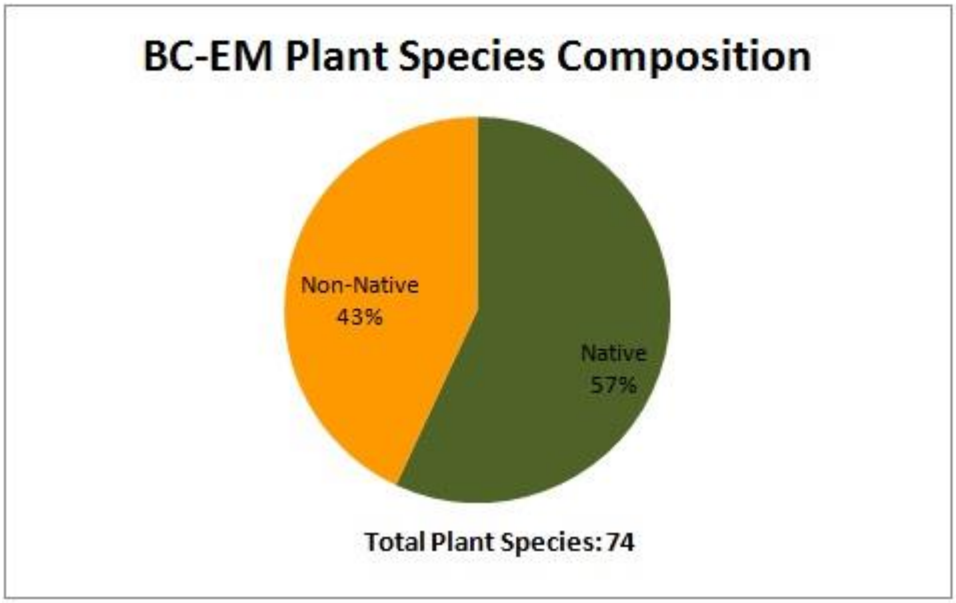
Ecological System: North American Arid West Emergent Marsh

Bear Creek Park Emergent Marsh

Size of assessment area: 11.7 acres **Elevation**: 1631 m

General Description: The Bear Creek Park Emergent Marsh AA is an emergent marsh located on the floodplain that flanks the south side of Bear Creek within the boundary of Bear Creek Park. The wetland is in a depression south of the current river corridor that was likely an active part of the historic floodplain. A bike trail and numerous smaller trails separate this wetland from the river along the floodplain. This site represents one of the widest expanses of non-paved surfaces (also without large expanses of lawns) in the Denver Metropolitan area. Although the area is impacted by storm runoff and other anthropogenic factors, native plants dominate the wetland vegetation. Cattails (*Typha latifolia*) dominate the marsh with showy milkweed (*Ascelpias speciosa*), Indianhemp (*Apocynum cannabinum*), Nuttall's sunflower (*Helianthus nuttallii*) sand bar willow (*Salix exigua*), peachleaf willow (*Salix amygdaloides*) and redosier dogwood (*Cornus sericea*) among some of the native species adding to the biodiversity of the site. Sedges, rushes, spike rushes and bulrushes were also present in the marsh; these species have only been observed at higher quality sites within the County. Smooth brome (*Bromopsis inermis*), crested wheatgrass (*Agropyron cristatum*) and New Mexico locust (*Robinia neomexicana*) are examples of widely planted, non-native species that dominate the drier areas of the wetland. Russian-olive (*Elaeagnus angustifolius*), Kentucky bluegrass (*Poa pratensis*), alfalfa (*Medicago sativa*) and smooth brome readily invade wetlands from nearby sites and is some areas inside the AA were intentionally planted.

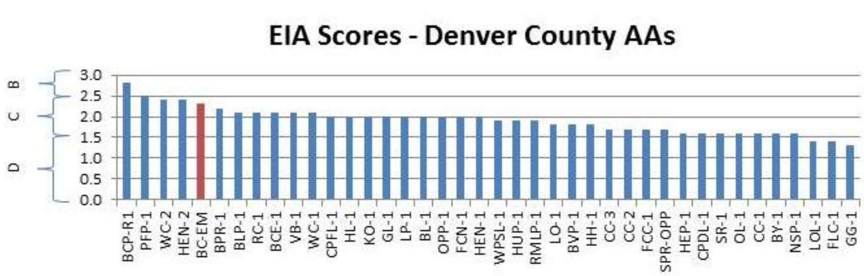
Floristic Composition:



Mean C: 2.28 (CCD Range 0.82-2.84) **FQI= 19.23** (CCD Range 3.05-20.82)

The plant list included 74 different species, 57% were native and the relative cover of native plants was fairly high at 67%. This is reflected in the high Mean C value and overall high floristic quality index score for Denver County.

Key Environmental Factors: This site is unique among the Denver County wetlands surveyed; it is the only site with no dense residential and industrial areas within the 100 meter buffer and less than 50% of dense urban development in the 500 meter buffer. The wetland also appears to have hydrological connectivity to Bear Creek. This is also reflected in the high biodiversity of the site (74 species in 11.7 acres). Another key environmental factor is its location on the south and west boundary of Denver County where it receives water before it reaches the dense urban development of the City. The floristic composition at this site is one of the few areas where the cover is dominated by native plants.



Rank Comments: The overall EIA rank for this site was 2.3 out of a range of 1.3-2.8 for the City and County of Denver. The score fell short of receiving C or moderate rank (2.5-3.4). This is one of the higher quality wetlands within the Denver Metropolitan area and it is due to the fact that dense urban development makes up less than 50% of the 500 meter buffer, 0% of the 100 meter buffer and the hydrological connection to the river is still intact.

Protection Urgency Comments: Every effort should be made to protect this wetland and surrounding undeveloped lands. Maintaining the buffer, without adding impervious surfaces will benefit the wildlife, improve the aesthetic values, water quality and flood control abilities. Weed treatments or soil disturbances should be carefully considered before application so that no harm is done to the water quality or the biodiversity of this site.

Colorado 2014 Noxious Weed List: One List A: hairy willowherb (*Epilobium hirsutum* <2%), five List B: Canada thistle (*Cirsium arvense* <5%), musk thistle (*Carduus nutans*) (<1%), bull thistle (*Cirsium vulgare* <1%), houndstongue (*Cynoglossum officinale* <1%) and Russian-olive (*Eleagnus angustifolia* <1%); and four List C: field bindweed (*Convolvulus arvensis* <1%), cheatgrass (*Bromus tectorum* <1%), poison hemlock (*Conium maculatum* <5%), and burdock (*Arctium minus* <1%), were observed during the survey.

Wildlife Comments: Observations during the survey included abundant birds, butterflies, dragonflies, damselflies and bees.

Recommendations: Canada thistle was the only noxious species with an estimated coverage up to 5%. Clipping the tops of the Canada thistle flowers will reduce the seed bank. This is recommended over herbicide applications to discourage proliferation of smooth brome (*Bromus inermis*) which had a 2-5% cover. The presence of smooth brome, an aggressive non-native grass in the riparian zone, has been shown to increase and lower biodiversity when herbicides are used in riparian zones (Rondeau, R. and A. Lavender 2012 -See section in Discussion on non-native species and herbicide use in urban areas.)

References:

Colorado Natural Heritage Program Field Surveys, July 8, 2013. Field Forms on File at CNHP, Fort Collins, CO.

Rondeau, R. and A. Lavender 2012. Noxious Weed Monitoring at the U.S. Air Force Academy – Year 7 Results April 2012. Colorado Natural Heritage Program www.cnhp.colostate.edu

BEAR CREEK PARK-RIPARIAN (BCP_R1)

EIA Overall Rank: 2.8 C

Biotic Condition: 1.86 D **Hydrologic Condition: 3.80 B**

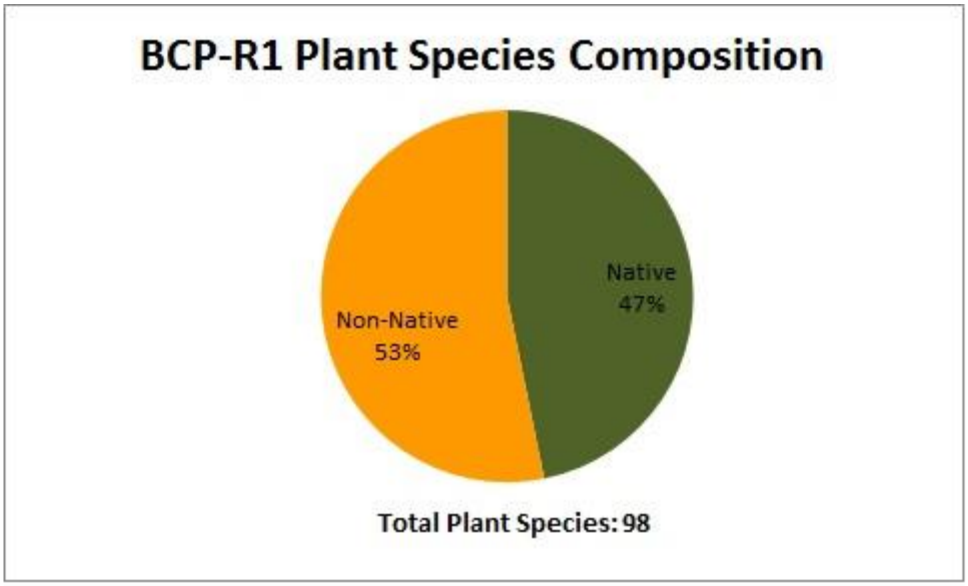
Landscape Context: 3.44 C **Physiochemical Condition: 2.50 D**

Ecological System: Western Great Plains Riparian

Size of assessment area: 15.3 acres **Elevation**: 1618 m

General Description: The Bear Creek Park Riparian AA includes a half of a mile stretch of Bear Creek located in southwest Denver County south of Highway 285 and east of Sheridan Blvd. Bear Creek is a tributary of the South Platte River; the headwaters originate from Summit Lake in Clear Creek County. The site contains high plant diversity (98 species) and consists of a matrix of scrub shrub and forested patches with small areas of emergent wetlands. It is adjacent to the Bear Creek Emergent Marsh AA. The diversity of wildlife species observed is likely a result of the mosaic of habitats. Pockets of emergent vegetation along the channel are dominated by cattails (*Typha angustifolia*) and coyote willow (*Salix exigua*). Plains cottonwood (*Populus deltoides*) and boxelder (*Acer negundo*) are the most common overstory trees found in the floodplain. Several species with that are indicative of high quality habitats were documented here including false indigo bush (*Amorpha fruticosa*), Macoun's buttercup (*Ranunculus macounii*), and giant goldenrod (*Solidago gigantea*). The native aquatic plant species, horned pondweed (*Zannichellia palustris*), has been documented in Bear Creek and in the ponds just north of Kenyon Avenue. This plant species offers food for ducks and cover for fish and macroinvertebrates. The pond nearest to Kenyon Avenue also supports three other native aquatic plant species: curly pondweed *(Potamogeton crispus*), leafy pondweed (*P. foliosus* ssp. *foliosus*), and *Lemna* sp (Majack 2014).

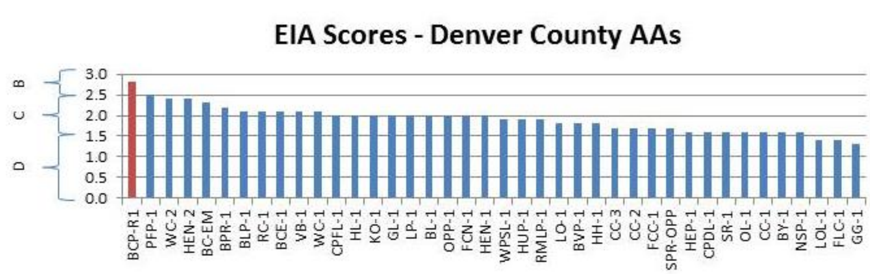
Floristic Composition:



Mean C: 1.67 (CCD Range 0.82-2.84) **FQI: 16.06** (CCD Range 3.05-20.82)

There were 98 plant species on the plant list making this a highly diverse area, 47% of the species on the list were native and the relative native cover was 53% which is excellent for an urban park. The Mean C value and FQI metrics were average for the AAs in Denver County.

Key Environmental Factors: This AA has one of the least developed landscapes compared to the other AAs in urban Denver and it is connected to wetlands upstream and downstream. Plant species diversity is very high for an urban wetland with 98 total species.



Rank Comments: The EIA Score and Rank of 2.8 (C) is the highest score of all of the urban wetlands in Denver County evaluated during the project. The Landscape Context score of 3.44 is high compared to other AAs as is the Hydrological Condition of B. The quality of the buffer is one of the largest contributing factors to these high scores. This site serves as an island of biodiversity in Denver with diverse habitats and highly functioning wetlands.

Protection Urgency Comments: This is the number one ranked AA in our survey for Denver County. This AA matched one of the Denver Mountain Park scores (Dedisse Park). Every effort should be made to protect this site. The low development of the surrounding lands should be maintained to protect the quality of this site.

Colorado 2014 Noxious Weed List: List A (<1%): purple loosestrife (*Lythrum salicaria*); List B (<1-2%) : Canada thistle (*Cirsium arvense*), Russian-olive (*Elaeagnus angustifolia*), teasel (*Dipsacus fullonum*), whitetop (*Cardaria draba*), broadleaved pepperweed (*Lepidium latifolium*), houndstongue (*Cynoglossum officinale*), leafy spurge (*Euphorbia esula* var. *uralensis*) ; List C <1%): poison hemlock (*Conium maculatum*), common mullein (*Verbascum thapsus*), field bindweed (*Convolvulus arvensis*), chickory (*Chicorium intybus*), quackgrass (*Elymus repens 2-5%*) and burdock (*Arctium minus*). One List B species, Dalmatian toadflax (*Linaria dalmatica*) is known from the park (pers.comm. Kelly Uhing 2015).

Wildlife Comments: The complex vegetation structure and diverse habitat provides excellent wildlife habitat. Signs of beaver activity were observed. Abundant insect activity was observed including butterflies, dragonflies, native bees, and damselflies.

Recommendations: To preserve the biodiversity and the wildlife habitat, protecting the lands surrounding this AA are of utmost importance. Continue to protect the undeveloped surrounding lands; decrease the acreage of impervious surfaces and lawn acreage where possible by allowing shoreline vegetation to expand. Consideration should be given to environmentally friendly landscaping techniques for the surrounding landscape. The wetland vegetation will regenerate successfully with intact hydrological features. These efforts will not only increase the aesthetic and recreational values, but enhance the ecological services this site is providing to the community. The use of pesticides and herbicides in the wetland corridor is not recommended because of the presence of smooth brome and to protect water quality and native species. Efforts should be made to maintain the cover of native aquatic plants in Bear Creek and the pond nearest to Kenyon Ave.

References:

Colorado Natural Heritage Program Field Surveys. July 9, 2013. Field Forms on File at CNHP, Fort Collins, CO.

Majack, M.L. The vascular flora of Denver, Colorado: A case study of floristics in the twenty-first century in Contributions to the flora of Colorado. Master's thesis, University of Colorado Denver, 2014.

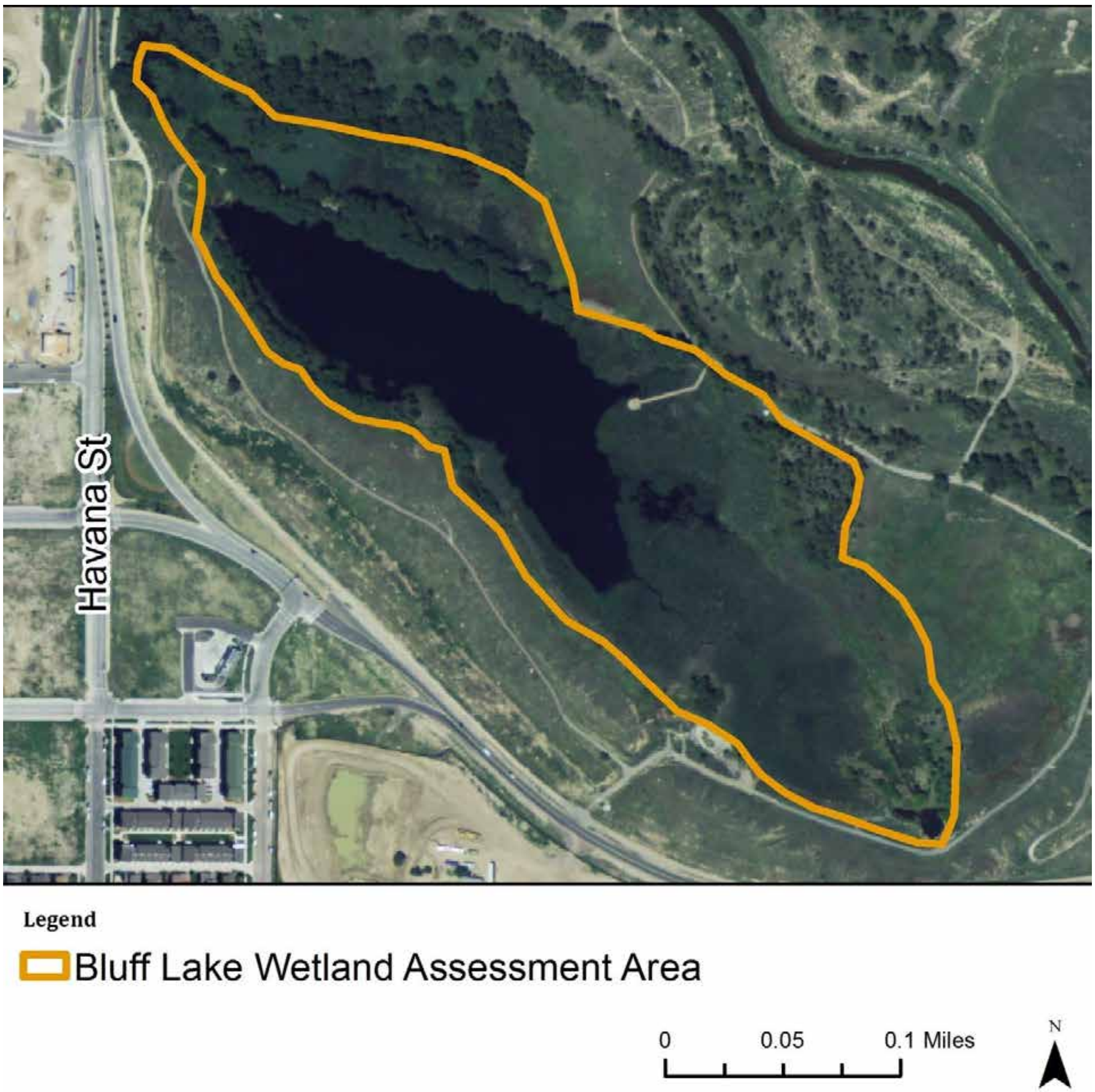
BLUFF LAKE (BL_1)

EIA Overall Rank: 2.0 D

Biotic Condition: 2.23 D **Hydrologic Condition: 1.40 D**

Landscape Context: 2.54 C **Physiochemical Condition: 1.50 D**

Ecological System: North American Arid West Emergent Marsh

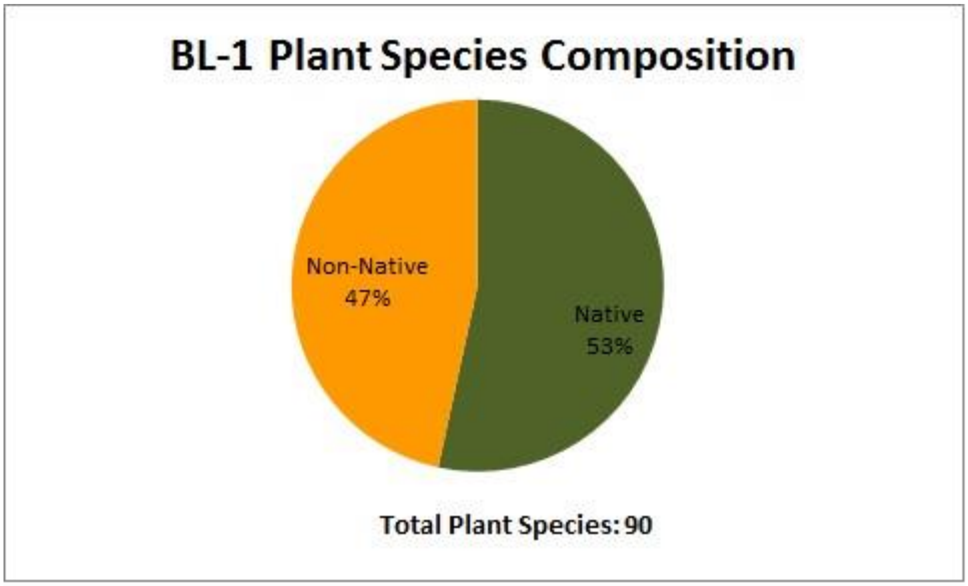


Bluff Lake

Size of assessment area: 27.4 acres **Elevation**: 1618 m

General Description: The Bluff Lake AA includes an emergent marsh dominated by cattails (*Typha latifolia, T angustifolia*) with small areas of forested and shrub wetlands dominated by cottonwoods (*Populus deltoides*) and coyote willow (*Salix exigua*). An old dam structure around 100 years old is included in the northeast portion of the AA. The wetland water level fluctuates widely from year to year and can be dry for parts of the year (Personal communication Chris Story, site manager August 14, 2014). A significant water source is stormwater which enters from a large pipe on the southeast side. This condition assessment was conducted during a wet season and standing water was present. The location of the AA adjacent to Sand Creek, suggests this wetland is in the floodplain and the hydrology is still connected to the creek. A high water table supports the dense growth of cattails and other wetland plants even during dry seasons. The buffer lands surrounding the wetland support a variety of interesting prairie species including yerba mansa (*Anemopsis californica*), croton (*Croton texensis*) and green needle grass (*Nasella viridula*). Searches of local herbarium records for both wetland and upland sites at the Bluff Lake Nature Center show at least 285 species (upland and wetland) are present in the area.

Floristic Composition:

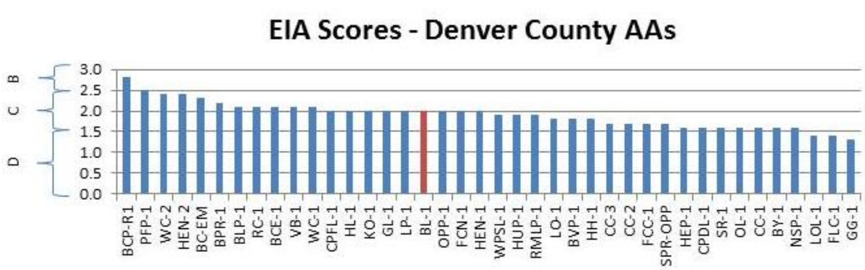


Mean C: 1.98 (CCD Range 0.82-2.84) **FQI: 18.33** (CCD Range 3.05-20.82)

The plant list included 90 different species in the wetland with 53% native species and a relative cover of native species at 69% which is high for an urban setting. This is reflected in the high Mean C and FQI scores.

Key Environmental Factors: The low development in the surrounding upland buffer areas which were found to have a large variety of native prairie species is a very important environmental factor that likely protects and enhances this wetland site. The Landscape Context score in the C range and the Biotic Condition scores were both relatively high compared to other urban Denver sites.

Land Use History: It is in the original buffer zone for the former Stapleton Airport.



Rank Comments: This survey area was ranked 2.0 for the overall EIA score. For Denver County, the overall EIA ranks ranged from a high of 2.8 (C) to 1.3 (D). Of the 40 sites in Denver County there was a range of 13 different numerical scores. Eight other sites also scored a 2.0 overall EIA, placing this AA at number 7 out of the 13 possible scores which is in the medium range. The landscape context rank was quite high for this site reflecting the low development in the surrounding buffer lands. The plant diversity and native plant cover were high and were reflected in the fairly high Biotic Condition score for this site. The Hydrologic Condition is not as high as the other scores because of the miles of storm drains that feed the wetland and the dam structure within the AA.

Protection Urgency Comments: The entire area that includes both the AA and the surrounding buffer lands are extremely important to protect. The AA is a central portion of the Bluff Lake Natural Area which is a very busy private environmental education center that provides many experiences for local school children and other citizens. It is a significant area for wildlife and provides important flood control, runoff containment, water quality enhancement and groundwater recharge.

Colorado 2014 Noxious Weed List: Eight List B: (<1%): Canada thistle (*Cirsium arvense*), leafy spurge (*Euphorbia esula*), Scotch thistle (*Onopordum acanthium*), Russian knapweed (*Acroptilon repens*), houndstongue (*Cynoglossum officinale*), Russian-olive (*Elaeagnus angustifolia*), cutleaf teasle (*Dipsacus laciniatus*), and musk thistle (*Carduus nutans*. Six List C (<1%) : field bindweed (*Convolvulus arvensis*), mullein (*Verbascum thapsus*), moist sowthistle (*Sonchus uliginosus*), field sowthistle (*Sonchus arvensis*), quackgrass (*Elymus repens* 1-2%) and burdock (*Arctium minus*). One Watch List: <2%: common reed (*Phragmites australis*).

Wildlife Comments: Bird observations: Western Kingbird, Mallard (with ducklings), Barn Swallow, American Goldfinch, American Robin, Mourning Dove, Red-winged Blackbird, black capped chickadee, house finch, American crow, snowy egret, Black-crowned Night Heron (immature), Canada Goose, Common Grackle, Northern Flicker, Song Sparrow, Red-tailed Hawk (immature), Broad-tailed Hummingbird and Yellow Warbler. Amphibian observations: Woodhouse toads including adults, juveniles and tadpoles were observed at the site. Animal observations: beaver, red squirrel, mice, cottontail rabbit, and mule deer. Insects and other invertebrate observations: mosquito, dragonfly, stonefly, snail, damselfly, and milkweed borer beetle.

Recommendations: Keeping the existing buffer lands surrounding this wetland undeveloped should be a high priority. Adding paved roads and impervious surfaces should be avoided or kept to an absolute minimum. Allowing the existing buffer to remain and provide filtration, contribute to the plant biodiversity and wildlife habitat would go a long way to protect this important natural area.

References: Colorado Natural Heritage Program Field Surveys. August 14, 2014. Field Forms on File at CNHP, Fort Collins, CO.

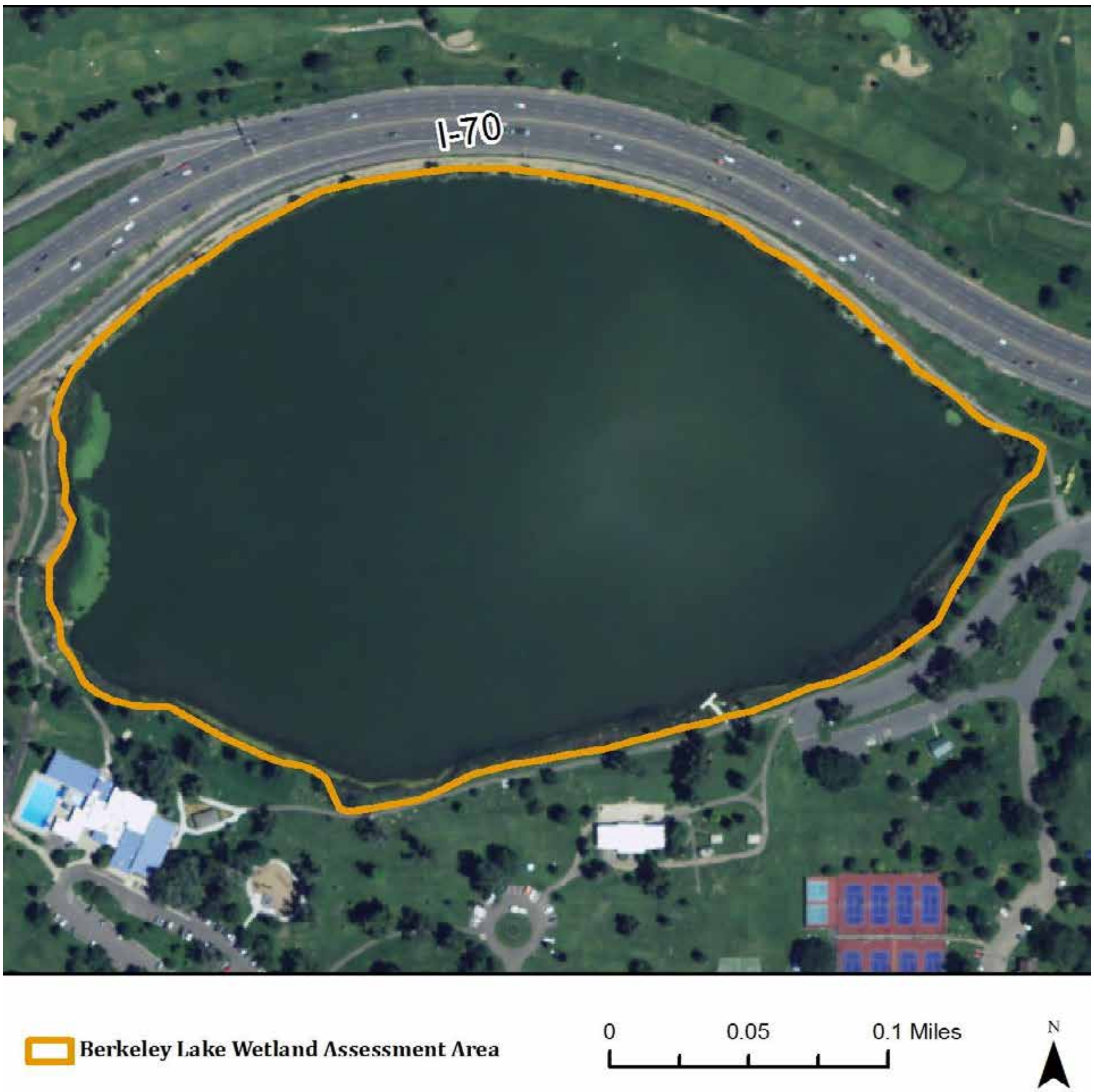
BERKELEY LAKE PARK (BLP-1)

EIA Overall Rank: 2.1 D

Biotic Condition: 2.85 C **Hydrologic Condition: 2.00 D**

Landscape Context: 1.27 D **Physiochemical Condition: 1.00 D**

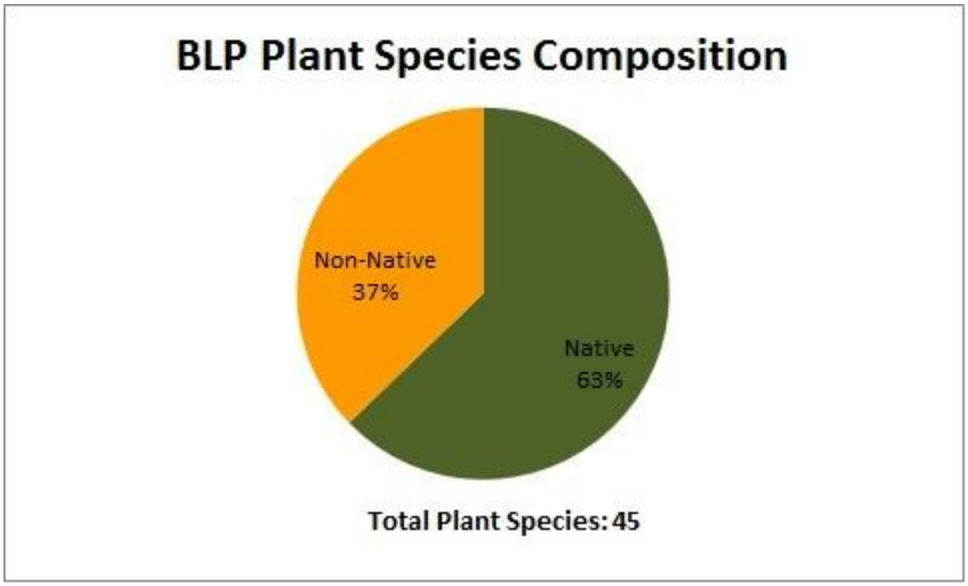
Ecological System: North American Arid West Emergent Marsh



Size of assessment area: 37 acres **Elevation**: 1646 m

General Description: The Berkeley Lake AA is large compared to other lakes in the survey. It supports an extensive fringe of wetland vegetation with a unique and diverse assemblage of native wetland plant species. The shrub layer includes native willows (*Salix exigua, S. amygdaloides*), several species of bulrushes *Schoenoplectus* spp.), cattalis (*Typha* spp.), narrowleaf cottonwood (*Populus angustifolia*), rushes (*Juncus* spp.), buttercups (*Ranunculus* spp.), wild licorice (*Glycchrizia lepidota*) and water mudwort (*Limosella aquatica*). A maintained bluegrass lawn surrounds the AA and a paved trail circles the lake. Photos of the lake from the early 1900s show the lake has been popular for many years. This basin has been manipulated and modified over the years but most recently construction on the north side required draining the lake in 2011. Water quality ponds have been built around the perimeter to filter some of the runoff. The maximum depth of the lake is approximately 10 feet with an average depth of 6.5 feet. Arsenic has been identified as a known contaminant in the water column (pers.comm A. Polonsky July 2014). The shoreline is compacted from fishing and foot traffic. However, Berkeley Lake is one of the few Denver Lakes with aquatic macrophytes including Canadian waterweed (*Elodea canadensis*), leafy pondweed (*Potamogeton foliosus* ssp. *foliosus*), horned pondweed (*Zannichellia palustris*), and turion duckweed (*Lemna turionifera*). The non-native European white waterlily (*Nymphaea alba*) as well other non-native waterlilies (Majack 2014). However, the lake appears to be treated every year with herbicides to prevent growth of macrophytes. A ring of emergent marsh vegetation dominated by cattails surrounds about 35% of the lake with few shrubs. A state rare (G4?S1) plant, sweet flag (*Acorus calamus*) was noted at this site in the emergent zone (see section in Discussion on aquatic macrophytes in urban lakes).

Floristic Composition:



Mean C: 2.26 (CCD Range 0.82-2.84) **FQI: 14.66** (CCD range 3.05-20.82)

The species list for the site includes 45 different species, 63% are native and the relative cover of native species is very high at 75%. The Mean C and FQA values are good which is reflected in the Biotic Condition score of 2.85 C and is the second highest score for the 40 AAs in Denver County.

Key Environmental Factors: The wetland fringe that has developed around the lake supports a unique variety of wetland plant species. A population of seaside arrowgrass (*Triglochin maritima*), a wide variety of native, floating and submerged aquatic plants that were not found at any other park in this survey set this AA apart. An interesting water lily hybrid that appears to be specific to Berkeley Lake has been named as *Nymphaea* “Berkeley Lake” hybrid #15 (Denver Botanic Gardens). The vegetated fringe and aquatic plants contribute to valuable wildlife habitat especially for birds and fish. This buffer also serves to enhance water quality by providing capture for contaminants and sediments in runoff and by providing habitat for uncommon plants.

Land Use History: The source water for Berkeley Lake was originally Rocky Mountain Ditch water when the park and the lake were constructed around the turn of the century. A golf course was added to the north end of the lake in 1935. In 1965, construction of I-70 modified the lake removing 15 acres of land (7 lake acres) changing the north shore. The lake was excavated to make it deeper to compensate for the loss in surface area (Dudley, M. 2004). In 2011, the lake was drained for construction on the north side and small water quality ponds were constructed.

Rank Comments: The AA ranked 2.1 for the overall EIA score. For Denver County, the overall EIA ranks ranged from a high of 2.8 (C) to 1.3 (D). Of the 40 sites in Denver County there was a range of 13 different numerical scores. Five other sites also scored a 2.1 overall EIA, placing this AA at number 6 out of the 13 possible scores which is in the medium range. The Biotic Condition score for this AA was the second highest of all 40 AAs in urban Denver.

Protection Urgency Comments: This was one of the few study areas with a moderate or C rank for the Biotic Condition score. This AA offers an array of significant benefits and contains state rare and uncommon plant species.

Colorado 2014 Noxious Weed List: One List B >2%, Canada thistle (*Circium arvense*); one List C: cheat grass (*Bromus tectorum* <1%) and one Watch List: yellow flag iris (*Iris pseudacorus* <1%).

Wildlife Comments: During the survey numerous large crayfish were observed and were being caught in traps. Bullfrogs were common in the water quality ponds. Damselflies, common green darner dragonflies, water boatman and a variegated meadowhawk dragonfly were observed. Fish observed included black bullheads and carp. Bird observations included: Double-crested Cormorants, Mallard adults and young, American Coots, Clark's Grebes, Red-winged Blackbirds, Hooded Merganser, Gadwalls, Spotted Sandpipers, Cliff Swallows, Common Grackles, Yellow Warbler and an American Robin were observed.

Recommendations: Expand the shoreline fringe of vegetation by reducing the amount of mowed and manicured area adjacent to the lakeshore and by allowing aquatic macrophyte growth. The native vegetation fringe along the lake shore not only provides wildlife habitat, helps to clean the surface runoff to the lake but it provides enhanced experiences for people who visit the park. There are also a number of rare and uncommon plant species. The eradication of aquatic plants is not recommended. Both the native and non-native water milfoils (*Myriophyllum sibiricum, M. spicatum* respectively) are present, as well as other native aquatics like coontail (*Ceratophyllum demersum*) and leafy pondweed (*Potamogeton foliosus*). These aquatic species provide excellent habitat for fish and aquatic macroinvertibrates, and provide important food for birds and insects. Aquatic plants provide many benefits to the lake system (see section in Discussion on aquatic macrophytes). The growth of aquatic plants and reduction of mowing in the vicinity of the lake fringe would allow more wetland vegetation to regenerate, thus improving the water quality and wildlife habitat (State of Washington 2014). The public would benefit from the improved aesthetics and might also decrease the Canada Goose population. Some non-native plants were treated with herbicides that are not on the noxious weed list (i.e. alfalfa (*Medicago sativa* - see section in the Discussion on herbicide use and non-native species in urban settings).

References:

Colorado Natural Heritage Program Field Surveys. 2014. Field Forms on File at CNHP, Fort Collins, CO.

Dudley, M. 2004. Lake Management and Protection Plan, City and County of Denver, April 2004. Prepared for Gayle Weinstein, Natural Areas Unit Department of Parks and Recreation.

Majack, M.L. The vascular flora of Denver, Colorado: A case study of floristics in the twenty-first century in Contributions to the flora of Colorado. Master's thesis, University of Colorado Denver, 2014.

State of Washington. 2014. Native Freshwater Plants: Aquatic Plants and Lakes. Access Washington Department of Ecology,: http://www.ecy.wa.gov/programs/wq/plants/native/uses.html accessed November 2014.

BIBLE PARK RIPARIAN (BPR-1)

EIA Overall Rank: 2.2 D

Biotic Condition: 2.15 D **Hydrologic Condition: 3.20 C**

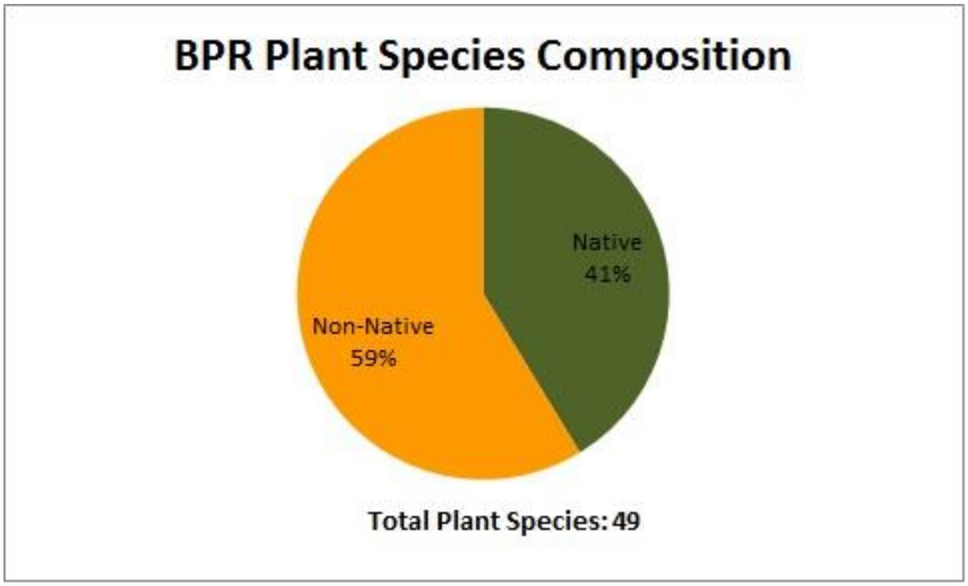
Landscape Context: 0.70 D **Physiochemical Condition: 2.00 D**

Ecological System: North American Arid West Emergent Marsh

Size of assessment area: 4.5 acres **Elevation**: 1675 m

General Description: The Bible Park Riparian AA lies just west of S. Quebec Street and includes about a half mile of wetland area between Yale Avenue on the north and Eastman Avenue on the south. The stream is largely unconfined but is allowed to meander within the Bible Park boundary. It is circled by the Highline Canal which is not part of the AA and was dry during this survey. The area includes both native and non-native wetland species as does the buffer. Cottonwoods (*Populus deltoides, P. x acuminata*) dominate the overstory of the forested section with sandbar willow (*Salix exigua*) and peachleaf willow (*Salix amygdaloides*) common in the shrub layer. A diversity of herbaceous plants was observed including a rather uncommon plant known as erect smartweed (*Polygonum erectum*), which was observed in the herbaceous layer along with a variety of bulrushes, Nuttall's sunflower (*Helianthus nuttallii*), wild cucumber (*Echinocystis lobata*) and showy milkweed (*Asclepias speciosa*). The stream has a sandy bottom; storm sewer drains were common in the AA. Dead plants from high runoff flows and overbank flooding were observed. Sedimentation, undercutting and algal growth were also observed. The northern section of the stream includes some large boulders that constrict the flow in that area. The north end is forested while the south section is dominated by shrubs and herbaceous growth.

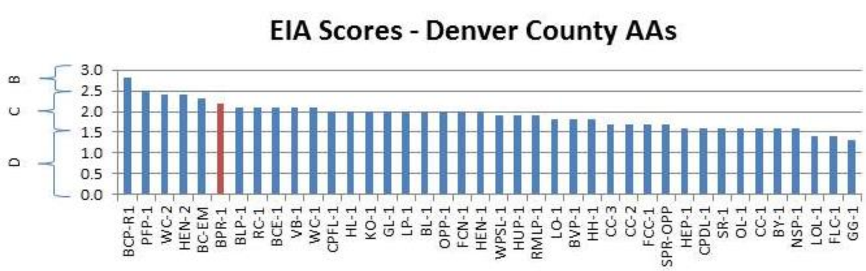
Floristic Composition:



Mean C: 1.77 (CCD Range 0.82-2.84) **FQI: 11.76** (CCD Range 3.05-20.82)

The plant list included 49 different species with 41% native and a relative cover of native species at 55% which is very good for an urban wetland.

Key Environmental Factors: Forested wetland and shrub communities that provide excellent wildlife habitat and buffer land for surface runoff are key environmental factors which are the driving reasons for the high (C range) Hydrological Condition score. In addition, an uncommon native plant which has been collected infrequently over the years: erect smartweed was observed. This wetland is likely not natural but the result of seepage from the Highland Canal. However, the area has been wet long enough to develop a mature forested canopy along the stream with associated wetland shrubs and herbaceous growth with excellent wildlife habitat.



Rank Comments: The biotic and hydrologic condition scores at this site were high and contribute to the relatively high score of 2.2 (CCD range 1.3-2.8). Of the 40 sites in Denver County there was a range of 13 different numerical scores. Only this site scored a 2.2 overall EIA, placing this AA at number 5 out of the 13 possible scores which is in the medium high range.

Protection Urgency Comments: Bible Park has one of the rarest wetland types (forested wetlands) in Denver County. The mature overstory especially benefits wildlife and provides significant hydrological benefits. Protecting the natural features of this park and maintaining the buffer in a natural state should be a priority. This is one of the few areas where the stream has room to meander.

Colorado 2014 Noxious Weed List: Four List B: cutleaf teasel (*Dipsacus laciniatus* <1%), Canada thistle (*Cirsium arvense* <5%), Russian-olive (*Elaeagnus angustifolia* <1%) and leafy spurge (*Euphorbia esula* <1%); three List C: quack grass (*Elymus repens* <1%), poison hemlock (*Conium maculatum* <5%) and field bindweed (*Convolvulus arvensis* <1%); and one Watch List: garlic mustard (*Alliaria petiolata* 2-5%). One List B species, Dalmatian toadflax (*Linaria dalmatica*) is reported from this park (pers. comm. Kelly Uhing 2015).

Wildlife Comments: Yellow warblers, woodpeckers and red tailed hawks were observed in the forest canopy during the survey. Blue damselfies and a dead crayfish were noted in the understory. A nesting Red-tailed hawk was observed along the riparian zone in mature cottonwood tree.

Recommendations: The retention of even a few feet of vegetated shoreline near wetlands, reduce sediment and chemical concentrations before water flows into the stream. This will also increase wetland habitat for wildlife. Switching to more environmentally friendly landscaping with low chemical use and less mowing would enhance the ecological and social benefits to the site.

References:

Colorado Natural Heritage Program Field Surveys. June 17, 2014. Field Forms on File at CNHP, Fort Collins, CO.

