

City of Boulder, Planning Housing & Sustainability
**Site Suitability Analysis For
University Of Colorado South Campus**



September 2016 DRAFT

Biohabitats
1732 Wazee Street
Denver, CO 80202



Table of Contents

Table of Contents	1
1 Introduction.....	1
1.1 Purpose and Scope.....	1
1.2 Site Background.....	1
2 Methods	3
2.1 Data Collection and Field Assessment	5
2.2 Conservation Suitability Analysis.....	7
2.3 Secondary Analysis.....	9
3 Summary of Findings	10
3.1 Ecological Characterization.....	10
3.2 Conservation Suitability Mapping	23
3.3 Secondary Considerations	23
4 Next steps.....	27
References	28
Attachments	29

List of Figures

- Figure 1 Site Location and Context
- Figure 2 Land Use Classifications
- Figure 3 Flood Mitigation Alternative D
- Figure 4 Model of GIS Suitability Analysis
- Figure 5 Geology and Regional Groundwater
- Figure 6 Water Resources of the Property
- Figure 7 Plant Communities of the Property
- Figure 8a Select Wildlife Ranges
- Figure 8b Habitat Connectivity Considerations
- Figure 9 Preliminary Conservation Suitability Analysis
- Figure 10 Sketch of Connectivity Considerations
- Figure 11 Sketch of Preliminary Viewshed Analysis

1 Introduction

This report provides a preliminary conservation suitability analysis of the University of Colorado South Campus property (“CU South”) with respect to protecting sensitive areas and identifying suitable development and conservation envelopes based on current natural resource conditions, opportunities, and constraints. The overarching goal of this analysis is to inform the CU South planning process – including land use change as part of Boulder Valley Comprehensive Plan – by providing an understanding of ecological patterns that have developed in the area over time. The results of the analysis are intended to provide a framework for maintaining a multifunctional landscape that can integrate multiple land use objectives including improving flood control, protecting ecological values, and identifying compatible development locations.

1.1 Purpose and Scope

With upcoming plans to implement the 2015 South Boulder Creek Major Drainageway Flood Mitigation Plan and desire to change land use to accommodate eventual development by the University of Colorado, the City of Boulder authorized a site suitability analysis for the property to serve as a guide to inform discussions regarding future uses on the property. The suitability analysis was conducted as part of the major update to the Boulder Valley Comprehensive Plan (BVCP) that will include updates to the land use designations for the parcel. The imperative articulated by the BVCP below guided the consideration of priorities in the current site suitability study:

...conserve and preserve environmental resources including its unique or distinctive natural features, biodiversity, and ecosystems through protection and restoration in recognition of the irreplaceable character of such resources and their importance to the quality of life.

In addition to interfacing with the BVCP, the suitability analysis is intended to inform considerations of annexing the property to the City of Boulder including:

- Findings on differential suitability across the site for development and conservation, and
- A framework, specific to CU South, for future annexation and agreements between the city and the University of Colorado (CU).

Biohabitats’ scope of work for the current effort included: attending a kick-off meeting on June 3, 2016, with city staff; reviewing available background information provided by the city; conducting a desktop analysis; completing a field assessment; meeting with city staff from Public Works and Open Space and Mountain Parks (OSMP) to gather additional information on pending flood control planning and sensitive species; selecting primary criteria for conservation suitability and preparing a Geographic Information Systems (GIS) analysis; and developing conceptual diagrams for secondary criteria associated with views and connectivity to offsite areas associated with conservation suitability.

1.2 Site Background

The subject property is owned by the University of Colorado (“CU”) and consists of a 316-acre parcel located immediately south of the juncture of U.S. Highway 36, Table Mesa Dr./South Boulder Road, and Foothills Parkway (Figure 1). The parcel was historically farmed and grazed