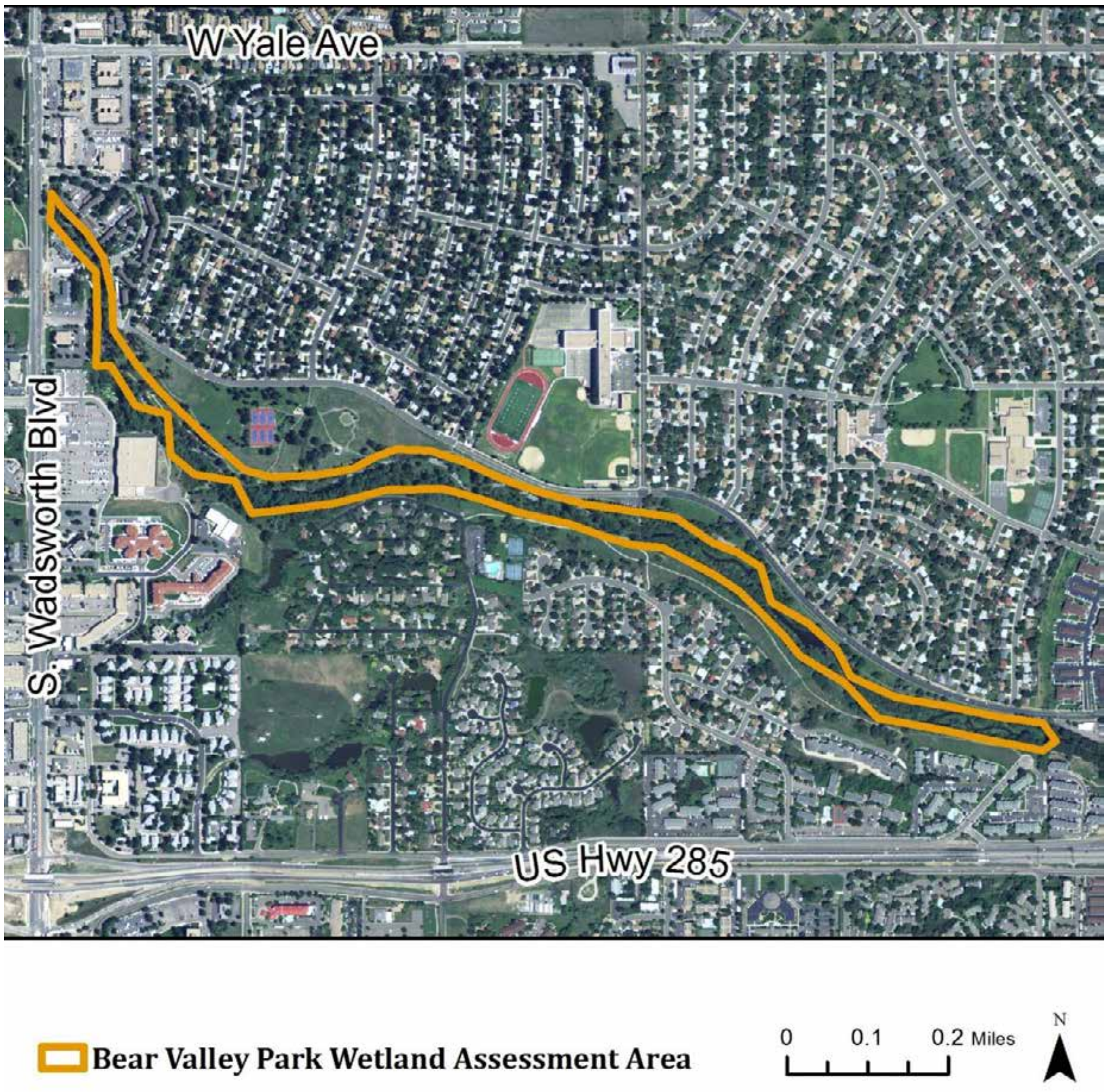
Bear Valley Park (BVP_1)

EIA Overall Rank: 1.8 D

Biotic Condition: 1.66 D **Hydrologic Condition: 2.00 D**

Landscape Context: 1.60 D **Physiochemical Condition: 2.00 D**

Ecological System: Western Great Plains Riparian

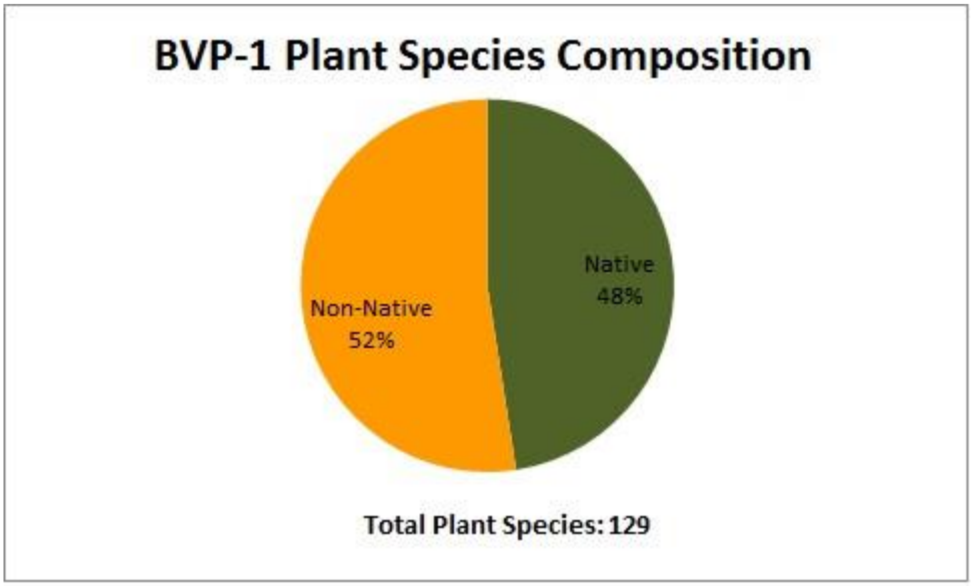


Size of assessment area: 33.4 acres **Elevation**: 1637-1650 m

General Description: The Bear Valley Park AA contains a 1.5 mile stretch of Bear Creek. Culverts that convey urban runoff to the creek were observed within the AA.

Plant species diversity was very high with 129 species. The floodplain of the creek is forested, and the overstory is dominated by plains cottonwood (*Populus deltoides*). The banks are lined with extensive stands of coyote willow (*Salix exigua*). Green ash (*Fraxinus pennsylvanica*) and crack willow (*Salix fragilis*) are present in patches along the floodplain. The understory is dominated by smooth brome (*Bromus inermis*), reed canarygrass (*Phalaris arundinacea*), and climbing nightshade (*Solanum dulcamara*). The streambed contains submerged aquatics including leafy pondweed (*Potamogeton foliosus*). Many insects and birds were present at the time of survey. Bullfrogs (*Lithobates catesbeianus*), considered non-native in Colorado, were also present.

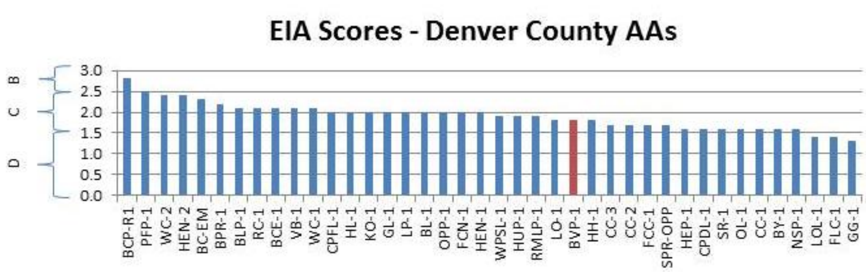
Floristic Composition:



Mean C: 1.89 (CCD Range 0.82-2.84) **FQI: 20.82** (CCD Range 3.05-20.82)

There were 129 species of plants on the species list with 48% native and a 48% relative cover of native species. The FQI for this AA was the highest among all of the Denver County AAs. However, the overall Biotic Condition score is low (1.66 D) due to the high cover of non-native species including reed canary grass (*Phalaris arundinacea*) and cattails (*Typha* spp.).

Key Environmental Factors: This site is part of a five mile stretch of Bear Creek that begins at Bear Creek Reservoir. This reach of the creek contains some of the longest stretches of continuous wetlands within the Denver Metro area. The FQI was very high (highest of all AAs in Denver County) because of the overall biodiversity of the site. The buffer, unlike Bear Creek Emergent Marsh and Bear Creek Riparian AAs, is very small resulting in a low Landscape Context score.



Rank Comments: This AA had the highest FQI score of all of the urban Denver study sites. The overall EIA score of 1.8 reflects the higher hydrology and physiochemical scores. For Denver County, the overall EIA ranks ranged from a high of 2.8 (C) to 1.3 (D). Of the 40 sites in Denver County there was a range of

13 different numerical scores. Three other sites also scored a 1.8 overall EIA, placing this AA at number 10 out of the 13 possible scores which is in the low-medium range.

Protection Urgency Comments: This site is part of a stretch of riparian wetlands along Bear Creek that is one of the longest observed in urban Denver. Despite its lack of buffer, plant species diversity is very high at the site (129 species) and the types of native plants also indicate this AA supports excellent wildlife habitat. An observation of the northern leopard frog was reported at the site. The manicured lawn area could be reduced and would help protect and enhance the integrity of the biological resources at this site.

Colorado 2014 Noxious Weed List: Two <u>List A (<1%):</u> purple loosestrife (*Lythrum salicaria*) and <u>(<1%):</u> hairy willow-herb (*Epilobium hirsutum*); Twelve <u>List B (<1%):</u> Canada thistle (*Cirsium arvense*), Russian-olive (*Elaeagnus angustifolia*), leafy spurge (*Euporbia esula*), teasel (*Dipsacus fullonum*), moist sowthistle (*Sonchus uliginosus*), poison hemlock (*Conium maculatum*), broadleaved pepperweed (*Lepidium latifolium*), bouncingbet (*Saponaria officinalis*), Scotch thistle (*Onopordum acanthium*), tamarisk (*Tamarix ramosissima*) musk thistle (*Carduus nutans*), and houndtongue (*Cynoglossum officinale*) <u>Four List C (<1%):</u> field bindweed (*Convolvulus arvensis*), burdock (*Arctium minus*), quackgrass (*Elymus repens*), and chickory (*Chicorum intybus*).

Invasive garden escapes: Bluebells (*Campanula rapunculoides*) and crown vetch (*Securigera varia*).

Wildlife Comments: Because of the high biodiversity, this area offers high quality wildlife habitat compared to other sites in urban Denver. Wildlife observations during the survey included crayfish, fish, bullfrogs, meadow voles, recent beaver tree-fall, deer tracks, bobcat tracks, raccoon tracks and an old beaver dam. Bird species observed included: Mallards, Northern Flickers, American Robins, Double-crested Cormorant, Red-winged Blackbird, Rock Dove, Common Grackles, Chipping Sparrows, Yellow Warbler, Blue Jay, Mourning Dove, European Starlings, and American Crow. Western tiger swallowtail butterflies and two-tailed tiger swallowtails were observed mudding along the lakeshore.

Recommendations: Efforts should be made to limit the installation of more impervious surfaces and planted lawn in the buffer. The reduction of mowed areas next to the wetland vegetation could also be beneficial for providing buffer to filter runoff and protect existing vegetation. Since there was an observation of the state rare northern leopard frog (*Lithobates pipiens*) during this survey, an amphibian survey is recommended. Mowing and herbicide treatment should be avoided in and around the wetland as smooth brome is present in the riparian zone and can outcompete other native species with the use of certain herbicides (see Discussion section on herbicide use).

References: Colorado Natural Heritage Program Field Surveys. August 6, 2013. Field Forms on File at CNHP, Fort Collins, CO.

Babi-Yar Park (BY_1)

EIA Overall Rank: 1.6 D

Biotic Condition: 1.45 D **Hydrologic Condition: 1.70 D**

Landscape Context: 2.03 D **Physiochemical Condition: 1.50 D**

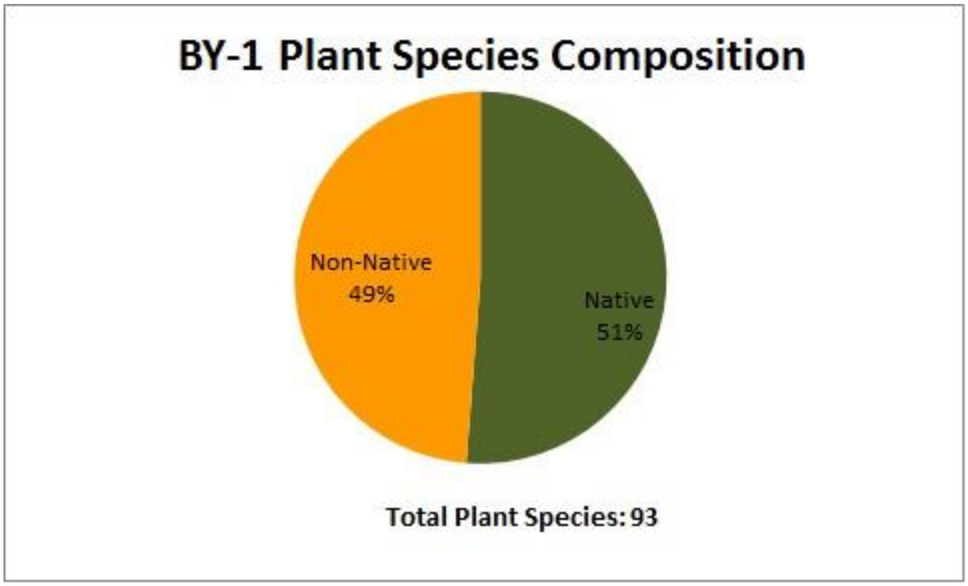
Ecological System: Western Great Plains Riparian

Babi-Yar Park

Size of assessment area: 3.4 acres **Elevation**: 1667 m

General Description: The Babi-Yar Park AA is located within a memorial dedicated to victims of a massacre that took place in Ukraine in 1941. The site contains a small perennial stream. The stream channel is lined with metal culverts and large amounts of rip rap and rope rolls have been placed along the channel to prevent erosion. Efforts to establish native vegetation have been made, and planted cottonwoods can be found growing along the channel. The dominant overstory species present at the site are plains cottonwood (*Populus deltoides),* crack willow (*Salix fragilis*), American plum (*Prunus americana*), a cultivated plum species (*Prunus* sp.), and softstem bulrush (*Schoenoplectus tabernaemontani*). Weedy species are present such as leafy spurge (*Euphorbia esula*) and diffuse knapweed (*Acosta diffusa).* The uplands surrounding the site have been planted with a diverse seed mix of native prairie species including bush morning glory (*Ipomoea leptophylla)*, prairie spiderwort (*Tradescantia occidentalis*), and buffalograss (*Buchloe dactyloides*).

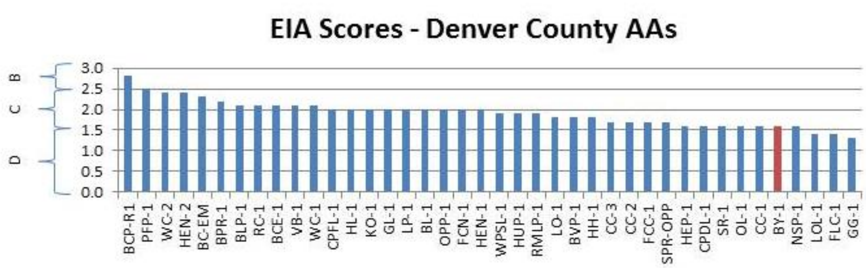
Floristic Composition:



Mean C: 2.04 (CCD Range 0.82-2.84) **FQI: 18.33** (CCD Range 3.05-20.82)

There were 93 different species of plants on the species list for the AA with 51% native species and a relative cover of native species at 57%.

Key Environmental Factors: This site is located adjacent to the Hentzell Park AA. Although the wetlands have a relatively low Overall EIA rank they are connected to more high quality wetlands at Hentzell Park. Together, these are remnants of the wetland complex along Cherry Creek that likely used to be extensive. Today, development is present on all sides of both of these wetlands, and the only vegetated buffer is a golf course. The restoration efforts conducted at Babi-Yar are an excellent starting place for improving buffer conditions and erosion problems along the stream.



Rank Comments: This survey area was ranked 1.6 for the overall EIA score. For Denver County, the overall EIA ranks ranged from a high of 2.8 (C) to 1.3 (D). Of the 40 sites in Denver County there was a range of 13 different numerical scores. Six other sites also scored a 1.6 overall EIA, placing this AA at number 11 out of the 13 possible scores which is in the low medium range. This site received a lower rank due to the small size of the vegetated buffer. The site is surrounded by urban development. The narrow buffer that is present consists of areas that have been planted with a diverse mix of native prairie species.

Protection Urgency Comments: Efforts should be made to protect this site and the adjacent Hentzell Park, as they form a small but important pocket of wetlands in an otherwise urban landscape.

Colorado 2014 Noxious Weed List: Four List B: diffuse knapweed (*Acosta diffusa* <1%), Canada thistle (*Cirsium arvense* <2%), Russian-olive (*Elaegnus angustifolia* <2%) and leafy spurge (*Euphorbia esula* <1%); Five List C: quackgrass (*Elymus repens* <5%),field sowthistle (*Sonchus arvensis* <1%), field bindweed (*Convolvulus arvensis* >1%), storksbill fritillary (*Erodium cicutarium* <1%) and common mullein (*Verbascum thapsus* <1%).

Wildlife Comments: Water striders, dragonflies and a Red-tail Hawk were observed during the survey.

Recommendations: The restoration efforts at this site help improve habitat diversity for wildlife and insects, and less herbicide use and mowing would help improve water quality.

References: Colorado Natural Heritage Program Field Surveys. July 23, 2013. Field Forms on File at CNHP, Fort Collins, CO.

Cherry Creek (CC_1)

EIA Overall Rank: 1.6 D

Biotic Condition: 1.36 D **Hydrologic Condition: 2.50 D**

Landscape Context: 1.00 D **Physiochemical Condition: 1.50 D**

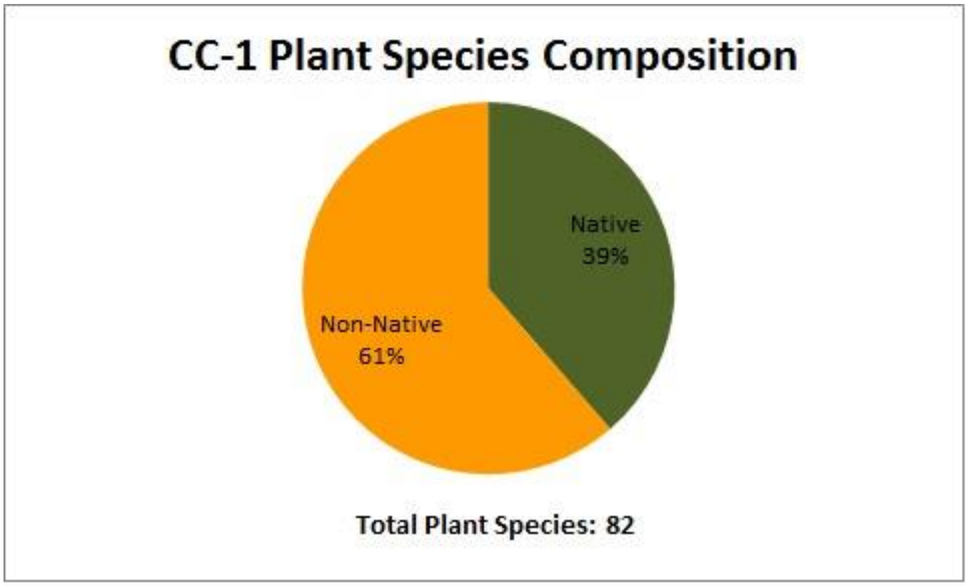
Ecological System: Western Great Plains Riparian

Cherry Creek

Size of assessment area: 6.2 acres **Elevation**: 1629 m

General Description: The Cherry Creek AA is located along a 700 meter (half mile) stretch of Cherry Creek that lies just south of the Cherry Creek Shopping Mall. There were six culverts within the AA, the sedimentation is very high and erosion is common on the banks. The forested banks provide wildlife habitat. Common woody species included plains cottonwood (*Populus deltoides*), common buckthorn (*Rhamnus cathartica*), chokecherry (*Prunus* cultivars), green ash (*Fraxinus pennsylvanica*), crack willow (*Salix fragilis*) and western snowberry (*Symphoricarpos occidentalis*). A wide variety of herbaceous plants included: great ragweed (*Ambrosia trifida*), annual sunflower (*Helianthus annus*), American licorice (*Glycyrrhiza lepidota*), wild cucumber (*Echinocystis lobata*), green bulrush (*Scirpus microcarpus*) and riverbank grape (*Vitis riparia*).

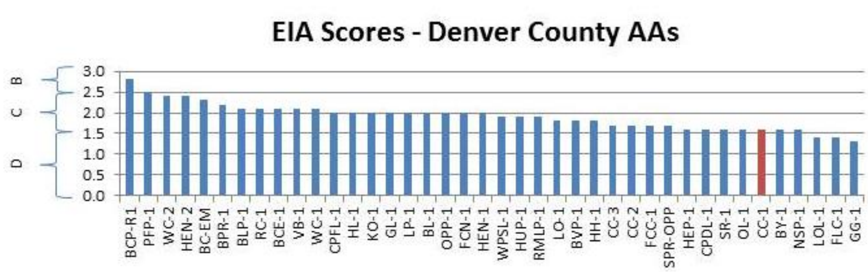
Floristic Composition:



Mean C: 1.45 (CCD Range 082-2.84) **FQI: 12.44** (CCD Range 30.5-20.82)

There were 82 different species of plants on the species list with 39% native and a 23% relative cover of native plants.

Key Environmental Factors: This site is located along Cherry Creek, next to the City of Karmiel and City of Takayama Park assessment area. These two sites contain wetlands that have been altered by heavy urban development. When precipitation events occur in the area, the creek rapidly rises. The banks have been scoured by this flash flooding, and the soil profile along the riparian corridor contains very deep deposits of sand. This site received a low D rank due to its lack of buffer, altered hydrology, and surrounding heavy urban development. However, the site does support 82 plant species along with a diversity of wildlife species.



Rank Comments: This AA ranked 1.6 for the overall EIA score. For Denver County, the overall EIA ranks ranged from a high of 2.8 (C) to 1.3 (D). Of the 40 sites in Denver County there was a range of 13 different numerical scores. Six other sites also scored a 1.6 overall EIA, placing this AA at number 11 out of the 13 possible scores which is in the low medium range. This site received a low D rank due to the lack of a vegetated buffer. The site is surrounded by urban development. The narrow buffer that is present is low quality consisting of manicured park lawns.

Protection Urgency Comments: Efforts should be made to protect creek and its vegetated shoreline, along with the adjacent City of Karmiel site, as it provides some of the only wildlife habitat in this part of Denver and is connected to the Cherry Creek watershed.

Colorado 2014 Noxious Weed List: Five List B: leafy spurge (*Euphorbia esula* var. *uralensis* <1%), bouncingbet (*Saponaria officinale* <2%), broadleaf pepperweed (*Lepidium latifolium* <1%), Canada thistle (*Cirsium arvense* <1%) and Scotch thistle (*Onopordum acanthium* <1%); Seven List C: quackgrass (*Elymus repens* <5%), redstem stork's bill (*Erodium cicutarium* <1%), poison hemlock (*Conium maculatum* <1%), chicory (*Chicorum intybus* <1%), cheatgrass (*Bromus tectorum* <2%), field bindweed (*Convolvulus arvensis* <1%) and burdock (*Arctium minus* <1%); one Watch List: garlic mustard (*Alliaria petiolata* <2%).

Wildlife Comments: Wildlife observed during the survey included: crayfish, damselfies, dragonflies, minnows, Mallards, Snowy Egrets and Osprey.

Recommendations: Water quality could be improved at this site by planting native species in the buffer instead of turfgrass, and limiting herbicide, mowing and fertilizer treatments in the buffer. At present, park crews mow all the way to the edge of the riparian habitat.

References: Colorado Natural Heritage Program Field Surveys. July 17, 2013. Field Forms on File at CNHP, Fort Collins, CO.

City of Karmiel and City of Takayama Parks (CC_2)

EIA Overall Rank: 1.7 D

Biotic Condition: 1.89 D **Hydrologic Condition: 2.30 D**

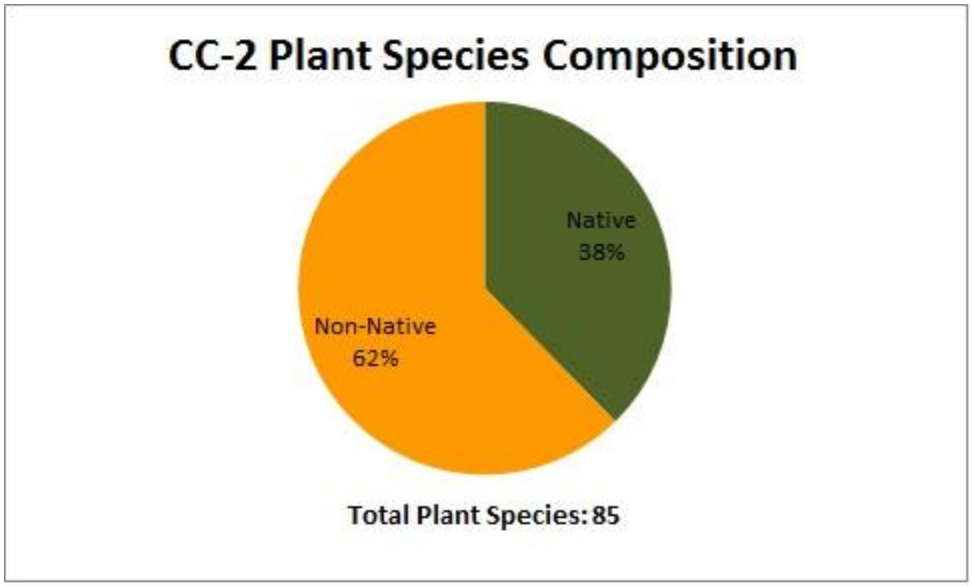
Landscape Context: 1.00 D **Physiochemical Condition: 1.00 D**

Ecological System: Western Great Plains Riparian

Size of assessment area: 10.9 acres **Elevation**: 1630 m

General Description: The City of Karmiel and City of Takayama Park AA includes a 0.6 mile stretch of Cherry Creek River within a densely developed part Denver near the Cherry Creek Mall along Cherry Creek South Drive. A paved bike path runs along the north border of the AA. Cherry Creek is highly manipulated by Cherry Creek Dam and is also impacted by large flow from runoff evident from numerous culverts and extremely high sedimentation. Plains cottonwoods (*Populus deltoides*) dominate the overstory with a very rich shrub and herbaceous layer included in the openings and understory. Common species include crack willow (*Salix fragilis*), coyote willow (*Salix exigua*), buckthorn (*Rhamnus cathartica*), reed canary grass (*Phalaris arundinaceaa*) and smooth brome (*Bromis inermis*). The mature forest that has developed on the shoreline is the highlight of this site with mature cottonwoods and a large variety of shrubs and herbs in the understory which provides shade and structure for wildlife, fish, invertebrates and recreationists using the area.

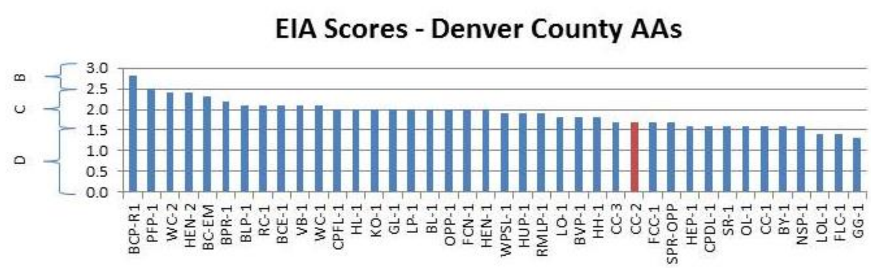
Floristic Composition:



Mean C: 1.32 (Range 0.82-2.84) **FQI: 11.47** (CCD Range 3.05-20.82)

There were 85 species of plants on the species list, 38% were native with a relative cover of native species at 46%.

Key Environmental Factors: The mature forested banks are important and add to the quality of this site. The connectivity of the river to upstream and downstream stretches also is significant. Although the river is highly manipulated and constricted by development, there is space to allow overbank flooding.



Rank Comments: This survey area was ranked 1.7 for the overall EIA score. For Denver County, the overall EIA ranks ranged from a high of 2.8 (C) to 1.3 (D). Of the 40 sites in Denver County there was a range of 13 different numerical scores. Three other sites also scored a 1.7 overall EIA, placing this AA at number 10 out of the 13 possible scores which is in the low medium range. The overall score underestimates the benefit of the mature overstory. It provides wildlife habitat and recreation potential to citizens. The biodiversity of the site was high with one of the larger plant lists and a medium high relative cover of native species. The hydrological importance of this site is reflected in the Hydrologic Condition score because of the connectivity of this riverine system.

Protection Urgency Comments: Because of the location of this site in Denver there are very little vegetated uplands around the wetland (<30% in the 100 m buffer). It is largely concrete, highways, manicured lawns and buildings. The environmental and structural benefits to the City and County of Denver are worth the efforts to protect this area from development, especially the mature forest cover.

Colorado 2014 Noxious Weed List: Eight List B: leafy spurge (*Euphorbia esula* <1%), broadleaf pepperweed *Lepidium latifolium* <1%), Canada thistle (*Cirsium arvense* <2%), bouncingbet (*Saponaria officinalis* <1%), Scotch thistle (*Onopordum acanthium* <1%), *Dipsacus* sp. <1%), Russian-olive (*Elaeagnus angustifolia* <1%) and whitetop (*Cardia draba*); five List C: quackgrass (*Elytmus repens* <1%), poison hemlock (*Conium maculatum* <1%), burdock (*Arctium minus* <1%), field bindweed (*Convolvulus arvensis* <1%) and cheatgrass (*Bromus tectorum*); one Watch List: garlic mustard (*Alliaria petiolata* <5%).

Wildlife Comments: Mallards were observed in the area. This is likely a very important area for birds because of the complex structure provided by the mature overstory and rich understory woody species that are intermixed with open herbaceous areas.

Recommendations: The vegetated shores of the river are the most important aspect to protect as well as the small amount of vegetated buffer in the 100 m zone surrounding the AA. The mature forested banks should be protected and not developed.

References:

Colorado Natural Heritage Program Field Surveys, July 18, 2013. Field Forms on File at CNHP, Fort Collins, CO.

Cherry Creek at Kennedy Golf Course (CC_3)

EIA Overall Rank: 1.7 D

Biotic Condition: 1.60 D **Hydrologic Condition: 2.40 D**

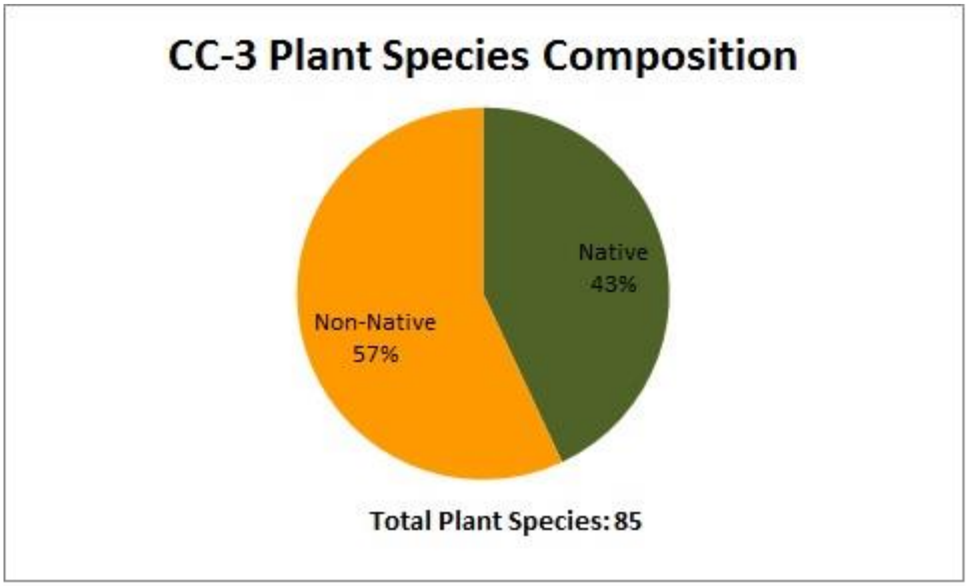
Landscape Context: 1.00 D **Physiochemical Condition: 1.00 D**

Ecological System: Western Great Plains Riparian

Size of assessment area: 6.8 acres **Elevation**: 1652 m

General Description: The Cherry Creek at Kennedy Golf Course AA includes a 0.4 mile section of Cherry Creek that runs just north of the Cherry Creek Dam weir structure on the south east side of Denver County. It is a shrub dominated riverine wetland with good sinuosity. Large sediment deposits are evidence of the extremely "flashy" nature of this site. At the time of the survey the river was not flowing and there were many pockets of turbid standing water. The northwest section of the AA is bounded by Havanna Street where the river runs under the highway. The survey site is embedded in a highly maintained golf course. There are large areas of bare soil interspersed with thick shrub growth. The dominant species included coyote willow (*Salix exigua*), reed canary grass (*Phalaris arundinacea*), plains cottonwood (*Populus deltoides*), smooth brome (*Bromis inermis*) and green ash (*Fraxinus pennsylvanica*).

Floristic Composition:



Mean C: 1.68 (Range 0.82-2.84) **FQI: 14.83** (CCD Range 3.05-20.82)

There were 85 species of plants on the species list, with 43% native and a relative native cover of 59%.

Key Environmental Factors: The River is connected to downstream sites and has a vegetated shoreline with a diversity of plant species.

Rank Comments: This survey area was ranked 1.7 for the overall EIA score. For Denver County, the overall EIA ranks ranged from a high of 2.8 (C) to 1.3 (D). Of the 40 sites in Denver County there was a range of 13 different numerical scores. Three other sites also scored a 1.7 overall EIA, placing this AA at number 10 out of the 13 possible scores which is in the low medium range. This was one of the lower scoring AAs in the survey. The site has some natural hydrology but it is impacted severely by the upstream dam flows and urban runoff. The underlying natural hydrology is one of the high quality features of this site. There was a high diversity of plants at the site which is an important factor for restoration potential and likely helps filter runoff from the surrounding manicured lawns.

Protection Urgency Comments: Because of the connectivity and flow to many other wetlands in Denver County, this area is worthy of protection. The shrub dominated shoreline has a very high diversity of plant species indicating the potential for restoration and habitat for wildlife.

Colorado 2014 Noxious Weed List: Four List B (<2%): Canada thistle (*Cirsium arvense*), leafy spurge (*Euphorbia esula*), Russian-olive (*Elaeagnus angustifolia*) and broadleaved pepperweed (*Lepidium latifolium*); five List C: quackgrass (*Elymus repens*), common mullein (*Verbascum thapsus* <1%), cheatgrass (*Bromus tectorum* <2%), poison hemlock (*Conium maculatum* <1%) and field bindweed (*Convolvulus arvensis* <1%).

Wildlife Comments: The structure at the site and diversity of vegetation provide good habitat for wildlife. The highly manipulated flows make it difficult for fish and other aquatic animals to thrive. Species observed during the survey include: Mallards, Red-winged Blackbirds, Mourning Doves, American Robins, Common Ravens, House Finches, Barn Swallows, Canada Geese, Northern Flicker, and Black-capped Chickadees.

Recommendations: Twenty percent of the natural lands in the 100m buffer zone around the AA are significant and should continue to be protected. Efforts to increase the buffer and protect the existing buffer would improve the wetland. In addition, working with Cherry Creek Dam personnel to see if flows can be adjusted so the river does not go dry or have extreme flow fluctuations would also improve not only this wetland but all of the downstream areas for wildlife, water quality and recreation.

References:

Colorado Natural Heritage Program Field Surveys, July 29, 2103. Field Forms on File at CNHP, Fort Collins, CO.

City Park Ferril Lake (CPFL-1)

EIA Overall Rank: 2.0 D

Biotic Condition: 2.50 D **Hydrologic Condition: 2.00 D**

Landscape Context: 1.00 D **Physiochemical Condition: 1.50 D**

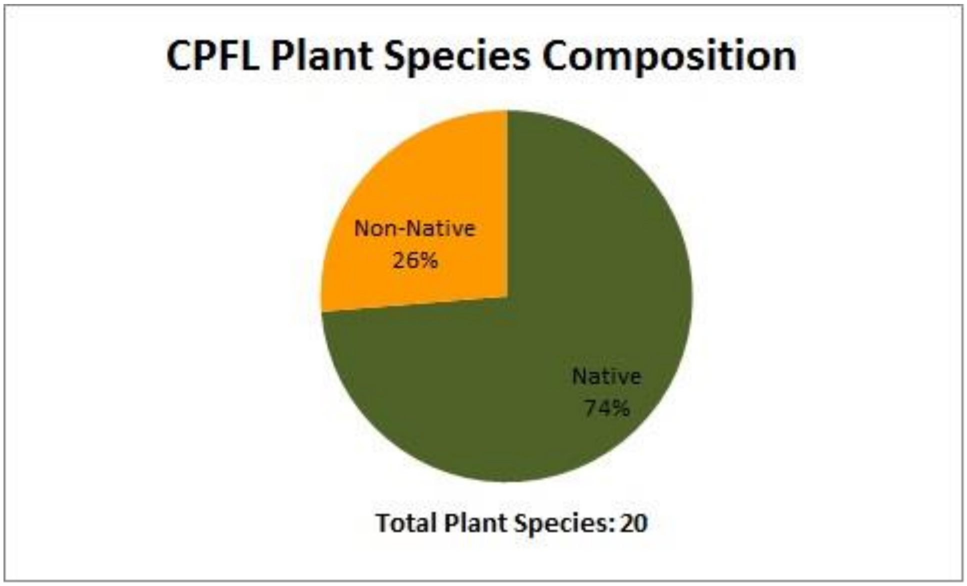
Ecological System: North American Arid West Emergent Marsh

City Park Ferril Lake

Size of assessment area: 24.2 acres **Elevation**: 1616 m

General Description: The City Park Ferril Lake AA includes a large, shallow, artificial lake in downtown Denver located just northeast of the intersection of Colfax Ave and Colorado Blvd. The lake has a cement wall and some structures that were built directly on the shoreline. A narrow band of native wetland vegetation covers 20% of the perimeter of the lake. The small vegetated fringe contains native plant species including a state rare plant, sweetflag (*Acrous calamus*) (G4?S1) with a native sedge (*Carex pellita*), bulrushes (*Schoenoplectus* spp.). Plains cottonwood (*Populus deltoides*) and willow shrubs (*Salix exigua*) are interspersed around the shoreline. Horned pondweed, a native aquatic plant, is found in open water at Ferril Lake. A small island in the middle of the lake is forested with mature trees and provides nesting sites for a variety of native bird species.

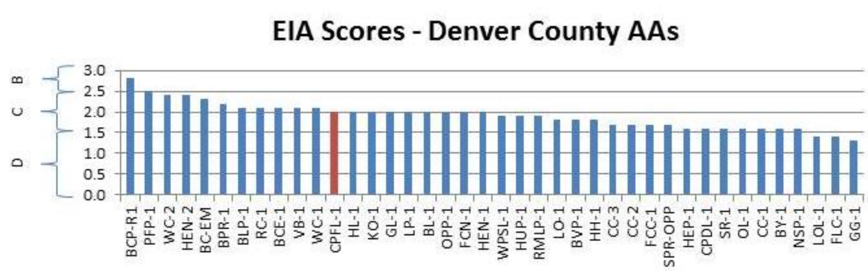
Floristic Composition:



Mean C: 2.84 (Range 0.82-2.84) **FQI: 12.39** (CCD Range 3.05-20.82)

There were 20 species on the plant list with 74% native and an 85% relative cover of native species. The wetland fringe is small but of high quality botanically. The high quality of the vegetation is reflected in the very high Mean C value which is the highest among all of the 40 Denver County AAs. The wetland lake fringe area is very small and is highly confined by mowing.

Key Environmental Factors: The vegetated fringe is an important characteristic of the AA because it can regenerate more high quality lake fringe if mowing is curtailed. Also wildlife habitat is very good here and includes a rookery on the island that supports a variety of nesting bird species.



Rank Comments: This survey area was ranked 2.0 for the overall EIA score. For Denver County, the overall EIA ranks ranged from a high of 2.8 (C) to 1.3 (D). Of the 40 sites in Denver County there was a range of 13 different numerical scores. Eight other sites also scored a 2.0 overall EIA, placing this AA at number 7 out of the 13 possible scores which is in the medium range. This AA had the highest Mean C for Denver County but it had a very low biodiversity because of the small area where native plants are permitted to flourish. The biotic condition score and Mean C reflect the large restoration potential as well as the potential to expand the existing wetland fringe.

Protection Urgency Comments: The high quality vegetated fringe shows a high potential for expansion, especially if mowing was reduced near the shoreline. This is a heavily used park and the wetland vegetation on the lake fringe offers important services that improve water quality and wildlife habitat as well as improve visitor experiences.

Colorado 2014 Noxious Weed List: One List B: Canada thistle (*Cirsium arvense* <1%).

Wildlife Comments: Invertebrates include: water boatman, common green darner dragonfly, damselflies, and crayfish. Fishes: catfish, trout, bass, goldfish, and koi fish (ornamental carp). Bird species include: Double-crested Cormorants, 3 nests, chicks and juveniles, Black-crowned Night Herons (7 adults/juveniles, 9 nests), Canada Geese (77 sightings, 37 chicks), Snowy Egrets, Great Blue Herons, Redwing Blackbirds, Western Grebes, Common Grackles, American Robin, European Starlings, Barn Swallows, and House Sparrows.

Recommendations: Allowing the wetland fringe to expand along the lakeshore and permitting aquatic macrophyte growth is recommended to help improve water quality and wildlife benefits (see section in Discussion on aquatic plants, weeds in urban environments and pesticide use). The native aquatic plant species, horned pondweed (*Zannichellia palustris*), has been documented in Ferril Lake. This plant species offers food for ducks and cover for fish and macroinvertebrates.

References:

Colorado Natural Heritage Program Field Surveys. June 03, 2014. Field Forms on File at CNHP, Fort Collins, CO.

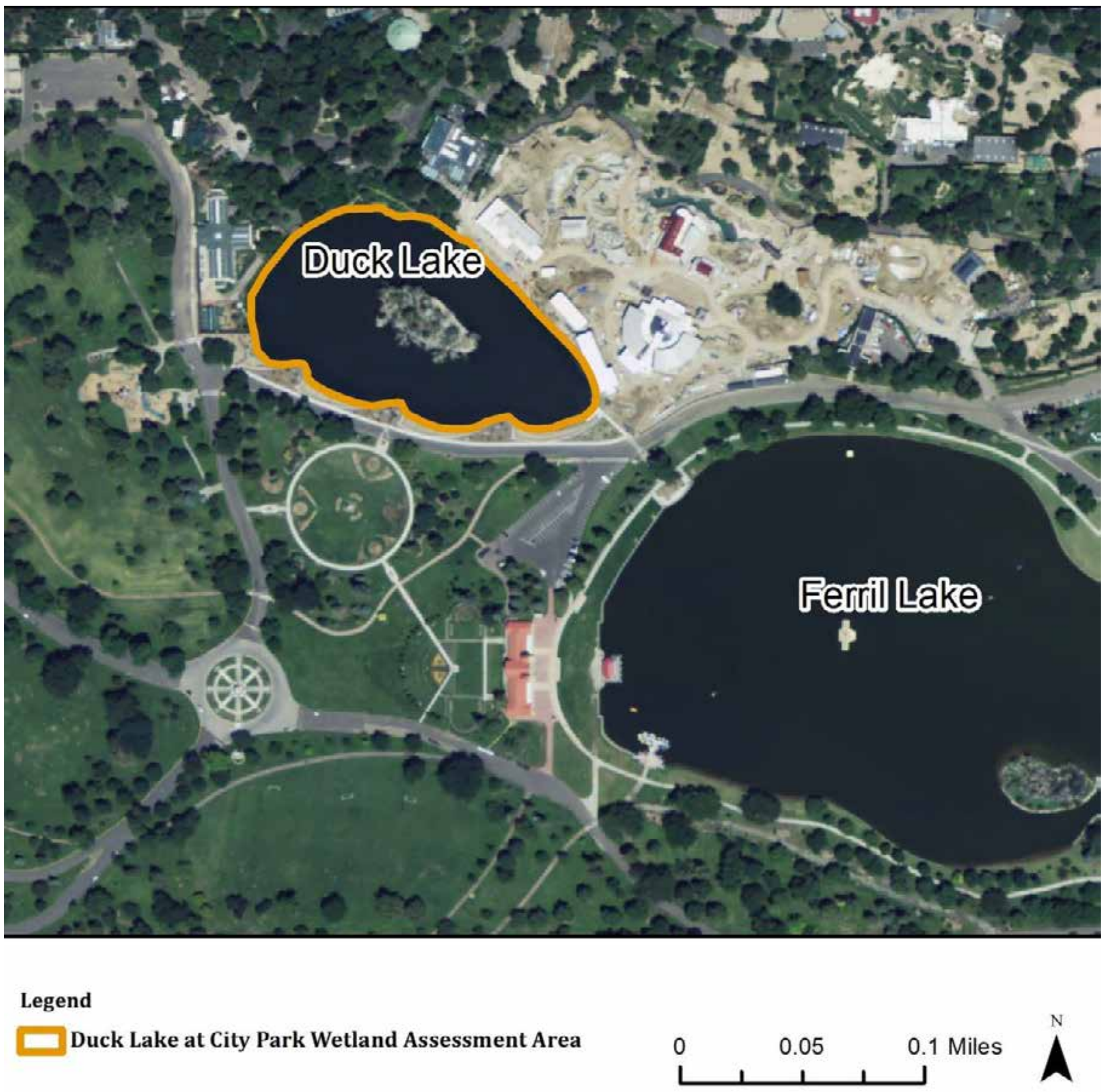
City Park Duck Lake (CPDL-1)

EIA Overall Rank: 1.6 D

Biotic Condition: 2.00 D **Hydrologic Condition: 1.80 D**

Landscape Context: 1.00 D **Physiochemical Condition: 1.00 D**

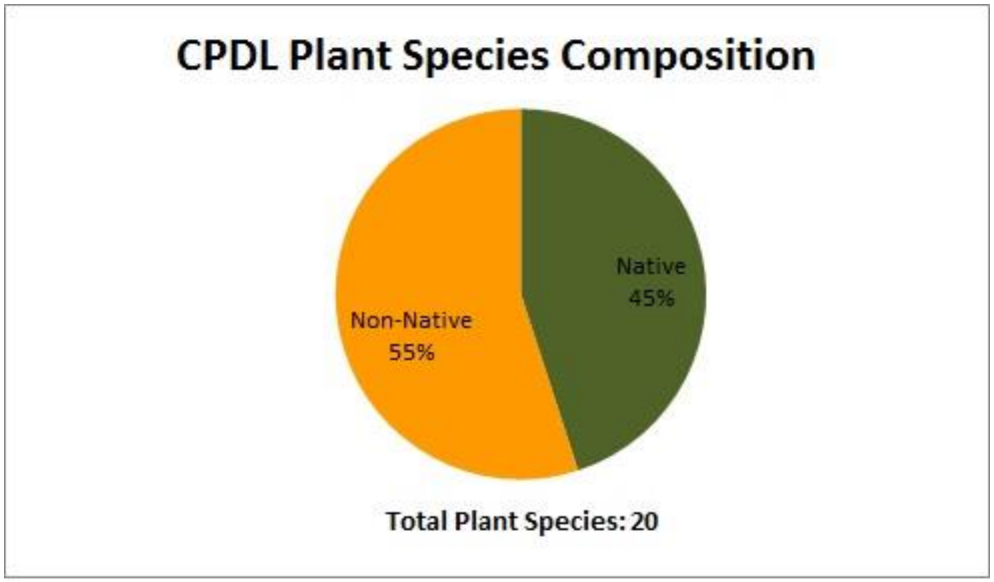
Ecological System: North American Arid West Emergent Marsh



Size of assessment area: 5.5 acres **Elevation**: 1611 m

General Description: The Duck Lake AA at City Park in Denver is a created wetland. There is a large cormorant rookery on an island in the center of the pond. The shoreline has been sculpted with raised upland plantings of native or cultivated plants. The northeast shore is part of the Denver Zoo and is adjacent to the site. The average water depth is 5 feet and maximum depth is reported at 8 feet. It is known to have high levels on nitrogen (pers. comm. A. Polonsky, July 2014). The aquatic macrophytes are treated with herbicides. None were visible during this survey but have been noted as being prolific in the past. Native plant species included: common three square bulrush (*Shoenoplectus pungens*), Artic rush (*Juncus arcticus*), Torrey's rush (*Juncus torreyi*), prairie cordgrass (*Spartina pectinata*), water speedwell (*Veronica anagallis-aquatica*), cursed buttercup (*Ranunculus scleratus*), were common along the shore. Common tree species included cottonwood (*Populus deltoides*) and green ash (*Fraxinus pennsylvanica*).