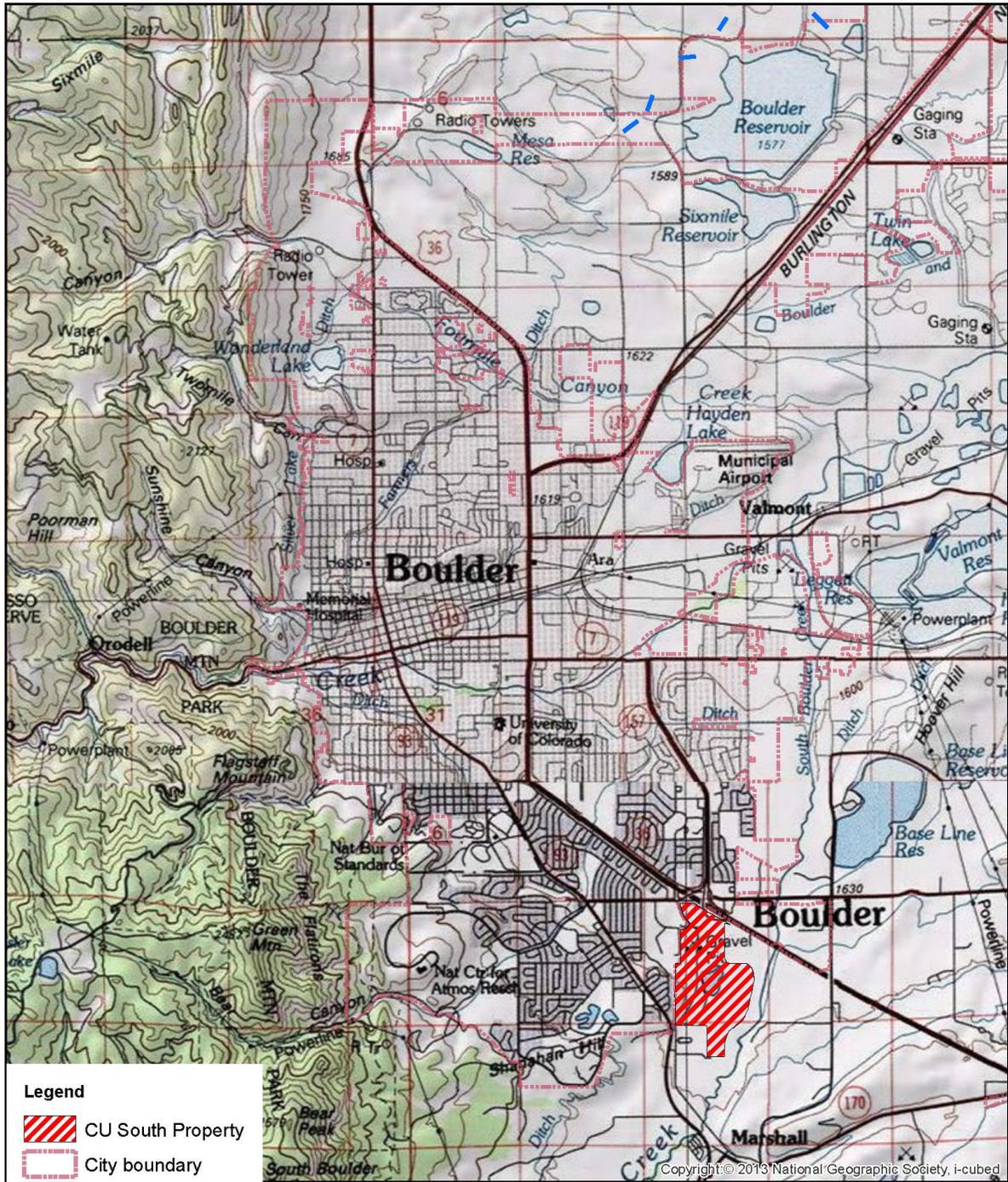


Figure 1
Site Location
CU South Property

until sand and gravel mining replaced agricultural uses, removing aggregate material from the majority of the property. In 1996, Flatiron Companies sold the property to CU.

Major features of CU South include a flood control berm that parallels the eastern boundary and northern edge of the southern “panhandle” (refer to Figure 3). The western portion of the property is characterized by a steep topographic gradient that forms a terrace. The northern half of the property has 4 ponds interspersed with development, including tennis courts, maintenance buildings, parking lots, and roads. The interior of the property is could be characterized as a basin dominated by non-native grasslands.

Current Land Uses

Currently the site is used by the CU tennis and cross-country programs with 12 tennis courts and upgraded running courses. The public also makes regular use of the trails for exercise and off-leash opportunities for dogs. These uses align with the 2001-2008 Campus Master Plan, which originally mandated that the South Campus be used only for athletic and recreational pursuits. Future uses by CU are uncertain.

Primary vehicular access to the property is at the northwest corner via South Loop Drive off of Table Mesa Drive. A less direct approach is at the southwest corner from Marshall Road. Pedestrian users can also access the property from a dirt road on the west side that leads onto the property from the intersection of Tantra Drive and East Moorhead Circle.

To the north of the property, there is a Regional Transportation District transit station and parking garage at Table Mesa as well as the intersection of three major roads. Low- and medium-density residential development borders the west side. City of Boulder Open Space lies to the south and east of the property and includes South Boulder Creek.

Under the current BVCP, the majority of CU South is designated as Open Space-Other (193.25 acres) and other portions of the property are designated for Medium-Density Residential (66.75 acres) (MR, 6-14 dwelling units/acre) and Low-Density Residential (49.36 acres) (LR, 2-6 dwelling units/acre) (Figure 2).

2 Methods

The overall approach for this suitability analysis was to map ecologically functional zones of the site as determined by biotic communities and hydrology and, using a GIS-based scoring system, overlay these with other natural features to create a base map showing a range of sensitive natural resource areas. The primary criteria include existing native plant communities, wetlands and buffers, aquatic habitat, and identified habitat zones for rare species. Ecological connectivity to offsite properties and views within and beyond the property are secondary criteria addressed separately. Utilities, roads, and planned flood improvements were not evaluated in the base map; however, future updates to the sensitivity analyses are expected to be needed to incorporate these constraints and considerations. Additional details about methods are described below.

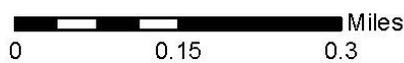
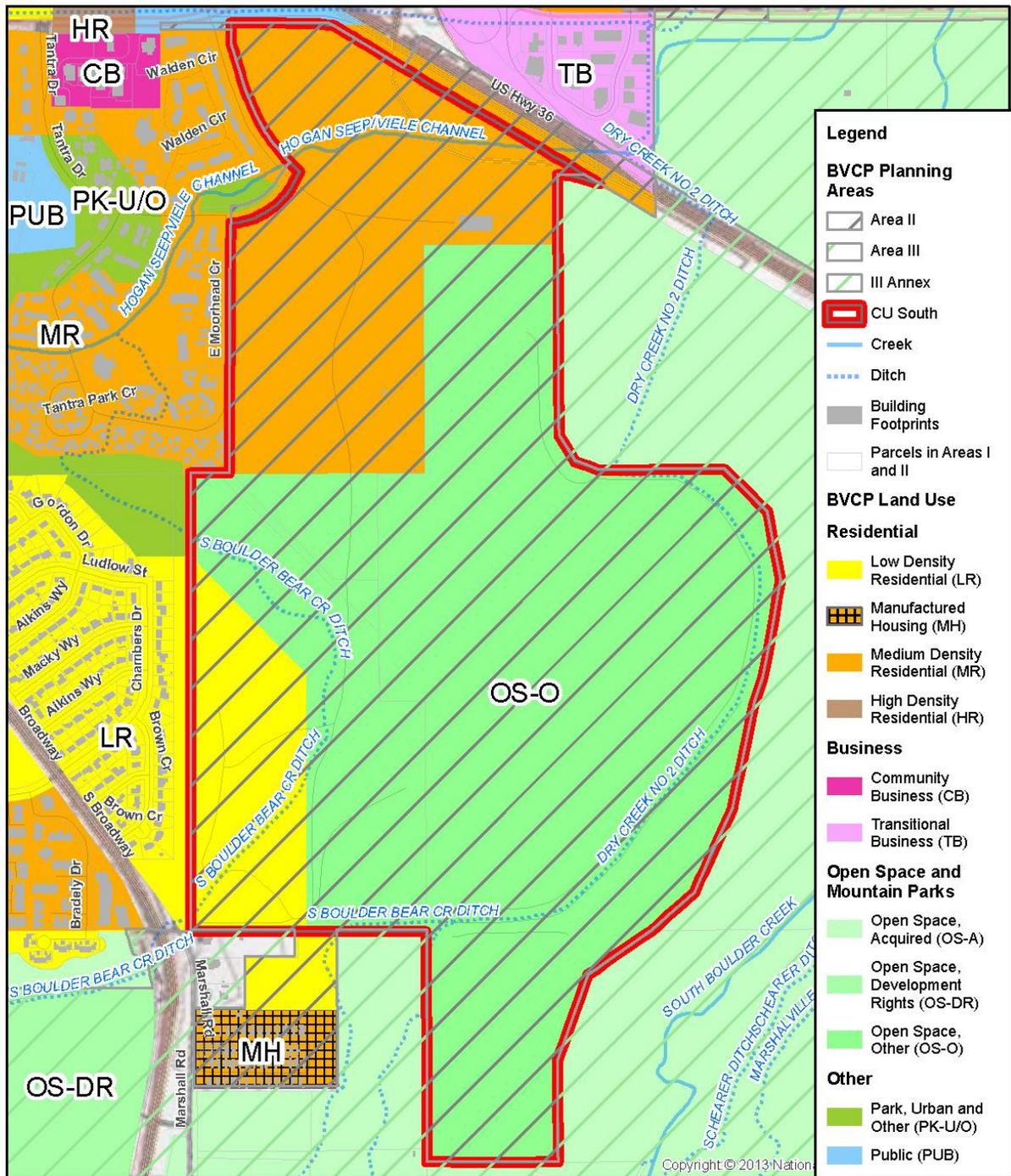


Figure 2
Land Uses
CU South Property

2.1 Data Collection and Field Assessment

Prior to field work, available site data and background information were collected and reviewed. These included but were not limited to GIS data provided by the city, the South Boulder Creek Flood Mitigation Study, previous evaluations of the site, zoning designations, transportation studies, and information on sensitive species such as Preble's meadow jumping mouse (*Zapus hudsonius preblei*).

Previous Studies

CU South has been the subject of numerous prior studies. These include the Boulder Valley Comprehensive Plan parcel report (1995), a Conceptual Land Use Assessment (Shapins Associates, Inc., 2002), a wetland delineation report (ERO Resources, 2013), the South Boulder Creek Major Drainageway and Flood Mitigation Plan (2015), and a transportation analysis (Fox Tuttle Hernandez Transportation Group, 2016). The property was also part of the U.S. 36 Mobility Project analysis (OSMP, undated).

Noteworthy among these studies is the 2002 Conceptual Land Use Assessment, which organized its findings into themes of transportation, potential building areas, flood storage, and natural areas. The Land Use Assessment also documented utility lines and transportation opportunities, thus providing a baseline for the current site suitability analysis.

A memorandum prepared by city staff for City Council in September 2014 summarized environmental considerations during the review of the South Boulder Creek Major Drainageway Mitigation Plan. The memorandum provided context on ecological values relevant to the project area including:

- Wetlands
- Preble's meadow jumping mouse (*Zapus hudsonius preblei*)
- Ute ladies'-tresses orchid (*Spiranthes diluvialis*)
- Northern leopard frog (*Rana pipiens*)
- Native fish and ground-nesting birds, and
- The South Boulder Creek State Natural Area (SBCSNA)

Additionally, the 2015 South Boulder Creek Major Drainageway and Flood Mitigation Plan will be highly influential on future development scenarios of the property. The preferred Alternative D will entail construction of a berm along US 36, excavation of 81 acres in the northeast portion of the CU South property to create a detention pond, and fill of approximately 31 acres of the northwestern portion of the CU South property to 5370 feet a.s.l. (Figure 3). Of the seven alternatives considered, Alternative D minimized impacts to sensitive species from nearby OSMP properties and minimized impacts to sensitive environmental resources.

Field Assessment

Field base maps were prepared using aerial photographs and available geospatial information. The purpose of the field assessment was to verify and supplement the available information to reflect existing water resources; plant communities (0.25-acre minimum) and their conditions as reflected by dominant species; connectivity to adjoining habitat; elements of concern such as hazards, erosion, waste, and/or disturbance; landscape features and character; and uses and impacts of adjoining properties. The site visit was conducted on June 21, 2016 by Claudia Browne, Water Resources Specialist and Conservation Planner, and Susan Sherrod, Ph.D., Certified Ecologist. Dr. Sherrod returned for a second visit on June 27, 2016. In August 2016, OSMP staff also conducted a high-level review of site conditions to evaluate potential habitat for

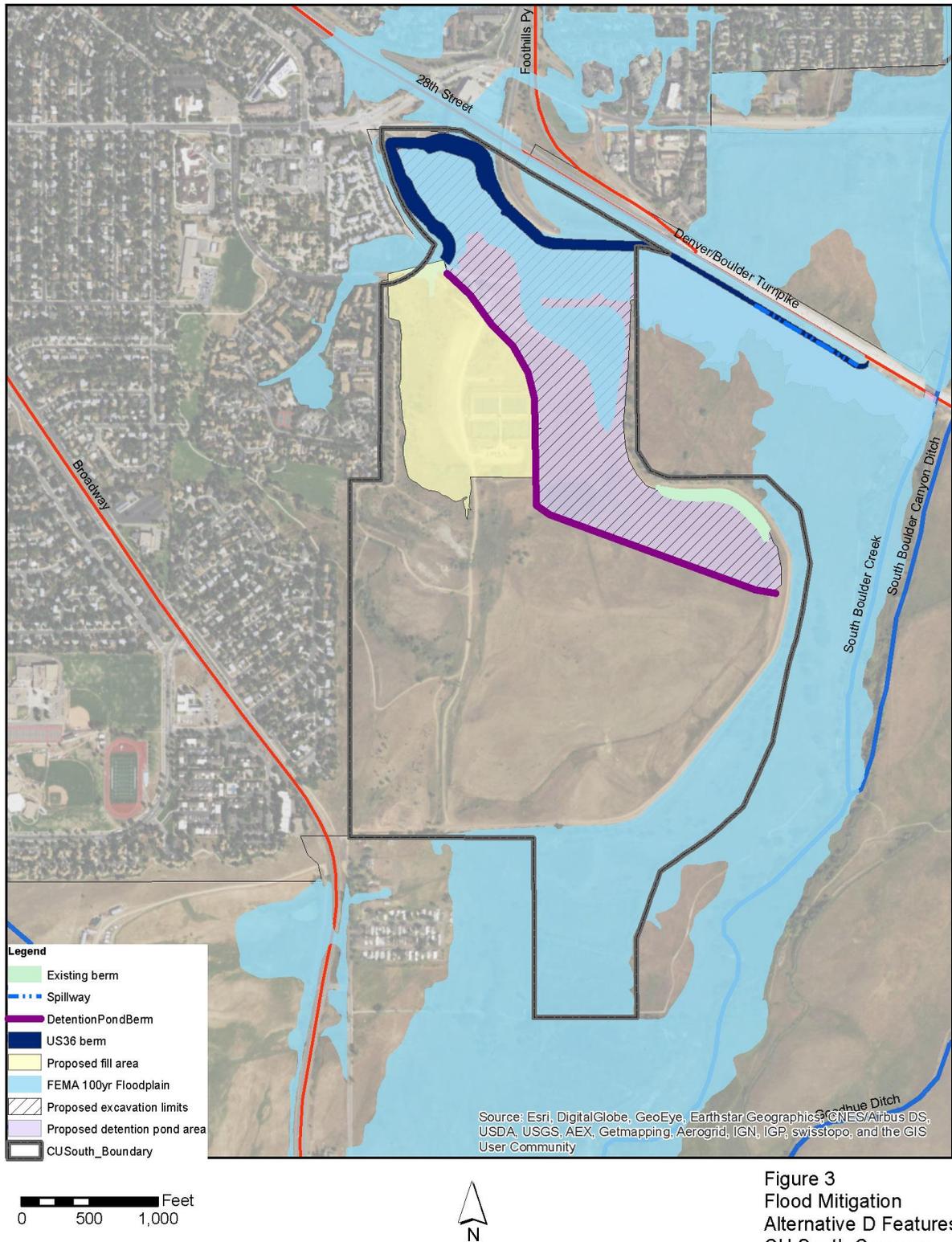


Figure 3
Flood Mitigation
Alternative D Features
CU South Campus

the Northern leopard frog and other native amphibians, Ute ladies'-tresses orchid, and native neotropical migratory and grassland-breeding bird species.