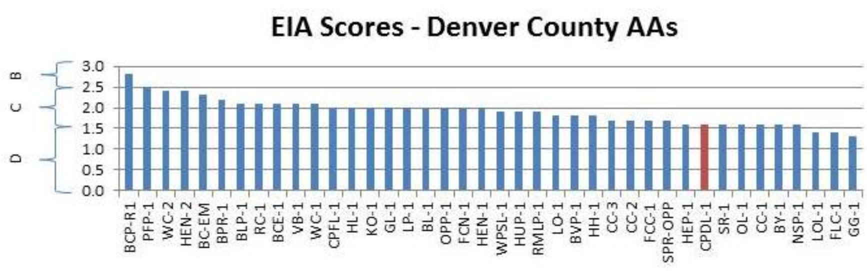
Floristic Composition:



Mean C: 1.75 (CCD Range 0.82-2.84) **FQI: 7.83** (CCD Range 3.05-20.82)

There were 20 species of plants with 45% native (planted) and a relative native cover of 50%.

Key Environmental Factors: The fact that native plantings were doing well along the pond shore indicate this wetland can support more native species. A few of the reasons the AA scored low overall is because of the highly developed buffer lands with little natural vegetation, the lack of connectivity to a natural hydrological feature and high nutrient inputs.



Rank Comments: This survey area was ranked 1.6 for the overall EIA score. For Denver County, the overall EIA ranks ranged from a high of 2.8 (C) to 1.3 (D). Of the 40 sites in Denver County there was a range of 13 different numerical scores. Six other sites also scored a 1.6 overall EIA, placing this AA at number 11 out of the 13 possible scores which is in the medium range. This was among the lowest ranked wetlands in Denver County with a score of 1.6. The surrounding landscape is highly developed and there is virtually no natural vegetation cover in the buffer lands which are largely manicured lawns, paved roads, parking lots and buildings.

Protection Urgency Comments: The site supports native plants and an active Double-crested Cormorant rookery.

Colorado 2014 Noxious Weed List: Two List B <1%: musk thistle (*Carduus nutans*) and Canada thistle (*Cirsium arvense* <1%); and one List C <1%: redstem stork's bill (*Erodium cicutarium*).

Wildlife Comments: Observations during the survey include: Double-crested Cormorant (312 adults/juveniles), 130 Cormorant nests, Common Grackle, Canada Geese, Western Grebe, Belted Kingfisher, Mallard, European Starling and Snowy Egrets. Thousands of fathead minnows, other species of fish, damselflies and an orange sulfur butterfly were observed in the AA.

Recommendations: This water body is heavily impacted by nutrients from stormwater inflows as well as the cormorant rookery. Any efforts to allow wetland vegetation to grow in and around the wetland can help alleviate water quality and algae problems.

References:

Colorado Natural Heritage Program Field Surveys. June 03, 2014. Field Forms on File at CNHP, Fort Collins, CO.

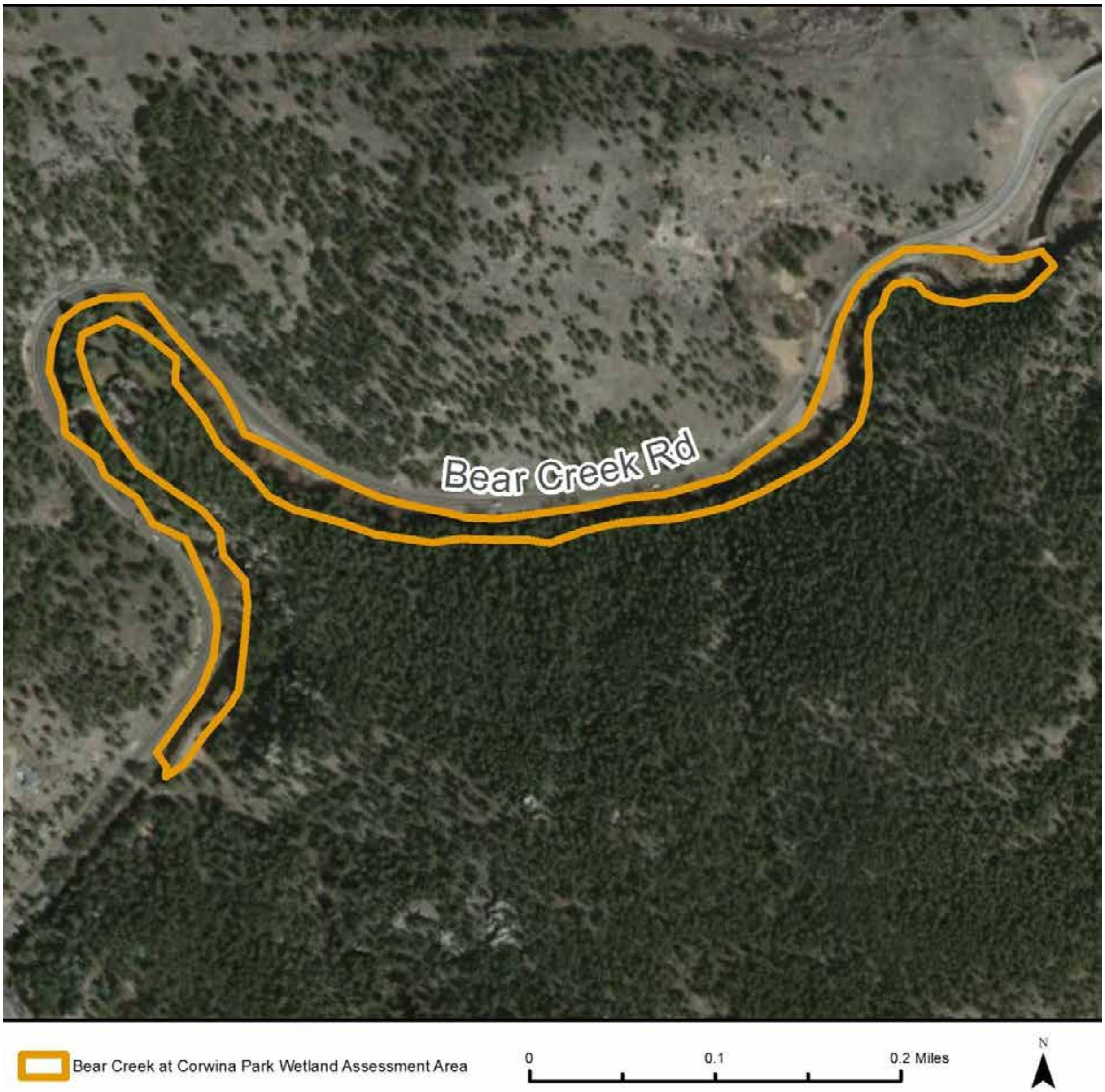
BEAR CREEK AT CORWINA PARK (CW_1)

EIA Overall Rank: 2.9 C

Biotic Condition: 1.89 D **Hydrologic Condition: 3.30 C**

Landscape Context: 3.74 B **Physiochemical Condition: 3.80 B**

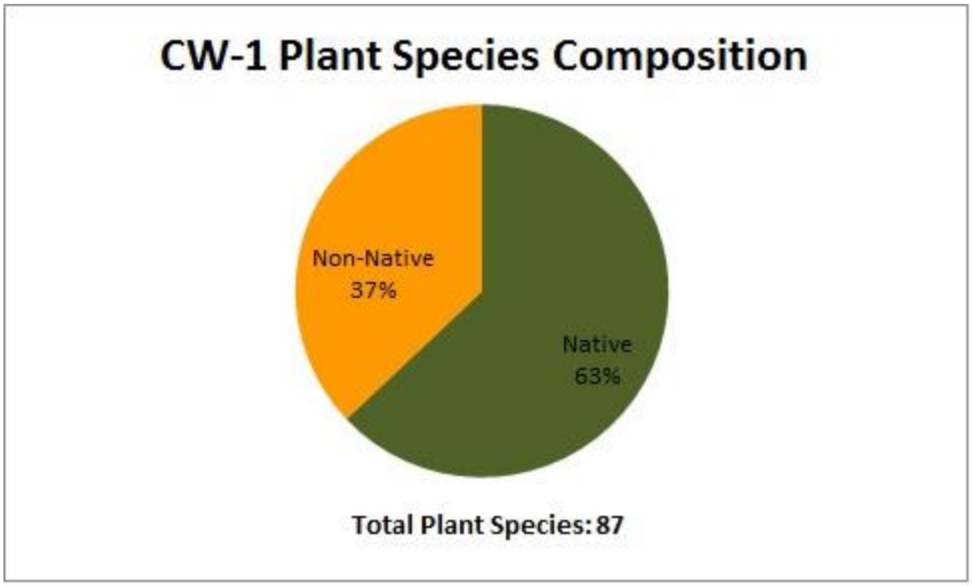
Ecological System: Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland



Size of assessment area: 10.5 acres **Elevation**: 2072 m

General Description: The Bear Creek at Corwina Park AA includes a forested 0.9 mile section of Bear Creek in the upper foothills zone in Jefferson County at about 6,800 feet elevation and about 15 miles upstream of the City and County of Denver.The AA is located about seven miles west of the town of Morrison along Highway 74. The north boundary of the AA is the highway. This Denver Mountain Park site was selected because of its location on Bear Creek which flows about 10 miles east to Bear Creek Dam and then another 3.5 miles to the Denver County line. While the northern boundary is confined by the highway, the south shore of the AA is bounded by very large areas of upland conferous forest that includes ponderosa pine (*Pinus ponderosa*), Douglas fir (*Pseudotsuga menziesii*) and blue spruce (*Picea pungens*). A first order stream runs into Bear Creek (Corwina Park Tributary AA) at the west side of the AA. A thick layer of smooth brome (*Bromis inermis*) is present on the north shore near the roadway. A diverse mix of species including: crack willow (*Salix fragilis*); thin-leaf alder (*Alnus incana*), coyote willow (*Salix exigua*), birch (*Betula occidentalis*), Scouler's willow (*Salix scouleriana*), red-twig dogwood (*Cornus sericea*), plains cottonwood (*Populus deltoides*) and blue spruce (*Picea pungens*) were common with crispy leaf pondweed (*Potomogeton crispus*), and a variety of rushes, sedges, forbs and cattails were observed in the open areas and understory.

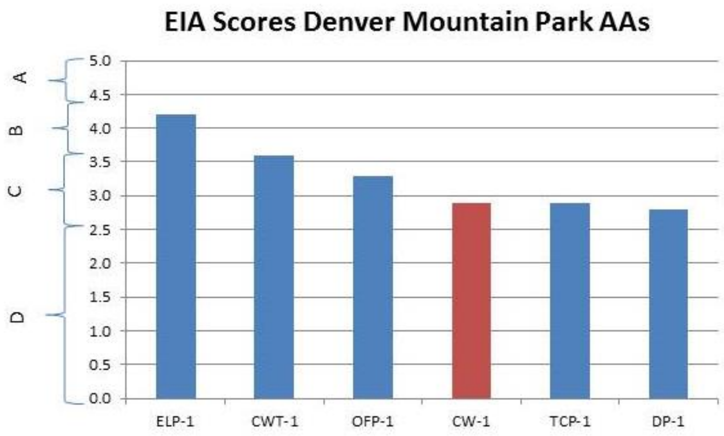
Floristic Composition:



Mean C: 3.33 (DMP Range 2.99-5.74) **FQI: 30.55** (DMP Range 26.38-52.93)

There were 87 species of plants on the species list, 63% were native with a relative native cover of 37%.

Key Environmental Factors: Compared to other AAs in the Denver Mountain Parks, this stretch of Bear Creek seems to be heavily impacted from upstream developments as well as the highway that is adjacent to this stretch of the river. The low cover of native species was surprising but likely due to the roadway disturbance and upstream residential development.



Rank Comments: This survey area was ranked 2.9 for the overall EIA score. For Denver County, the overall EIA ranks ranged from a high of 2.8 (C) to 1.3 (D) and the range for Denver Mountain Parks was

2.8 (C)-4.2 (B). Of the six AAs in Denver Mountain Parks (Jefferson/Clear Creek Counties) there was a range of five different numerical scores. One other site also scored a 2.9 overall EIA, placing this AA at number 4 out of the 5 possible scores for the Mountain Parks. The overall EIA rank was one of the lower scores for the six Denver Mountain Parks surveyed. The very low relative cover of native plants compared to other Denver Mountain Parks in this survey is indicative of the high disturbance from the adjacent highway and residential developments upstream of the site. The score was similar to the Bear Creek sites on the western side of Denver where the creek joins Denver County. This AA scored just slightly higher than the Bear Creek AAs in Denver County. The water quality was probably impacted at this site as well, there was a strong smell of treated wastewater and the water appeared turbid (recent rain event).

Protection Urgency Comments: This area is connected to many downstream wetlands.

Colorado 2014 Noxious Weed List: Five List B <1%: Oxeye daisy (*Leucanthemum vulgare*), yellow toadflax (*Linaria vulgaris*), leafy spurge (*Euphorbia esula* var. *esula*), leafy spurge (*Euphorbia esula* var. *uralensis*), bouncingbet (*Saponaria officinialis*); and two List C <1%: mullein (*Verbascum thapsis*) and field sowthistle (*Sonchus arvensis*) were observed.

Wildlife Comments: Excellent wildlife habitat is present at the site. Boulders and cobbles along the river that include mature overstory conifers and dense shrub layers provide structure and shade. A garter snake, chipmunks, beaver and invertebrates including stoneflies, and crayfish were observed during the survey. Also a wide variety of bird species were observed: Canada Geese, Common Raven, Mountain Chickadee, Broad-tailed Hummingbird, House Finch, Pine Siskin, Black-capped Chickadee, Pygmy Nuthatch, Lesser Goldfinch, White-breasted Nuthatch, Turkey Vulture, and Virginia's Warbler.

Recommendations: Wastewater inputs from upstream sites could be contributing to water quality impacts and should be considered. The roadside development has likely caused most of the impacts to the vegetation especially on the north side. The natural vegetation that exist upslope of the site should be protected from development.

References:

Colorado Natural Heritage Program Field Surveys. August 20, 2013. Field Forms on File at CNHP, Fort Collins, CO.

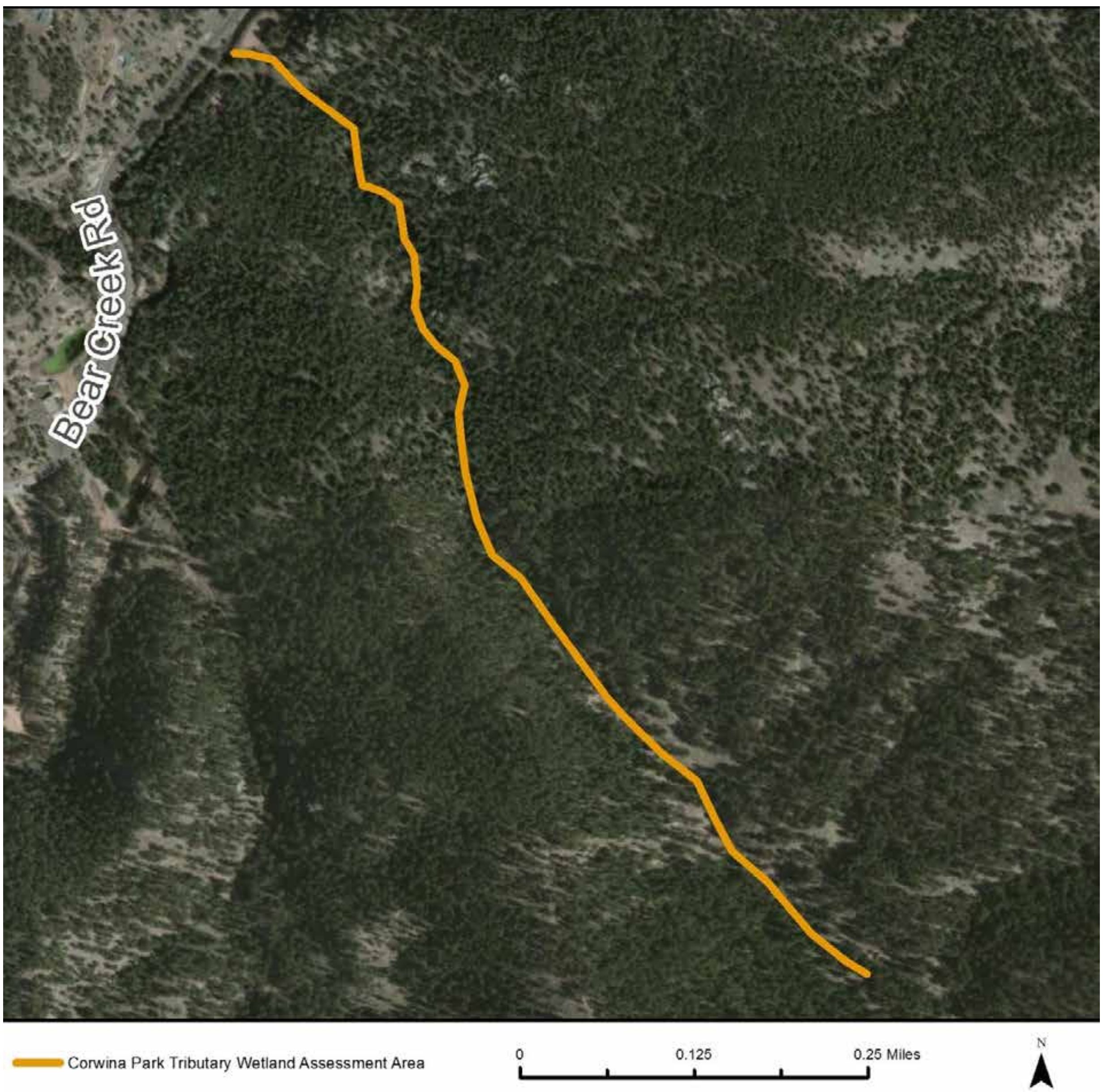
Corwina Park Tributary (CWT_1)

EIA Overall Rank: 3.6 B

Biotic Condition: 2.96 C **Hydrologic Condition: 4.00 B**

Landscape Context: 3.68 B **Physiochemical Condition: 4.50 B**

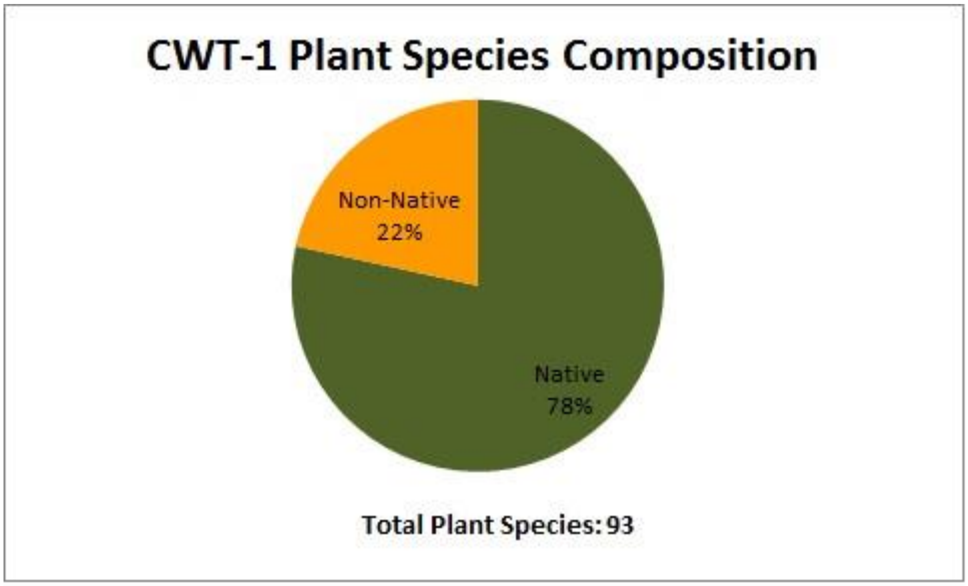
Ecological System: Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland



Size of assessment area: 11.3 acres **Elevation**: 2057-2176 m

General Description: The Corwina Park Tributary AA consists of a small linear wetland that is 0.8 miles long, and located in the lower montane foothills of Jefferson County about seven miles to the west of the Town of Morrison. The wetland is supported by a small first order unnamed tributary that flows into Bear Creek. The vegetation is dominated by a blue spruce (*Picea pungens*) and Douglas fir (*Pseudotsuga menziesii*) overstory with alternating open herbaceous meadows and shrublands. Small pockets of shallow standing water with intermittent above ground flows were present at time of survey. Ponderosa pine (*Pinus ponderosa*) was the dominant species in the buffer. Herbaceous cover throughout the AA included a mosaic of forbs and graminoids while the buffer consisted primarily of native grasses with larger patches of smooth brome (*Bromus inermis*). Hiking and biking trails are in the surrounding upland area. Unlike the other AAs in the Denver Mountain Parks, this stream is not bounded by a major roadway or highway.

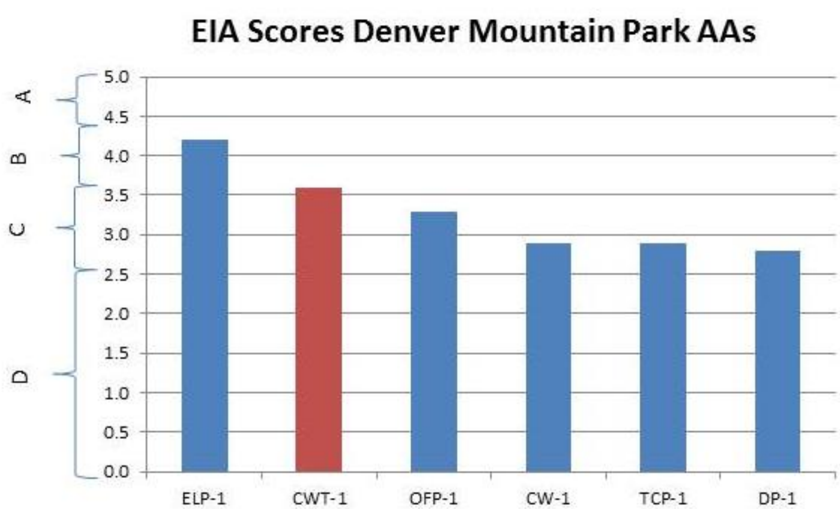
Floristic Composition:



Mean C: 4.49 (DMP Range 2.99-5.74) **FQI: 40.94** (DMP Range 26.83-52.93)

There were 93 species on the plant species list, 78% were native with a high relative cover of 91%. Non-vascular plants present included mosses and liverworts.

Key Environmental Factors: A small AA compared to others with 93 different species, and a high cover of native species. The buffering lands were also of high quality.



Rank Comments: This survey area was ranked 3.6 (B) for the overall EIA score. The overall EIA ranks ranged from a high of 2.8 (C) to 1.3 (D) and the range for Denver Mountain Parks was 2.8 (C)-4.2 (B). Of the six sites in Denver Mountain Parks (Jefferson/Clear Creek Counties) there was a range of five different numerical scores. This was the second highest scoring wetland of all 46 AAs surveyed and only one of two B-ranked AAs. The large natural buffer lands are paramount in promoting the species diversity, low cover of non-native species and high scores in all four categories.

Protection Urgency Comments: A FQI score in the 40s is significant and worthy of protection; this tributary to Bear Creek is providing a high quality water source and also includes benefits for local water quality and wildlife.

Colorado 2014 Noxious Weed List: Four List B: Canada thistle (*Cirsium arvense* <2%), bull thistle (*Cirsium vulgare* <1%), leafy spurge (*Euphorbia esula* <1%) and houndstongue (*Cynoglossum officinale* <1%); and one List C <1%: common mullein (*Verbascum thapsus*).

Wildlife Comments: Chipmunks, grey squirrel, Abert's squirrel and red fox were observed during the survey. Bird sightings included: Bushtit, Broad-tailed Hummingbird, Common Raven, American Robin, Cooper's Hawk, White-breasted Nuthatch, Mountain Chickadee, Pygmy Nuthatch, Dark-eyed Junco, Hairy Woodpecker, Black-billed Magpie, Red-tailed Hawk, Ruby-crowned Kinglet, Northern Flicker, and Ovenbird. Dragonflies and damselflies were also observed.

Recommendations: Limit development in the AA as well as the buffering lands within 100- 500 meters or more if possible.

References:

Colorado Natural Heritage Program Field Surveys. August 21, 2013. Field Forms on File at CNHP, Fort Collins, CO.

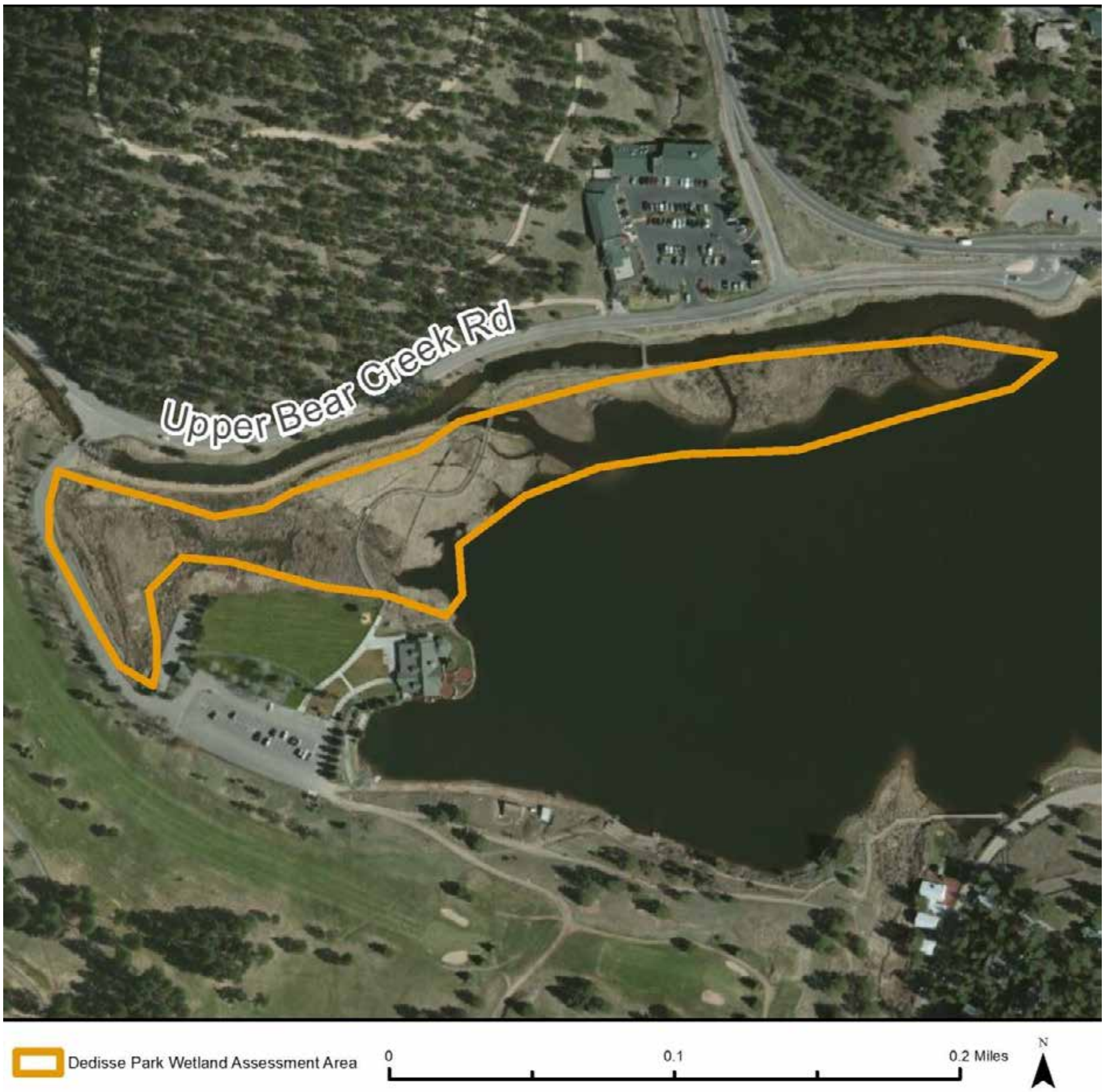
DEDISSE PARK (DP_1)

EIA Overall Rank: 2.8 C

Biotic Condition: 2.79 C **Hydrologic Condition: 2.40 D**

Landscape Context: 3.13 C **Physiochemical Condition: 3.50 C**

Ecological System: North American Arid West Emergent Marsh

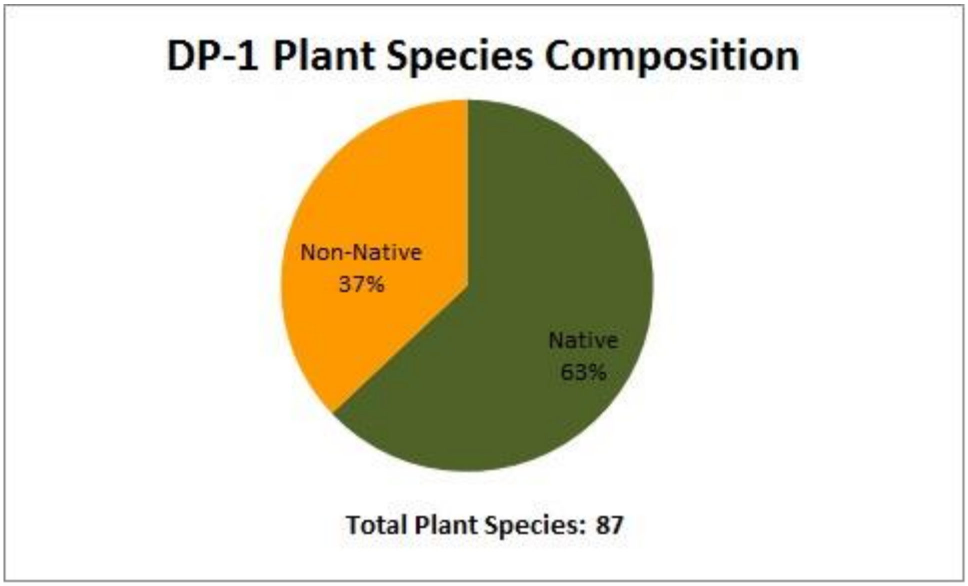


Dedisse Park

Size of assessment area: 7.4 acres **Elevation**: 2169-2173 m

General Description: The Dedisse Park AA is located north of the Town of Evergreen along Highway 74 and includes a large emergent marsh on the edge of a 45 acre impoundment (dam) on west side of Evergreen Lake. This site is located three miles upstream from Bear Creek at Corwina Park and O'Fallen AAs. Bear Creek supplies the water to the wetland and adjacent impoundment. Bear Creek is minimized to a drainage canal at the west end of the impoundment and the north side of the AA. There is a trail/boardwalk that cuts through the marsh. A dirt trail, possibly a road, exists on the north shore forming a solid berm between the stream and the emergent marsh. Cattails (*Typha* spp.) and bluejoint (*Calamagrostis canadensis*) were the dominant species of this emergent marsh. Small trees and shrubs surrounding the marsh included coyote willow (*Salix exigua*), water birch (*Betula occidentalis*), and thin-leaf alder (*Alnus incana*). Bulrushes (*Scirpus microcarpus, S. pallidus*), cattails (*Typha latifolia, T. angustifolia*), a variety of rushes (*Juncus nodosus, J. longistylus, J. interior, J. ensifolius*) and sedges (*Carex utriculata, C. bebbii*, *C. nebrascensis*), fowl bluegrass (*Poa palustris*), yellow avens (*Geum aleppicum*), water smart weed (*Persicaria amphibia*), Scouler's St. Johnswort (*Hypericum scouleri*) and vernal water-starwort (*Callitriche palustris*) were observed in the marsh. A major roadway runs along the north border of the impoundment, and a golf course lies to the west. The buffer lands surrounding this AA are more developed than other AAs in the Mountain Parks. Parking lots, dense residential development and roads are common in the buffer land with some areas of ponderosa pine (*Pinus ponderosa*) woodlands.

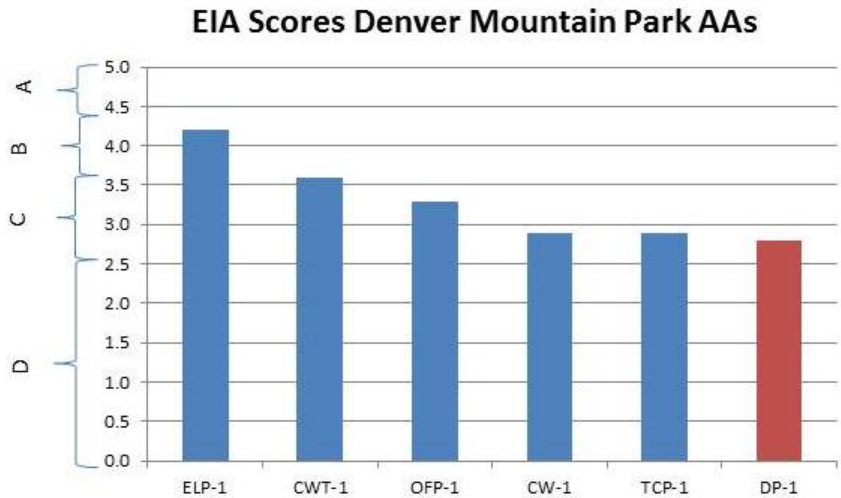
Floristic Composition:



Mean C: 2.99 (DMP Range 2.99-5.74) **FQI: 26.38 (**DMP Range 26.38-52.93)

There were 87 species of plants on the species list with 63% native and a relative cover of native species at 85%. The high cover of bluejoint, a native marsh grass , which has a C value of 6 (indicative of a high quality site), forms a matrix with cattails that includes a variety of herbaceous wetland species.

Key Environmental Factors: The large plant list indicates a high biodiversity; the structural complexity of the herbaceous and shrub layer is excellent for wildlife, protecting water quality and slowing runoff flows from the surrounding developed landscape.



Rank Comments: This survey area was ranked 2.8 (C) for the overall EIA score. For Denver County, the overall EIA ranks ranged from a high of 2.8 (C) to 1.3 (D) and the range for Denver Mountain Parks was 2.8 (C)-4.2 (B). Of the six AAs in Denver Mountain Parks (Jefferson/Clear Creek Counties) there was a range of five different numerical scores. This was the lowest ranked wetland of the six AAs surveyed in the Denver Mountain Parks due to the lower landscape context, hydrological and physiochemical condition scores. It is also reflected in the Biotic Condition score which includes the lowest FQI and Mean C scores among the Denver Mountain Parks. The location of this AA is one of the more heavily developed landscapes that included residences, highways, parking lots and manicured golf course lands. Impacts from soil disturbance and fill are evident in places. The hydrology is manipulated by the dam which is just downstream of the site and the canal that feeds water into the site.

Protection Urgency Comments: This is a high quality emergent marsh worthy of protection efforts. It is valuable for flood attenuation and storage and removal of nutrients, toxicants and sediments.

Colorado 2014 Noxious Weed List: Three List B: Canada thistle (*Cirsium arvensis* <5%), yellow toadflax (*Linaria vulgaris* <1%), and bull thistle (*Cirsium vulgare* <1%); two List C: common mullein (*Verbascum thapsus* <1%) and quackgrass (*Elymus repens* <2%).

Wildlife Comments: Observations during the survey include: various fish, chorus frog, old beaver sign, northern leopard frog and dragonflies. Bird observations include: Mallard, Barn Swallow, Red-winged Blackbird, Common Raven, Gray Jay, Belted Kingfisher, Pine Siskin, Double-crested Cormorant, Violet-green Swallow, Hairy Woodpecker, and Mountain Chickadee.

Recommendations: Efforts to slow the surface flows into the wetland by reducing the mowed area on the west side near the wetland would be beneficial.

References: Colorado Natural Heritage Program Field Surveys. August 30, 2014. Field Forms on File at CNHP, Fort Collins, CO.

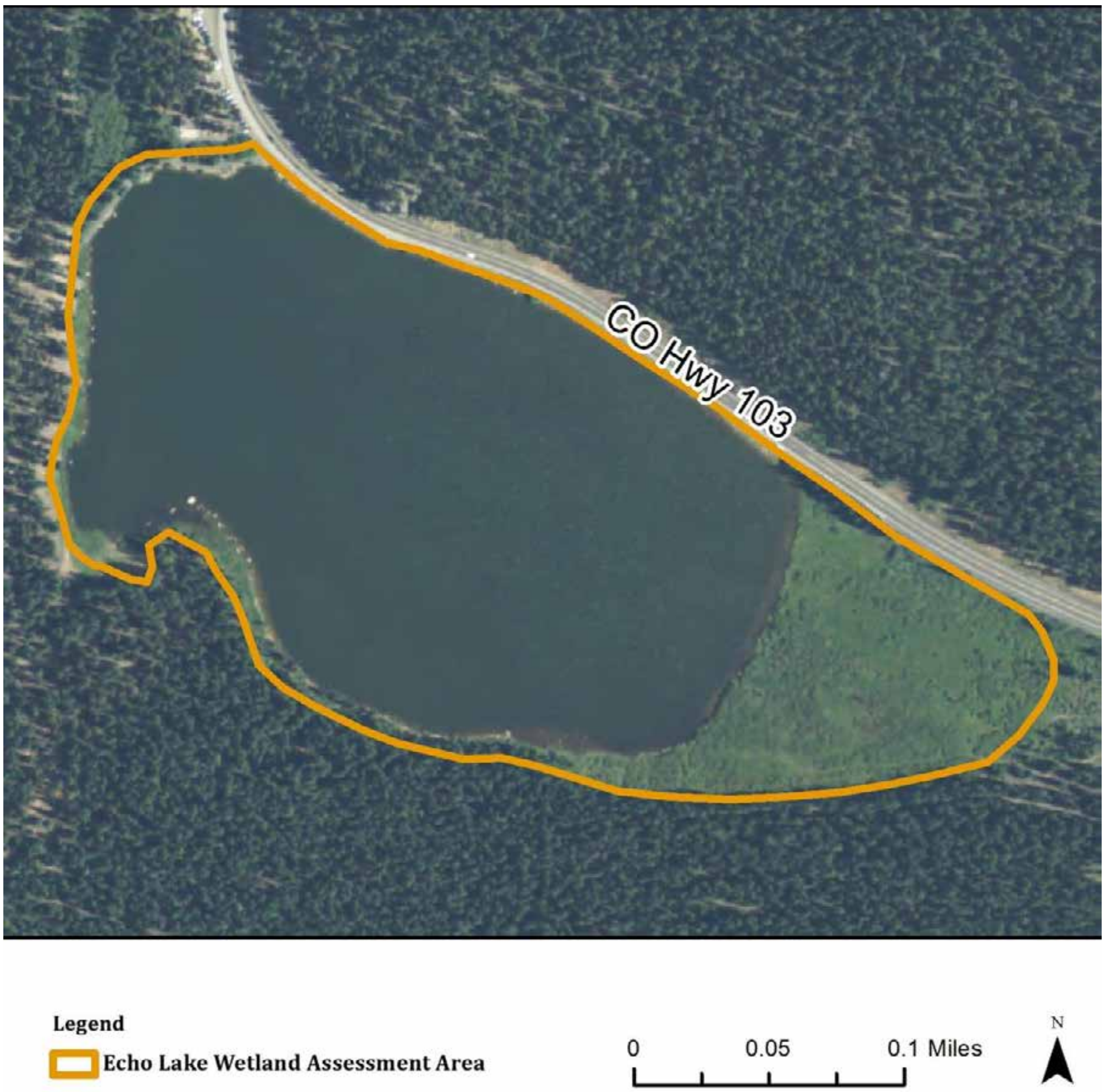
ECHO LAKE PARK (ELP-1)

EIA Overall Rank: 4.2 B

Biotic Condition: 4.05 B **Hydrologic Condition: 4.70 A**

Landscape Context: 3.82 B **Physiochemical Condition: 4.40 B**

Ecological System: Rocky Mountain Alpine-Montane Wet Meadow

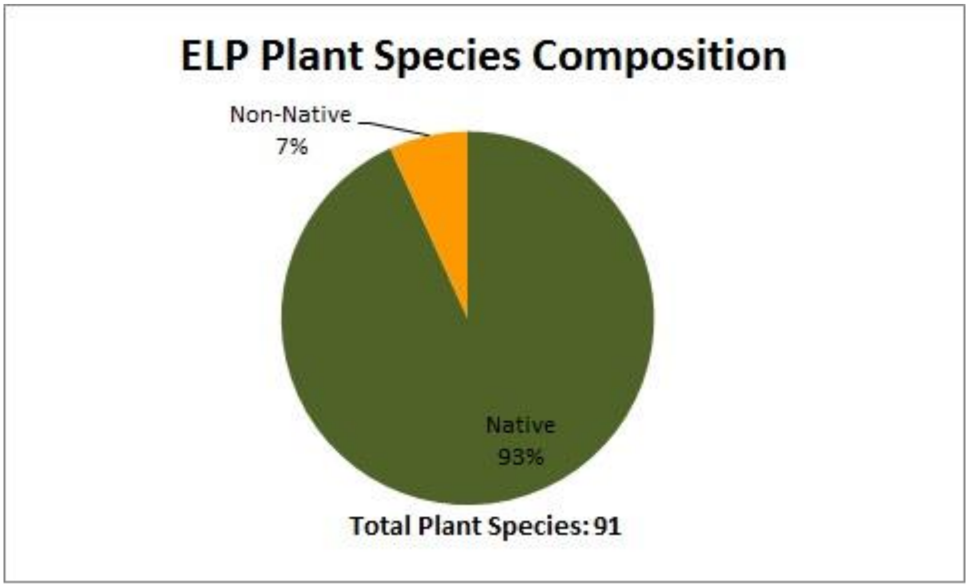


Size of assessment area: 33.2 acres **Elevation**: 3240 m

General Description: The Echo Lake Park AA is located in the subalpine-montane zone along Highway 103 which leads to Mount Evans. The AA includes a clear, deep water, high elevation lake and willow dominated shrublands. An uncommon native aquatic plant: whitestem pondweed (*Potomogeton praelongus*) dominates the lake. The willow dominated shrubland on the east side of the lake supports a diversity of native forb species in a matrix of shrublands and sedge dominated marsh. Mature blue spruce (*Picea pungens*) line the south shore. Engelmann spruce (*Picea engelmannii*), bristlecone pine (*Pinus aristata*) and lodgepole pine (*Pinus contorta*) forests dominate the surrounding uplands. There was a large diversity of sedges (*Carex* spp. 9 different species) at the site with water sedge (*Carex aquatilis*) dominant on the lakeshore and in the wetland on the west side of the lake. Many native species of grasses and rushes were also present at the site. Common willow species included: planeleaf willow (*Salix planifolia*), short-fruited willow (*S. brachycarpa)* and Bebb's willow (*S. bebbiana*). Many species of forbs, mosses and lichens added to the biodiversity of this site. A trail surrounds the entire wetland with anglers and hikers creating social trails throughout the area. A small portion on the southwest corner has been closed for re-vegetation efforts. Flow to the lake is from Beaver Dam Lake located to the south. Echo Lake does not appear to have an obvious outlet. There is a small wet area on the north that has been fragmented from the lake by the trail that surrounds the lake. The park is closed in the winter but is heavily utilized in the summer months. The state rare duck, Barrow's

Goldeneye (*Bucephala islandica*) (G5S2B), was documented on the lake with offspring, and is apparently breeding at this site. A young Northern Saw-whet Owl (*Aegolius acadicus*) was documented in the spruce and pine forests that surround the lake.