In addition to observing the above-noted features, viewshed observations were collected by Biohabitats, and photographs were taken at locations across the site to document scenic features on-site as well as views outward from the property. In a follow-up effort, City of Boulder planning staff collected additional panoramic photographs from the eastern boundary to address views from off-site across the property.

2.2 Conservation Suitability Analysis

A range of possible information sources and data layers were considered for inclusion in GIS the conservation suitability analysis including the items listed below:

- Water resources (floodplains, drainageways, lakes)
- Wetlands and buffers
- Plant communities
- Species of concern
- Habitat connectivity to adjoining properties
- Wildlife observations
- Landscape features in topography & geology

(Note that other factors such as transportation, access, and utilities are being considered separately.)

Biohabitats considered and tested a range of possible ways to group the data layers into primary or secondary criteria, to aggregate information into potential “neighborhoods” for views, to include offsite data, and to weight layers. Consistent use of data layers from previous evaluations conducted by the city for the floodplain study was also a consideration. Table 1 and the model diagram in Figure 4 show the layers that were included as primary criteria in the analysis.

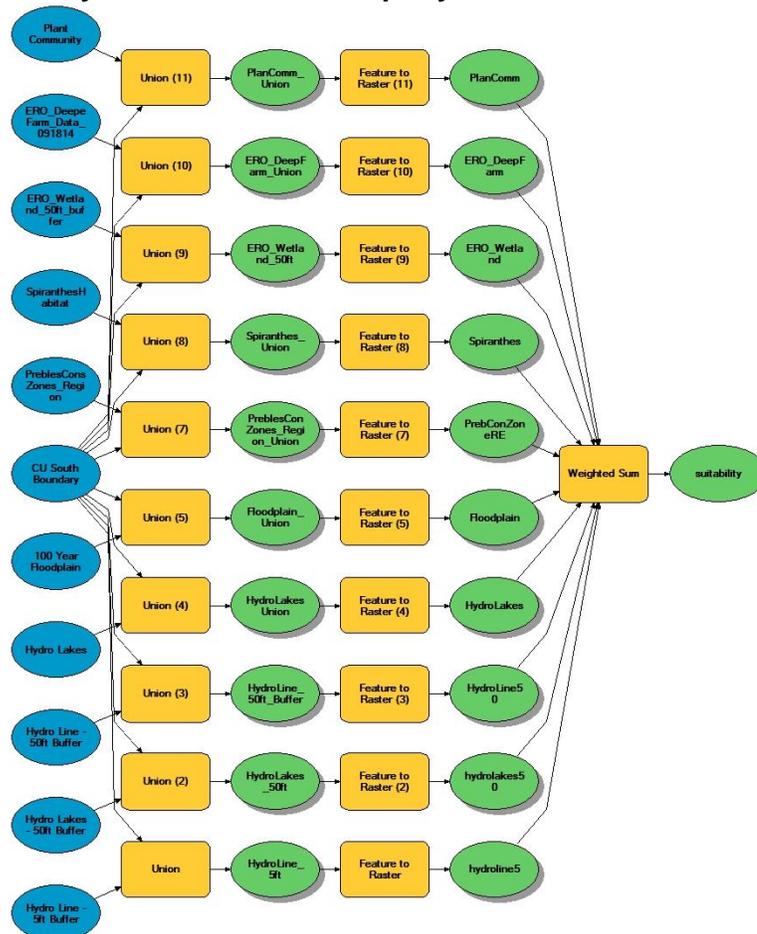
To complete the GIS analysis, the layers of primary criteria (Table 1, Fig. 4) were compiled into a geodatabase and organized into feature datasets by analysis step. The first step of analysis required clipping data to the property extents to ensure each feature represented the same area of interest. All data were assigned the same projected coordinate system, NAD 1983 HARN State Plane Colorado North FIPS 0501, to ensure spatial accuracy and alignment.

The second step of analysis involved the creation of buffers for hydrology features such as streams, lakes and wetlands. A 50-foot buffer was created around the previously delineated wetlands (ERO, 2013). This distance was selected to be conservative in the absence of wetland functional assessments, which are used by the city to determine if a 25- or 50 foot buffer is appropriate. A 5-foot buffer was also applied to stream centerlines to convert the GIS polyline to a polygon and to mimic estimated stream width. After applying buffers, “Score” fields were created in all the files in short integer format and assigned a value of 1 (for present), with the exception of the plant community layer where non-native plant communities received a 1 but native plant communities were assigned 2 to reflect their higher habitat value. Before converting data from vector to raster format, a union between each individual feature and the site boundary was required to create a cohesive layer representing all potential values throughout the site. When converted to raster format, areas where features do not exist were scored as 0 (and where features were present were a 1 or 2 as described above).

Table 1 Conservation Layers and Data Sources

Layer Category	File Name	Data Source
Lakes	Hydrology_Lakes	City data
Streams	Hydrology_Line	City data, Hydrology
Wetlands	ERO_Wetland	ERO
Wetland buffer	ERO_Wetland_50ft_Buffer	Created by Biohabitats
Floodplain	City_100Year_Floodplain	City data
Plant community	Community_Plant_Types_8-1	Created by city from Biohabitats field data
Preble's meadow jumping mouse regional	PrebleConsZone_Regional	City data (OSMP)
Preble's meadow jumping mouse critical habitat	PreblesCriticalHabitat	City data (OSMP)
Preble's meadow jumping mouse conservation zone	PreblesConsZone	City data (OSMP)
Rare plant	Spiranthes_Habitat_Field_Review	Created by city from OSMP field data
CU boundary	Project boundary	City data

Figure 4 Model of GIS Analysis for CU South Property



The final step of the process was the execution of a weighted sum overlay using ArcGIS Spatial Analyst tools. This step combines all raster datasets that were created and scored previously by overlaying each feature and summing areas of overlap. The goal of the analysis is to highlight areas with the highest density of sensitive ecological features that will be less suitable for development (see Section 3, Summary of Findings).

2.3 Secondary Analysis

Beyond the primary ecological considerations included in the GIS analysis, secondary considerations that encompass the human experience and user relationships with the ecological features on site may also be used in the analysis. These, too, have a role in determining conservation suitability, as they aim to address the relationship between a user's sense of place and the value of a site as a destination for active and passive recreation. Put another way, the secondary considerations account for ecological value through the lens of aesthetics and experience.

The first part of this secondary analysis was a landscape character viewshed analysis, a rapid assessment of quality of landscape character at a series of viewpoints throughout the site. This was based in part on the USFS Landscape Aesthetics Handbook for Scenery Management (USDA FS 1995). The key elements taken from that guidance document were a general understanding of landscape character (considering ecological systems, existing land use patterns and uses, and scenic integrity), attractiveness, and views of natural resources within different distance zones (immediate foreground: 0-300', foreground: 300'-1/2 mile, middle ground: 1-4 miles, and background: 4 miles to the horizon)¹. The landscape character viewshed analysis examined locations within the site and also considered views outward from and across the site toward the west.

One of the basic premises of this viewshed analysis of landscape character is that "scenery contributes to a 'sense of place,' a mutually shared image" (USDA FS 1995). Some of the specific landscape characteristics that define the site's sense of place directly associated with ecological resources include: a sense of isolation from development based on the presence or absence of structures or roads, natural character reflecting native and diverse ecosystems, wide and open views to the mountains, views across open water and wetlands, access via trails, and other sensory experiences such as natural versus man-made sounds and availability of shade along trails. Each viewpoint was scored for the presence of these landscape characteristics and then total scores were determined across the site, as well as within each of the 4 distance zones to get a sense of the highest scoring points of view on the site (see Table A-1, attached).

Other secondary suitability criteria that may be integrated include availability and location of trails and recreation opportunities directly associated with the ecological resources on site, restoration potential, presence of other ecological resources associated with geology, steep slope areas that may be sensitive to erosion with future development, and social path connections.

¹ Due to topography and other existing conditions the site is limited in terms of middle ground characteristics.

3 Summary of Findings

The primary outcomes of the site conservation suitability analysis are an ecological characterization, suitability mapping, and preliminary sketches of watershed and connectivity considerations. The purpose of these findings is to understand high-value ecological areas to help guide future planning decisions. The ecological characterization summarized in Section 3.1 describes how the elements of the site work together to support the natural systems included in the suitability analysis, and the results of the suitability analysis follow in Section 3.2.

3.1 Ecological Characterization

Ecological resources of the CU South property are related to physical resources of the site and landscape context. Key factors such as topography, geology, and water resources interact to control ecosystem characteristics such as plant community type, wildlife use, and the occurrences of sensitive species. Human activities such as water diversions, development, and transportation further influence habitat features via disturbance and management practices.

Geology

Geologic characteristics of the site were considered during this suitability analysis primarily as they relate to hydrology (described in the following subsection). As shown in Figure 5, there are 5 major surficial geologic units mapped on the property. The main portion of the site is underlain by Post Piney Creek and Piney Creek Alluvium (Qp) and Broadway Alluvium (Qb). The Piney Creek alluvium (Holocene, less than 4,000 yrs ago) occurs in a band along the South Boulder Creek corridor, and to the west is the slightly older Broadway alluvium in the northwest and central portion of the site. A small area of Louviers Alluvium (Upper Pleistocene) also occurs in the southwest corner of the property.

Pierre Shale bedrock (Cretaceous Period, 65-144 Mya) outcrops on the southwest side of the site, on the edge of the terrace formation. In the upland areas to the west of the shale, the Slocum Alluvium (Quaternary Period, mid-late Pleistocene, 1.8-2 Mya) is characterized as “10 to 90 ft of moderate reddish-brown, well-stratified, clayey coarse sand with lenticular beds of pebbles and silt” (Moore et al, 2001).²

Water Resources

The property is located within about 500 feet of South Boulder Creek, and a portion of the 100-year floodplain is on the property. Dry Creek Ditch No. 2 runs along the interior of the eastern border and Bear Creek Ditch is in the western portion of the property (Figure 6).

Four former gravel pits, now ponds, occur in the northern half of the site. The ponds appear to be fed primarily by groundwater with relatively stable water levels (based on vegetation). Detailed flow information was not reviewed for the ditches; however, wetland communities are supported along most of the channels, indicating sufficient hydrology for this habitat type.

Shallow groundwater occurs beneath most of the property in an unconfined sand and gravel aquifer (sometimes called a water table aquifer). Because groundwater may support baseflow and vegetation in the riparian areas along the creeks, understanding and maintaining groundwater hydrology can be important for long-term viability in these ecosystems. In

² Note: an evaluation of soil distribution was not included in the current analysis. The majority of the property has been mined and undergone earthwork and agricultural uses, such that soil descriptions are not expected to be pertinent to the current conditions on the property. Should restoration of portions of the site be desired, historic soil mapping could be viewed for possible insights into opportunity areas based on pre-mining conditions (depending on the date and accuracy of the mapping).