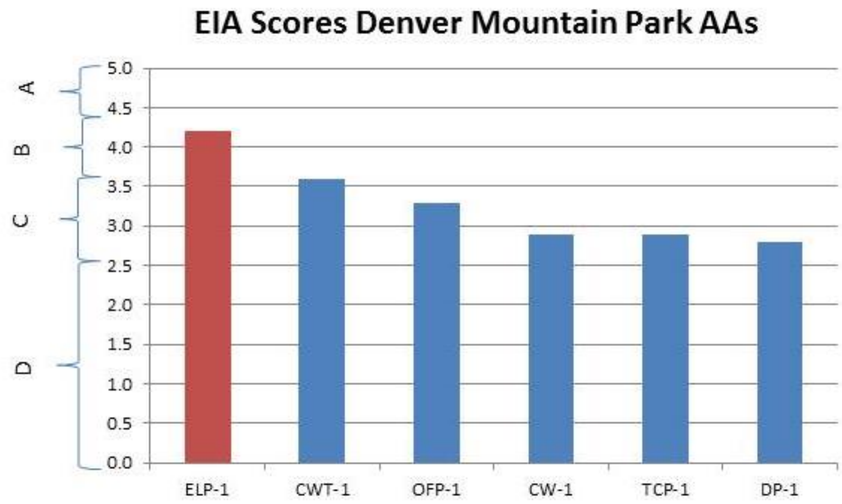
Floristic Composition:



Mean C: 5.74 (DMP Range 2.99-5.74) **FQI: 52.93** (DMP Range 26.38-52.93)

There were 91 species on the plant list with 93% native and a relative native cover of 98% the highest of all of the AAs in the study.

Key Environmental Factors: The location of the AA in a large expanse of lightly developed to mostly undeveloped landscape contributed to the high quality of the site.



Echo Lake

Rank Comments: This was the highest scoring AA in all categories and across all 46 AAs. The highway located on the northern boundary of the lake is probably the reason this AA did not get an A rank. This survey area was ranked 2.9 for the overall EIA score. For Denver County, the overall EIA ranks ranged from a high of 2.8 (C) to 1.3 (D) and the range for Denver Mountain Parks was 2.8 (C)-4.2 (B). Of the six sites in Denver Mountain Parks (Jefferson/Clear Creek Counties) there was a range of five different numerical scores. This site was the only one to score a 4.2 and only one of two in the B rank range.

Protection Urgency Comments: The AA is part of a public park, which affords some protection. The surrounding landscape should be considered in protection efforts to ensure the quality of the lake and wetland. The entire AA is within the boundaries of the Echo Lake Potential Conservation Area (PCA) (Appendix H). Efforts are underway to restore a section on the southwest side of the wetland. A wet meadow area on the northeast has signs posted asking visitors to avoid the sensitive area. However, the signs are not visible especially to anglers.

Colorado 2014 Noxious Weed List: One <u>List B <1%:</u> Canada thistle (*Cirsium arvense*).

Wildlife Comments: Twenty-five species of birds were identified during the survey and included a state rare CNHP tracked animal species, Barrow's Goldeneye (Leatherman 2014a – Appendix I). An adult Barrow's Goldeneye female and two juveniles were documented at the site which is exemplary for wildlife. Hundreds of thousands of blue damselflies hatched the day of the survey.

Recommendations: This is the highest scoring AA in the survey. It is currently a Denver Mountain Park and is afforded some protection; the surrounding landscape is very important to protect from development to maintain the integrity of the wetland. The Barrow's Goldeneye is a cavity nesting duck that requires large trees. The protection of the buffer is a good way to help keep habitat for these ducks and a wide variety of other native plant and animal species, as well as mitigating impacts from the adjacent roadway. Keeping the southeast corner of the lake closed permanently will keep impacts from fishing and hiking activities to a minimum and will allow water fowl partial relief from the heavy human and dog traffic the lake sustains during the summer months. The current signage near the road is not effective as most people access the wetland from the lake and not the road. Place a sign on the trail on the south side of the lake to discourage access to the east side wetland. For additional recommendations see Leatherman 2014b in Appendix I.

References:

Colorado Natural Heritage Program Field Surveys. September 9, 2013 and July 9, 2014. Field Forms on File at CNHP, Fort Collins, CO.

Leatherman, D.A. 2014a Bird list for Echo Lake Park, Clear Creek County, Colorado. (Appendix I).

Leatherman, D. A. 2014b Further Observations from 9 July 2014 visit to Echo Lake Park (Appendix I).

First Creek Central (FCC_1)

EIA Overall Rank: 1.7 D

Biotic Condition: 2.25 D **Hydrologic Condition: 1.40 D**

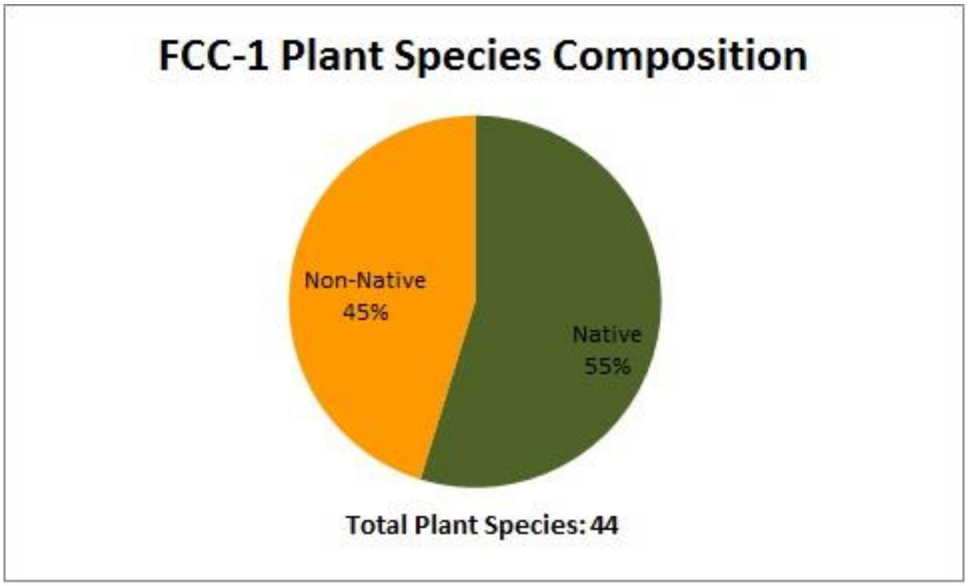
Landscape Context: 1.37 D **Physiochemical Condition: 1.00 D**

Ecological System: Western Great Plains Riparian

Size of assessment area: 3.2 acres **Elevation**: 1655 m

General Description: The First Creek Central AA encompasses a 0.2 mile section of First Creek. The creek likely contains surface water only during periods of heavy rain. The AA is dominated by native willow species including coyote willow (*Salix exigua*) and peachleaf willow (*Salix amygdaloides*). Plains cottonwood (*Populus deltoides*) and green ash (*Fraxinus pennsylvanica*) are common tree species. The understory is dominated by smooth rush (*Equisetum laevigatum*) and includes other native species: showy milkweed (*Asclepias speciosa*), giant goldenrod (*Solidago gigantea*), hedge false bindweed (*Calystegia sepium* ssp. *angulata*), white panicle aster (*Symphyotrichum lanceolatum* ssp. *hesperium*), American licorice (*Glycyrrihza lepidota*) and sedges (*Carex* sp.). The grasses include mostly non-native species and the most common are smooth brome (*Bromis inermis*) and quack grass (*Elymus repens*). The AA is bounded by a bike path (north side), an RV parking lot (east side), and an open area with planted native and non-native grasses (west side) and 42nd Avenue (south). Flood debris and sand deposits were excessive and choked culverts and cement channels in the AA. The stream experiences unnaturally large fluctuations because of urban stormwater runoff from large areas of pavement and development.

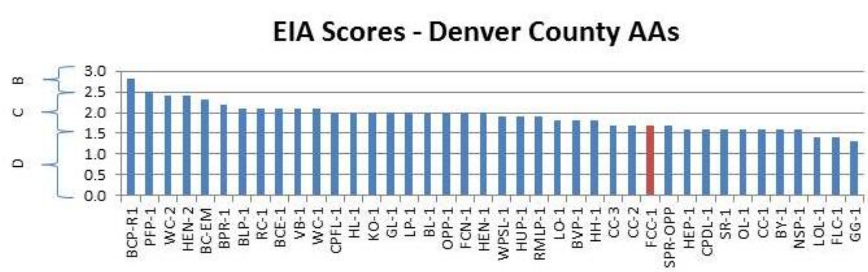
Floristic Composition:



Mean C: 2.24 (CCD Range 0.82-2.84 **FQI: 14.50** (3.05-20.82)

There were 44 species of plants on the species list with 55% native and a relative native cover of 80%. The Mean C score is high and reflects the high relative cover of native species which is unusual in dense urban settings.

Key Environmental Factors: This site is located in northeast Denver in an area near agricultural fields. The site received a high D score due to the presence of a vegetated buffer consisting primarily of native plants, and a connection to seasonal fluctuations in the hydroperiod. The hydrology of First Creek was likely that of a true plains stream: very little surface water present during the year except during precipitation events in the spring and summer. This flashy hydrology, while still present, has become more dramatic due to the increased addition of stormwater runoff from urban development. Just before this survey, the dry channel had risen from no surface water to 10 feet following a recent rain event.



Rank Comments: This survey area was ranked 1.7 for the overall EIA score. For Denver County, the overall EIA ranks ranged from a high of 2.8 (C) to 1.3 (D). Of the 40 sites in Denver County there was a range of 13 different numerical scores. Three other sites also scored a 1.7 overall EIA, placing this AA at number 10 out of the 13 possible scores which is in the medium range. The site received a high D score for Biotic Condition, due to the presence of a vegetated buffer, vegetation composition that contains more native than non-native species, and connection to natural season fluctuations in hydroperiod.

Protection Urgency Comments: Every effort should be made to protect this wetland from urban development. The wetland has relatively natural hydroperiods, and it provides wildlife habitat in a landscape that has not yet been completely developed.

Colorado 2014 Noxious Weed List: One List B: Canada thistle (*Cirsium arvense* <1%), and two List C: field bindweed (*Convolvulus arvensis* <1%) and quackgrass (*Elymus repens* <2%).

Wildlife Comments: Wildlife observed during the survey included: raccoon, red fox, Mourning Doves, Black-capped Chickadees, Barn Owl, cicadas and woodhouse toads.

Recommendations: This site should be protected from future urban development; mowing and herbicide treatment should be avoided. This is especially important since both smooth brome (*Bromus inermis*) and Canada thistle (*Cirsium arvense*) are present in the wetland (see Discussion section on herbicides).

References:

Colorado Natural Heritage Program Field Surveys. August 13, 2013. Field Forms on File at CNHP, Fort Collins, CO.

First Creek North (FCN_1)

EIA Overall Rank: 2.0 D

Biotic Condition: 2.05 D

Hydrologic Condition: 2.70 C

Landscape Context: 1.35 D

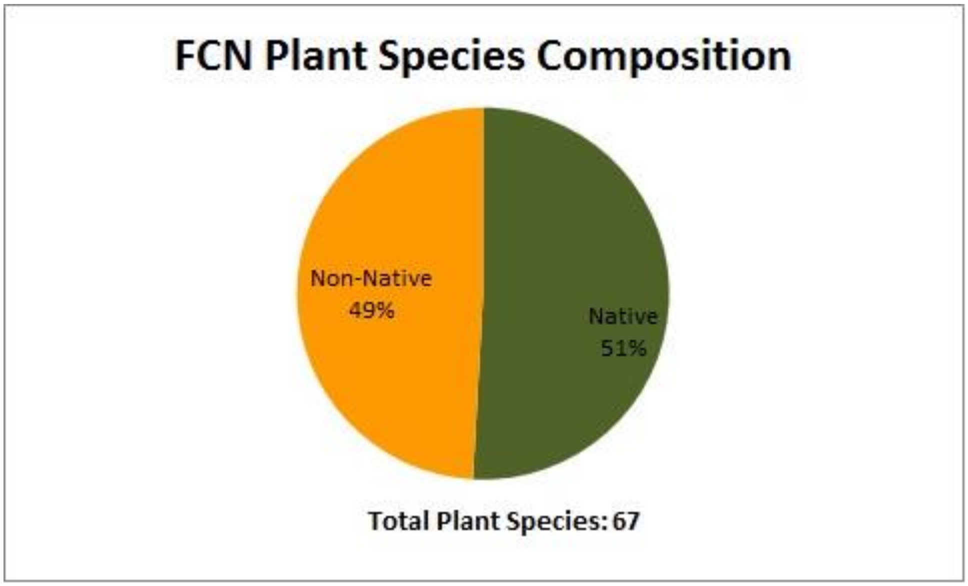
Physiochemical Condition: 1.00 D

Ecological System: Western Great Plains Riparian

Size of assessment area: 4.9 acres **Elevation**: 1650 m

General Description: The First Creek North Wetland AA includes a 0.3 mile section of First Creek that is bounded by E. 48th Avenue on its northern border. There is a vegetated buffer on the west side of the AA, while the east side is a housing development and to the south is a golf course. This creek likely contains surface water only during periods of heavy rain. The banks of the creek contain thick stands of coyote willow (*Salix exigua*), peachleaf willow (*Salix amygdaloides*), and cattails (*Typha angustifolia*). Common tree species include: plains cottonwood (*Populus deltoides*), green ash (*Fraxinus pennsylvanica*), and Siberian elm (*Ulmus pumila*). Native bulrushes (*Schoenoplectus acutus, S. pungens*), white panicle aster (*Symphyotrichum lanceolatum* ssp. *hesperium*), showy milkweed (*Asclepias speciosa*), giant goldenrod (*Solidago gigantea*), hedge false bindweed, smooth rush (*Equisetum laevigatum*) and western goldentop (*Euthamia occidentalis*) include some of the common native species in the understory. Approximately 10 days before this survey, First Creek flooded and the water levels were approximately 10 feet high in the channel. Flood debris and sand deposits were excessive, and choked the culverts and cement channels in the AA. First Creek is a plains stream that naturally experiences flashy hydrology, but it is dramatically increased due to large volumes of stormwater runoff from impervious surfaces. As more urban development replaces agricultural fields in this area, this stream will likely experience more extreme flooding events.

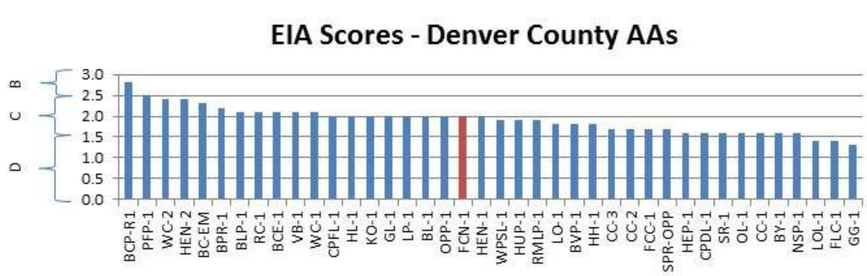
Floristic Composition:



Mean C: 1.98 (CCD Range 0.82-2.84) **FQI: 14.83** (CCD Range 3.05-20.82)

There were 67 species of plants on the species list with 51% native and an 80% relative cover of native species. This site is similar to First Creek Central but with a slightly lower Mean C score.

Key Environmental Factors: This site is located in northeast Denver in an area near agricultural fields. The hydrology of First Creek was likely that of a true plains stream with very little surface water present during the year except during precipitation events in the spring and summer. This flashy hydrology, while still present, has become more dramatic due to the increased addition of stormwater runoff from urban development. Just before our survey, the dry channel had risen from no surface water to 10 feet following a rain event. Compared to other urban wetlands in this survey, there was buffer land surrounding the wetland that help attenuate surface water runoff and help to support the healthier riparian area along the creek.



Rank Comments: This survey area was ranked 2.0 for the overall EIA score. For Denver County, the overall EIA ranks ranged from a high of 2.8 (C) to 1.3 (D). Of the 40 sites in Denver County there was a

First Creek North

range of 13 different numerical scores. Eight other sites also scored a 2.0 overall EIA, placing this AA at number 7 out of the 13 possible scores which is in the medium range. The site received higher scores for Hydrologic Condition and Biotic Condition due to the presence of a vegetated buffer, vegetation composition that has an 80% relative cover of native species, and connection to natural seasonal fluctuations in hydroperiod.

Protection Urgency Comments: This wetland is on the edge of the urban development envelope of northeast Denver. The hydroperiod is still largely natural, but increasing amounts of urban runoff are shunted into the creek from nearby housing developments. As the area becomes more developed, it is critical to avoid interrupting the continuity of this small creek's riparian corridor.

Colorado 2014 Noxious Weed List: Two List B: Canada thistle (*Cirsium arvense* <1%) and Russian-olive (*Elaeagnus angustifolia* <1%); five List C: field bindweed (*Convolvulus arvensis* <1%), redstem stork's bill (*Erodium cicutarium* <1%), cheatgrass (*Anisantha tectorum* <1%) and field sowthistle (*Sonchus arvensis* <1%) and quackgrass (*Elymus repens* <2%).

Wildlife Comments: Wildlife observed during the survey included: woodhouse toads, skunks, red foxes, garter snakes, monarch butterflies and dragonflies. A number of birds were observed and included: American Robin, Barn Swallows, Mourning Doves, American Crows, House Finches, Common Grackles, Cave Swallows, Western Kingbirds, and Song Sparrows.

Recommendations: This site should be protected from future urban development and mowing and herbicide treatment should be avoided. The presence of both smooth brome and Canada thistle should be considered in any treatment plan (see comments on herbicide use in Discussion section). The dense shoreline vegetation helps attenuate the flows from precipitation events, it also helps protect the relatively large cover of native species, wildlife habitat and water quality.

References:

Colorado Natural Heritage Program Field Surveys. August 13, 2013.

Fort Logan National Cemetery (FLC_1)

EIA Overall Rank: 1.4 D

Biotic Condition: 1.25 D **Hydrologic Condition: 1.60 D**

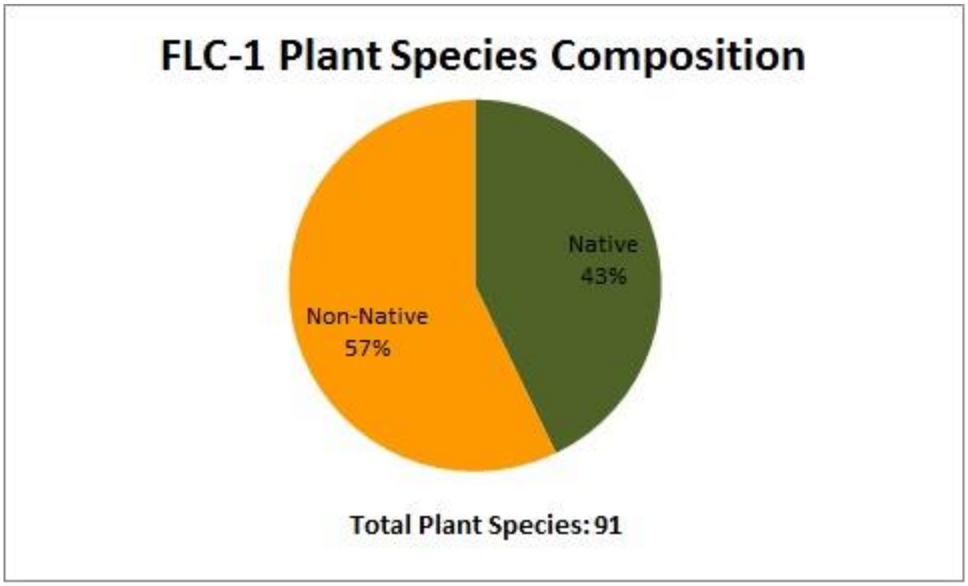
Landscape Context: 0.90 D **Physiochemical Condition: 2.00 D**

Ecological System: Western Great Plains Riparian

Size of assessment area: 3.0 acres **Elevation**: 1640 m

General Description: The Fort Logan National Cemetery AA is located in central Denver County, west of Sheridan Avenue and south of West Kenyon Avenue. The wetland includes a small ditch that feeds the wetland adjacent to Incinerator Lake, eventually feeding a larger complex of wetlands associated with Bear Creek. The site is dominated by cattails (*Typha* spp.), crack willow (*Salix fragilis*), and plains cottonwood (*Populus deltoides*). An occurrence of roundleaf monkeyflower (*Mimulus glabratus*), a species typically restricted to relatively undisturbed wetlands that has not been collected in Denver County since 1916, was documented in the AA. Aquatic species included lesser duckweed (*Lemna minor*), leafy pondweed (*Potamogeton foliosus*), and watercress (*Nasturtium officianale*). Native emergent species included spikerush (*Eleocharis macrostachya*), bulrush (*Schoenoplectus acutus*), cutleaf waterparsnip (*Berula erecta*) and Torrey's rush (*Juncus torreyi*). Water quality in the wetland is poor. Fertilizers and runoff from the cemetery and surrounding housing developments likely impact the water quality. The banks of the ditch are severely eroded in places indicative of the high volume of runoff that the ditch receives.

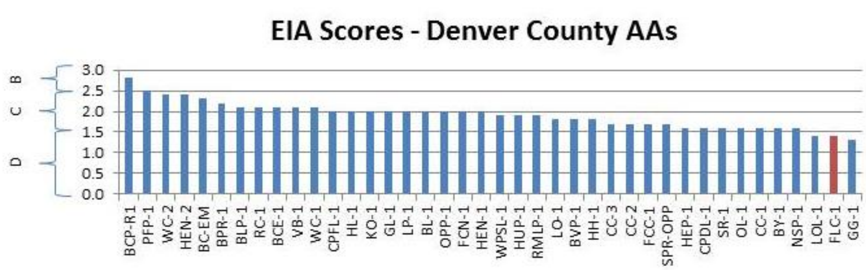
Floristic Composition:



Mean C: 1.81 (CCD Range 0.82-2.84) **FQI: 16.58** (CCD Range 3.05-20.82)

There were 91 species of plants on the species list, with 43% native and a 40% relative cover of native species.

Key Environmental Factors: The occurrence of the uncommon roundleaf monkeyflower and the moderate cover of vegetation growth within the AA provide excellent wildlife habitat and helps protect the wetland from the runoff from the surrounded manicured landscape and roads.



Rank Comments: This survey area was ranked 1.4 for the overall EIA score. For Denver County, the overall EIA ranks ranged from a high of 2.8 (C) to 1.3 (D). Of the 40 sites in Denver County there was a range of 13 different numerical scores. One other site also scored a 1.4 overall EIA, placing this AA at number 12 out of the 13 possible scores which is in the very low D range. This site received a low D score due to its small size, buffer that consists of turfgrass, water quality issues from heavy herbicide and fertilizer use, and large area in buffer that has been logged to remove Russian-olive trees. The diversity of plant species was very high at this site with 91 species and a good cover of native species.

Protection Urgency Comments: The AA is part of a larger complex of wetlands along Bear Creek. The Bear Creek complex is the highest quality wetland we documented in urban Denver. Protecting this small extension of wetland would be helpful for maintaining habitat connectivity in urban Denver.

Colorado 2014 Noxious Weed List: Five List B: Canada thistle (*Cirsium arvense* <2%), Scotch thistle (*Onopordum acanthium* <1%), Russian-olive (*Elaeagnus angustifolia* <5%), houndstongue (*Cynoglossum officinale* <2%), and musk thistle (*Carduus nutans*); six List C : field bindweed (*Convolvulus arvensis* <1%), field sowthistle (*Sonchus arvensis* <1%), burdock (*Arctium minus* <5%), mullein (*Verbascum thapsis* <1%) quackgrass (*Elymus repens* <5%) and chickory (*Chicorium intybus* <2%).

Wildlife Comments: Due to the site's close proximity to Bear Creek, this wetland provides important wildlife habitat for urban Denver. During the survey raccoons were observed within the AA. Land managers at Fort Logan National Cemetery have observed deer, elk, and mountain lions.

Recommendations: Reduce the amount of mowing and manicured lawns around the wetland allowing the wetland fringe vegetation to expand where possible to help enhance water quality and wildlife. Consider more environmentally friendly approach to weed management. The AA is dominated by non-native species (57%). Land managers at the cemetery removed approximately 500 Russian-olive (*Eleagnus angustifolius*) trees from the AA in 2013 by the Mile High Youth Corps. Restoration efforts should include replacing the Russian-olive trees with native tree and shrubs. Herbicide use is heavy throughout the cemetery, and is likely affecting the water quality of the wetland. See Discussion section on non-native plants in urban areas and herbicide use.

References:

Colorado Natural Heritage Program Field Surveys. September 18, 2013. Field Forms on File at CNHP, Fort Collins, CO.

Goldsmith Gulch (GG_1)

EIA Overall Rank: 1.3 D

Biotic Condition: 1.67 D

Hydrologic Condition: 1.00 D

Landscape Context: 1.00 D

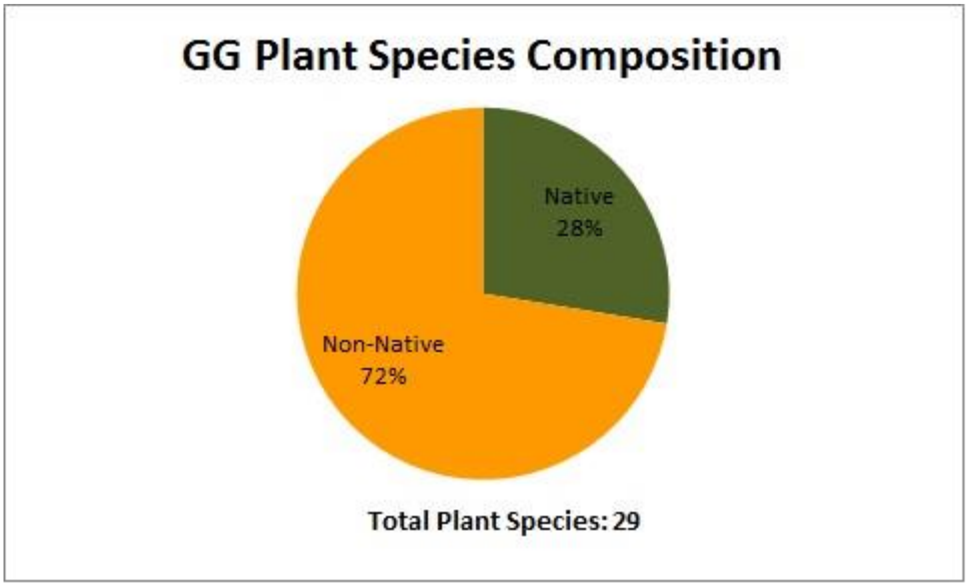
Physiochemical Condition: 1.00 D

Ecological System: North American Arid West Emergent Marsh

Size of assessment area: 3.2 acres **Elevation**: 1689 m

General Description: The Goldsmith Gulch AA is located in a densely developed part of Denver and follows a half mile section of the Goldsmith Gulch ditch that runs along S. Tamarac Drive between Rosemary and Mansfield Avenues in Denver. This site includes an artificial system that serves as a water conveyance ditch for Denver. This site was selected because of a known occurrence of a globally and state vulnerable (G3/S3) rare plant, plains ragweed (*Ambrosia linearis*) that had been documented a decade ago by a local biologist, Rick Brune. This species is only known from Colorado. The AA is dominated (>75%) by smooth brome (*Bromus inermis*), an aggressive non-native grass that is often planted along roadsides. There are scattered native forbs including the plains ragweed, growing within the dense stand of smooth brome and these include: woodbine (*Partenocissus vitacea*), cumin ragweed (*Ambrosia psilostachya*), and white prairie aster (*Virgulus falcatus*). A few species of noxious weeds and aggressive garden escapes, including crown vetch (*Securgia varia*) and purple sage (*Salvia nemorosa*), were also observed in the dense grassy area of the AA. Plains cottonwood (*Populus deltoides*) and green ash (*Fraxinus pennsylvanica*) trees are scattered along the edges of the AA.

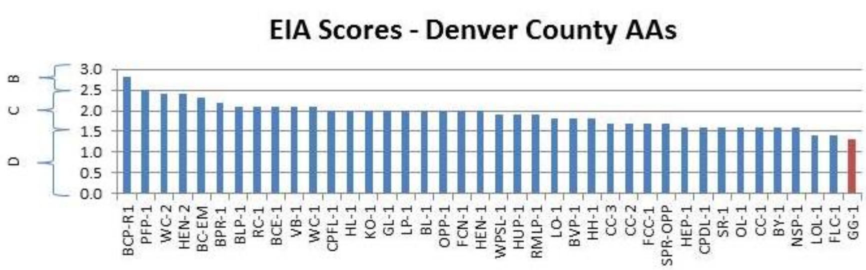
Floristic Composition:



Mean C: 0.82 (CCD Range 0.82-2.84) **FQI: 4.35** (CCD Range 3.05-20.82)

There were 29 species of plants on the species list with 28% native and a 5% relative cover of native species. This site had the lowest overall cover of native species among all 46 AAs. This is also one of the most disturbed and unnatural sites in our survey.

Key Environmental Factors: One of the most significant features of this AA is it supports a globally and state vulnerable (G3/S3) state endemic species that has been present for at least 10 years at this site. This AA had the lowest overall EIA score among all 46 sites, yet still harbors a rare native plant species. This is not the only example of a low scoring AA that supports uncommon plants. The Fort Logan Cemetery AA scored 1.4 and supports an uncommon monkey flower. Also, a City and County of Denver employee reported a sighting of a native orchid along Sanderson Gulch (not in an AA), another unnatural water conveyance in urban Denver in 2013. CNHP confirmed that it was a native orchid species, the first documented occurrence of a native orchid in Denver County.



Rank Comments: This AA was the lowest ranked site of all 46 sites surveyed. This is a reflection this highly disturbed non-natural feature. This very low scoring site provided an opportunity to calibrate metrics for the survey. Initially, the target wetlands were prioritized by high quality; thus not representing the range of wetlands. Water conveyance ditches are common throughout Denver County and all along the Front Range. Despite the low ranks for all categories, this area still provided habitat for a rare plant species.

Protection Urgency Comments: Timing is good for land managers, to rethink mowing practices around the urban ditches. Scaling back mowing will benefit urban wetlands by reducing air pollution, slowing and filtering surface runoff before it enters the waterway, and costs while protecting wildlife and plant habitat.

Wildlife Comments: Mallards and blue damselflies were observed in the waterway.

Recommendations: Support Urban Drainage efforts to reduce or stop mowing the water conveyance ditches. Utilize environmentally friendly practices in and near areas with water and wetlands and reconsider the treatment of weeds in these corridors (see Discussion section on non-native species in urban areas). The extremely high cover of smooth brome (*Bromus inermis*) which is >75%, could be further exacerbated by herbicides (Rondeau and Lavender 2012).

References:

Colorado Natural Heritage Program Field Surveys. June 17, 2014. Field Forms on File at CNHP, Fort Collins, CO.

Rondeau, R. and A. Lavender 2012. Noxious Weed Monitoring at the U.S. Air Force Academy – Year 7 Results April 2012. Colorado Natural Heritage Program www.cnhp.colostate.edu

GARFIELD LAKE (GL-1)

EIA Overall Rank: 2.0 D

Biotic Condition: 2.73 C **Hydrologic Condition: 2.00 D**

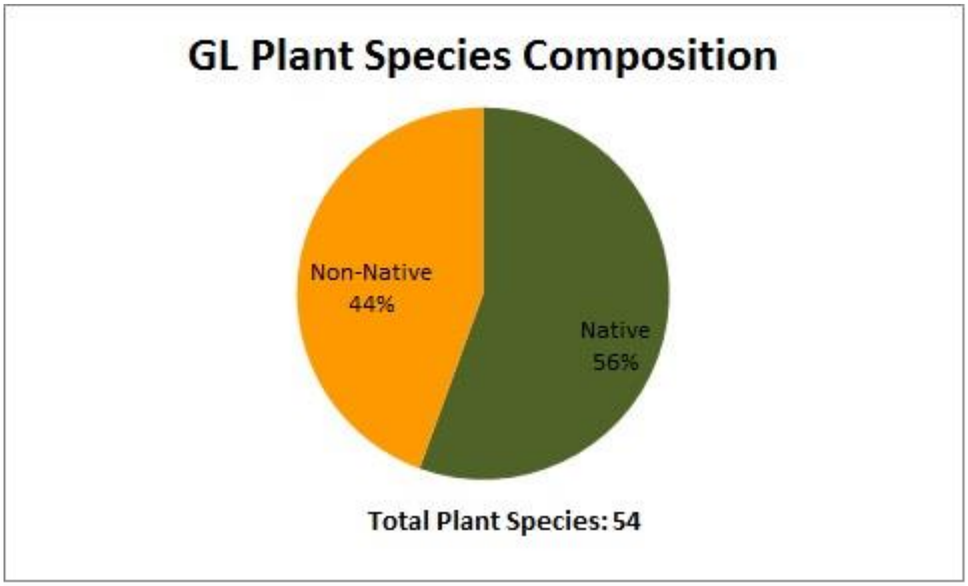
Landscape Context: 1.00 D **Physiochemical Condition: 1.50 D**

Ecological System: North American Arid West Emergent Marsh

Size of assessment area: 8.9 acres **Elevation**: 1662

General Description: The Garfield Lake AA includes a nine acre pond in a densely populated urban setting. There is a ring of emergent vegetation around the pond dominated by cattails (*Typha* spp.) and a mix of shrubs including coyote willow (*Salix exigua*), plains cottonwood (*Populus deltoides*), peachleaf willow (*Salix amygdaloides*) and green ash (*Fraxinus pennsylvanica*). There were four different species of bulrushes (*Schoenoplectus* spp., *Scirpus* spp), and a number of different native sedges. An aquatic plant, mudwort (*Limosella aquatica*), was observed growing along the island shorelines. This was the one of only two known occurrences of mudwort during the project. In addition, a population of sweetflag (*Acorus calamus*), (G4?S1), a state rare species was documented in the AA. A number of flowering herbaceous plants were observed and included wild licorice (*Glycyrrhiza lepidota*), paradox cinquefoil (*Potentilla paradoxa*) and Indianhemp (*Apocynum cannabinum*). Many areas are mowed and intensively manicured all the way to the water line. The dense phytoplanktonic algal growth is likely a result of a number of factors including suppression of aquatic macrophytes and nutrient inputs from storm water runoff and lawn chemicals. Two small forested islands are located in the center of the pond. These islands provide more shoreline for wetland plant species and wildlife along the edges and are dominated by mature cottonwood trees and shrubs. A large number of bird species use the islands. The average water depth is about 6.5 feet and the maximum depth is reported to be 16 feet (pers. Comm. A. Polonsky, July 2014).

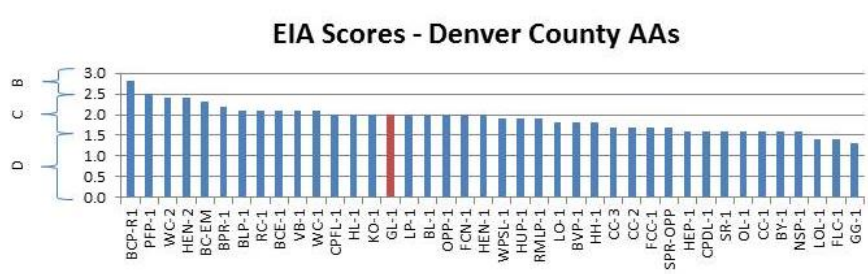
Floristic Composition:



Mean C: 2.10 (CCD Range 0.82-2.84) **FQI: 15.12** (CCD Range 3.05-20.82)

There were 54 species of plants on the species list with 56% native and a 79% relative cover of native species. The high Mean C, FQI and the high cover of native species are why this AA has such a high (C) rank for the Biotic Condition score.

Key Environmental Factors: The natural fringes of wetland vegetation that surrounds the pond and covers the islands are the driving factor for this AA. This site provides excellent habitat for wildlife and uncommon plant species. The wetland fringe of vegetation that includes the bulrushes, shrubs and cattails provides an array of important benefits to the area including the reduction of impacts from urban runoff and improving aesthetic and recreational enjoyment of the area.



Rank Comments: An overall EIA rank of 2.0 for urban Denver AAs is among the higher scores which range from 1.3 to 2.8. Of the 40 sites in Denver County there was a range of 13 different numerical scores. Eight other sites also scored a 2.0 overall EIA, placing this AA at number 7 out of the 13 possible scores which is in the medium range. This park had one of the highest Biotic Condition scores because of the high cover of native species and the quality of the plants at the site.

Protection Urgency Comments: This site contains species that were not recorded at other AAs in Denver. The Garfield Lake shoreline supports native wetland species; this is a compelling reason for protection of the wetland with buffer.

Colorado 2014 Noxious Weed List: One List A <1%): hairy willow-herb (*Epilobium hirsutum*); **o**ne List B<1%: Canada thistle (*Cirsium arvense*); two List C quackgrass (*Elymus repens*) and common mullein (*Verbascum thapsus*).

Wildlife Comments: Canada Geese, Black-crowned Night Herons, shore birds, Red-winged Blackbirds, Mallards, Snowy Egrets and Double-crested Cormorants were observed during the survey. Also bullfrogs, snakes, dragonflies and koi fish were also noted at the site.

Recommendations: Reduce the mowing zone around the perimeter of the pond allowing shoreline vegetation to expand. Consider the reduction of herbicide use around the water's edge and utilize more environmentally friendly management practices. Allow aquatic macrophyte growth to improve water quality and reduce algal growth (see Discussion sections on herbicide use in urban areas, aquatic macrophyte growth and non-native species in urban areas).

References:

Colorado Natural Heritage Program Field Surveys. July 2, 2014. Field Forms on File at CNHP, Fort Collins, CO.

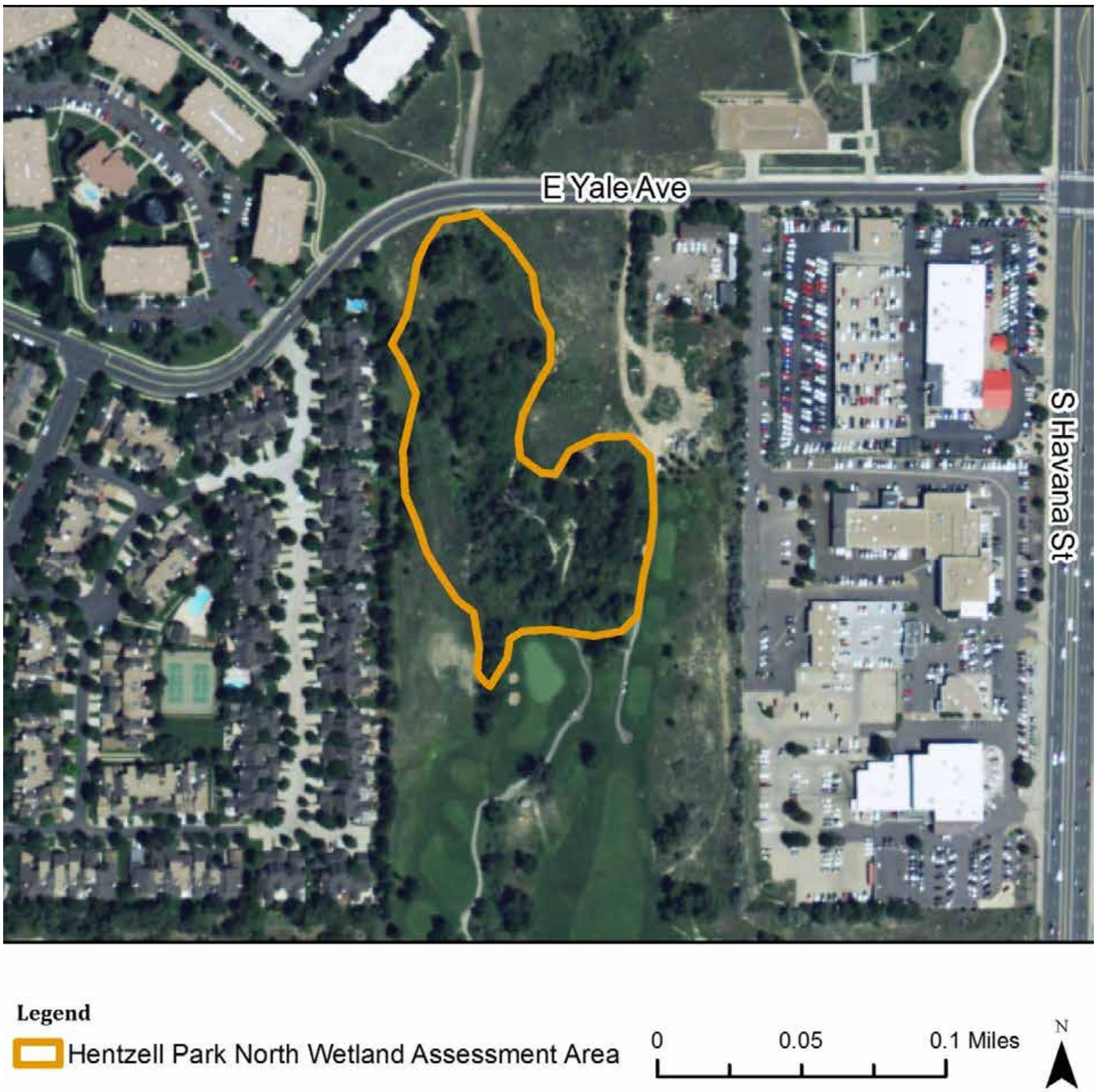
Hentzell Park North (HEN_1)

EIA Overall Rank: 2.0 D

Biotic Condition: 1.65 D **Hydrologic Condition: 2.90 C**

Landscape Context: 1.57 D **Physiochemical Condition: 1.50 D**

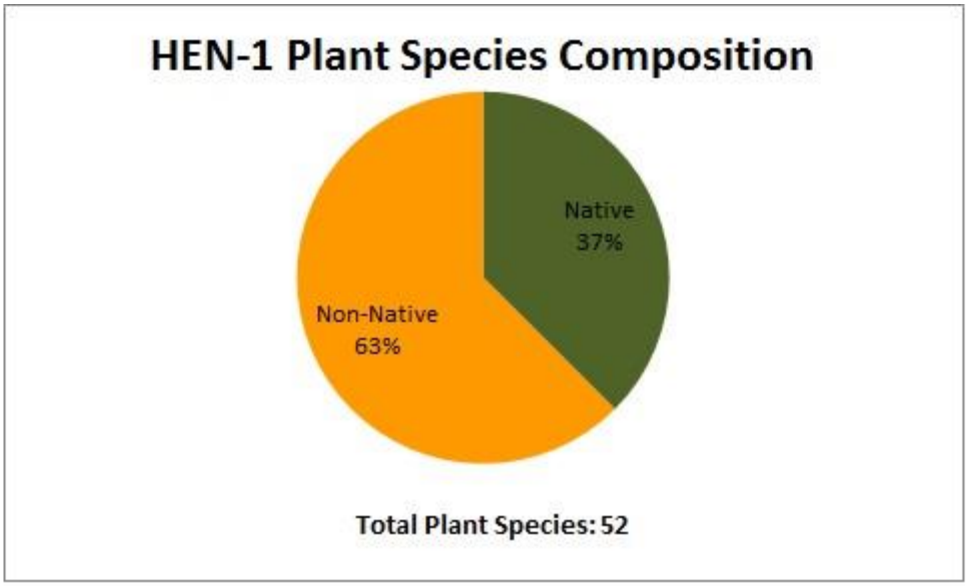
Ecological Systems: Western Great Plains Riparian



Size of assessment area: 5.3 acres **Elevation**: 1664 m

General Description: The Henzell Park North AA is a remnant perennial stream that has development on all sides including a golf course, residences, and a highway. It is located southeast of the intersection of S. Havana Street and E. Yale Avenue in Denver. The vegetation includes dense woodlands with a thick cover of shrubs and trees. The most common species present include plains cottonwood (*Populus deltoides*), green ash (*Fraxinus pensylvanica*), chokecherry (*Prunus virginiana*), buckthorn (*Rhamnus cathartica*) and coyote willow (*Salix exigua*). The understory is dominated by smooth brome (*Bromus inermis*). Other native species included: golden current (*Ribes aureum*), wild plum (*Prunus americanus*), Indianhemp (*Apocynum cannabinum*), showy milkweed (*Asclepias speciosa*), water smartweed (*Polygonum amphibium*), bulrush (*Scirpus* sp.), and cutleaf waterparsnip (*Berula erecta*). A small vegetated buffer is present on the north side. It is approximately 50 meters wide, and is dominated by cheatgrass (*Bromus tectorum*). Although this wetland contains a high percentage of non-natives, almost half the cover was from native species. The AA is almost completely surrounded by urban development; it does have connectivity to other wetlands. This connectivity, along with the complex structure of trees, shrubs, and herbaceous plants, is important for urban wildlife.

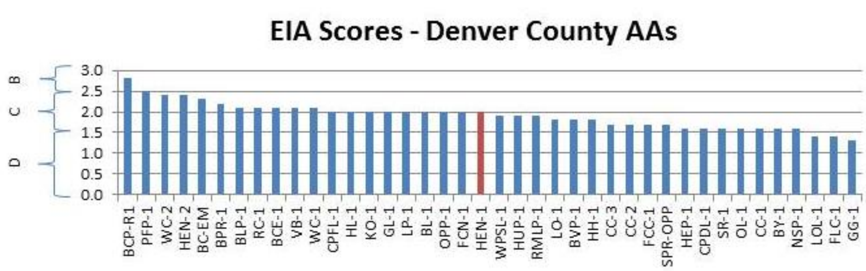
Floristic Composition:



Mean C: 1.30 (CCD Range 0.82-2.84) **FQI: 8.85** (CCD Range 3.05-20.82)

There were 52 different species of plants, 37% were native with a 50% relative cover of native species.

Key Environmental Factors: This site is located in between two other wetlands that were assessed for this study: Babi-Yar and Hentzell Park 2. The connectivity to other wetlands and the presence of some natural cover in the surrounding landscape contribute to the higher Hydrologic Condition score in the C range. The relative cover of 50% native plant species is good for an urban setting. This site provides an important habitat corridor for urban wildlife species that reside or travel through this small complex of fragmented wetlands.



Rank Comments: This AA ranked 2.0 for the overall EIA score. For Denver County, the overall EIA ranks ranged from a high of 2.8 (C) to 1.3 (D). Of the 40 sites in Denver County there was a range of 13 different numerical scores. Eight other sites also scored a 2.0 overall EIA, placing this AA at number 7 out of the 13 possible scores which is in the medium range. The buffer surrounding the site is narrow, but provides some filtration from the surrounding surface runoff flows and is one of the reasons the Hydrological Condition score is high at this site compared to many other AAs in Denver County. The surrounding area is dominated by roads, a highway, golf course, and dense housing developments. The small stream is fed by runoff from the golf course and housing developments. Algal growth was observed in most of the surface water in the wetland.

Protection Urgency Comments: This site is part of a complex of remnant wetlands surrounded by urban development. It provides critical habitat for wildlife species in an otherwise urban landscape.

Colorado 2014 Noxious Weed List: Four List B: houndstongue (*Cynoglossum officinale* <1%), Scotch thistle (*Onopordum acanthium* <1), Canada thistle (*Cirsium arvense* <1%) and leafy spurge (*Euphorbia esula* <1%); four List C: quackgrass (*Elymus repens* <2%), field bindweed (*Convovulus arvensis* <2%), poison hemlock (*Conium maculatum* <2%) and cheatgrass (*Bromus tectorum* <1%).

Wildlife Comments: Raccoon prints were noted in the wetland.

Recommendations: Management efforts should focus on continuing to protect the more natural buffer lands around the wetland on the north and east sides of the AA and not developing those open areas or installing lawns.

References:

Colorado Natural Heritage Program Field Surveys. July 23, 2013. Field Forms on File at CNHP, Fort Collins, CO.

Hentzell Park South (HEN_2)

EIA Overall Rank: 2.4 D

Biotic Condition: 2.03 D **Hydrologic Condition: 3.10 C**

Landscape Context: 2.39 D **Physiochemical Condition: 2.00 D**

Ecological Systems: Western Great Plains Riparian

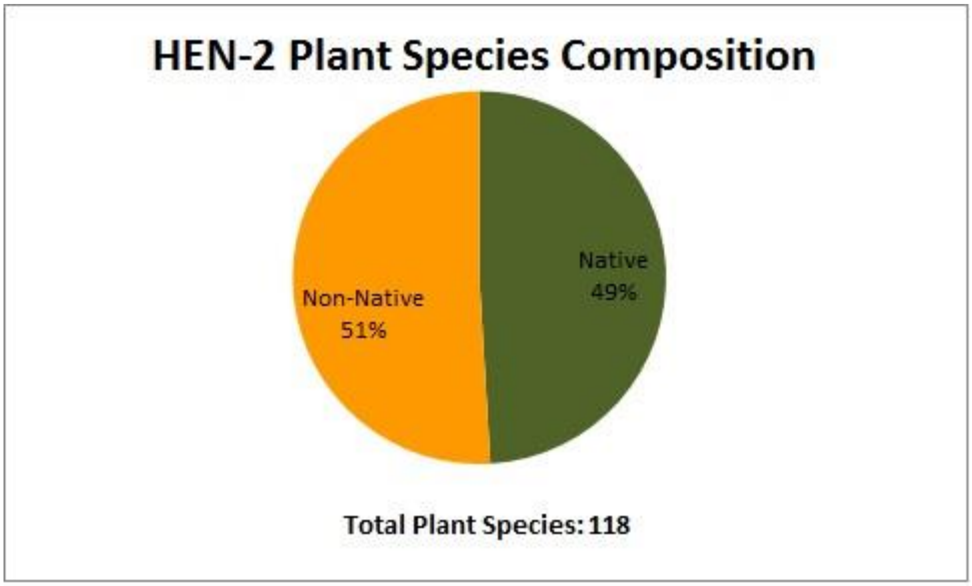
Hentzell Park South

Size of assessment area: 12.9 acres **Elevation**: 1677 m

General Description: Henzell Park South AA is comprised of a meandering half-mile section of Cherry Creek located just northeast of Cherry Creek Dam and west of Havana Street in Denver. It is part of a complex of wetlands assessed for this study: Babi-Yar, Hentzell Park 1, Hampden Heights North, and Cherry Creek at Kennedy Golf Course. The canopy is dominated by plains cottonwood (*Populus deltoides*), green ash (*Fraxinus pennsylvanica*), and crack willow (*Salix fragilis*). Understory species include snowberry (*Symphoricarpus occidentalis*), chokecherry (*Padus virginiana* ssp. *melanocarpa*), and coyote willow (Salix exigua). Native aquatic and emergent species include lesser duckweed (*Lemna minor*), fineleaf pondweed (*Stuckenia filiformis*), broadleaf arrowhead (*Sagittaria latifolia*), water speedwell (*Veronica anagallis-aquatica*), knotted rush (*Juncus nodosus*), and bulrushes (*Schoenoplectus maritimus, S. acutus*). The plant species diversity at this site is very high for an urban wetland with 119 species. Although non-native species are common, the native species provide most of the vegetation cover. The buffer width ranges from 10-75m wide on the north, west, and east sides of the AA, with additional open upland buffer of 300m on the south side. The Highline Canal passes under Cherry Creek in a siphon tunnel that does not directly impact Cherry

Creek. A large storm drain on the northwest side of the AA also contributes stormwater into Cherry Creek.

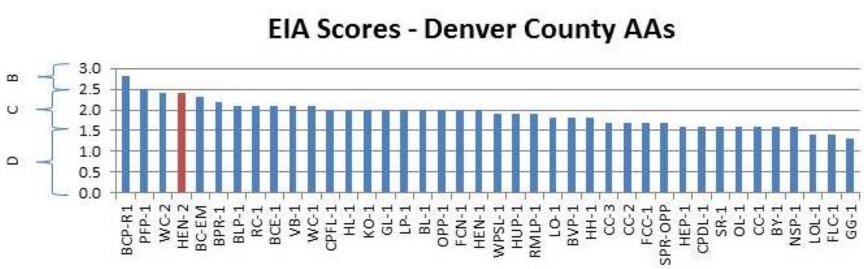
Floristic Composition:



Mean C: 1.68 (CCD Range 0.82-2.84) **FQI: 16.93** (CCD Range 3.05-20.82)

There were 118 plant species on the species list with 49% native and a 41% relative cover of native plants.

Key Environmental Factors: This site is part of a complex of connected wetlands along Cherry Creek; the connectivity to other wetlands resulted in the relatively high Hydrologic Condition score. Plant species diversity is very high at the site (119 species) as compared with other urban wetlands assessed for this study. There is a section of buffer land to the south of the AA which is important for hydrological functioning and adding scenic opportunities for recreationists.



Rank Comments: This survey area was ranked 2.4 for the overall EIA score just below a C rank. For Denver County, the overall EIA ranks ranged from a high of 2.8 (C) to 1.3 (D). Of the 40 sites in Denver County there was a range of 13 different numerical scores. Only one other site scored a 2.4 overall EIA

(Westerly Creek Emergent Marsh), placing this AA at number 2 out of the 13 possible scores which is in the high D range. This is due to the high species diversity, complex vegetation structure, wide buffer on the south side, and a more natural hydroperiod that is still connected to local precipitation events.

Protection Urgency Comments: This site is part of a complex of remnant wetlands surrounded by urban development. It provides critical habitat for wildlife species in an otherwise urban landscape.

Colorado 2014 Noxious Weed List: Two List A <1%: myrtle spurge (*Euphorbia myrsinites*) and purple loosestrife (*Lythrum salicaria*); four List B <1%: bouncingbet (*Saponaria officinalis*), musk thistle (*Carduus nutans*), Russian-olive (*Elaeagnus angustifolia*) and yellow toadflax (*Linaria vulgaris*); six List C <1%: quackgrass (*Elymus repens*), poison hemlock (*Conium maculatum*), puncturevine (*Tribulus terrestris*), redstem stork's bill (*Erodium cicutarium*), field bindweed (*Convolvulus arvensis*) and mullein (*Verbascum thapsis*).

Wildlife Comments: Wildlife observed during the survey included a variety of birds: Bushtits, Northern Flicker, Double-crested Cormorants, Mourning Doves, American Robins and Mallards.

Recommendations: Management efforts should focus on supporting the wetlands and habitat connectivity, protecting the buffer by not mowing along the wetland, and avoiding herbicide application in or near the wetland.

References:

Colorado Natural Heritage Program Field Surveys. July 24, 2013. Field Forms on File at CNHP, Fort Collins, CO.

Heron Pond (HEP_1)

EIA Overall Rank: 1.6 D

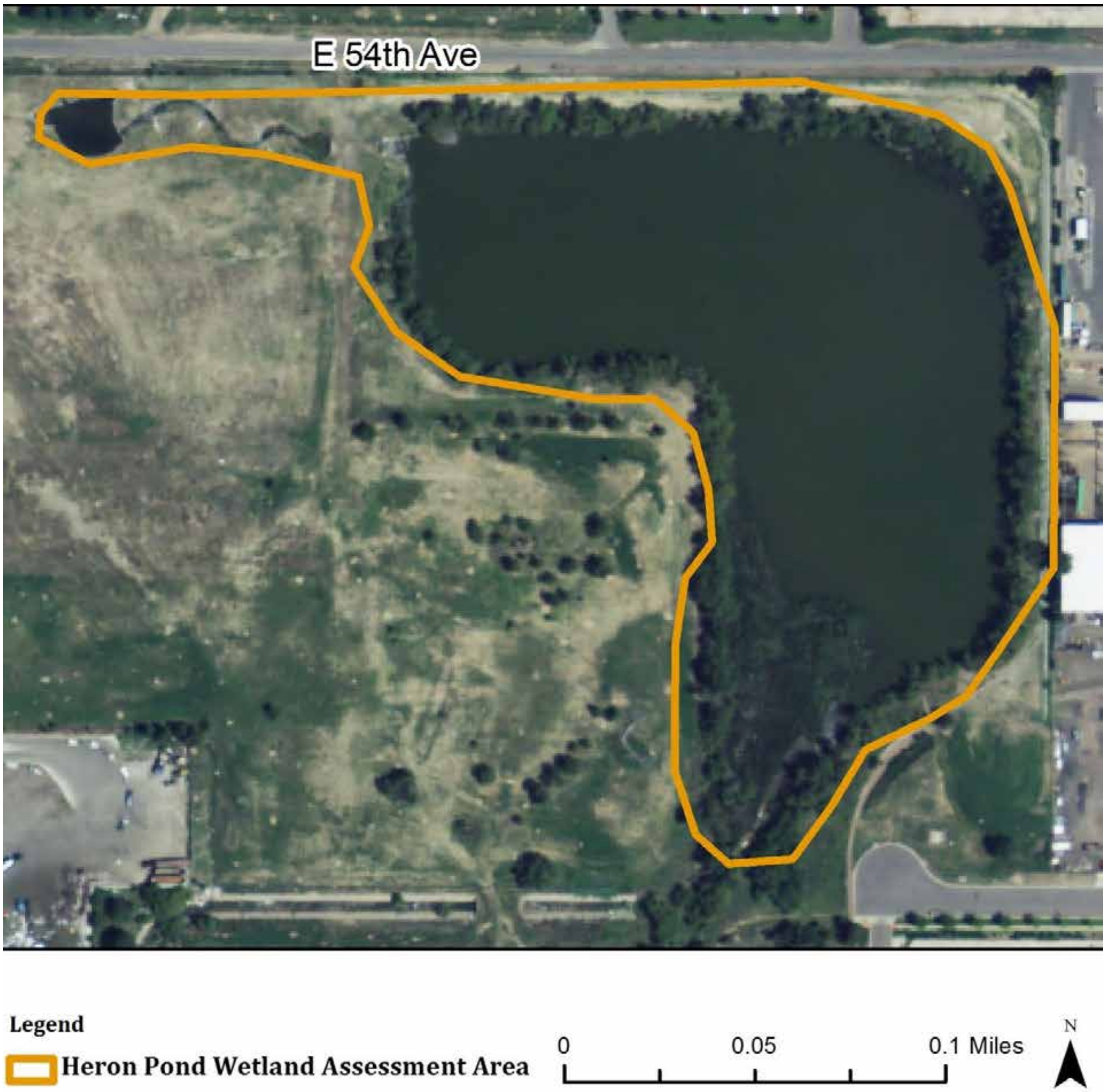
Biotic Condition: 1.85 D

Hydrologic Condition: 1.20 D

Landscape Context: 2.03 D

Physiochemical Condition: 1.00 D

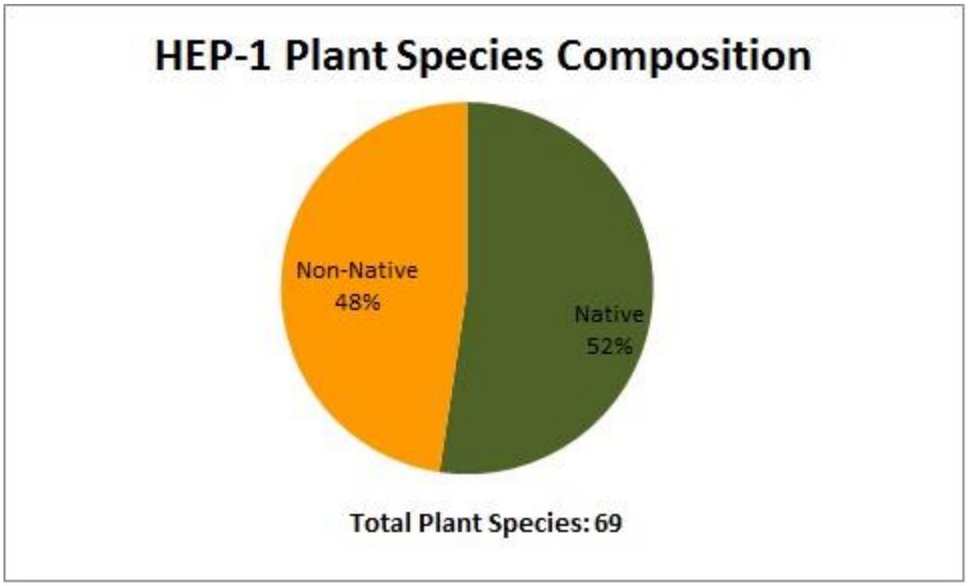
Ecological System: North American Arid West Emergent Marsh



Size of assessment area: 15.2 acres **Elevation**: 1560 m

General Description: Heron Pond AA is located in a Denver County Natural Area. The pond is used for stormwater detention. It is located within the ASARCO Superfund Site. The northern boundary is delineated by a chain link fence along 54th Avenue. The western boundary is delineated by Washington Street. The eastern boundary abuts a solid waste recycling plant. Heron Pond is located on the floodplain of the South Platte River. The pond was built in 1977 to store water from stormwater discharge. Soil contaminants are present at the site including cadmium, arsenic, and mercury. The site is an open water pond ringed by a narrow band of peachleaf willow (*Salix amygdaloides*), crack willow (*Salix fragilis*) and plains cottonwood (*Populus deltoides*). Patches of native cattails (*Typha latifolia*), bulrushes (*Schoenoplectus maritimus, S. pungens*), and prairie cordgrass (*Spartina pectinata*) are common in the wetland. Native forbs include water speedwell (*Veronica anagallis-aquatica*), alkalai buttercup (*Ranunculus cymbalaria*), and Mexican dock (*Rumex triangulivalvis*). The riparian area also includes some interesting native species including a native thistle, yellowspine thistle (*Cirsium ochrocentrum*), along with Texas croton (*Croton texensis*) and toothed spurge (*Poinsettia dentata*). An assessment was conducted on a wetland to the south of the pond at Northside Park. These two AAs are connected by a small intermittent stream and a thick band of coyote willow (*Salix exigua*).

Floristic Composition:



Mean C: 1.89 (CCD Range 0.82-2.84) **FQI: 14.99** (CCD Range 3.05-20.82)

There were 69 species on the plant list with 52% native and a 65% relative cover of native species.

Key Environmental Factors: Plant species diversity is moderate and includes structural complexity as well as a relatively high native plant relative cover. The Landscape Context score was the highest metric score for this AA reflecting the buffer land on the southeast border. This landscape is an important area that might help sequester some of the contaminants from former industrial uses. The dense vegetated cover on the shore is particularly important to stabilize the banks and to provide habitat for wildlife and aesthetic value to visitors. At the time of the survey, water in the small stream was bright orange, potentially indicating some contaminated discharge.

Land Use History: This site is located within the ASARCO Superfund Site boundary. Heavy metals and other contaminants have been documented at the site, and clean-up efforts have not been completed. Heron Pond is stated by the EPA as having "elevated levels of metals and organics", but that "sediments in the detention pond are perennially covered with water, cutting off exposure pathways and risk to human health. Therefore, no cleanup was required" (EPA 2009).

Heron Pond

Rank Comments: This survey area was ranked 1.6 for the overall EIA score. For Denver County, the overall EIA ranks ranged from a high of 2.8 (C) to 1.3 (D). Of the 40 sites in Denver County there was a range of 13 different numerical scores. Six other sites also scored a 1.6 overall EIA, placing this AA at number 11 out of the 13 possible scores which is in the low medium range. The highest ranking metric was the Landscape Context score for this site reflecting the open land on the southeast corner. This land is extremely important in providing filtration and buffer for surface runoff from the surrounding urban environment to this already heavily stressed system.

Protection Urgency Comments: This site provides critical habitat for wildlife species in an otherwise urban landscape. This is one of five formally-designated Natural Areas within Denver County.

Colorado 2014 Noxious Weed List: Four List B <1%: Canada thistle (*Cirsium arvense*), leafy spurge (*Euphorbia esula*), Dalmation toadflax (*Linaria genistifolia*) and Scotch thistle (*Onopordum acanthium*); three List C<1%: quackgrass (*Elymus repens*), cheatgrass (*Bromus tectorum*) and field bindweed (*Convolvulus arvensis*).

Wildlife Comments: Bullfrogs, garter snakes, cottontail rabbits and damselflies were observed along with a variety of birds. The bird species included: Black-crowned Night Herons, Great Blue Herons, American White Pelicans, Double-crested Cormorants, Snowy Egrets, Barn Swallows, Rock Doves, Mourning Doves, Black-capped Chickadees, Western Kingbirds, Red-winged Blackbirds, and Northern Flickers.

Recommendations: This site is one of only a few Natural Areas in the County, more natural areas would be beneficial. Setting aside more Natural Areas anywhere in a watershed improves overall water quality (Naselli-Flores 2008). The protection of the existing buffer land especially on the southeast side of the pond is recommended to maintain the integrity of the site. Allowing the vegetated fringe to expand and to protect the open lands on the southeast from development would help protect this wetland and provide a better experience for visitors and wildlife. Avoiding mowing and herbicide application in and around the wetland will also be prudent especially since there is likely a complex of chemicals in the environment due to its prior use as a smelter. This would also encourage the relatively high native cover that currently exists at the site. See Discussion section on non-native species in urban settings.

References:

Colorado Natural Heritage Program Field Surveys. August 8, 2013. Field Forms on File at CNHP, Fort Collins, CO.

Naselli-Flores, L. 2008. Urban Lakes: Ecosystems at Risk, Worthy of Best Care. Proceedings of Taal 2007: The 12th World Lake Conference: 1333-1337.

Hampden Heights North Park (HH_1)

EIA Overall Rank: 1.8 D

Biotic Condition: 1.65 D **Hydrologic Condition: 2.20 D**

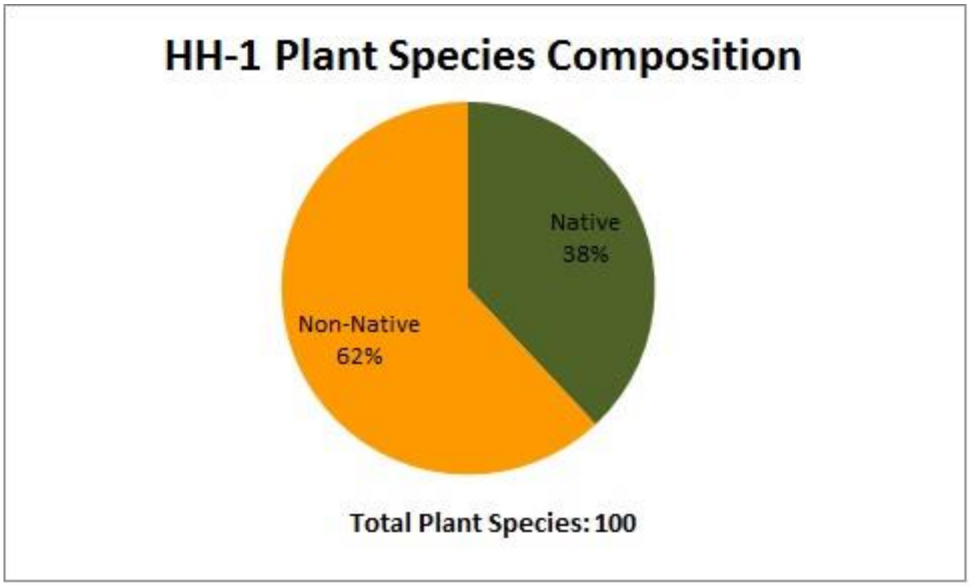
Landscape Context: 1.98 D **Physiochemical Condition: 1.00 D**

Ecological System: Western Great Plains Riparian

Size of assessment area: 5.9 acres **Elevation**: 1664 m

General Description: Hampden Heights North Park AA encompasses a quarter mile section of Cherry Creek, located in southeast Denver County just northwest of Cherry Creek Dam and east of the intersection of S. Havana Street and Dartmouth Avenue. It is part of the Hentzell Natural Area. Hentzell Park 1 and Cherry Creek at Kennedy Golf Course are adjacent AAs. Presently, the AA has buffer lands. However, this is a potential site for a new school. The prairie dog town and adjacent open lands are important ecological factors of the AA, as well as natural buffer zone to protect wildlife and water quality. At the time of the survey the stream banks were dominated by coyote willow (*Salix exigua*) with a mix of forbs and graminoid understory including spike rushes (*Eleocharis* spp.), showy milkweed (*Ascepias speciosa*), Indianhemp (*Apocynum cannabinum*), Torrey's rush (*Juncus torreyi*), cutleaf waterparsnip (*Berula erecta*), duckweed (*Lemna minor*), water lily (*Nyphaea* sp.), and panicled bulrush (*Scirpus microcarpus*). Plains cottonwood (*Populus deltoides*) and green ash (*Fraxinus pennsylvanica*) were scattered along the shoreline. In the buffer there were some very interesting native prairie species including: plains snakecotton (*Froelichia floridana*), a Denver County record, native ragweeds (*Ambrosia trifida, A. psilostachya*), and annual sunflowers (*Helianthus annus*).

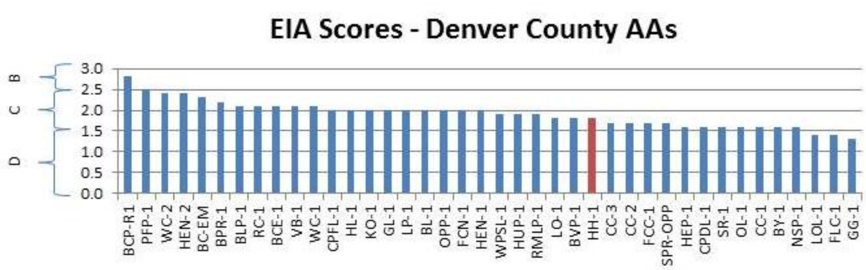
Floristic Composition:



Mean C: 1.30 (CCD Range 0.82-2.84) **FQI: 14.83** (CCD Range 3.05-20.82)

There were 100 plants on the species list with 38% native and 52% relative cover of native species.

Key Environmental Factors: This wetland includes the shoreline of Cherry Creek. It had one of largest plant species list reflecting the relatively high biodiversity. The Mean C value of 1.3 is low because of the large number of non-native species but the relative cover of native plant species was in the high range for what is expected in dense urban natural areas; between 40-50% native is typical (Kowarik 2008).



Rank Comments: This AA ranked 1.8 for the overall EIA score. For Denver County, the overall EIA ranks ranged from a high of 2.8 (C) to 1.3 (D). Of the 40 sites in Denver County there was a range of 13 different numerical scores. Two other sites also scored a 1.8 overall EIA, placing this AA at number 9 out of the 13 possible scores which is in the medium range. The scores for Hydrologic Condition and Landscape Context are relatively high and reflect the surrounding natural lands.

Protection Urgency Comments: This site is part of a complex of remnant wetlands surrounded by urban development. It provides critical habitat for wildlife species in an otherwise urban landscape. The important buffer lands that surround this area are slated to be developed soon. It is important to keep as much of the landscape in a natural state to protect hydrological functions, water quality and wildlife habitat. This area is within the Hentzel Natural Area, one of five formally-designated Natural Areas within Denver County.

Colorado 2014 Noxious Weed List: Six List B: broadleaved pepperweed (*Lepidium latifolium* <2%), Canada thistle (*Cirsium arvense* <1%), diffuse knapweed (*Acosta diffusa* <1%), musk thistle (*Carduus nutans*,1%), Scotch thistle (*Onopordum acanthium* <1%) and Russian-olive (*Elaeagnus angustifolia* <2%); seven List C: quackgrass (*Elymus repens* <2%), poison hemlock (*Conium maculatum* <1%), field bindweed (*Convolvulus arvensis* <1%), puncturevine (*Tribulus terrestris* <1%), redstem stork's bill (*Erodium cicutarium* <1%), mullein (*Verbascum thapsus* <1%) and cheatgrass (*Bromus tectorum* <5%).

Wildlife Comments: Wildlife observations during the survey included: raccoon, beaver, herons, crayfish, garter snakes, wolf spiders, black-tailed prairie dogs, Mallards, Common Grackles, Red-wing Blackbirds, Swallows and Warblers.

Recommendations: Protect the prairie dog town and surrounding grassland, allow vegetation to grow along the wetland shorelines by not mowing to the edges and avoid the applications of chemical pesticides. See Discussion sections on non-native species in urban areas and herbicide use in urban areas.

References:

Colorado Natural Heritage Program Field Surveys. July 29, 2013. Field Forms on File at CNHP, Fort Collins, CO.

Kowarik, I. 2008. On the role of Alien Species in Urban Flora and Vegetation. Urban Ecology 2008, pp. 321-338.

HUSTON LAKE (HL_1)

EIA Overall Rank: 2.0 D

Biotic Condition: 2.60 C **Hydrologic Condition: 2.00 D**

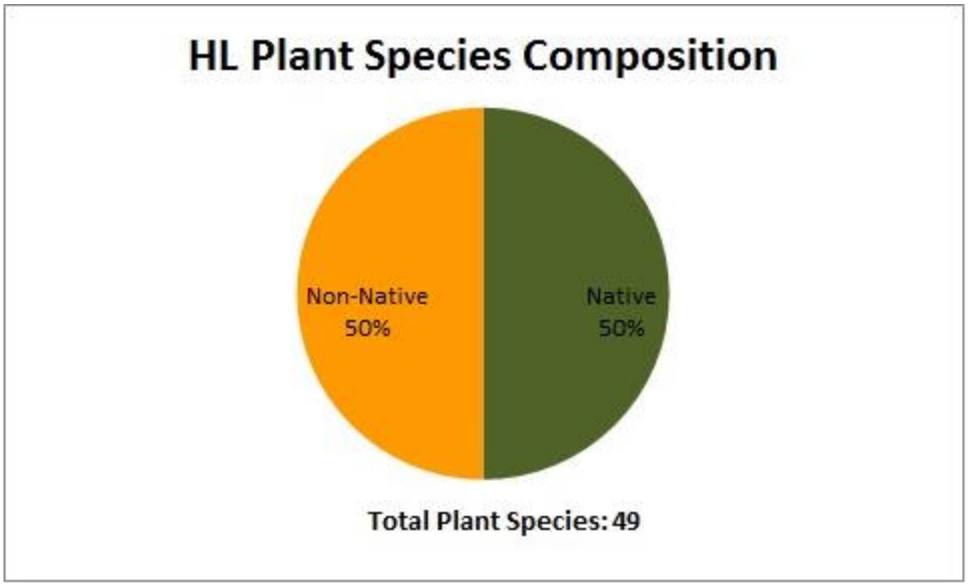
Landscape Context: 1.00 D **Physiochemical Condition: 1.50 D**

Ecological System: North American Arid West Emergent Marsh

Size of assessment area: 14.4 acres **Elevation**: 1639 m

General Description: Huston Lake Wetland AA is a fourteen acre pond in a densely developed residential area. It is located between W. Ohio and W. Kentucky Avenues on the west side of Denver. It is surrounded by extremely dense residential development, a concrete bike path and acres of manicured lawns. The wetland fringe supports a diversity of emergent wetland plant species including: cattails (*Typha* spp.), bulrushes (*Schoenoplectus* spp.), goldenrods (*Solidago canadensis, S. gigantea*), milkweed (*Asclepias speciosa*), smartweeds (*Persicaria hydropiper, P. maculata*) and other native wetland forbs. Woody shrubs include water birch (*Betula occidentalis*), cottonwoods (*Populus deltoides*), coyote willows (*Salix exigua*) and redstem dogwood (*Cornus sericea*). There are small areas where an overstory of trees has developed along the shore. Some of the lakeshore is highly compacted, open and disturbed with no shoreline vegetation. Herbicide drift from treatment is evident on adjacent woody plants (leaf curl) and the open water area appears to have been treated to remove aquatic macrophytes resulting in dense growth of phytoplanktonic algae in the water column. The pond is relatively shallow with an average reported depth of 3.5 feet and a maximum depth of 4 feet. It has been reported to have had submerged vegetation stands in the past (pers. comm. A. Polonsky, July 2014).

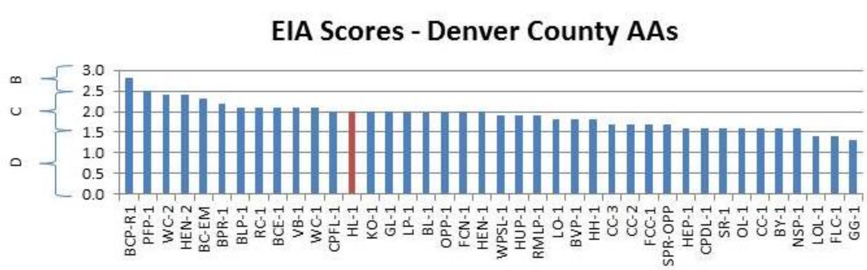
Floristic Composition:



Mean C: 2.07 (CCD Range 0.82-2.84) **FQI: 13.57** (CCD Range 3.05-20.82)

There were 49 species of plants on the species list with 50% native and a 60% relative cover of native species. The Mean C score was fairly high and indicative of the high quality native plants that were in the lake fringe vegetation. The FQI was in the moderate range for Denver County.

Key Environmental Factors: The quality and regenerative potential for native plant species at this site stands out. The Biotic Condition score was one of the higher scores among the Denver AAs. There were virtually no natural buffer lands because of the highly developed section of town and the large areas of manicured lawns.



Rank Comments: This AA was ranked 2.0 for the overall EIA score. For Denver County, the overall EIA ranks ranged from a high of 2.8 (C) to 1.3 (D). Of the 40 sites in Denver County there was a range of 13 different numerical scores. Eight other sites also scored a 2.0 overall EIA, placing this AA at number 7 out of the 13 possible scores which is in the medium range. The Biotic Condition score was high for Denver AAS in the C rank range. This is reflected in the high quality native plants that were found along the lake fringe. There are virtually no good buffer lands surrounding this AA. The lake fringe vegetation is extremely important in protecting the water quality and shoreline stability.

Protection Urgency Comments: The regeneration potential for more wetland plants at this site is very high as evidenced by the lake fringe vegetation. Efforts to protect the vegetated fringe and allow it to expand would be beneficial to the area. Wetlands of this quality are fairly uncommon in metropolitan areas.

Colorado 2014 Noxious Weed List: One List A: hairy willow-herb (*Epilobium hirsutum* <1%); one List B: Canada thistle (*Cirsium arvense* <1%); two List C: field bindweed (*Convolvulus arvensis* <1%) and quackgrass (*Elymus repens* <1%).

Wildlife Comments: Canada Geese and chicks, Red-winged Blackbirds, a snake and dragonflies were observed during the survey.

Recommendations: Since the wetland fringe has a very high diversity of native plant species along with a high native cover, it would be beneficial to allow more cover to grow by reducing the mowed lawn area. Adopting more environmentally friendly landscaping and weed treatments and allowing aquatic plants to grow would further improve the quality and valuable wetland functions and wildlife habitat provided by this wetland (see Discussion section on herbicide use, aquatic plants and non-native species in urban areas).

References:

Colorado Natural Heritage Program Field Surveys. July 02, 2014. Field Forms on File at CNHP, Fort Collins, CO.

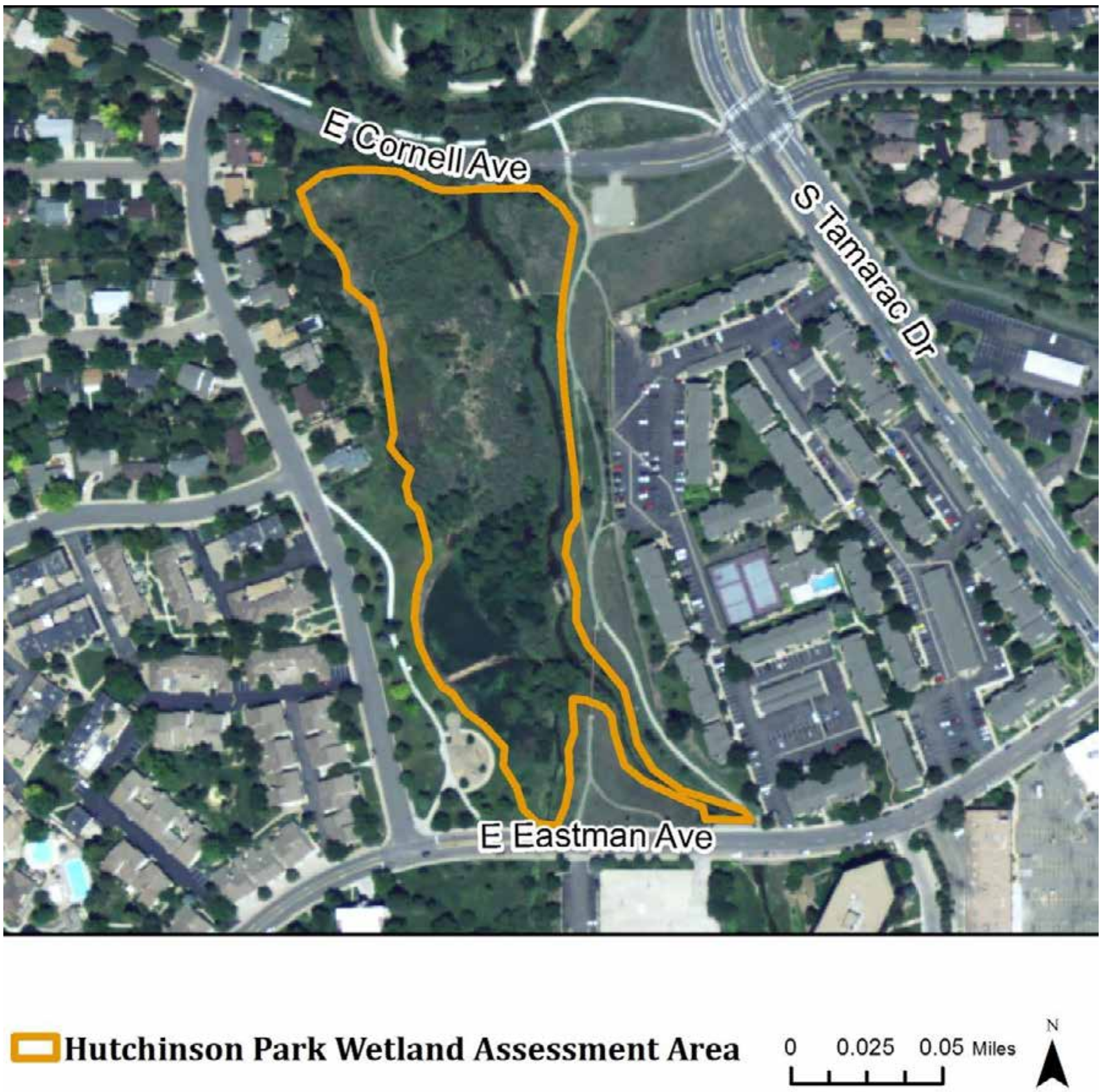
HUTCHINSON PARK (HUP_1)

EIA Overall Rank: 1.9 D

Biotic Condition: 2.19 D **Hydrologic Condition: 2.20 D**

Landscape Context: 1.00 D **Physiochemical Condition: 2.00 D**

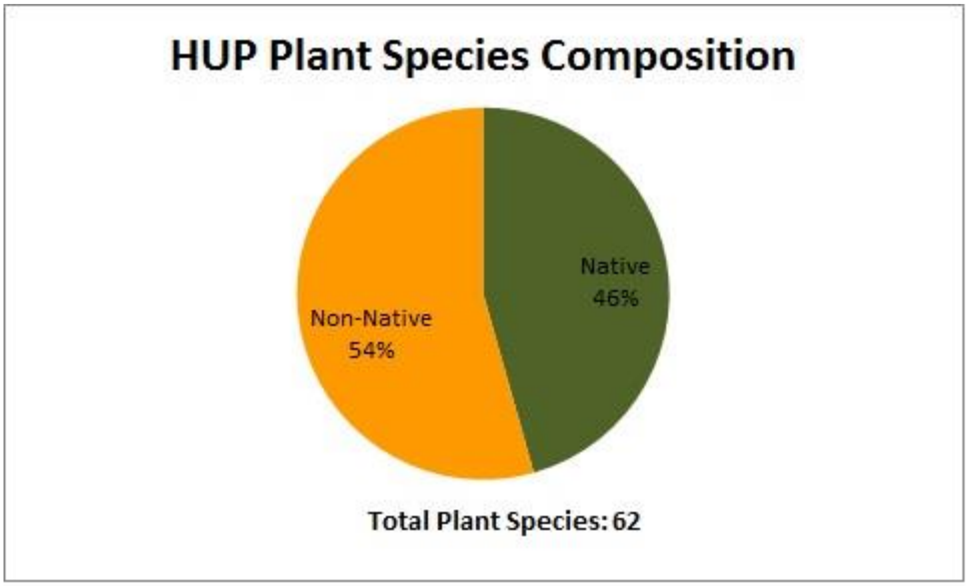
Ecological System: North American Arid West Emergent Marsh



Size of assessment area: 7.5 acres **Elevation**: 1682 m

General Description: The Hutchinson Park Wetland AA is located in densely developed southeast Denver County. It is located along Tamarac Drive between Cornell and E. Eastman Avenues. The AA is dominated by woody shrub and emergent marsh species with some forested wetland areas in a fairly large depression that surrounds a small stream (Goldsmith Gulch). A second stream (Highline Canal) runs along the northern border of the wetland. Maintained park lawns, highways and dense residential and commercial developments surround the area. This wetland is connected to other wetlands to the north and the south. The wetland at Hutchinson Park is wide compared areas north and south with a diversity of habitat types. Cattails (*Typha* spp.), smooth brome (*Bromus inermis*) and reed canarygrass (*Phalaris arundinacea*) were common in the open areas with a variety of forbs including showy milkweed (*Asclepias speciosa*), goldenrod (*Solidago canadensis*), wild licorice (*Glycorrhiza lepidota*), common groundsel (*Senecio vulgaris*), and various rushes and sedges. Coyote willow (*Salix exigua*), peachleaf willow (*Salix amygdaloides*) and golden current (*Ribes aureum*) were common in the shrub layers and green ash (*Fraxinus pennsylvanica*), boxelder (*Acer negundo*), honey locust (*Gleditisia tricanthos*) and cultivated choke cherry (*Prunus* sp.) were common in the forested sections.

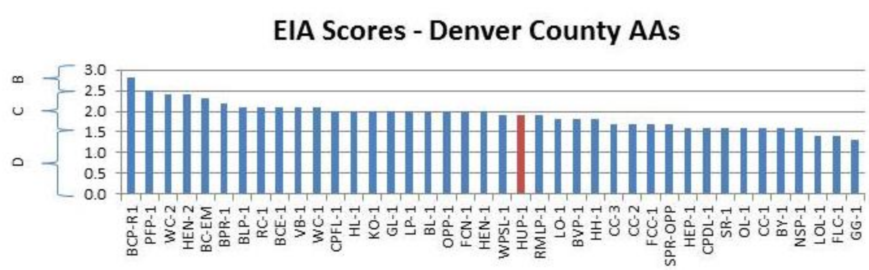
Floristic Composition:



Mean C: 1.66 (CCD Range 0.82-2.84) **FQI: 12.09** (CCD Range 3.05-20.82)

There were 62 species of plants on the species list with 46% native and a 69% relative cover of native species. This area scored in the medium range overall compared to other AAs in Denver County. The Biotic Condition score is one of the higher scores because of the high cover of native plant species.

Key Environmental Factors: The high cover of native plant species and the higher Hydrologic Condition score are positive attributes of this AA. The forested area in a matrix of open water, meadows and shrubland areas make it diverse structurally as well.



Rank Comments: This survey area was ranked 1.9 for the overall EIA score. For Denver County, the overall EIA ranks ranged from a high of 2.8 (C) to 1.3 (D). Of the 40 sites in Denver County there was a range of 13 different numerical scores. Two other sites also scored a 1.9 overall EIA, placing this AA at number 8 out of the 13 possible scores which is in the medium high range for Denver AAs. This is largely due to the cover of native plant species in the AA. The diversity of plant species and structure adds significantly to wildlife and aesthetic benefits. The low Landscape Context score is due to the fact there is essentially no natural buffer lands around this site.

Protection Urgency Comments: This AA is relatively large and has a good diversity of habitats for wildlife because of the structural diversity of mature trees, shrub thickets, open meadows and flowing open water. The ecological benefits are high as there is some nutrient cycling, shading, water flow abatement and filtration likely occurring at the site helping to mitigate the high runoff flows that are evidenced in the vegetation near inflow areas.

Colorado 2014 Noxious Weed List: Two List B: Canada thistle (*Cirsium arvense* <1%), houndstongue (*Cynoglossum officinale* <1%) and Scotch thistle (*Onopordum acanthium* , <1%); four List C: quackgrass (*Elymus repens* <1%), poison hemlock (*Conium maculatum*), cheatgrass (*Bromus tectorum* <1%) and field bindweed (*Convolvulus arvensis* <1%); one Watch List: garlic mustard (*Alliaria petiolata* <1%).

Wildlife Comments: Mallards, Yellow Warblers and tiger swallowtail butterflies were observed during the survey.

Recommendations: The entire area that is included in the AA wetland boundary is the only area of natural vegetation. The surrounding landscape includes high density residential development and highways. Continuing to protect the wetland by keeping it undeveloped maximizes the ecological, hydrological and physiochemical benefits. Utilizing environmental landscaping techniques with low chemical use and encouraging local residences to do the same would help this wetland continue to provide the valuable functions that is provides to Denver County.

References:

Colorado Natural Heritage Program Field Surveys. June 19, 2014. Field Forms on File at CNHP, Fort Collins, CO.

Kelly Open Space (KO_1)

EIA Overall Rank: 2.0 D

Biotic Condition: 1.75 D **Hydrologic Condition: 2.00 D**

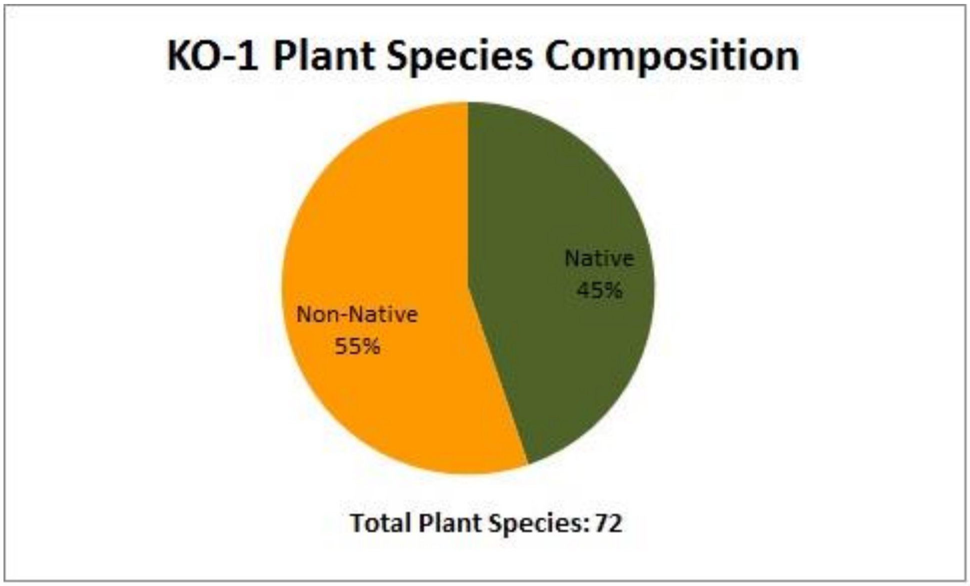
Landscape Context: 2.30 D **Physiochemical Condition: 2.50 D**

Ecological System: North American Arid West Emergent Marsh

Size of assessment area: 14.6 acres **Elevation**: 1631 m

General Description: The Kelly Open Space AA is a large emergent marsh in central Denver County just west of Aurora. The wetland developed as a result of blocking the flow of Westerly Creek. The AA is surrounded by large earthen berms and includes engineered inlet/outlet structures. Westerly Creek flows into the impoundment. The engineered inlet on the south end feeds the marsh. The wetland includes dense patches of wetland vegetation and likely contained wetlands before the surrounding area was developed. Cattails (*Typha* spp.) dominated the marsh with some open areas of water that contained aquatic plants including duckweed (*Lemna minor*) and leafy pondweed (*Potomogeton foliosus*), which are both valued by waterfowl and wildlife. Rushes, bulrushes, spikerushes and grasses were scattered throughout the cattails, as were many forbs including narrowleaf dock (*Rumex stenophyllus*) and giant ragweed (*Ambrosia trifida*). Smooth brome (*Bromopsis inermis*) was very common in the upland buffer area as well as along the wetland border. The wetland grass species included: baryard grass (*Echinochloa crus-gali*), inland saltgrass (*Distichlis spicata*) and quackgrass (*Elymus repens*). Crack willow (*Salix fragilis*), coyote willow (*Salix exigua*) and plains cottonwood (*Populus deltoides*) were common shrubs in the AA.