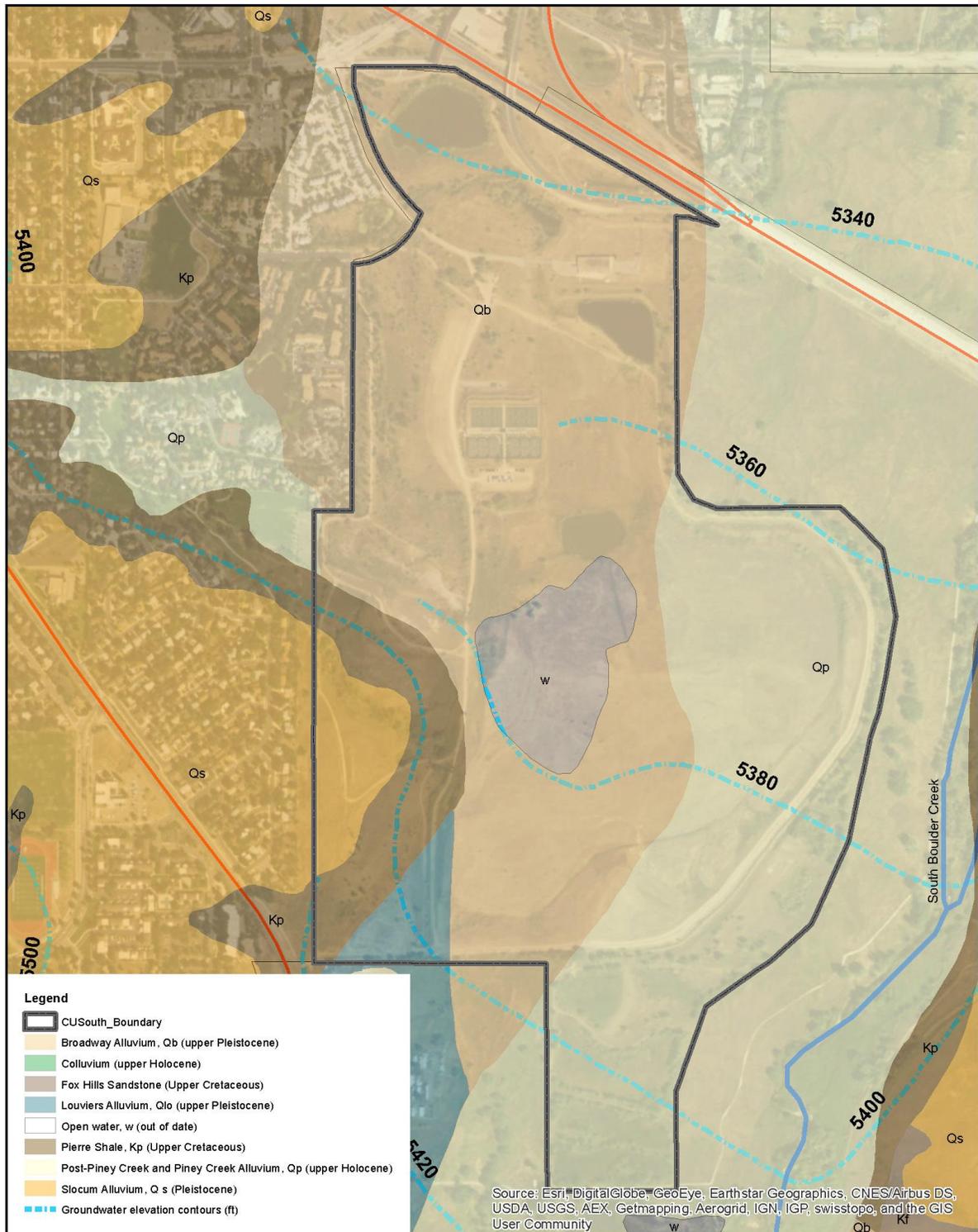
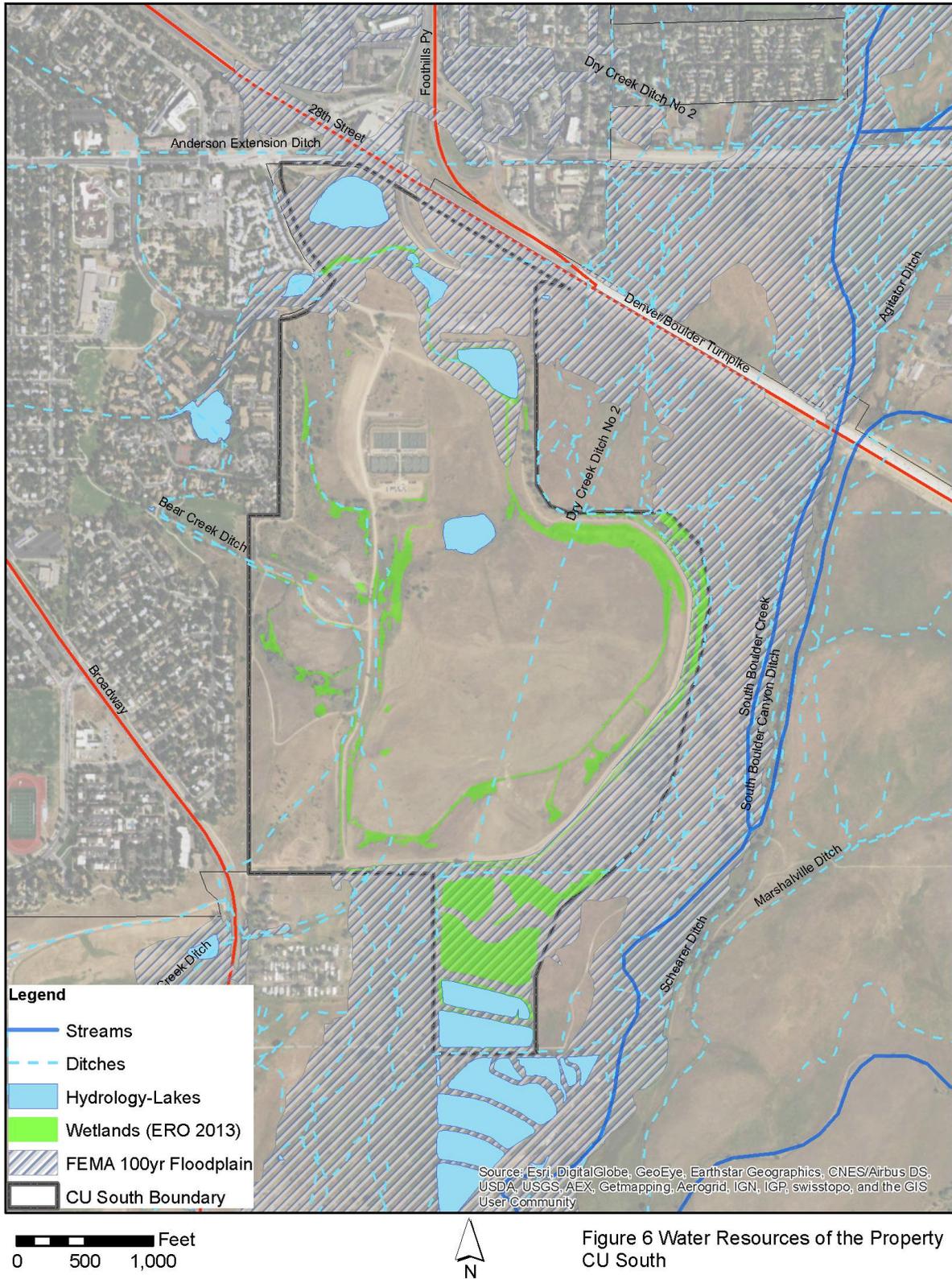


Figure 5
Geology and Regional Groundwater
CU South



unconfined systems, precipitation infiltrates in upland areas to recharge groundwater, and the groundwater moves through the subsurface generally following topography until it reaches discharge points. Groundwater discharge occurs where the aquifer intersects the ground surface, and water is released into lakes, seeps, or springs that feed streams and wetlands. Water table aquifers will fluctuate up and down with seasonal and annual climate variations. In the Front Range, the water table generally rises in the winter, peaks after spring snowmelt, and decreases steadily throughout the growing season. Droughts and human water management practices associated with new development (e.g., diversion ditches, wells, sump pumps, and storm sewers) can cause significant long-term changes in the water table.