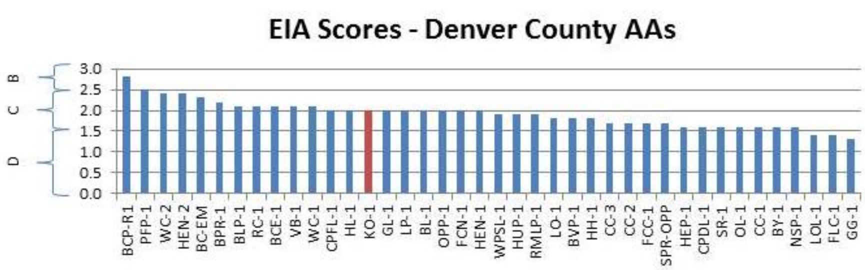
Floristic Composition:



Mean C: 1.47 (CCD Range 0.82-2.84) **FQI: 11.94** (CCD Range 3.05-20.82)

There are 72 species on the plant list with 45% native and 62% relative cover of native species, which is high for an urban area.

Key Environmental Factors: The wetland has natural vegetation in the surrounding upland landscape although non-native grasses like smooth brome and crested wheatgrass (*Agropyron cristatum*) had high cover in the surrounding uplands. Portions of the AA likely retain hydrological flows from Westerly Creek. There is a relatively high cover of native species in the wetland for an urban setting.



Rank Comments: This survey area was ranked 2.1 for the overall EIA score. For Denver County, the overall EIA ranks ranged from a high of 2.8 (C) to 1.3 (D). Of the 40 sites in Denver County there was a range of 13 different numerical scores. Five other sites also scored a 2.1 overall EIA, placing this AA at number 6 out of the 13 possible scores which is in the medium range. The overall EIA rank for this AA was fairly high and was due to the high relative cover of native plants within the AA and to buffer lands that are available in the upland area surrounding the wetland, which is reflected in the Physiochemical Condition and the Landscape Context scores.

Protection Urgency Comments: The wetland area is protected because it is a densely vegetated marsh without trails. It is an excellent spot for bird watching. There are buffer lands between the surrounding trails and the wetland.

Colorado 2014 Noxious Weed List: Two List B: Canada thistle (*Cirsium arvense* <2%) and whitetop (*Cardaria draba* <1%); five List C: quackgrass (*Elymus repens* <5%), chickory (*Chichorium intybus* <1%), redstem stork's bill (*Erodium cicutarium* <1%), cheatgrass (*Bromus tectorum* <1%) and field bindweed (*Convolvulus arvensis* <2%).

Wildlife Comments: Many birds were observed during the survey and include Snowy Egrets, Red-tailed Hawk, Red-winged Blackbirds, Western Kingbirds, Mourning Doves, Swallows and Black-crowned Night Herons. Other animals include minnows, snails, garter snake, mayflies, dragonflies and crayfish.

Recommendations: Continue to protect and surrounding buffering lands by not adding developments. Utilize environmentally friendly landscaping techniques and avoid chemical sprays near the wetland area.

References:

Colorado Natural Heritage Program Field Surveys. August 01, 2013. Field Forms on File at CNHP, Fort Collins, CO.

Lowry Wetlands (LO_1)

EIA Overall Rank: 1.8 D

Biotic Condition: 1.65 D **Hydrologic Condition: 2.00 D**

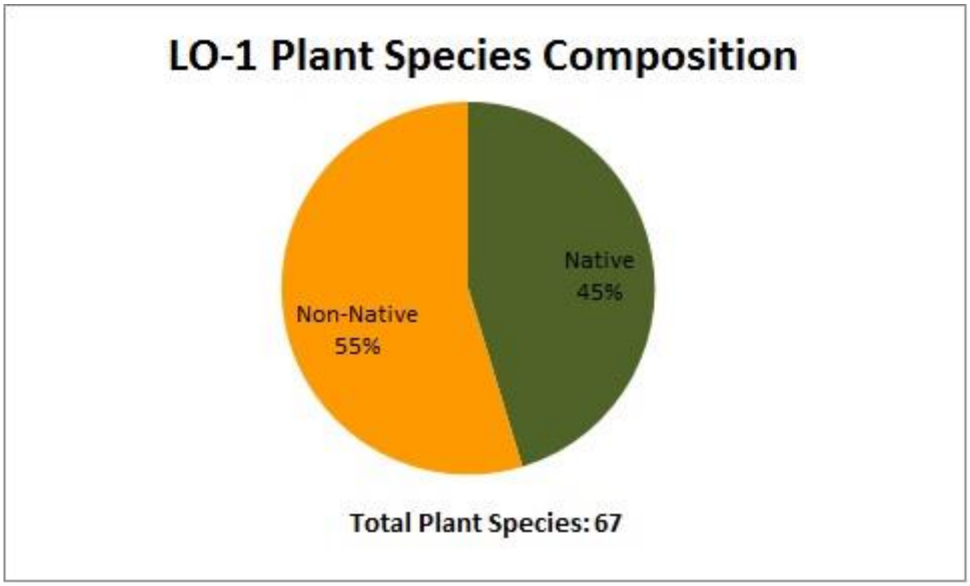
Landscape Context: 1.60 D **Physiochemical Condition: 2.50 D**

Ecological System: North American Arid West Emergent Marsh

Size of assessment area: 85.4 acres **Elevation**: 1646 m

General Description: Lowry Wetlands is the largest AA of the 46 sites in the survey. It is located in southeast Denver County north of Alameda Drive. It is bounded by a large earthen berm on ¾ of the perimeter. A golf course is adjacent to the wetland on the east side. The landscape includes developed residential lands and a large sports field area. The wetland is a central part of a flood control impoundment that exists within the historic floodplain of Westerly Creek. A ditch channels water to the AA on the southeast side and an outlet allows flow to exit on the northeast corner. Cattails (*Typha angustifolia*.) dominate the marsh with coyote willow (*Salix exigua*) plains cottonwood (*Populus deltoides*), peachleaf willow (*Salix amygdaloides*) common woody species around the perimeter of the marsh. The macroscopic green algae *Chara* sp. was common in the open water. Other native species in the marsh included: lesser duckweed (*Lemna minor*), American sloughgrass (*Beckmannia syzigachne*), spikerushes (*Eleocharis* sp.), rushes (*Juncus interior, J. balticus, J. torreyi*), sedges (*Carex* sp.), bulrushes (*Scirpus microcarpus, Schoenoplectus acutus*), small pondweed (*Potamogeton pusillus*), bog yellowcress (*Rorippa palustris*), paradox cinquefoil (*Potentilla paradoxa*), Mexican dock (*Rumex triangulivalvus*), showy milkweed (*Asclepias speciosa*) and horned pondweed (*Zannichellia palustris*).

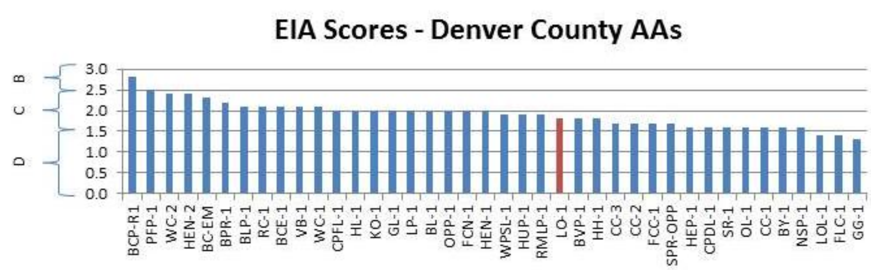
Floristic Composition:



Mean C: 1.40 (CCD Range 0.82-2.84) **FQI: 10.84** (CCD Range 3.05-20.82)

There are 67 species on the plant list with 45% native and a 15% relative cover of native species.

Key Environmental Factors: The AA supports excellent habitat for wildlife and serves an important function for flood prevention. There is a small buffer of natural lands to the south which help provide filtration services and protects water quality. The AA's hydrology has been disrupted, although remnants of hydrology likely exist due to the location within the historic floodplain of Westerly Creek.



Rank Comments: The AA was ranked 1.8 for the overall EIA score. For Denver County, the overall EIA ranks ranged from a high of 2.8 (C) to 1.3 (D). Of the 40 AAs in Denver County there was a range of 13 different numerical scores. Two other AAs also scored a 1.8 overall EIA, placing this AA at number 9 out of the 13 possible scores which is in the medium range. This AA had a very low cover of native species.

Protection Urgency Comments: The AA is heavily impacted by runoff and any efforts to help improve water quality are warranted.

Colorado 2014 Noxious Weed List: Two List A <1%: purple loosestrife (*Lythrum salicaria*) and hairy willow-herb (*Epilobium hirsutum* <1%); six List B: Canada thistle (*Cirsium arvense* <2%), musk thistle (*Carduus nutans* <1%), whitetop (*Cardaria draba* <1%), broadleaved pepperweed (*Cardaria latifolia* <1%), cutleaf teasel (*Dipsacus laciniatus* <2%) and Russian-olive (*Eleaegnus angustifolia* <1%); two List C <1%: field bindweed (*Convolvulus arvensis*) and quackgrass (*Elytmus repens* <1%).

Wildlife Comments: This is a well-known area for bird watching. The habitat includes woody shrubs, a matrix of open water interspersed in the cattails and provides excellent wildlife habitat. During the survey a pair of Red-tailed Hawks, a mule deer, Western Kingbirds, Yellow Warblers, Barn Swallows, Common Ravens, Mourning Doves, Northern Flickers, Mallards and a Gull were observed.

Recommendations: Leaving as much of the surrounding landscape undeveloped (especially the area on the south) would improve water quality of the AA. Non-chemical treatment of Canada thistle is recommended for the wetland because of the low cover (<2%) and presence of smooth brome (*Bromus inermis*), an aggressive non-native species that can be exacerbated by chemical treatments for Canada thistle (Rondeau and Lavender 2012). A natural buffer between the golf course and the wetland would be beneficial for water quality. Utilizing environmentally friendly landscaping around the wetland and for the adjacent golf course would protect water quality and wildlife.

References:

Colorado Natural Heritage Program Field Surveys. August 05, 2013. Field Forms on File at CNHP, Fort Collins, CO.

Rondeau, R. and A. Lavender. 2012. Noxious Weed Monitoring at the U.S. Air Force Academy – Year 7 Results April 2012. Colorado Natural Heritage Program www.cnhp.colostate.edu.

LAKE OF LAKES (LOL_1)

EIA Overall Rank: 1.4 D

Biotic Condition: 1.73 D

Hydrologic Condition: 1.20 D

Landscape Context: 1.00 D

Physiochemical Condition: 1.00 D

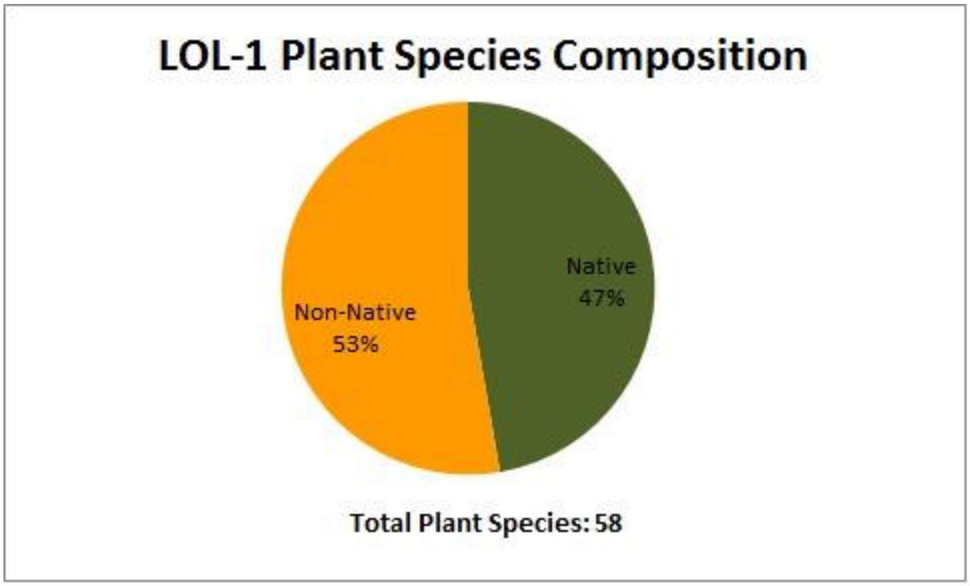
Ecological System: North American Arid West Emergent Marsh

Lake of Lakes

Size of assessment area: 4.5 acres **Elevation**: 1703 m

General Description: The Lake of Lakes AA consists of a small urban runoff pond that serves a housing development. It is located in southeast Denver just to the east of Marston Reservoir. Storm drains from the housing development and its streets empty into the pond. The pond contains a very small vegetated buffer that is dominated by coyote willow (*Salix exigua*), cattails (*Typha angustifolia* and *T. latifolia*) and cottonwoods *(Populus deltoides, P. angustifolia*). Lesser duckweed (*Lemna minor*), spikerush (*Eleocharis macrostachya*), knotted rush (*Juncus nodosus*), bulrushes (*Scirpus pallidus, Schoenoplectus acutus, S. pungens*), mapleleaf goosefoot (*Chenopodium simplex*), redosier dogwood (*Cornus sericea*), showy milkweed (*Asclepias speciosa*), and Nuttall's sunflower (*Helianthus nuttallii*) are some of the native species in the lake fringe. Henry Lake is adjacent to Lake of Lakes. These two lakes are separated by Quincy Avenue. The water was very cloudy with cover of algae.

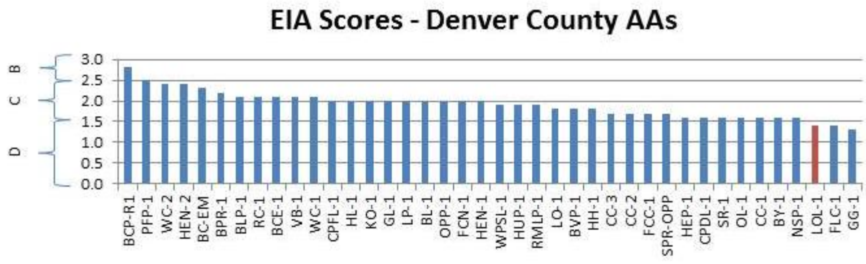
Floristic Composition:



Mean C: 1.59 (CCD Range 0.82-2.84) **FQI: 11.70** (CCD Range 3.05-20.82)

There are 58 species on the plant list with 47% native and an 87% relative cover of native species.

Key Environmental Factors: This site is a small stormwater detention pond, and has a narrow vegetated buffer. The relative cover of native species is very high at 87%. Cattails (*Typha latifolia*), bulrushes (*Schoenoplectus pungens* and *S acutus*) provide excellent habitat for waterfowl.



Rank Comments: This survey area was ranked 1.4 for the overall EIA score. For Denver County, the overall EIA ranks ranged from a high of 2.8 (C) to 1.3 (D). Of the 40 sites in Denver County there was a range of 13 different numerical scores. One other site also scored a 1.4 overall EIA (Fort Logan Cemetery), placing this AA at number 12 out of the 13 possible scores which is in the low D range. This site received a lower rank due to its poor water quality, small vegetated buffer that is in poor ecological condition, and its position within a highly developed urban landscape.

Protection Urgency Comments: Although the site received a low EIA score, it does provide water filtration, flood mitigation, and habitat for wildlife in an otherwise paved landscape and a surprisingly high cover of native species in the vegetated fringe.

Colorado 2014 Noxious Weed List: Two List A<1%: purple loosestrife (*Lythrum salicaria*) and hairy willow-herb (*Epilobium hirsutum* <1%); five List B: Canada thistle (*Cirsium arvense* <5%), broadleaved pepperweed (*Cardaria latifolia* <1%), Russian-olive (*Elaeagnus angustifolia* <2%), musk thistle (*Carduus nutans*, 1%) and poison hemlock (*Conium maculatum* <1%); three List C <1%: chickory (*Chichorium intybus*), quackgrass (*Elymus repens* <1%), and field bindweed (*Convolvulus arvensis*).

Wildlife Comments: A garter snake, mice, and American coot were observed during the field survey.

Recommendations: Due to the poor water quality at the site and the presence of smooth brome, herbicide application is not advised. The high disturbance and low diversity at the site are conditions that will only allow for more ruderal, non-native species to occur. Water quality and wildlife habitat would likely improve if the buffer was not mowed all the way to the edge of the water. Also, dog and human traffic has created soil compaction along the margin of the lake, and high disturbance has allowed for the growth of weedy species. Establishing areas that are off limits to hikers and pets would help allow for the growth of more wetland plant species.

References:

Colorado Natural Heritage Program Field Surveys. July 16, 2013. Field Forms on File at CNHP, Fort Collins, CO.

Lily Pond (LP_1)

EIA Overall Rank: 2.0 D

Biotic Condition: 2.58 C **Hydrologic Condition: 2.00 D**

Landscape Context: 1.00 D **Physiochemical Condition: 1.50 D**

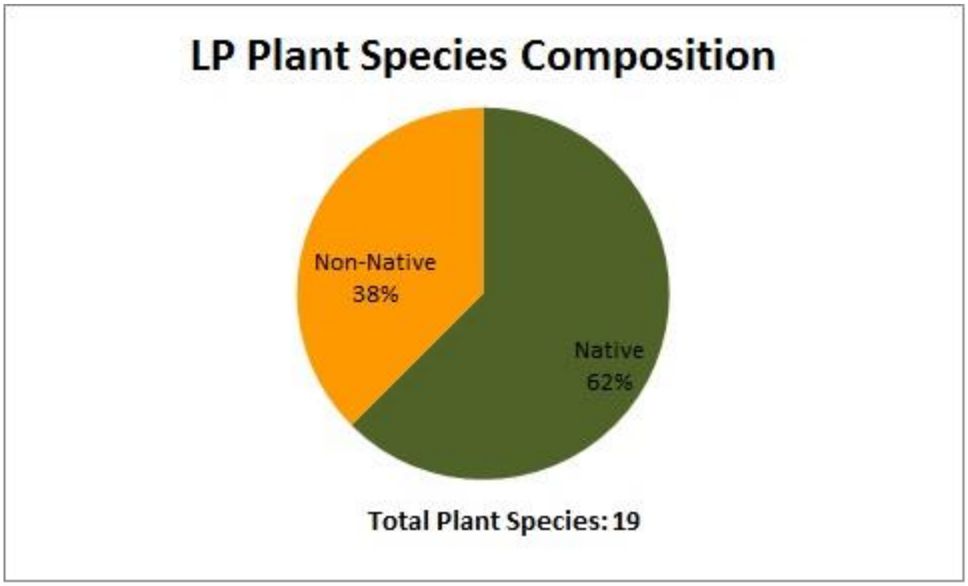
Ecological System: North American Arid West Emergent Marsh

Lily Pond

Size of assessment area: 1.4 acres **Elevation**: 1617 m

General Description: The Lily Pond AA is a very small excavated pond that was created for a youth fishing area and managed by Colorado Parks and Wildlife. It is located on the northeast corner of Washington Park in south central Denver County. The pond is within an urban metro park that is heavily utilized and highly manicured. The park is heavily used for fishing and the trails for walking and biking. The vegetated fringe of the pond includes cattails (*Typha angustifolia*), and a number of native emergent marsh species including: bulrushes (*Schoenoplectus acutus*), sedges (*Carex aquatilis, C. emoryi, C. stipata*), Baltic rush (*Juncus balticus*), and showy milkweed (*Asclepias speciosa*). Bare ground is evident along the shoreline from overuse and trampling. Fish are stocked and aquatic plants and shoreline weeds are mowed and managed.

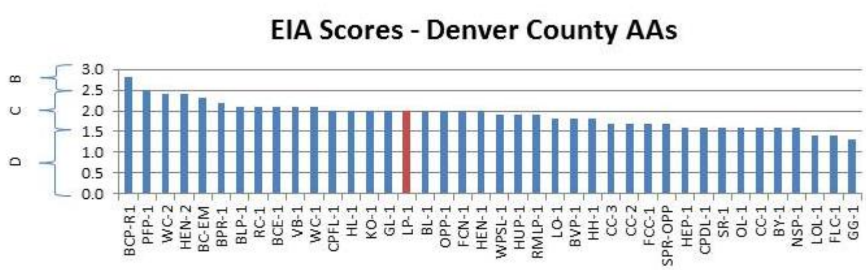
Floristic Composition:



Mean C: 2.46 (CCD Range 0.82-2.84) **FQI: 8.88** (CCD Range 3.05-20.82)

There are 19 plants on the species list with 62% native and an 81% relative cover of native species. Although the plant list is among the smallest in the survey, the sedge species are more diverse here. Sedge species were often indicative of higher quality wetlands among the Denver County AAs.

Key Environmental Factors: This is the smallest AA of the 46 in the study. Where the shoreline vegetation is allowed to flourish it is of high quality. The native sedges, wetland grasses and cattails dominate providing good habitat for wildlife and some filtration and shoreline stabilization and provide a high likelihood for regeneration of native species.



Rank Comments: This survey area was ranked 2.0 for the overall EIA score. For Denver County, the overall EIA ranks ranged from a high of 2.8 (C) to 1.3 (D). Of the 40 sites in Denver County there was a range of 13 different numerical scores. Eight other sites also scored a 2.0 overall EIA, placing this AA at number 7 out of the 13 possible scores which is in the medium range. However, the Biotic Condition score (C) is probably higher than it should be for this area and this is reflected in the very low FQI score of 8.88. Size is not included in the metric calculations and this is such a small area so the coverage of species appears to be over emphasized in the smaller AAs.

Protection Urgency Comments: As a park in a dense metropolitan area it is somewhat protected. The shoreline vegetation that is comprised largely of native species should be encouraged to grow by not mowing so close to the shoreline.

Colorado 2014 Noxious Weed List: One List B: Canada thistle (*Cirsium arvense*) <1%.

Wildlife Comments: Bird species observed during the survey included: Red-wing Blackbirds, Common Grackles, House Sparrows, and Mallards. A fox squirrel, common green darner dragonflies, damselflies, crayfish and bluegill sunfish were observed at this pond.

Recommendations: The water quality of Lily Pond could be improved by allowing some aquatic macrophytes to grow in the water column to provide shelter and food for fish and wildlife and to help reduce the water quality impacts from surface and runoff from culverts and drains. Allowing more of the wetland vegetation to flourish by reducing mowing would also improve the quality of this site and reduce maintenance costs. Environmentally friendly landscaping techniques should be used on the surrounding lands (see Discussion section on herbicide use and non-native species in urban areas).

References:

Colorado Natural Heritage Program Field Surveys. June 3, 2014. Field Forms on File at CNHP, Fort Collins, CO.

Northside Park (NSP_1)

EIA Overall Rank: 1.6 D

Biotic Condition: 2.28 D **Hydrologic Condition: 1.10 D**

Landscape Context: 1.30 D **Physiochemical Condition: 1.00 D**

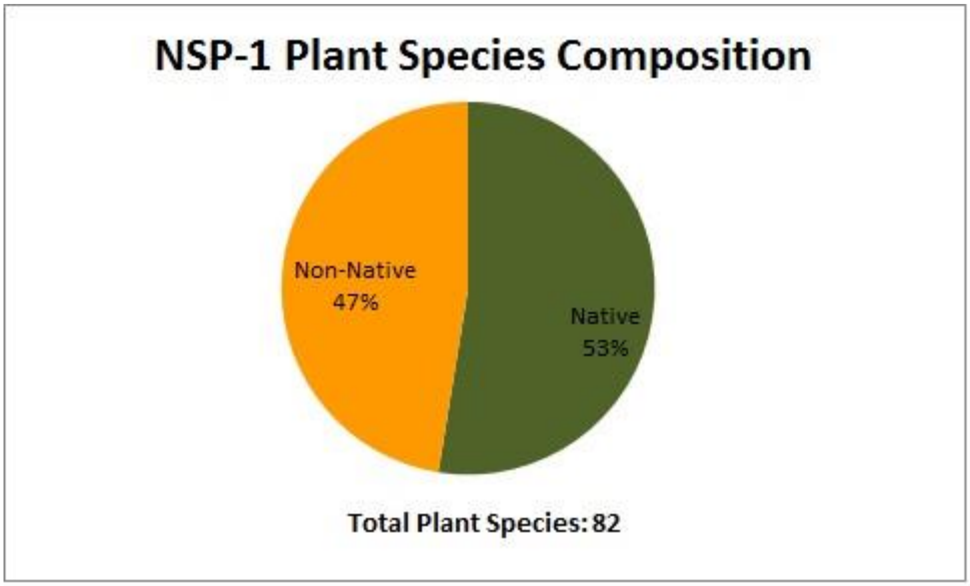
Ecological System: Western Great Plains Riparian

Size of assessment area: 1.9 acres **Elevation**: 1569 m

General Description: The Northside Park AA is located along the South Platte River in central Denver northeast of the intersection of Interstates I-25 and I-70. The east side of the AA is a public park with a lawn. The west side has had soils removed because of heavy metal contamination. Upland native grasses were seeded on the west side. The AA is dominated by willows including coyote willow (*Salix exigua*) and crack willow (*Salix fragilis*). The wettest areas have a high cover of hardstem bulrush (*Schoenoplectus acutus, Scirpus pallidus*) and a native cattail (*Typha latifolia*). Native forbs observed include: goldentop (*Euthamia occidentalis*), Macoun's buttercup (*Ranunculus macounii*), giant goldenrod (*Solidago gigantea*), and Indianhemp (*Apocynum cannabinum*). The native graminoids included: American sloughgrass (*Beckmannia syzigachne*), Indiangrass (*Sorgastrum nutans*), Northwest Territory sedge (*Carex utriculata*), and Baltic rush (*Juncus balticus*). The water in the small stream that dissects the AA had a bright orange color the day of the survey.

Land Use History: Northside Park was a sewage treatment facility for Denver in the 1930s. It is located within the ASARCO Superfund site. After its closing in the 1950s, it was abandoned and fell into disrepair. In the 1990s it was overhauled and turned into a multi-use public park. The area has been and is likely still contaminated with metals and organics such as cadmium, lead, and arsenic from smelter operations.

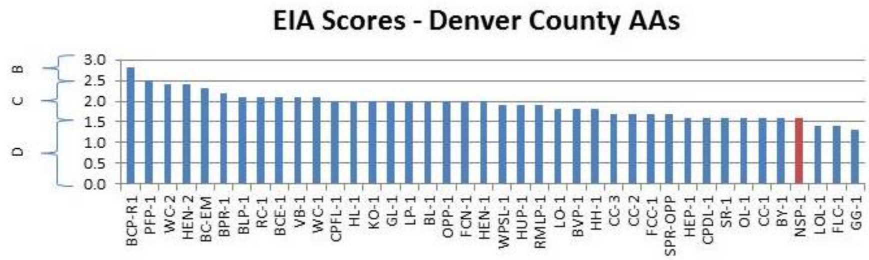
Floristic Composition:



Mean C: 2.17 (CCD Range 0.82-2.84) **FQI: 19.14** (CCD Range 3.05-20.82)

There were 82 species on the plant list with 53% native and 84% relative cover of native species.

Key Environmental Factors: The AA is part of a small urban park that contains a small stream with wetland vegetation. The wetland has very high plant species diversity. Although the AA is located within the ASARCO Superfund site, it serves as wildlife habitat. The soils at the site likely contain contaminants such as lead, arsenic, and cadmium. The EPA states that the adjacent Heron Pond has “elevated levels of metals and organics”, but “sediments in the detention pond are perennially covered with water, cutting off exposure pathways and risk to human health. Therefore, no cleanup was required.” Wildlife using the pond may be subjected to these contaminants. Lead, zinc, and cadmium have been shown to have drastic effects on the growth and development of vertebrates, from tadpoles to humans (Neufeld 1987; Read and Tyler 1994; Lefcort 1998).



Rank Comments: The AA was ranked 1.6 for the overall EIA score. For Denver County, the overall EIA ranks ranged from a high of 2.8 (C) to 1.3 (D). Of the 40 AAs in urban Denver there was a range of 13 different numerical scores. Six other AAs also scored a 1.6 overall EIA, placing this AA at number 11 out of the 13 possible scores, which is in the low D range. The position in a dense, urban setting with surrounding buffer lands that had topsoil scraped off for hazardous waste removal are reflected in the low Landscape Context, Hydrologic and Physiochemical scores. The AA had a high Biotic Condition score because of the high cover of native plant species.

Protection Urgency Comments: The high Biotic Condition score reflects the high diversity of plant species at this site. The filtration and cover value provided by the plants contribute to the important cover of wetlands in the City and County of Denver.

Colorado 2014 Noxious Weed List: Three List B: Canada thistle (*Cirsium arvense* <1%), musk thistle (*Carduus nutans* <1%) and Russian-olive (*Elaeagnus angustifolia* <1%); five List C <1%: quackgrass (*Elymus repens* <2%), puncturevine (*Tribulus terrestris*), redstem stork's bill (*Erodium cicutarium*), field bindweed (*Convolvulus arvensis*) and common mullein (*Verbascum thapsus*).

Wildlife Comments: Red-winged Blackbird, House Finch, Barn Swallow, Northern Flicker, American Goldfinch, Western kingbird, bullfrog, and two garter snakes were observed during the survey.

Recommendations: It is important to protect the open lands surrounding the wetland area at Northside Park. Reducing mowing, the amount of manicured lawn area and allowing as much wetland vegetation to thrive as possible in the area will likely assist in the remediation of this once heavily contaminated site. Weed control efforts should not occur without a specific site plan.

References:

Colorado Natural Heritage Program Field Surveys. August 8, 2013. Field Forms on File at CNHP, Fort Collins, CO.

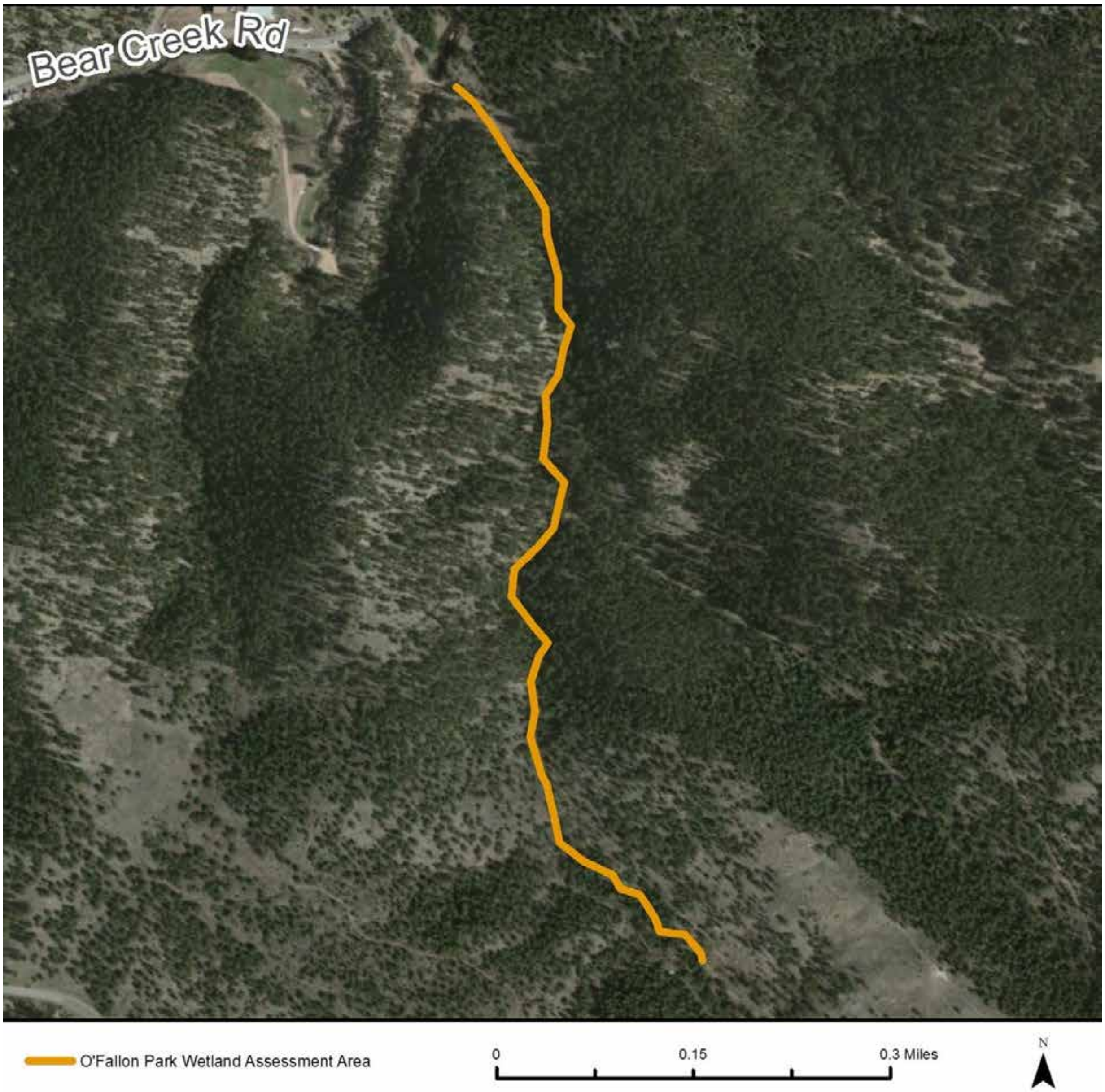
O'FALLON PARK (OFP_1)

EIA Overall Rank: 3.3 C

Biotic Condition: 2.86 C **Hydrologic Condition: 3.80 B**

Landscape Context: 3.11 C **Physiochemical Condition: 4.30 B**

Ecological System: Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland



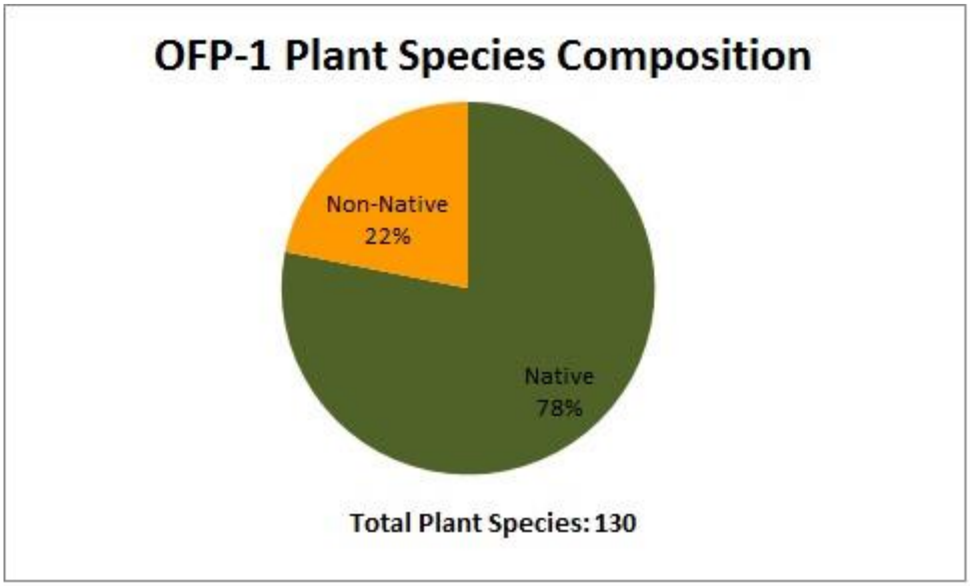
O'Fallon Park

American dipper on rock in Bear Creek (photo P. Smith 2013).

Size of assessment area: 15.8 acres **Elevation**: 2074-2155 m

General Description: The O'Fallon Park Wetland AA is a ¾ mile long riverine wetland that follows an intermittent stream to its confluence with Bear Creek. It is located east of the Town of Kittredge and north of Highway 74. The unnamed stream is a first order intermittent stream dominated by narrowleaf cottonwood (*Populus angustifolia*), blue spruce (*Picea pungens*) and Douglas fir (*Pseudotsuga menziesii*). Dense willows (*Salix drummondiana, S. bebbiana,* and *S. monticola*) and water birch (*Betula occidentalis*) are the dominant understory species. Rocky Mountain maple (*Acer glabrum*) is a common understory tree with snowberry (*Symphoricarpus occidentalis*) common in the shrub layer. The grasses are dominated by non-native species especially smooth brome (*Bromis inermis*), quackgrass (*Elymus repens*) and bent grass (*Agrostis stolonifera*). Common native plants in the understory include horsetails (*Equisetum laevigatum, E. arvense*), tobacco root (*Valeriana edulis*), largeleaf avens (*Geum macrophyllum*), tall fringed bluebells (*Mertensia ciliata*), cutleaf coneflower (*Rudbeckia ampla*), black snakeroot (*Sanicula marilandica*), Canadian anemone (*Anemone canadensis*), Fendler's meadow-rue (*Thalictrum fendleri*) and diversity of native sedges, grasses, rushes and woodrush (*Luzula parviflora*).

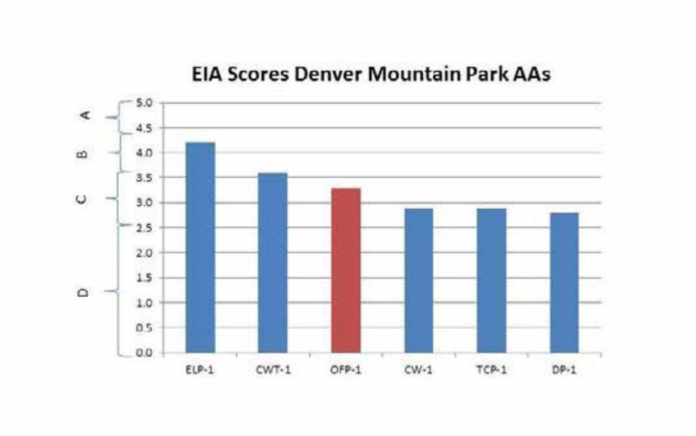
Floristic Composition:



Mean C: 4.33 (DMP Range 2.99-5.74) **FQI: 46.44** (DMP Range 26.38-52.93)

There were 130 species on the plant list with 78% native and a 92% relative cover of native species.

Key Environmental Factors: The large undeveloped landscape that surrounds the AA contributes to the quality of the wetland area. Although culverts change some of the natural movement of water, for the most part the stream is largely unrestricted.



Rank Comments: The AA was the third highest scoring AA among all 46 AAs surveyed. The AA ranked 3.3 (C) for the overall EIA score. For Denver County, the overall EIA ranks ranged from a high of 2.8 (C) to 1.3 (D) and the range for Denver Mountain Parks was 2.8 (C)-4.2 (B). Of the six AAs in Denver Mountain Parks (Jefferson/Clear Creek Counties) there was a range of five different numerical scores, this was the only AA that scored a 3.3 overall EIA, placing this AA at number 3 out of the 5 possible scores for Mountain Parks and number 3 out of all 46 AAs. The overall EIA score was a high C with B ranks for the Hydrologic and Physiochemical condition scores. The very high FQI and Mean C scores reflect the diversity of plant species and the quality of the condition of the AA with a high relative cover of native species.

Protection Urgency Comments: Development of the surrounding landscape is a threat to the wetlands in this area.

Colorado 2014 Noxious Weed List: Four List B: Canada thistle (*Cirsium arvense*), musk thistle (*Carduus nutans*), leafy spurge (*Euphorbia esula* var.*uralensis* <2%) and bull thistle (*Cirsium vulgare* <1%); two List C: quackgrass (*Elymus repens* <2%) and common mullein (*Verbascum Thapsus* <1%).

Wildlife Comments: Species observed during the survey included: Common Raven, Mountain Chickadee, White-breasted Nuthatch, Pygmy Nuthatch, Pine Siskin, American Robin, Northern Flicker, Hairy Woodpecker, Lesser Goldfinch, Black-billed Magpie, Red-tailed Hawk, American Dipper, grey squirrel, chipmonk, and a pocket gopher.

Recommendations: Restrict development and trails from the wetland area as much as possible. Weed treatments should be environmentally friendly and appropriate for wetlands.

References:

Colorado Natural Heritage Program Field Surveys. September 6, 2013. Field Forms on File at CNHP, Fort Collins, CO.

OVERLAND LAKE (OL_1)

EIA Overall Rank: 1.6 D

Biotic Condition: 1.93 D **Hydrologic Condition: 1.60 D**

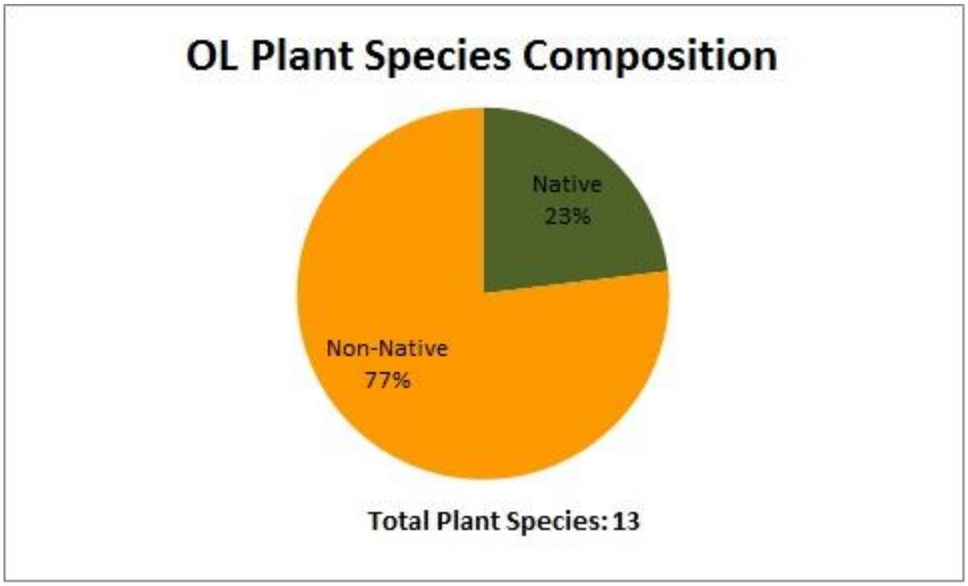
Landscape Context: 1.00 D **Physiochemical Condition: 1.00 D**

Ecological System: North American Arid West Emergent Marsh

Size of assessment area: 10.4 acres **Elevation**: 1610 m

General Description: The Overland Lake AA (better known as Aqua Golf) is an impounded 10 acre shallow pond along the South Platte floodplain in southwest Denver County near the intersection of Santa Fe and Florida Avenues. About 1/3 of the shoreline is a driving range for mini-golf. Aeration is used in the open water section and there are driving range targets throughout the pond. The average water depth is 2.5 feet and the maximum depth is 4 feet. The pond receives discharge from a waste water treatment plant about one mile upstream (pers. comm. A. Polonsky, July 2014) and through the adjacent flow-through pond at Overland Park. The vegetated fringe is only a very small part of the AA, the remainder of the lakeshore is developed. The AA is separated from the South Platte River by a road with a berm that prevents most overbank flooding from reaching the lake. Siberian elm (*Ulmus pumila*), and coyote willow (*Salix exigua*) were common woody species, showy milkweed (*Asclepias speciosa*), water horehound (*Lycopus americanus*), beggarticks (*Bidens frondosa*), smooth brome (*Bromopsis inermis*), Canada thistle (*Cirsium arvense*), were common herbaceous species in the wetland. Cheatgrass (*Bromus tectorum*) and crested wheatgrass (*Agropyron cristatum*) were common in the upland transition zone.

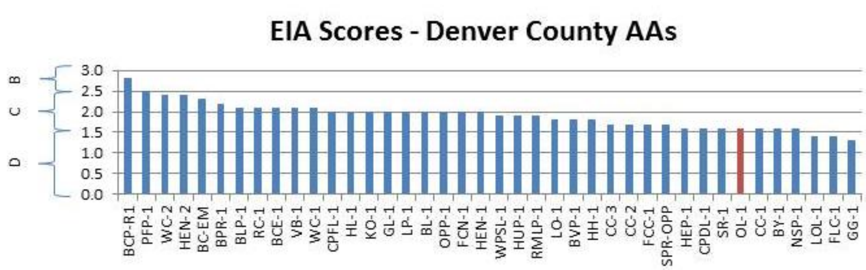
Floristic Composition:



Mean C: 0.85 (CCD Range 0.82-2.84) **FQI: 3.05** (CCD Range 3.05-20.82)

There were 13 species of plants on the species list with 23% native and a 29% relative cover of native species.

Key Environmental Factors: The AA is one of the most highly disturbed sites surveyed. There were virtually no intact buffer lands and the hydrology is highly impaired. Because the AA is located along the floodplain of the South Platte River there is a potential ground water connection.



Rank Comments: The AA ranked 1.6 for the overall EIA score. For Denver County, the overall EIA ranks ranged from a high of 2.8 (C) to 1.3 (D). Of the 40 AAs in Denver County there was a range of 13 different numerical scores. Six other AAs also scored a 1.6 overall EIA, placing the AA at number 11 out of 13 possible scores. The FQI score was the lowest of all 46 AAs and the Mean C score was the second lowest reflecting the disturbed nature of the area.

Colorado 2014 Noxious Weed List: Four List B: Canada thistle (*Cirsium arvense* <1%), Scotch thistle (*Onopordum acanthium* <1%); two List C<1%: quackgrass (*Elymus repens*) and field bindweed (*Convolvulus arvensis*).

Protection Urgency Comments: The connectivity to the South Platte and the vegetated buffer indicate a potential to improve the condition of the wetland vegetation. This area is included in the South Platte River Potential Conservation Area (Appendix H) and is very important for hydrologic and wildlife support.

Wildlife Comments: Snowy Egrets, Canada Geese, Sandpipers, Double-crested Cormorants, Killdeer, Red-winged Blackbirds, butterflies, turtles and lizards were observed in the AA during the survey.

Recommendations: Allow vegetated fringe around the lake to expand along the shoreline to help filter surface runoff and to provide habitat for wildlife. The protection of water quality and the protection and promotion of the existing shoreline vegetation and wildlife should be the highest priority (See Discussion sections on non-native species, herbicide use and aquatic plants in urban areas).

References: Colorado Natural Heritage Program Field Surveys. July 3, 2014. Field Forms on File at CNHP, Fort Collins, CO.

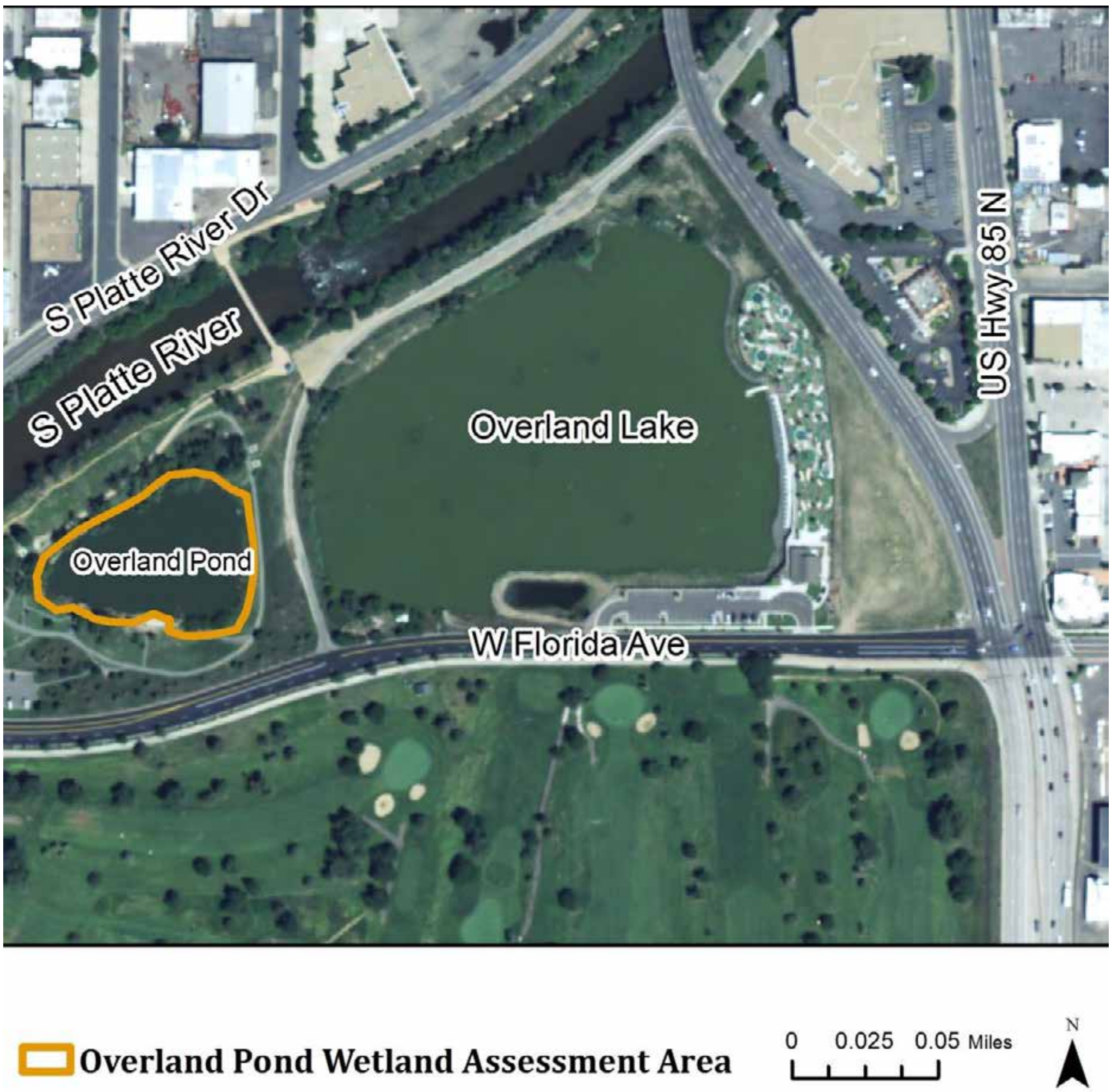
OVERLAND POND (OPP_1)

EIA Overall Rank: 2.0 D

Biotic Condition: 2.20 D **Hydrologic Condition: 1.80 D**

Landscape Context: 2.24 D **Physiochemical Condition: 1.00 D**

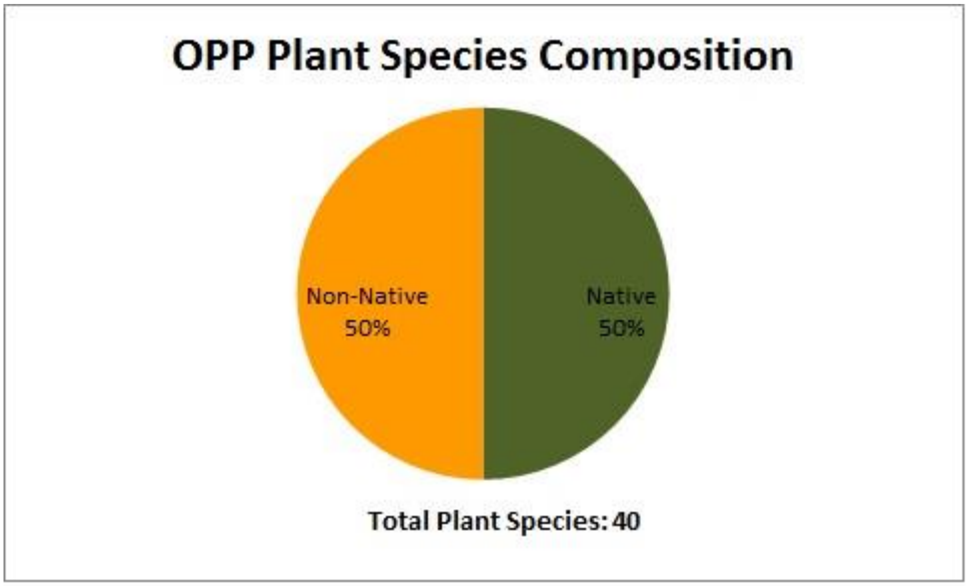
Ecological System: North American Arid West Emergent Marsh



Size of assessment area: 1.9 acres **Elevation**: 1610 m

General Description: The Overland Pond AA was one of the smaller sites in the survey. It is located along the floodplain of the South Platte River in southwest Denver County near Santa Fe and Florida Avenues. The pond has effluent piped to it from a nearby wastewater treatment plant and is considered a "pass through" pond where high water exchanges occur (personal communication, Al Polonsky July 2014). It is a popular park used by fisherman and walkers. The shoreline vegetation includes trees and shrubs, grasses and forbs. A fishing pier is installed on the south side of the pond, an inlet flow on the south and a weir structure on the northeast (flow to Overland Lake). Coyote willow (*Salix exigua*), cottonwood (*Populus deltoides*), and water birch (*Betula occidentalis*), are common native woody species. Willow dock (*Rumex salicifolius*), water horehound (*Lycopus americanus*), Macoun's buttercup (*Ranunculus macounii*), lady's thumb (*Persicaria maculata*) and Canada goldenrod (*Solidago canadensis*) are examples of the high quality native species found in the wetland.

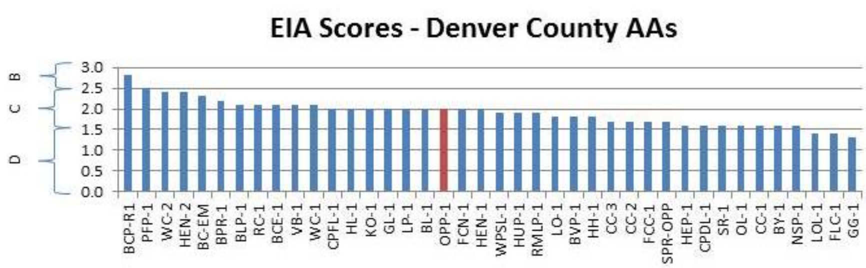
Floristic Composition:



Mean C: 2.31 (CCD Range 0.82-2.84) **FQI: 13.83** (CCD Range 3.05-20.82)

There were 40 species of plants on the species list with 50% native and a 70% relative cover of native species.

Key Environmental Factors: This is a highly disturbed site along the floodplain of the South Platte River. A large earthen berm with a road separates the pond from the river. The immediate surrounding landscape includes buffer lands that support the higher quality vegetation that grows along the shore.



Rank Comments: The AA ranked 2.0 for the overall EIA score. For Denver County, the overall EIA ranks ranged from a high of 2.8 (C) to 1.3 (D). Of the 40 AAs in Denver County there was a range of 13 different numerical scores. Eight other AAs also scored a 2.0 overall EIA, placing this AA at number 7 out of the 13 possible scores which is in the medium range. The rank for this AA is fairly high considering the level of disturbances. The Landscape Context and Biotic Condition scores are the drivers for the 2.0 overall rank score. The variety and quality of the native wetland forbs was high.

Colorado 2014 Noxious Weed List: Two List B: >2% diffuse knapweed (*Acosta diffusa*) and Canada thistle (*Cirsium arvense*); one List C: quackgrass (*Elymus repens* <5%). The surrounding upland area had many planted non-native species.

Protection Urgency Comments: The AA is in an urban park and is located within the South Platte River Potential Conservation Area (see Appendix H). Protecting the area from additional development is important because the buffer area is presently so small. Many high quality native forbs were noted in the vegetated fringe.

Wildlife Comments: American Robins, Red-winged Blackbirds, Snowy Egrets, Killdeer, Yellow Warblers, turtles, butterflies, and a bullfrog were observed during the survey.

Recommendations: Allow as much plant growth around the perimeter and in the pond as possible to abate surface runoff pollution and help slow flows to the wetland from pipes. Utilize environmentally friendly landscaping in the manicured lawns to protect the native wetland plants. Because of the low cover of noxious weeds and the presence of smooth brome in the wetland fringe, chemical herbicides are not recommended (see Discussion sections on herbicide use, aquatic plant growth and non-native species in urban areas).

References: Colorado Natural Heritage Program Field Surveys 2014. Field Forms on File at CNHP, Fort Collins, CO.

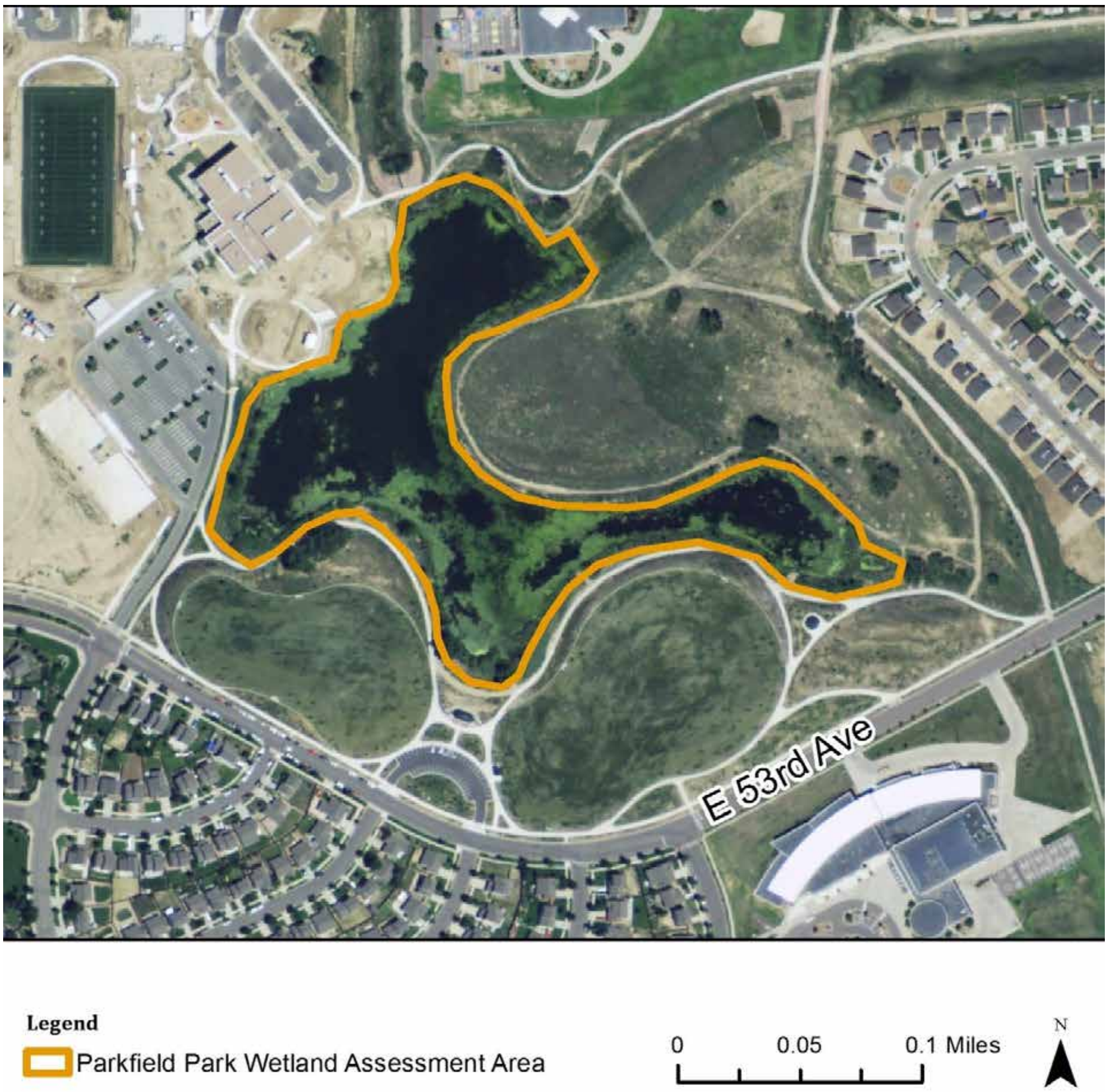
PARKFIELD PARK (PFP_1)

EIA Overall Rank: 2.5 C

Biotic Condition: 2.36 D **Hydrologic Condition: 3.00 C**

Landscape Context: 2.15 D **Physiochemical Condition: 2.50 D**

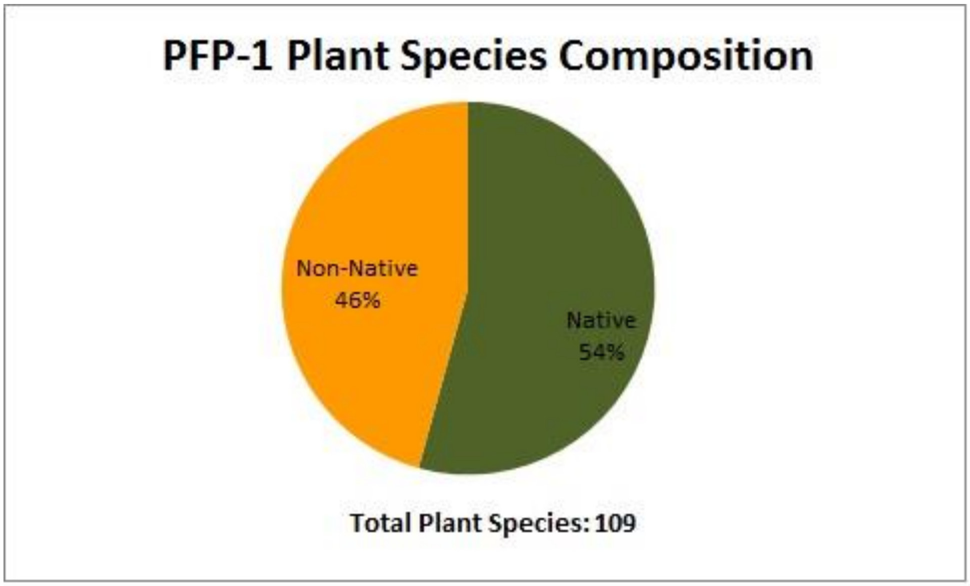
Ecological System: North American Arid West Emergent Marsh



Size of assessment area: 11.9 acres **Elevation**: 1624 m

General Description: The Parkfield Park AA is located in northeast Denver east of Montbello. The AA includes a pond and the surrounding wetland fringe of vegetation. Two large concrete culverts and a storm sewer inlet that are located around the perimeter funnel runoff into the lake. The shoreline is largely artificial with rip rap and concrete banks. The AA is in a depression and collects water and surface runoff. The lake is shallow and averages between two and three feet deep except during storm events and functions as a water detention pond (personal communication, A. Polonsky July 2014). This wetland is surrounded by a developed landscape with an upland prairie that provides high quality buffer land on the eastern side. A large number of birds, insects, and plants were recorded during the survey, as well as observations of fish, invertebrates, snails, and mussels. The plant diversity was very high compared to other sites and included some very uncommon species. Columbian watermeal (*Wolffia columbiana*) is an example of one of the uncommon plants, and was only known from Yuma and Larimer counties prior to this survey. Columbian watermeal is a tiny perennial floating aquatic plant (~0.5mm) that was found growing with another small floating plant, least duckweed (*Lemna minuta*). Other native aquatic macrophytes included pondweeds (*Potomogeton pusillus*, *P. nodosu*s, *P. foliosus* ssp. *foliosus*), twoleaf waterweed (*Elodea bifoliata*), coon's tail (*Ceratophyllum demersum*), turion duckweed (*Lemna turionifera*), sago pondweed (*Stuckenia pectinata*) and longroot smartweed (*Polygonum amphibium* var. *emersum*). Another Denver County record was documented at this AA, northern bugleweed (*Lycopus uniflorus*) which is uncommon in Colorado and was only known from Weld and Boulder counties until this survey. The overstory of the AA is dominated by plains cottonwood (*Populus deltoides*), coyote willow (*Salix exigua*) and peachleaf willow (*Salix amygdaloides*) and marsh areas were dominated with cattails (*Typha* spp.). Numerous species of sedges (*Carex* spp.), rushes (*Juncus* spp.), bulrushes (*Schoenoplectus* spp.) add to the diversity. Swamp milkweed (*Asclepias incarnata*), Nuttall's sunflower (*Helianthus nuttallii*), cutleaf waterparsnip (*Berula erecta*), and American sloughgrass (*Beckmannia syzigachne*) are native plants in the herbaceous layer.

Floristic Composition:

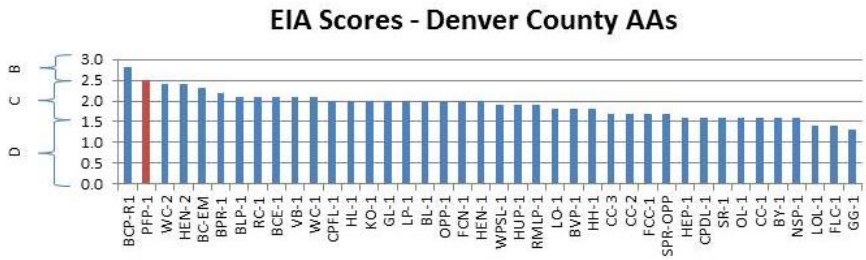


Mean C: 2.02 (CCD Range 0.82-2.84) **FQI: 20.20** (CCD Range 3.05-20.82)

There are 109 species on the plant list with 54% native and a 68% relative cover of native species.

Key Environmental Factors: The AA is one of the highest quality wetlands surveyed in urban Denver. The vegetation structure is complex and plant and wildlife species diversity is high. The natural vegetation on the east side and upslope of the pond provides an important buffer from surface runoff and allows for precipitation to penetrate into the soil. The fringe of dense, mostly native vegetation including layers of trees, shrubs, forbs, graminoids, and emergent and aquatic wetland plant species provide a complex structure.

Land Use History: Parkfield Lake was originally designed as a storm water retention pond (Dudley 2004).



Rank Comments: The AA was ranked 2.5 (C) for the overall EIA score. For Denver County, the overall EIA ranks ranged from a high of 2.8 (C) to 1.3 (D). Of the 40 AAs in Denver County there was a range of 13 different numerical scores. No other AA also scored a 2.5 overall EIA, placing this AA at number 2 out of the 13 possible scores which is in the low C range. The AA received a high score relative to other urban wetlands due to the presence of a fairly wide buffer, heavy cover of shoreline vegetation with woody debris and litter.

Protection Urgency Comments: This AA was one of Denver's highest ranked wetlands in the survey. It provides invaluable ecosystem services such as water filtration, flood mitigation, and wildlife and plant habitat as well as a natural space for the public. The large number of native wetland species including many uncommon species is worthy of protection.

Colorado 2014 Noxious Weed List: Four List B: Canada thistle (*Cirsium arvense* <2%), Russian-olive (*Elaeagnus angustifolia* <5%), musk thistle (*Carduus nutans* <1%) and tamarisk (*Tamarix* sp. <1%); and six List C <1%: quackgrass (*Elymus repens*), redstem stork's bill (*Erodium cicutarium*), field sowthistle (*Sonchus arvensis*), common mullein (*Verbascum thapsus*), puncturevine (*Tribulus terrestris*), cheatgrass (*Bromus tectorum*) and field bindweed (*Convolvulus arvensis*).

Wildlife Comments: Wildlife observations included: bullfrogs, tadpoles, woodhouse toads, Mallards, Barn Swallow, Snowy Egret, Double Crested Cormorant, American Coot, Gadwall, Canada Goose, Yellow Warbler, Lesser Goldfinch, Rock Dove, Red Winged Blackbird, Chipping Sparrow, Lark Sparrow, European Starling, Northern Flicker, Pied-billed Grebe, Violet-green Swallow, Say's phoebe, Bank Swallow, Common Yellowthroat, Marsh Wren, Barrow's Blackbird. We also observed bullfrog, coyote, and the following invertebrates: snails, two-ridge ramshorn snail, cicada killer wasp, forktails, tule bluets, common green darner, blue-eyed darner, wander glider and variegated meadowhawk dragonflies.

Recommendations: Allowing tall vegetation to expand around the pond perimeter and reducing the cover of lawn and protecting the existing buffer land on the east side of the pond will protect water quality by filtering surface runoff. The dominant non-native species include Canada thistle (*Cirsium arvense)* and smooth brome (*Bromus inermis*). Therefore, spraying herbicide to control non-native species is not recommended (see Discussion section on non-native species). Signs of herbicide drift onto native species, especially on cottonwood trees, were observed all around the perimeter. Manual removal of the tamarisk (*Tamarix* sp.) plant on the northeast shore of the lake is recommended. Efforts to maintain or encourage the growth of the very diverse native aquatic plants found at Rocky Mountain Lake will help provide food and cover for ducks as well as fish and invertebrates.

References:

Colorado Natural Heritage Program Field Surveys. August 7, 2013. Field Forms on File at CNHP, Fort Collins, CO.

Majack, M.L. The vascular flora of Denver, Colorado: A case study of floristics in the twenty-first century in Contributions to the flora of Colorado. Master's thesis, University of Colorado Denver, 2014.

RIVERSIDE CEMETERY (RC_1)

EIA Overall Rank: 2.1 D

Biotic Condition: 2.00 D **Hydrologic Condition: 3.00 C**

Landscape Context: 1.19 D **Physiochemical Condition: 2.00 D**

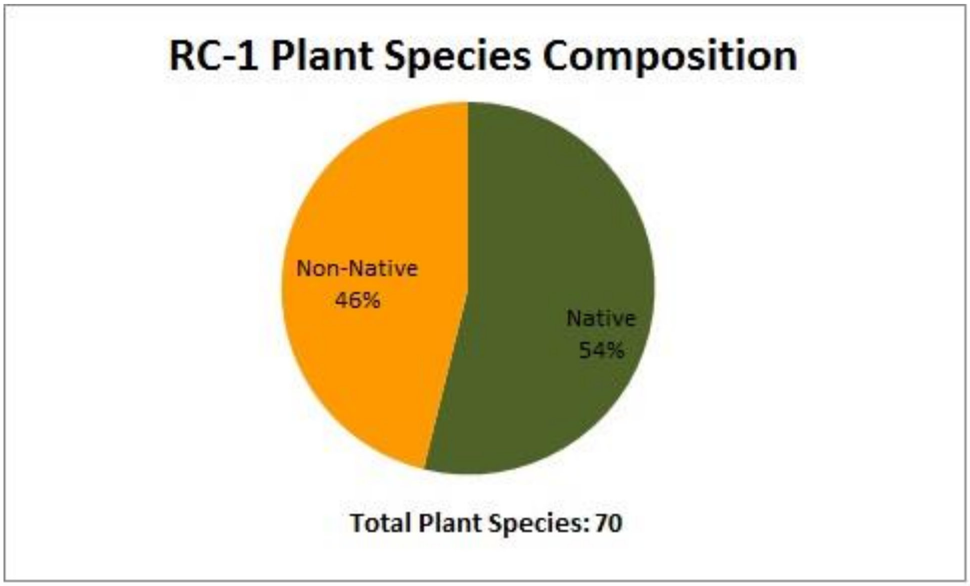
Ecological System: North American Arid West Emergent Marsh

Riverside Cemetery

Size of assessment area: 24.3 acres **Elevation**: 1554 m

General Description: The Riverside Cemetery AA is located on private land along the South Platte River on the northwest side of Riverside Cemetery. It is the only AA located in Adams County (on the Denver County border). The AA is separated from the South Platte River by an artificial berm on the northeast side. The Burlington Ditch and another smaller ditch are outside the AA. The surrounding landscape is comprised of industrial development and cemetery land. Several Superfund Sites are in the vicinity of the AA. The AA does not have significant recreational visitation due to private ownership. Cattails (*Typha* spp.) dominate the marsh, plains cottonwood (*Populus deltoides*), coyote willow (*Salix exigua*), crack willow (*Salix fragilis*) and Siberian elm (*Ulmus pumila*) are common woody species. Wild licorice (*Glycyrrhiza lepidota*), Canada thistle (*Cirsium arvense*), Indianhemp (*Apocynum cannabinum*), and rushes (*Juncus* spp.) were common herbaceous species. Smooth brome (*Bromus inermis*) is a dominant grass in the riparian area surrounding the marsh.

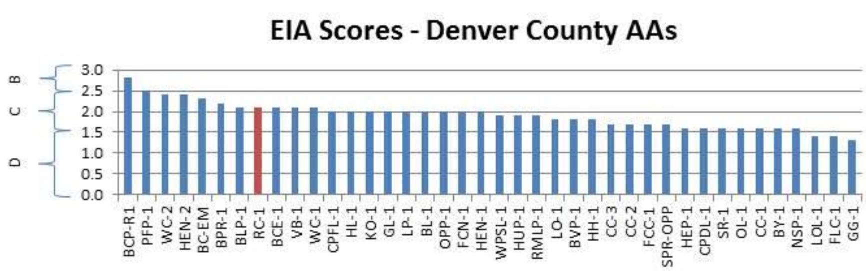
Floristic Composition:



Mean C: 1.97 (CCD Range 0.82-2.84) **FQI: 15.62** (CCD Range 3.05-20.82)

There are 70 plants on the species list with 54% native and a 55% relative cover of native species.

Key Environmental Factors: The AA is a complex of emergent marshes along an industrial area of the South Platte River. It received a high D rank due to its large buffer and complex vegetation structure. The wetlands in this area serve as a critical stop for birds migrating along the Central Flyway and this area is included in the South Platte River Potential Conservation Area (PCA) delineated by CNHP (see Appendix H).



Rank Comments: The AA ranked 2.1 for the overall EIA score. For Denver County, the overall EIA ranks ranged from a high of 2.8 (C) to 1.3 (D). Of the 40 AAs in Denver County there was a range of 13 different numerical scores. Five other AAs also scored a 2.1 overall EIA, placing this AA at number 6 out of the 13 possible scores which is in the medium range. The buffer extent is fairly large for an urban wetland, although the buffer condition is poor and dotted with heavy industrial activity. The structure of the vegetation is complex, and there are large amounts of woody debris and litter for wildlife habitat use. There is a likely a ground water connection to the South Platte River, because of the location on the historic floodplain and is the reason for the high (C) rank for the Hydrologic Condition score.

Protection Urgency Comments: Every effort should be made to avoid developing this area. It serves as a critical stop for birds migrating along the Central Flyway in an otherwise urban landscape and is within the South Platte River Potential Conservation Area (see Appendix H).

Colorado 2014 Noxious Weed List: One List A: purple loosestrife (*Lythrum salicaria*) (pers. comm. Kelly Uhing); six List B: broadleaved pepperweed (*Lepidium latifolium* <2%), cutleaf teasel (*Dipsacus laciniata* <5%), Russian-olive (*Elaeagnus angustifolia* <5%), poison hemlock (*Conium maculatum* <1%), leafy spurge (*Euphorbia esula* <1%) and Canada thistle (*Cirsium arvense* <5%); and five List C: cheatgrass (*Bromus tectorum* <2%), redstem stork's bill (*Erodium cicutarium* <1%), common mullein (*Verbascum thapsus* <1%), moist sowthistle (*Sonchus uliginosus* <1%) and field bindweed (*Convolvulus arvensis* <2%).

Wildlife Comments: Snowy Egret, Avocet, Bald Eagle, Osprey, Wild Turkeys and a large population of Woodhouse Toads was observed during the survey.

Recommendations: Consideration for a Natural Area designation to protect this area would benefit a much larger area because of the location along the South Platte River Corridor.

References: Colorado Natural Heritage Program Field Surveys. July 10, 2013. Field Forms on File at CNHP, Fort Collins, CO.

ROCKY MOUNTAIN LAKE PARK (RMLP_1)

EIA Overall Rank: 1.9 D

Biotic Condition: 2.03 D **Hydrologic Condition: 2.20 D**

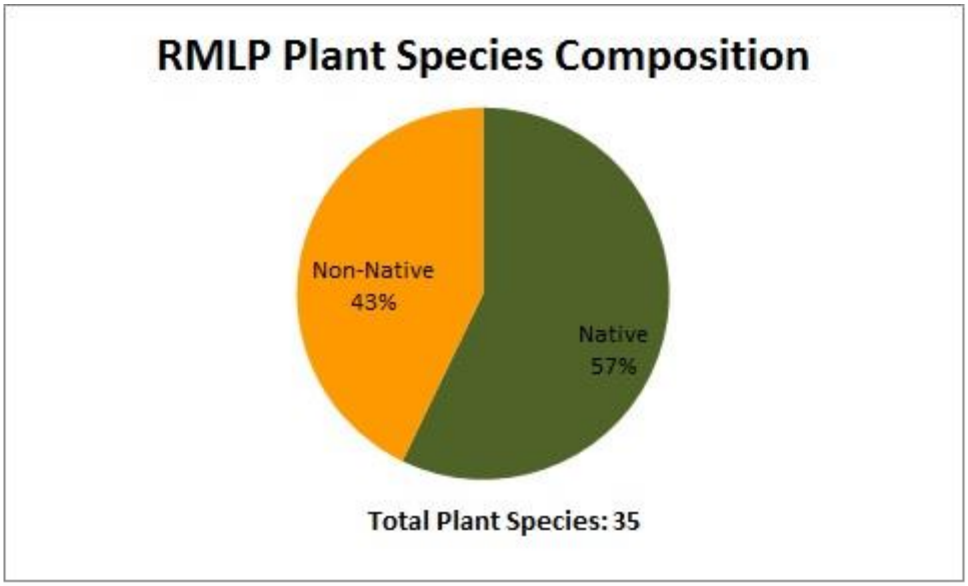
Landscape Context: 1.25 D **Physiochemical Condition: 1.50 D**

Ecological System: North American Arid West Emergent Marsh

Size of assessment area: 24.8 acres **Elevation**: 1642 m

General Description: Rocky Mountain Lake Park AA includes a 25 acre reservoir in a dense urban area that has been established for at least 95 years (archival photos from ca. 1920's). The average water depth is 10.5 feet and the maximum depth is 25 feet with deepest holes on the east and west bays (pers. comm. A. Polonsky, July 2014). A narrow band of emergent marsh dominated by cattails (*Typha* spp.), bulrushes (*Schoenoplectus* spp.) and scattered willow species grows on some of the lakeshore. The submerged vegetation is diverse and includes species of pond weeds (*Potamogeton pectinatus, P. filiformis*), watermilfoils (*Myriophyllum sibiricum, M. spicatum*), coontail (*Ceratophyllum demersum*), western waterweed (*Elodea nuttallii*), turion duckweed (*Lemna turionifera*), sago pondweed (*Stuckenia pectinata*) and native water lilies (*Nymphaea odorata*) (Majack 2014). An uncommon plant in Colorado, duck meat (*Spirodela polyrrhiza*), was documented as were two state rare plant species; sweetflag (*Acorus calamus*) (G4?/S1) and broadfruit bur-reed (*Sparganium eurycarpum*) (G5/S2).

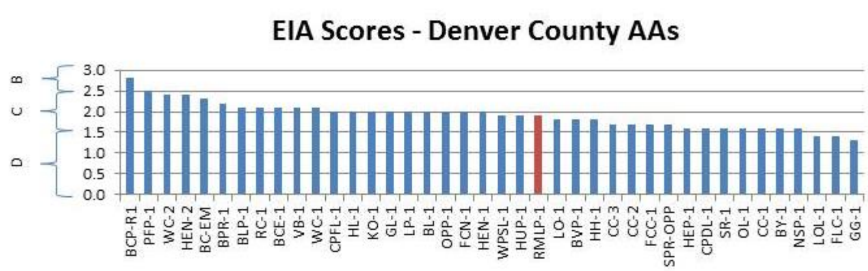
Floristic Composition:



Mean C: 1.94 (CCD Range 0.82-2.84) **FQI: 11.32** (CCD Range 3.05-20.82)

There are 35 plants on the species list with 57% native and a 75% relative cover of native species.

Key Environmental Factors: Although, this lake was never a natural feature and may or may not have had existing wetland hydrology it has been in existence for many years and has developed a wetland fringe of vegetation dominated by native species around the lake perimeter and aquatic plants in the lake.



Rank Comments: The AA ranked 1.9 for the overall EIA score. For Denver County, the overall EIA ranks ranged from a high of 2.8 (C) to 1.3 (D). Of the 40 AAs in Denver County there was a range of 13 different numerical scores. Two other AAs also scored a 1.9 overall EIA, placing this AA at number 8 out of the 13 possible scores which is in the medium range. Although the score was average for this AA compared to the other AAs in Denver County this area is worthy of protection because of the diversity of plants in the lake fringe and the potential for this wetland to greatly improve in quality.

Protection Urgency Comments: The protection of the existing vegetation layer is very important to protect the populations of uncommon and state rare plants. The broadfruit burr-reed was being trampled severely and the mow zone was right along the edge of the lake directly on the plant population. Allowing a larger fringe to develop around the lake would help protect this species.

Colorado 2014 Noxious Weed List: List A: hairy willow-herb (*Epilobium hirsutum* <1%); List B: Canada thistle (*Cirsium arvense* <5%); Eurasian watermilfoil (*Myriophyllum spicatum*) <5%).

Wildlife Comments: Green sunfish, bullfrogs, Canada Geese, Red-winged Blackbirds, European Starlings, Northern Flickers, American Coots, Double-crested Cormorants, American Crows, Grebes, Cliff Swallows, Ruddy Ducks, Mallards with chicks, and Northern Shoveler Ducks Common green darner dragonflies including a variegated meadowhawk, damselflies and checkered white butterflies were also observed in the AA.

Recommendations: Consider allowing aquatic macrophytes to grow in the lake. Common duckmeat (*Spirodela polyrrhiza*) is very uncommon in the state; the other six species of aquatic plants observed at this AA in addition to the common duckmeat, provide a high protein food source for birds and fish (Culver and Lemly 2013). Allow a larger ring of vegetation to develop around the lake by not mowing the the shoreline. Chemical herbicides should not be used in or near the wetlands for several reasons: 1) both the native and non-native species of milfoils, 2) state rare plants and uncommon plants are present, and 3) smooth brome is in the herbaceous layer (see Discussion section on herbicides). Killing plant species that are not on noxious weed lists is also discouraged (see Discussion on non-native species in urban environments). Reducing the amount of bare ground on the lake shore is also encouraged. The adjacent park lawns should be managed with environmentally friendly methods.

References:

Colorado Natural Heritage Program Field Surveys. May 27, 2014. Field Forms on File at CNHP, Fort Collins, CO.

Culver, D. and J. Lemly. 2013. Field Guide to Colorado's Wetland Plants: Identification, Ecology and Consevation. Colorado Natural Heritage Program, Colorado State University, Vision Graphics, Loveland, CO, 711pp.

Majack, M.L. The vascular flora of Denver, Colorado: A case study of floristics in the twenty-first century in Contributions to the flora of Colorado. Master's thesis, University of Colorado Denver, 2014.

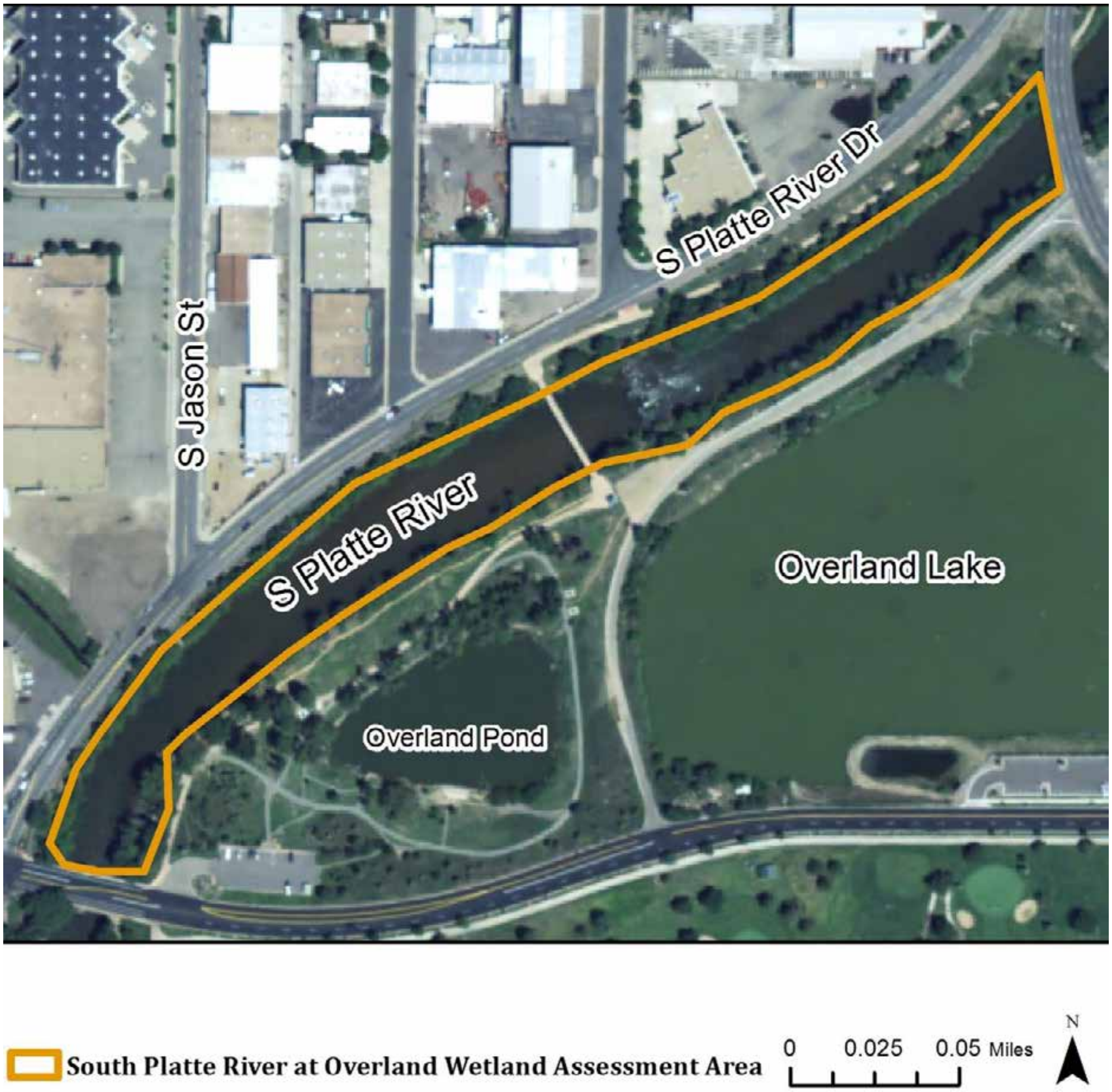
South Platte River at Overland Park (SPR-OPP)

EIA Overall Rank: 1.7 D

Biotic Condition: 1.76 D **Hydrologic Condition: 2.00 D**

Landscape Context: 1.55 D **Physiochemical Condition: 1.00 D**

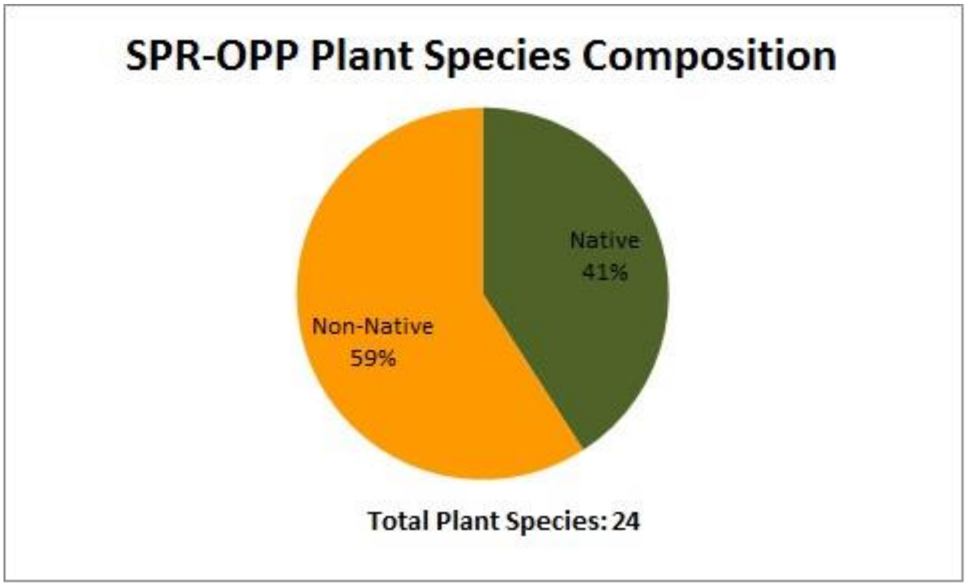
Ecological System: Western Great Plains Riparian



Size of assessment area: 6.3 acres **Elevation**: 1606 m

General Description: The South Platte River at Overland Pond Park AA includes a 0.4 mile (600 meter) stretch of the South Platte River as it flows through the Denver metropolitan area between Florida Ave and US 85 southbound. The river has been straightened and functions mainly as a water conveyance rather than a natural river course. The river bottom consists of a sediment layer covered with algae. The stream banks are covered with a mature overstory of non-native trees including Siberian elm (*Ulmus pumila*) and green ash (*Fraxinus pennsylvanica*). Coyote willow (*Salix exigua*) is a dominant shrub in open areas. Box elder (*Acer negundo*), choke cherry (*Prunus virginiana*), western snowberry (*Symphoricarpos occidentalis*) and peach leaf willow (*Salix amygdaloides*) added to the diversity in the shrub layer. Indianhemp (Apocynum cannabinum), smooth brome (*Bromus inermis*), spotted ladysthumb (*Polygonum persicaria*) and wild licorice (*Glycyrrhiza lepidota*) were commonly observed in the herbaceous layer.

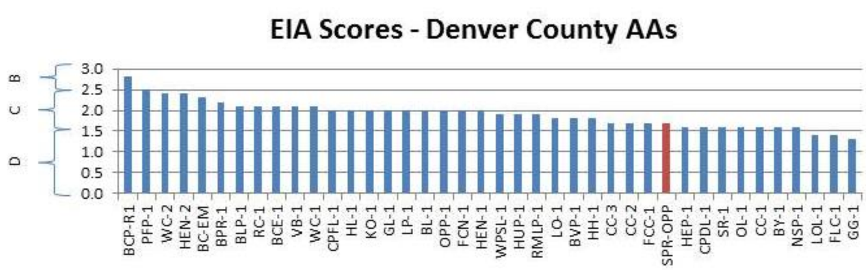
Floristic Composition:



Mean C: 1.52 (CCD Range 0.82-2.84) **FQI: 6.98** (CCD Range 3.05-20.82)

There are 24 plants on the species list with 41% native and a 49% relative cover of native species. The Mean C value is in the medium low range due to the high cover of a non-native species.

Key Environmental Factors: The South Platte River does not function as a natural system in urban Denver. However, the continuity of the river across Denver and associated wetlands still provide important ecological and hydrological functions for Denver. This AA is included within the South Platte River Potential Conservation Area because of the occurrences of rare animals including Bald Eagles along the South Platte corridor (see Appendix H).



Rank Comments: The AA ranked 1.7 for the overall EIA score. For Denver County, the overall EIA ranks ranged from a high of 2.8 (C) to 1.3 (D). Of the 40 AAs in Denver County there was a range of 13 different numerical scores. Three other AAs also scored a 1.7 overall EIA, placing this AA at number 10 out of the 13 possible scores which is in the low medium range. The overall rank is a low medium score because the river is more like a canal than a natural river system.

Protection Urgency Comments: The mature forested shoreline is very beneficial in terms of ecosystem services and aesthetic values; development of the shoreline should be limited to keep getting these valuable services that also include shoreline stabilization and wildlife habitats. This AA is part of the South Platte River Potential Conservation Area which was delineated to protect wildlife.

Colorado 2014 Noxious Weed List: Four List B: Canada thistle (*Cirsium arvense*), Scotch thistle (*Onopordum acanthium*), diffuse knapweed (*Acosta diffusa*), and nodding plumeless thistle (*Carduus nutans*) weeds were in the riparian and buffer land surrounding the AA.

Wildlife Comments: During the survey Canada Geese, Swallows, Mallards and damselflies were observed along the river.

Recommendations: Efforts to keep the mature forests along the South Platte River will provide shoreline stabilization and numerous ecological benefits to the City and County of Denver. The ecological connectivity, shade and structure for humans and wildlife are important as is flood attenuation and the movement of water through the city.

References:

Colorado Natural Heritage Program Field Surveys. July 03, 2014. Field Forms on File at CNHP, Fort Collins, CO.