Currently there are limited data on groundwater characteristics on the property. CU is planning to conduct a detailed groundwater investigation in the upcoming year, however, and its study results can help confirm some of the following initial observations of groundwater flow patterns.

- On the CU South property, groundwater generally flows from the southwest to the northeast, with water draining off of the foothill fans and discharging into the alluvial sand and gravel deposits along the creeks.
- As shown on Figure 6, regional groundwater contours in the eastern Piney Creek alluvial deposits depict the direction of flow to be generally perpendicular to South Boulder Creek. This pattern shows that the groundwater and creek interact, exchanging water depending on local differences in water elevations. In other words, there will be periods when groundwater will discharge to the creek and periods when the creek will recharge the nearby alluvial aquifer.
- Groundwater flowing from the uplands in the central and western portions of the property is recharged offsite in the foothills to the west.
- Site observations indicate a small zone of potential groundwater seepage/discharge at the base of the terrace on the western side where the surface deposits meet the underlying Pierre Shale bedrock which is relatively impermeable and acts as a lower boundary to the aquifer.

Note that the presence of perennial (i.e., year-round) water features and areas of shallow/exposed groundwater that can support wetlands and riparian vegetation is generally considered a valuable ecological asset in the semi-arid west where such features are not common.

Plant Communities

Plant community mapping was completed on June 21 and 27, 2016, to evaluate the vegetative component of conservation suitability at CU South (Figure 7). Key objectives of the mapping were to identify boundaries of major community types (at a ¼-acre scale) and to note the condition of each community based on whether dominant species were native or non-native. The OSMP Grassland Ecosystem Management Plan (2010) was used as a reference for defining the CU South plant communities. As shown in Table 2, four native communities were identified: Mixed Grass Prairie Mosaic, Native Riparian, Herbaceous Wetland, and Woody Wetland.³ In addition, there were non-native communities labeled Non-Native Riparian, Non-Native Upland, and an “Other” category for development, large patches of bare ground, salt flats, and living fences.

³ Note that ERO Resources (2013) report mapped jurisdictional wetlands in accordance with the 1987 U.S. Army Corps of Engineers Wetlands Delineation Manual. The plant community mapping conducted for this report was based on vegetation only and did not include evaluations of hydric soils or wetland hydrology. Moreover, the current mapping exercise was at a scale of ¼ acre minimum patch size. Thus, the wetlands presented in this report are not an update to the jurisdictional wetland mapping performed in 2013 nor are they intended for regulatory purposes.



0 500 1,000 Feet

Note: 2016 wetland plant community mapping is based on rapid assessment and did not include delineations for regulatory purposes.

Figure 7
Plant Communities of the Property
CU South

Table 2. Plant communities at CU South and observed dominant species

Plant Community	Plant Community Classification Criteria	Basis in OSMP Grassland Ecosystem Management Plan (2010)	Dominant Species Observed in 2016	Major Differences Between Expected and Observed Plant Community Characteristics	Acreage at CU South (% of plant comms.)
Native Riparian	Cottonwoods (plains, lanceleaf, narrowleaf) > 50%; box elder; shrubs, <i>e.g.</i> , snowberry, hawthorn, Woods' rose, plum, and grape; native herbaceous understories.	Riparian areas	Plains cottonwood most common, but frequently observed significant cover of Russian-olive. Peach-leaved willow and ash were also observed.	Plains cottonwood more prevalent than other native species. Native understory often not well-developed.	16 ac. (5%)
Herbaceous Wetland	Narrow-leaved cattail, bulrush, sedges, rushes, swamp bluegrass, milkweed, sedges, and grasses (foxtail barley, switchgrass, alkali muhly). Dominant species may include non-natives.	Wetlands (emergent and wet meadows)	Cattails most common site-wide. Also observed American threesquare, sedges, rushes, milkweed, and minor occurrences of teasel, sandbar willow and plains cottonwood saplings.	Extensive monocultures of cattail.	30 ac. (5%)
Woody Wetland	Sandbar willow, peach-leaved willow, leadplant, cattail, arctic rush. Could include minor tamarisk (non-native).	Wetlands (woody)	Native sandbar willow most common; often interspersed with cattail. Sedges, rushes, and occasional peach-leaved willow also observed.	Observations consistent with expectations (note no tamarisk found).	8 ac (3%)
Non-native upland (grassland)	Any of prairie types with >40% non-native pasture grasses, <i>e.g.</i> , smooth brome, orchardgrass, quackgrass, bluegrass, non-native wheatgrasses, upland weeds & forbs.	(none)	Dominant species observed were cheatgrass and alfalfa. Smooth brome, bindweed, and yellow salsify also very common, and western wheatgrass was observed.	Observations consistent with expectations.	233 ac (80%)
Non-native Riparian	Non-natives Russian-olive, crack willow	(none)	Russian-olive most common, but Siberian elm and crack willow dominant in some communities. Sandbar willow a frequent associate. Ash also observed.	Native associates were observed.	2 ac (1%)
Mixed Grass Prairie Mosaic	Native species relative cover >60%. Most prevalent native species to include western wheatgrass, blue grama, silver sage, Junegrass, buffalograss, snakeweed, scurfpea.	Mixedgrass Prairie Mosaic	Western wheatgrass, golden banner, yarrow, milkweed. Also Canada thistle.	Grasses not dominant, but rather co-dominant with forbs.	1 ac (<1 %)

High-resolution aerial photographs were used in the field to draw plant communities, and the polygons were then digitized using GIS. The smallest mapping unit for a polygon was approximately ~0.1 acre (~4,000 sq ft). Two or three dominant species were recorded for each polygon, “dominant” determined as covering at least 25% of area within the plant community.

Of the approximately 316 acres mapped at CU South, roughly 20% is comprised of native plant communities. Herbaceous wetland is the largest native plant community with most of these areas occurring in the southern part of the site and around the existing ponds and ditches. Descriptions of each of the plant communities are provided in the following subsections.

Native Riparian

Native riparian communities, comprising 16 acres (5%) of the survey area, are wooded areas with sufficient soil moisture to support trees and shrubs, and at CU South they are most commonly located near a water source such as a ditch or a wetland. Native riparian communities were observed forming a mosaic with the herbaceous wetlands in the southernmost leg of the property (Photograph 1), in the South Boulder Creek floodplain along the eastern boundary, and along the western terrace. Plains cottonwood (*Populus deltoides*) is the dominant species in all native riparian communities of the study area. The most commonly observed associate was non-native Russian-olive (*Elaeagnus angustifolia*). Ash (*Fraxinus pensylvanica*) and peach-leaved willow (*Salix amygdaloides*) are also typical.