SKEEL RESERVOIR (SR_1)

EIA Overall Rank: 1.6 D

Biotic Condition: 1.75 D **Hydrologic Condition: 2.00 D**

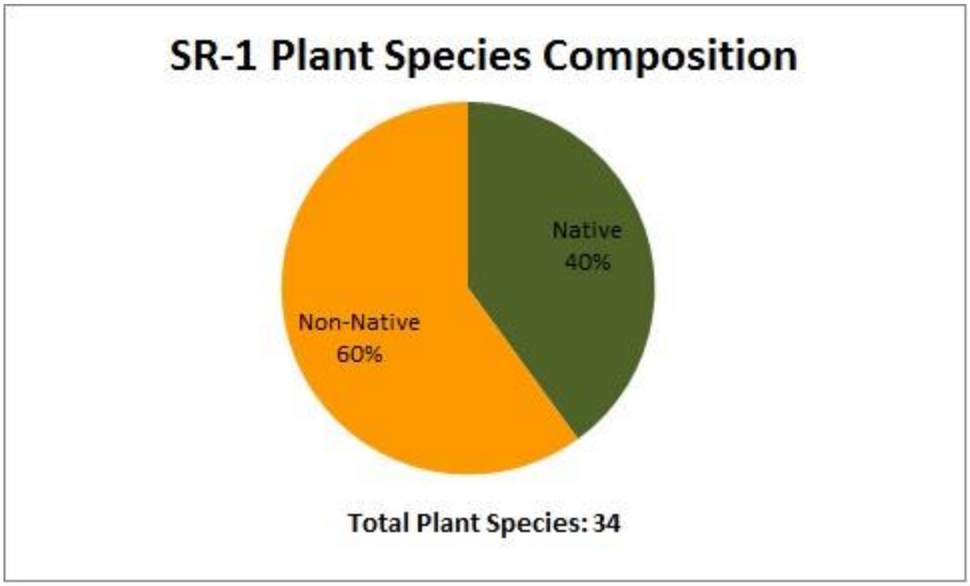
Landscape Context: 1.00 D **Physiochemical Condition: 1.00 D**

Ecological System: North American Arid West Emergent Marsh

Size of assessment area: 14.9 acres **Elevation**: 1664 m

General Description: The Skeel Reservoir AA is located in south Denver County, northwest of the intersection of S. Colorado Blvd. and Highway 285. The water supply for the reservoir is the Highline Canal. Skeel Reservoir is an artificial pond used to provide water to the adjacent golf course. The AA consists of a pond and the vegetated fringe that includes mature trees. The golf course maintenance staff said the water is usually 10-12 feet deep (typical draw down is two feet). The driving range is the open water of the reservoir. There is no natural buffer land to help filter surface runoff. The AA is embedded in the golf course which is surrounded by highways and dense residential development. The water was cloudy the day of the survey. The shoreline consists of very steep banks with a few feet of vegetation on the shore. Common woody plant species included plains cottonwood (*Populus deltoides*), coyote willow (*Salix exigua*), peachleaf willow (*Salix amygdaloides*), green ash (*Fraxinus pennsylvanica*), common buckthorn (*Rhamnus cathartica*) and Siberian elm (*Ulmus pumila*). Common threesquare (*Schoenoplectus pungens*), roundfruit rush (*Juncus compressus*), wild mint (*Mentha arvensis*) and western goldentop (*Euthamia occidentalis*) included some of the herbaceous species in the AA.

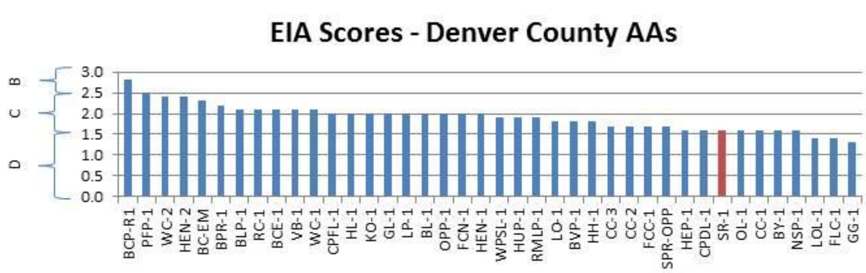
Floristic Composition:



Mean C: 1.55 (CCD Range 0.82-2.84) **FQI: 8.36** (CCD Range 3.05-20.82)

There are 34 species on the plant list with 40% native and 36% relative cover of native species. The forested overstory is 50% native cover.

Key Environmental Factors: There is a major cover of non-natives plant species especially the herbaceous layer where smooth brome dominates. The reservoir is artificial and is used as a driving range and to water the golf course. There are no natural buffer lands around the AA. The most significant feature is the wetland fringe that has structure for wildlife and includes a variety of native wetland species.



Rank Comments: The AA ranked 1.6 for the overall EIA score. For Denver County, the overall EIA ranks ranged from a high of 2.8 (C) to 1.3 (D). Of the 40 AAs in Denver County there was a range of 13 different numerical scores. Six other AAs also scored a 1.6 overall EIA, placing this AA at number 11 out of the 13 possible scores which is in the medium range. The overall rank of 1.6 for this wetland is among the lower scores of the 40 AAs in Denver County. This is an artificial wetland that is utilized for servicing a golf course and the main water inputs are from a canal. No natural hydrology exists and much of the input water is urban runoff.

Protection Urgency Comments: The vegetated fringe includes a number of wetland species that are important for wildlife and there is a diversity of native plants indicating a potential for restoration and expansion of the wetland fringe.

Colorado 2014 Noxious Weed List: Three List B <1%: Russian-olive (*Elaeagnus angustifolia*), Scotch thistle (*Onopordum acanthium*) and Canada thistle (*Cirsium arvense*); three List C <1%: field bindweed (*Convolvulus arvensis*), poison hemlock (*Conium maculatum*) and cheatgrass (*Bromus tectorum*).

Wildlife Comments: There is excellent structure along the shoreline for wildlife. However, the open water section is used as a driving range and is likely not as attractive to birds as the other wetlands in Denver. Wildlife observed during the survey included: Canada Geese, various ducks, song birds and crickets. Squirrels were observed in the surrounding uplands.

Recommendations: Encourage environmentally friendly practices for the golf course and allow the shoreline vegetation to grow to protect the water quality of the reservoir and to help slow and filter surface runoff.

References:

Colorado Natural Heritage Program Field Surveys. October 7, 2013. Field Forms on File at CNHP, Fort Collins, CO.

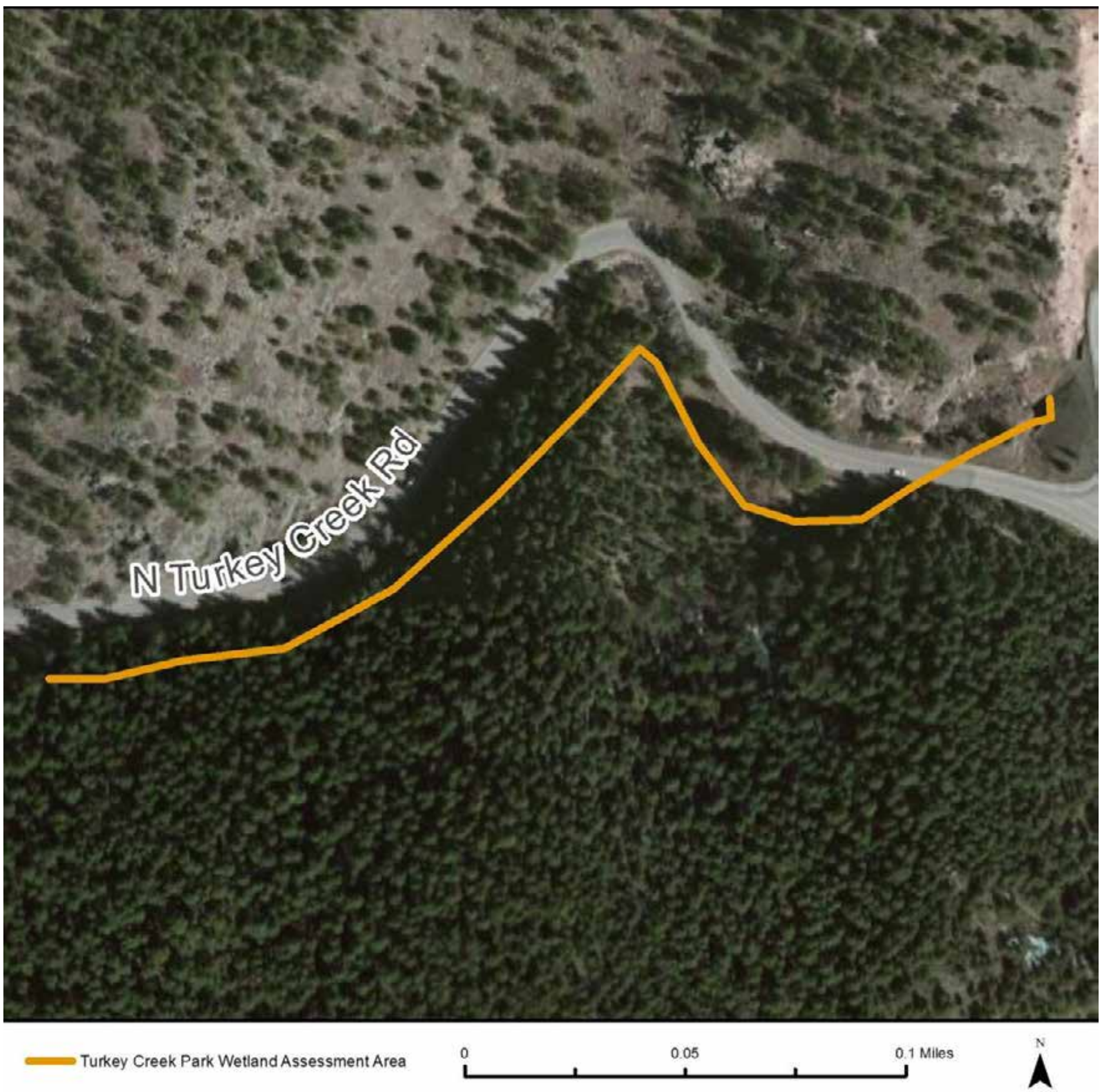
TURKEY CREEK PARK (TCP_1)

EIA Overall Rank: 2.9 C

Biotic Condition: 3.06 C **Hydrologic Condition: 2.90 C**

Landscape Context: 2.61 C **Physiochemical Condition: 3.30 C**

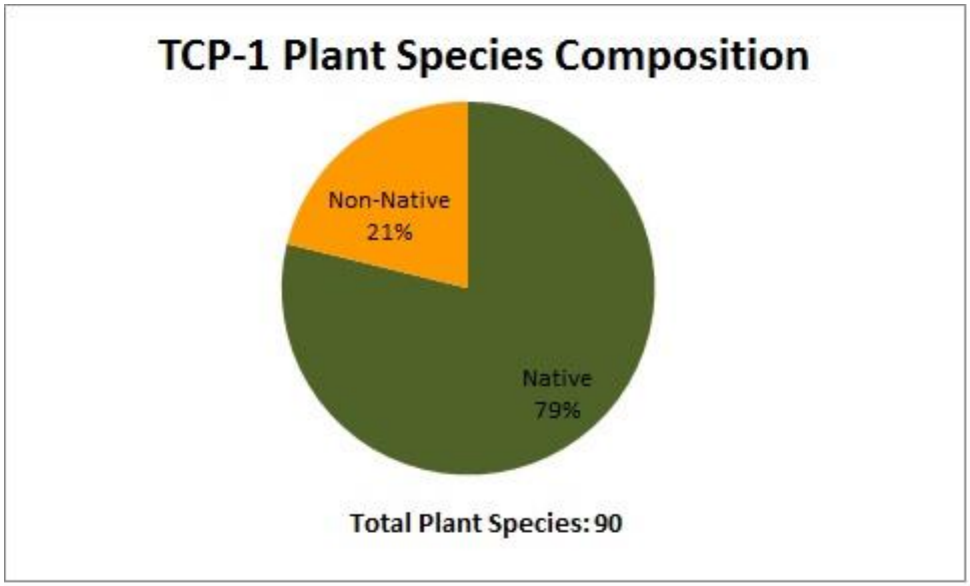
Ecological System: Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland



Size of assessment area: 0.8 acres **Elevation**: 2113-2149 m

General Description: The Turkey Creek Park AA includes a 400 m section (1/4 mile) of Turkey Creek. The north-facing side is dominated by coniferous forest and the south-facing side is bordered by North Turkey Creek Road. The eastern border of the AA ends at a culvert that runs under Hwy 285. The creek includes scoured bedrock and boulders with sandy-bottomed pools and small waterfalls. Blue spruce (*Picea pungens*) and Douglas fir (*Pseudotsuga menziesii*) are common trees species. A variety of native willows include bluestem (*Salix irrorata*), Scouler's (*Salix scouleriana*), Rocky Mountain (*Salix monticola*) and Bebb willows (*Salix bebbiana*). Other common shrubs included thin-leaf alder (*Alnus incana*), water birch (*Betula occidentalis*), Rocky Mountain maple (*Acer glabrum*) and red-twig dogwood (*Cornus sericea*). The herbaceous layer included native grasses: bluejoint (*Calamagrostis canadensis*), American mannagrass (*Glyceria grandis*) and fowl mannagrass (Glyceria striata). Native forbs included Macoun's buttercup (*Ranunculus macounii*), fringed loosestrife (*Lysimachia ciliata*), largeleaf avens (*Geum macrophyllum*), common cowparsnip (*Heracleum maximum*) and Arctic yellow violet (*Viola biflora*).

Floristic Composition:

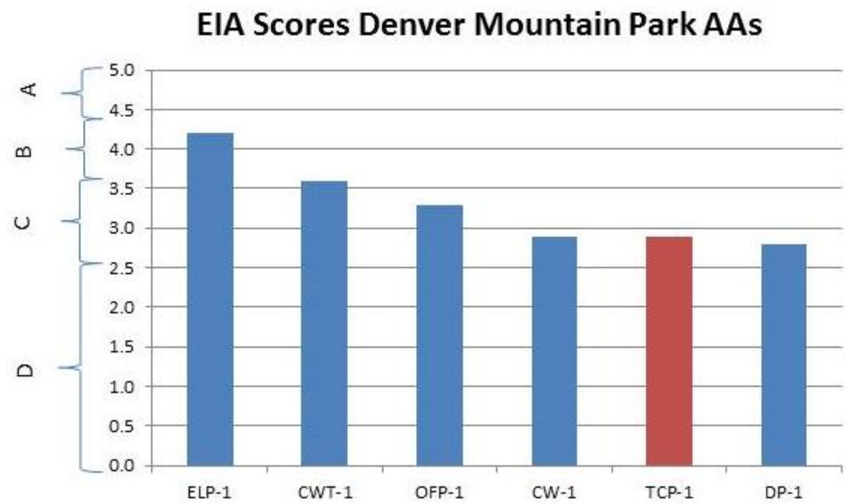


Mean C: 4.22 (DMP Range 2.99-5.74) **FQI: 34.47** (DMP Range 26.38-52.93)

There are 90 species on the plant list with 79% native and a 91% relative cover of native species.

Key Environmental Factors: High quality vegetation with a very high cover of native species and large areas of undeveloped surrounding lands protect the quality and integrity of the AA.

Land Use History: Turkey Creek Park was acquired in 1924.



Rank Comments: The Overall EIA score was a 2.9 (C rank). The range of EIA scores for Denver Mountain Parks was 2.8-4.2. The score was among the lower ones for the Mountain Parks. The FQI value is still high and indicative of a high quality park area. The AAs that were located in Mountain Parks but adjacent to major highways did not score as well as those without a major highway nearby.

Protection Urgency Comments: The land surrounding the AA (with the exception of the highway) is a park.

Colorado 2014 Noxious Weed List: One List B <1%: Canada thistle (*Cirsium arvense*); one List C <1%: quackgrass (*Elymus repens*) and common mullein (*Verbascum thapsus*); and one Watch List <1%: garlic mustard (*Alliaria petiolata*).

Wildlife Comments: Black bear scat was observed in the AA.

Recommendations: Herbicides should not be used in the wetland for weed control because smooth brome (*Bromus inermis*) is in the wetland. This aggressive non-native grass has the potential to increase its cover with herbicide applications for dicots including Canada thistle which is also present (Rondeau and Lavender 2012).

References:

Colorado Natural Heritage Program Field Surveys, August 29, 2013. Field Forms on File at CNHP, Fort Collins, CO.

Rondeau, R. and A. Lavender 2012. Noxious Weed Monitoring at the U.S. Air Force Academy – Year 7 Results April 2012. Colorado Natural Heritage Program www.cnhp.colostate.edu

VANDERBILT PARK (VB_1)

EIA Overall Rank: 2.1 D

Biotic Condition: 2.26 D **Hydrologic Condition: 2.40 D**

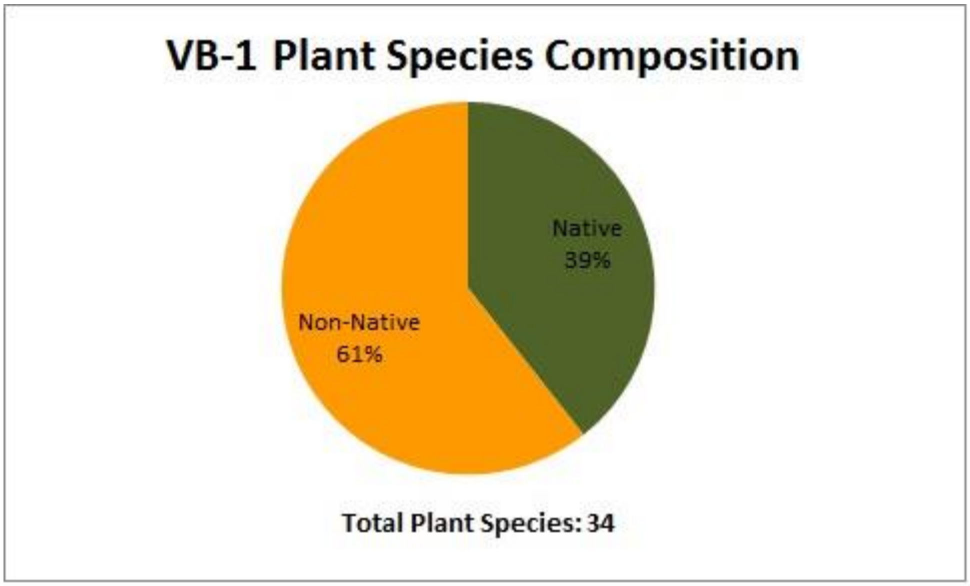
Landscape Context: 1.87 D **Physiochemical Condition: 1.50 D**

Ecological System: Western Great Plains Riparian

Size of assessment area: 6.2 acres **Elevation**: 1598 m

General Description: The Vanderbilt Park AA is located in southeast Denver off of Santa Fe and Mississippi Avenues. The AA includes a small pond in the floodplain of the South Platte River. The wetland has been separated from the river by residential development, highways, and roads. The shoreline is dominated by a dense layer (5-10 meters wide) of wetland forest. There are very large drains that feed large volumes of stormwater at high velocities into the pond, leaving large eroded areas. The mature forested edge includes plains cottonwood (*Populus deltoides*), Siberian elm (*Ulmus pumila*) and green ash (*Fraxinus pennsylvanica*). Native cattails (*Typha latifolia*), bulrushes (*Schoenoplectus* spp.), and native willows (*Salix exigua, S. amygdaloides*) are common. Lesser duckweed (*Lemna minor*) was observed floating on the water. Native forbs include: western goldenweed (*Euthamia occidentalis*), Geyer's aster (*Symphyotrichum laeve* var. *geyeri*), and Mexican dock (*Rumex triangulivalvis*).

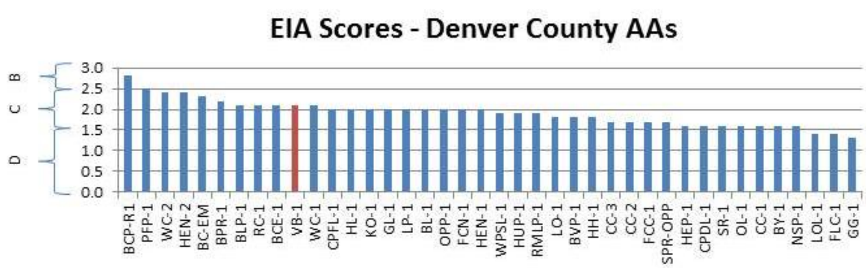
Floristic Composition:



Mean C: 1.42 (CCD Range 0.82-2.84) **FQI: 8.18** (CCD Range 3.05-20.82)

There are 34 species on the plant list with 39% native and a 64% relative cover of native species.

Key Environmental Factors: The forested fringe along the shoreline is an important feature of this wetland as is the cover of native species. Hydrological functions are likely higher here than at other parks because of the connectivity to the South Platte River floodplain.



Rank Comments: The AA ranked 2.1 for the overall EIA score. For Denver County, the overall EIA ranks ranged from a high of 2.8 (C) to 1.3 (D). Of the 40 AAs in Denver County there was a range of 13 different numerical scores. Five other AAs also scored a 2.1 overall EIA, placing this AA at number 6 out of the 13 possible scores. This AA ranked in the medium to medium high range for Denver County AAs. The availability of natural buffer lands to the southeast of the AA, and the location on the South Platte River floodplain are important ranking factors. There were many non-native plants but the cover of native species was high suggesting a very good potential to increase the quality of the AA by allowing more of the shoreline vegetation to proliferate.

Protection Urgency Comments: This AA lies within the South Platte River Potential Conservation Area (see Appendix H). All wetlands in Denver that support wetland fringe vegetation contribute an array of ecological services to the local area in terms of water quality, shoreline stabilization, while providing wildlife habitat, recreation and learning opportunities.

Colorado 2014 Noxious Weed List: Two List B: Canada thistle (*Cirsium arvense* <2%), and diffuse knapweed (*Acosta diffusa* <1%); and two List C: quackgrass (*Elymus repens* <2%) cheatgrass (*Bromus tectorum* <1%).

Wildlife Comments: Bird species observed during the survey included: Canada Geese, Snowy Egrets, Mallards, Double-crested Cormorants, Red-winged Blackbirds, Killdeer, Mourning Doves, House Finches, Northern Flickers, Barn Swallows, Common Grackles, American Crows, and European Starlings. Other wildlife observations include: bullfrogs, minnows, beaver sign, dragonflies, damselflies and grey squirrels

Recommendations: Allow as much shoreline vegetation to grow as possible for water quality, shoreline stabilization and wildlife habitat. Growth of the existing small remnant prairie area to the southeast should continue to be encouraged and any manicured grasslands should be reduced if possible. The remaining parklands should try to utilize environmentally friendly landscaping to protect the water quality of Vanderbilt Lake.

References:

Colorado Natural Heritage Program Field Surveys. August 9, 2013. Field Forms on File at CNHP, Fort Collins, CO.

WESTERLY CREEK RIPARIAN (WC_1)

EIA Overall Rank: 2.1 D

Biotic Condition: 2.36 D **Hydrologic Condition: 2.10 D**

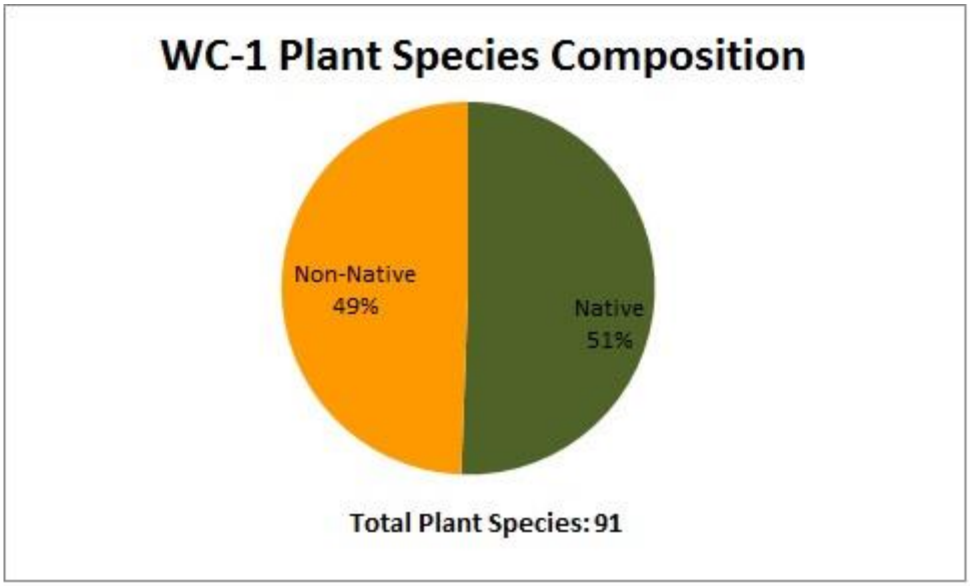
Landscape Context: 1.74 D **Physiochemical Condition: 1.50 D**

Ecological System: Western Great Plains Riparian

Size of assessment area: 6.0 acres **Elevation**: 1605 m

General Description: The Westerly Creek AA is located along Westerly Creek near the location of the former Stapleton Airport. The AA is surrounded by a housing development. The banks along the creek are dominated by peachleaf willow (*Salix amygdaloides*) coyote willow (*Salix exigua*), snowberry (*Symphoricarpos occidentalis*) cattails (*Typha* spp.) and prairie cordgrass (*Spartina pectinata*). Cottonwoods (*Populus deltoides, P. angustifolia*) are scattered throughout the AA. Native herbaceous species include: rushes (*Juncus balticus, J. torreyi*), sedges (Carex sp), bulrushes (*Schoenoplectus maritimus, S. pungens, S. acutus*), spikerush (*Eleocharis macrostachya*), duckweed (*Lemna minor*), small pondweed (*Potamogeton pusillus*), giant goldenrod (*Solidago gigantea*), goldentop (*Euthamia occidentalis*), and Nuttall's sunflower (*Helianthus nuttallii*). Westerly Creek Emergent Marsh AA is adjacent to this AA. Westerly Creek has been altered for flood control, and several cement runoff ponds are found along its course. The land on the north side is a golf course, and the south side is a bluegrass lawn. The upland areas along the creek have been planted with native grass species including switchgrass (*Panicum virgatum*) and side-oats grama (*Bouteloua curtipendula*).

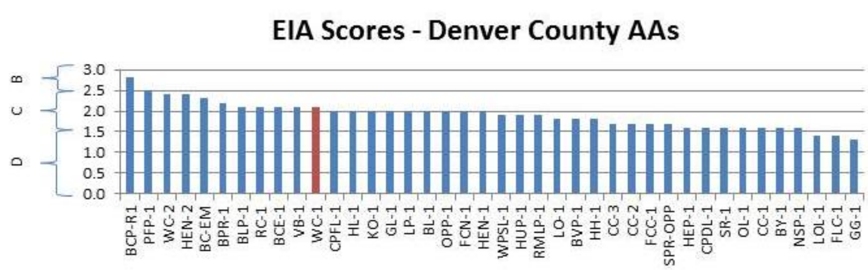
Floristic Composition:



Mean C: 2.00 (CCD Range 0.82-2.84) **FQI: 18.00** (CCD Range 3.05-20.82)

There are 91 species on the plant list with 51% native and an 83% relative cover of native species.

Key Environmental Factors: The AA is a high quality urban wetland with high plant species diversity. The extensive stands of prairie cordgrass (*Spartina pectinata*) help to prevent erosion along the stream bank of Westerly Creek. The creek is channelized, flashy, and floods quickly in a rainstorm. Large areas of the banks have been subject to erosion due to the heavy influx of water following storm events. In September 2013, a large flood event caused the water level to rise to the metal pedestrian bridge. The wetland buffer has been planted with many native plant species. The area has heavy human use and paved trails traverse the creek. Algae was dense and indicative of large nutrient inputs.



Rank Comments: The AA ranked 2.1 for the overall EIA score. For Denver County, the overall EIA ranks ranged from a high of 2.8 (C) to 1.3 (D). Of the 40 AAs in Denver County there was a range of 13 different numerical scores. Five other AAs also scored a 2.1 overall EIA, placing this AA at number 6 out of the 13 possible scores which is in the medium range. The buffer around the AA contains many planted native species which give the AA good Hydrologic and Biotic Condition scores. The north side of the AA is adjacent to a golf course. Channel and bank stability is compromised by the flashy nature of the stream. Algal growth was present in places, and turbidity was high in the stream which is reflected in the lower Physiochemical Condition score. Human use of the area including the AA is heavy, although most soil disturbance occurs near the paved trails, and not along the banks of the stream.

Protection Urgency Comments: Management and restoration efforts are actively occurring at this site. The Urban Drainage and Flood Control District has completed restoration and maintenance of the creek by repairing incised stream banks and re-establishing the stream elevation with multiple drop structures. The buffer has been planted with native species, and many areas are not mowed.

Colorado 2014 Noxious Weed List: Three List B: Canada thistle (*Cirsium arvense* <1%), Russian-olive (*Elaeagnus angustifolia* <2%) and leafy spurge (*Euphorbia esula* <1%); five List C <1%): quackgrass (*Elymus repens*), puncturevine (*Tribulus terrestris*), field bindweed (*Convolvulus arvensis*), poison hemlock (*Conium maculatum*) and common mullein (*Verbascum thapsus*); and one Watch List <1%: common reed (*Phragmites australis*).

Wildlife Comments: Westerly Creek provides habitat for many bird species, including Snowy Egret, Prairie Falcon, and Red-tailed Hawk. A bullfrog and Woodhouse's toad, as well as many dragonfly, damselfly, and butterfly species were observed during the survey.

Recommendations: Leaving large unmowed areas in the buffer is beneficial for slowing runoff and providing water filtration. Pesticide and herbicide applications should be reconsidered to include water quality protection and effects to non-target plants and animals. High levels of trash in the stream may present a risk to wildlife.

References:

Colorado Natural Heritage Program Field Surveys, August 15, 2013. Field Forms on File at CNHP, Fort Collins, CO.

Westerly Creek Emergent Marsh (WC_2)

EIA Overall Rank: 2.4 D

Biotic Condition: 2.96 C **Hydrologic Condition: 2.20 D**

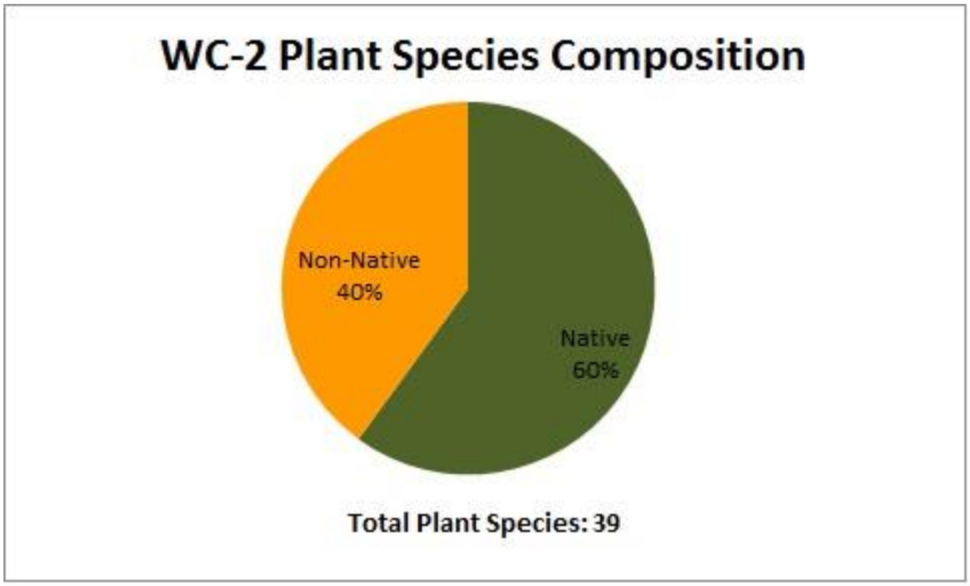
Landscape Context: 1.64 D **Physiochemical Condition: 2.00 D**

Ecological System: North American Arid West Emergent Marsh

Size of assessment area: 6.9 acres **Elevation**: 1610 m

General Description: The Westerly Creek AA is a small wetland located along Westerly Creek near the former Stapleton Airport and is adjacent to the Westerly Creek Riparian AA. The AA is surrounded by a housing development and serves as an urban runoff pond. The emergent marsh includes cattails (*Typha* spp.), coyote willow (*Salix exigua*) hardstem bulrush (*Schoenoplectus acutus*), pale spikerush (*Eleocharis macrostachya*), and a state rare plant, sweetflag (*Acorus calamus*) (G4?/S1). Small pondweed (*Potamogeton pusillus*) was found floating near the margins of the ponds. Black medic (*Medicago lupulina*) and little hogweed (*Portulaca oleracea*) were found growing in moist areas around the ponds where soils were disturbed by hikers and pets. Plains cottonwood (*Populus deltoides*), narrowleaf cottonwood (*Populus angustifolia*) peachleaf willow (*Salix amygdaloides*), snowberry (*Symphoricarpos occidentalis*) include some of the woody species in the AA. Other native wetland plants observed during the survey included swamp milkweed (*Asclepias incarnata*), showy milkweed (*Asclepias speciosa*), alkalai buttercup (*Ranunculus cymbalaria*) and knotted rush (*Juncus nodosus*).

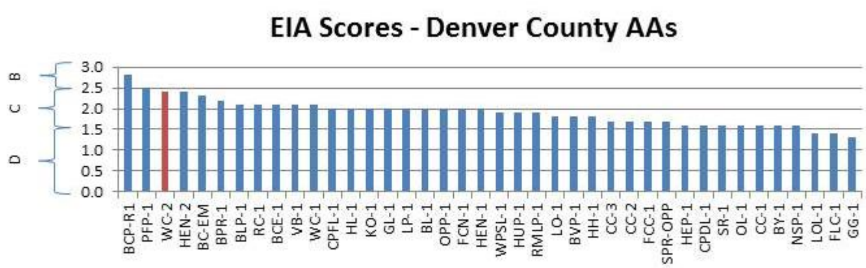
Floristic Composition:



Mean C: 2.29 (CCD Range 0.82-2.84) **FQI: 13.52** (CCD Range 3.05-20.82)

There were 39 species on the plant list with 60% native and an 84% relative cover of native species.

Key Environmental Factors: The high cover of native plant species and wide buffer surrounding the wetland are important factors for this AA. The AA is subject to fluctuating water levels due to the flashy hydrology of Westerly Creek.



Rank Comments: The AA ranked 2.4 for the overall EIA score. This score is higher than most of the urban wetlands assessed in this study for urban Denver and was close to a C-rank (2.5). For Denver County, the overall EIA ranks ranged from a high of 2.8 (C) to 1.3 (D). Of the 40 AAs in Denver County there was a range of 13 different numerical scores. Only one other AA scored a 2.4 overall EIA, placing this AA at number 3 out of the 13 possible scores. The wide vegetated buffer with native plant species (planted as part of a restoration effort) contribute to the high Mean C and Biologic Condition scores. Algal growth was present in the ponds, and the area was subject to a large raw sewage spill in September 2013 by a flood.

Protection Urgency Comments: The site contains one of the few occurrences in the Colorado of a state rare plant, sweetflag (*Acorus calamus*). The wetland also provides habitat for migrating waterfowl while providing flood mitigation and water filtration for the neighborhood.

Colorado 2014 Noxious Weed List: Two List B <1%: Canada thistle (*Cirsium arvense*) and Russian-olive (*Elaeagnus angustifolia*); and one List C <1%): poison hemlock (*Conium maculatum*).

Wildlife Comments: Westerly Creek and neaby ponds provide habitat for many bird species, including Snowy Egret, Prairie Falcon, Cinnamon Teal and Red Tail Hawk. A bullfrog and a Woodhouse's toad, as well as dragonfly, damselfly, and butterfly species were observed in the AA during the survey.

Recommendations: Leaving large unmowed areas in the buffer are beneficial for slowing runoff and providing water filtration. A stand of dead honey locust trees (*Gleditsia triocanthos*) was observed in the AA. This could be the result of an inappropriate herbicide application, unless these trees were targeted for removal. However, herbicide application should be avoided due to the presence of rare plants, and not in wetlands due to the high potential for negative impacts to non-target species and water quality.

References:

Colorado Natural Heritage Program Field Surveys. August 15, 2013. Field Forms on File at CNHP, Fort Collins, CO.

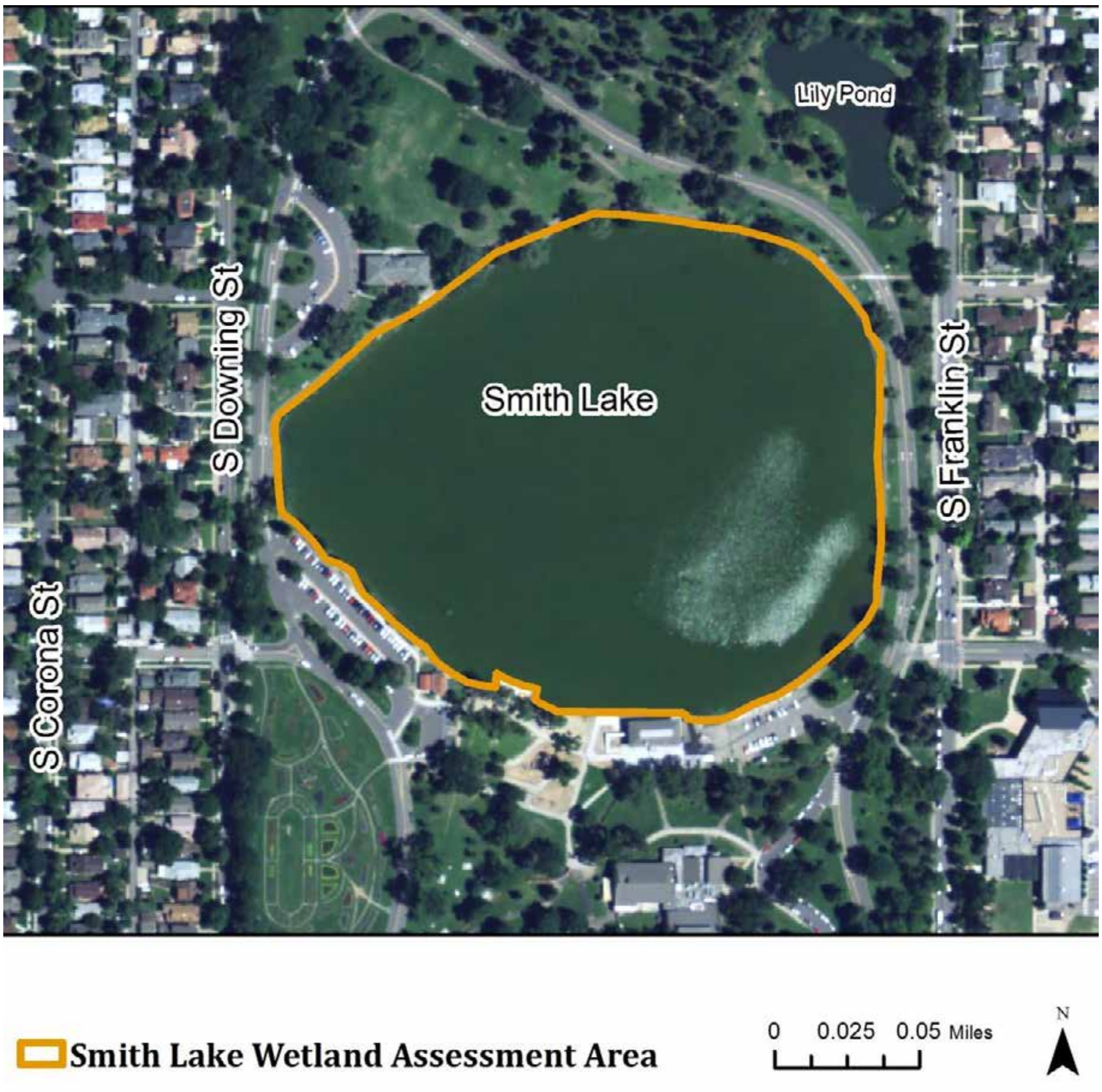
SMITH LAKE AT WASHINGTON PARK (WPSL_1)

EIA Overall Rank: 1.9 D

Biotic Condition: 2.67 C **Hydrologic Condition: 1.80 D**

Landscape Context: 1.00 D **Physiochemical Condition: 1.00 D**

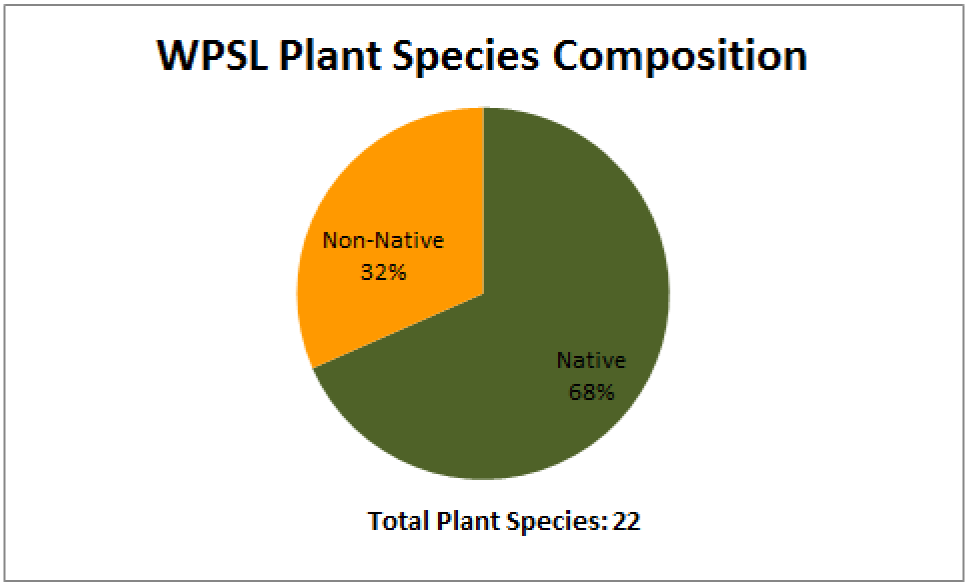
Ecological System: North American Arid West Emergent Marsh



Size of assessment area: 17.9 acres **Elevation**: 1620 m

General Description: The Smith Lake AA is located in central Denver County in a densely populated area near Alameda and Franklin Streets. The AA includes a reservoir with a small vegetated fringe (ca. 0.4 acres). The shoreline vegetation includes a number of native species: bulrushes (*Schoenoplectus pungens*), sedges (*Carex emoryi*), spikerushes (*Eleocharis macrostachya*), paradox cinquefoil (*Potentilla paradoxa*), water horehound (*Lycopus asper*) and white panicle aster (*Symphyotrichum lanceolatus* ssp. *hesperius*). A few trees and small shrubs are scattered along the shoreline including plains cottonwood (*Populus deltoides*), coyote willow (*Salix exigua*) and lancleaf willow (*Salix x acuminata*). The surrounding land is intensively developed as a city park with cultivated trees and a manicured lawn. There are roads and trails that encircle the immediate area and buildings that make up part of the shore of the reservoir. Input water comes from the southeast corner, a pump house is located to the southwest and a pipe on the northeast shore connects to Lily Pond, a small excavated impoundment (Lily Pond AA). The open water portion of the lake has no aquatic vegetation. Algae film covers the rocks and the water has a green cast from suspended algae. According to records from Denver County, this lake is high in nitrates and the average depth is about 6.5 feet.

Floristic Composition:



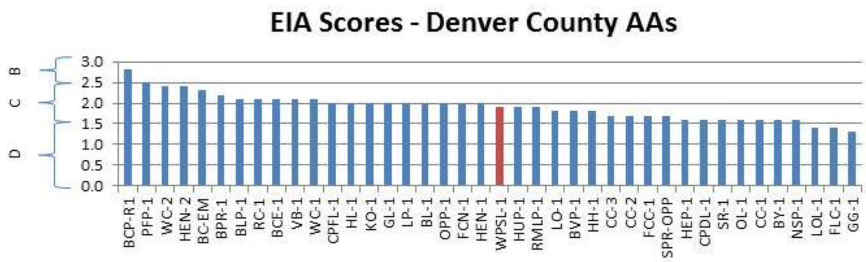
Mean C: 2.33 (CCD Range 0.82-2.84) **FQI: 9.90** (CCD Range 3.05-20.82)

There are 22 plants on the species list with 68% native and a 74% relative cover of native species. The plant diversity is low compared to other AAs, but the native plant cover is high. The quality of the plants is also high and is reflected in the Mean C score.

Photo 1. Native willow shrubs along Smith Lake shoreline. P. Smith 2014

Key Environmental Factors: The very small fringe of wetland plants on east-southeast shores of the lake are very important because they have the potential to expand by not mowing to the water's edge (Photo 1).

Land use history: This is one of the older parks in Denver County with the land acquired between 1887 and 1916 with notes indicating there was a wetland or existing water body at the time of acquisition (Dudley 2004).



Rank Comments: The AA ranked 1.9 for the overall EIA score. For Denver County, the overall EIA ranks ranged from a high of 2.8 (C) to 1.3 (D). Of the 40 AAs in Denver County there was a range of 13 different numerical scores. Two other AAs also scored a 1.9 overall EIA, placing this AA at number 8 out of the 13 possible scores which is in the medium range. This heavily used park scored in the high medium range. The Biotic Condition score (C rank range) and a relatively high Hydrologic Condition score perhaps reflecting natural hydrology contribute to the overall score.

Protection Urgency Comments: The AA is located at one of Denver's oldest parks.

Colorado 2014 Noxious Weed List: No noxious weeds were documented within the AA.

Wildlife Comments: Bird species observed in the AA: Canada Geese, Mallards and chicks, Rock Doves, Common Grackles, Double-crested Cormorants, and Barn Swallows. Other animal sightings included: crayfish, common green darner dragonflies, damselflies, carp, bluegill sunfish and a fox squirrel.

Recommendations: Allow vegetated fringe around lake to proliferate. Smith Lake has had water quality issues since 1955 when it was closed to swimmers. These issues are probably linked to the development that occurred over the years around the lake. Utilizing environmentally friendly landscaping in the surrounding park and avoiding the use of chemical pesticides and allowing aquatic vegetation to grow in the water column are advised (see Discussion sections on aquatic plants, non-native species in urban areas).

References:

Colorado Natural Heritage Program Field Surveys. June 3, 2014. Field Forms on File at CNHP, Fort Collins, CO.