Photograph 1. Mosaic of native riparian/herbaceous wetland communities in southernmost portion of CU South property. Native riparian patches are dominated by plains cottonwood.

Herbaceous Wetlands

Herbaceous wetlands cover 30 acres, or approximately 10%, of the survey area. The largest patches are located in the southernmost portion of the property, but they are also characteristic of the inner slope of the berm (Photograph 2) and occur sparsely around the ponds.

Cattail (*Typha* sp.) was the most common dominant species in the herbaceous wetlands, but we also observed both native and non-native rushes (*Juncus* sp.), sedges (*Carex* sp.), milkweed (*Asclepias* sp.), and American threesquare (*Schoenoplectus pungens*). Additionally, there were minor occurrences of teasel (*Dipsacus* sp.), sandbar willow (*Salix exigua*), and plains cottonwood saplings.



Photograph 2. Herbaceous wetland on the inside of the berm; photograph faces east-southeast. Dominant species in this patch are rushes, sedges, and cattail.

Woody wetlands

Woody wetlands comprise 8 acres (3%) of the survey area. Woody wetlands are found predominantly in the western portion of the property and typically abut native riparian communities.

Similar to other woody wetlands of the Boulder County area, the woody wetlands in the survey area are dominated by sandbar willow. Associates commonly include cattail, sedges, and rushes (Photograph 3). Peach-leaved willow was also observed.



Photograph 3. Woody wetland complexed with cattails on the west side of CU South. Photograph faces south.

Mixed Grass Prairie Mosaic

One patch of Mixed Grass Prairie Mosaic was observed at CU South, on the eastern boundary of the property. This patch was 0.9 acres and located between a patch of native riparian to the west and open space (beyond the property boundary) to the east.

In this sole native-dominated prairie patch observed at CU South, western wheatgrass (*Pascopyrum smithii*) is dominant, yet golden banner (*Thermopsis rhomboidea*), yarrow

(*Achillea* sp.), and milkweed were prevalent. Non-native Canada thistle (*Cirsium arvense*) was also noteworthy.

Non-Native Grassland

Non-native grassland comprises 233 acres (80%) of the property. The magnitude and features of this community reflect its history of disturbance including mining. Dominant species are cheatgrass (*Anisantha tectorum*) and alfalfa (*Medicago sativa*), and associates include bindweed (*Convolvulus arvensis*), yellow salsify (*Tragopogon dubius*), and smooth brome (*Bromopsis inermis*; Photograph 4). Patches of western wheatgrass were also observed.

Non-Native Riparian

Non-native riparian communities were relatively small at CU South covering only 2 acres (1% of survey area). These isolated patches occurred around one of the ponds in the northern portion of the site (Photograph 5), and along the eastern and western boundaries. Russian-olive was the typical dominant, but Siberian elm (*Ulmus pumila*) and crack willow (*Salix fragilis*) were dominant in some of these patches. Sandbar willow is a frequent associate and ash was also observed.



Photograph 5. Non-native riparian community around the shoreline of a pond in the northern portion of CU South. Non-native upland is in the foreground.

Open Water and Other

The remainder of the property consists of open water ponds (see previous water resources description), developed areas including tennis courts and roads, living fences (i.e., rows of non-native trees), and salt flats characterized by narrowleafed trefoil (*Lotus tenuis*). A waste pile of riprap and soil is also found in the southwest corner.



Photograph 4. Non-native grassland at CU South. Dominant species are cheatgrass and alfalfa. White tufts are yellow salsify.

Threatened Species' Habitat

On August 30, 2016, OSMP staff conducted a rapid assessment of CU South for potential habitat for Ute ladies'-tresses orchid (*Spiranthes diluvialis*), a threatened species, as well as actively growing individual *Spiranthes*. Potential habitat was observed primarily in areas that were classified as non-native upland but always adjacent to herbaceous and/or woody wetland Blue lobelia (*Lobelia siphilitica*), a common floral associate of *Spiranthes*, was also observed in onsite wetland. Due to the location of most wetlands on-site, the eastern and southern portions of the property were emphasized for the survey.

Figure 7 shows the areas identified as potential Ute ladies' tress orchid habitat at CU South based on OSMP's rapid assessment. Four individual *Spiranthes* plants were observed in association with a patch of herbaceous wetland adjacent to the berm close to the southeast edge. As shown on Figure 7, most of the potential habitat is identified in the eastern portion of the property, with additional patches located around the cattail wetlands in the southernmost "panhandle" as well as smaller areas adjacent to the ponds in the northern portion.

Note that this rapid assessment for *Spiranthes* habitat was not intended to meet the qualifications of a full survey for clearance from the Fish and Wildlife Service. For regulatory purpose, a more intensive survey prior to planning and development would be required. Similarly, careful surveys should be conducted for the Colorado butterfly plant (*Gaura neomexicana* ssp. *coloradensis*) prior to site development. The Colorado butterfly plant is also listed as threatened and its habitat requirements are similar to those of *Spiranthes*.

Wildlife Habitat

Detailed wildlife surveys have not been conducted on the CU South property. According to the Species Range Mapping for select mammals by Colorado Parks and Wildlife Department (CPW), most or all of the property is within the overall ranges of mule deer (*Odocoileus hemionus*), white-tailed deer (*Odocoileus virginianus*), bobcat (*Lynx rufus*), and mountain lion (*Puma concolor*), and contains potential Preble's meadow jumping mouse (*Zapus hudsonius preblei*) habitat. Figure 8a shows select ranges for bear and mule deer and Preble's. In addition to these species, a variety of common urban wildlife such as coyote, fox, and small mammals, as well as breeding grassland and wetland birds, fish, amphibians, and reptiles are likely to occur on the property, particularly given its location adjacent to OSMP-protected areas and the types of plant communities found on-site.

City OSMP staff provided further input on wildlife habitat features to include in the suitability analysis. Figure 8b shows the designated conservation areas for the Preble's meadow jumping mouse used by OSMP. In August 2016 OSMP staff conducted a high-level rapid survey of aquatic, wetland, and grassland areas to ascertain the presence of suitable habitat for breeding birds, Ute ladies'-tresses orchid, native fish, amphibians, and reptiles. Site observations included:

- Open water habitat provided habitat for native amphibians and reptiles. A single snapping turtle was observed in one pond and woodhouse toad tadpoles in another (the pond close to the tennis courts). OSMP notes from prior knowledge that native western chorus frog and woodhouse toad populations breed in the ditch on the western boundary (northern portion) as well as the herbaceous wetland communities south of the tennis courts.

The shallow depth of the lakes is a primary factor of their general low quality for wildlife as indicated by algal blooms and prevalence of non-native species such as bullfrog,



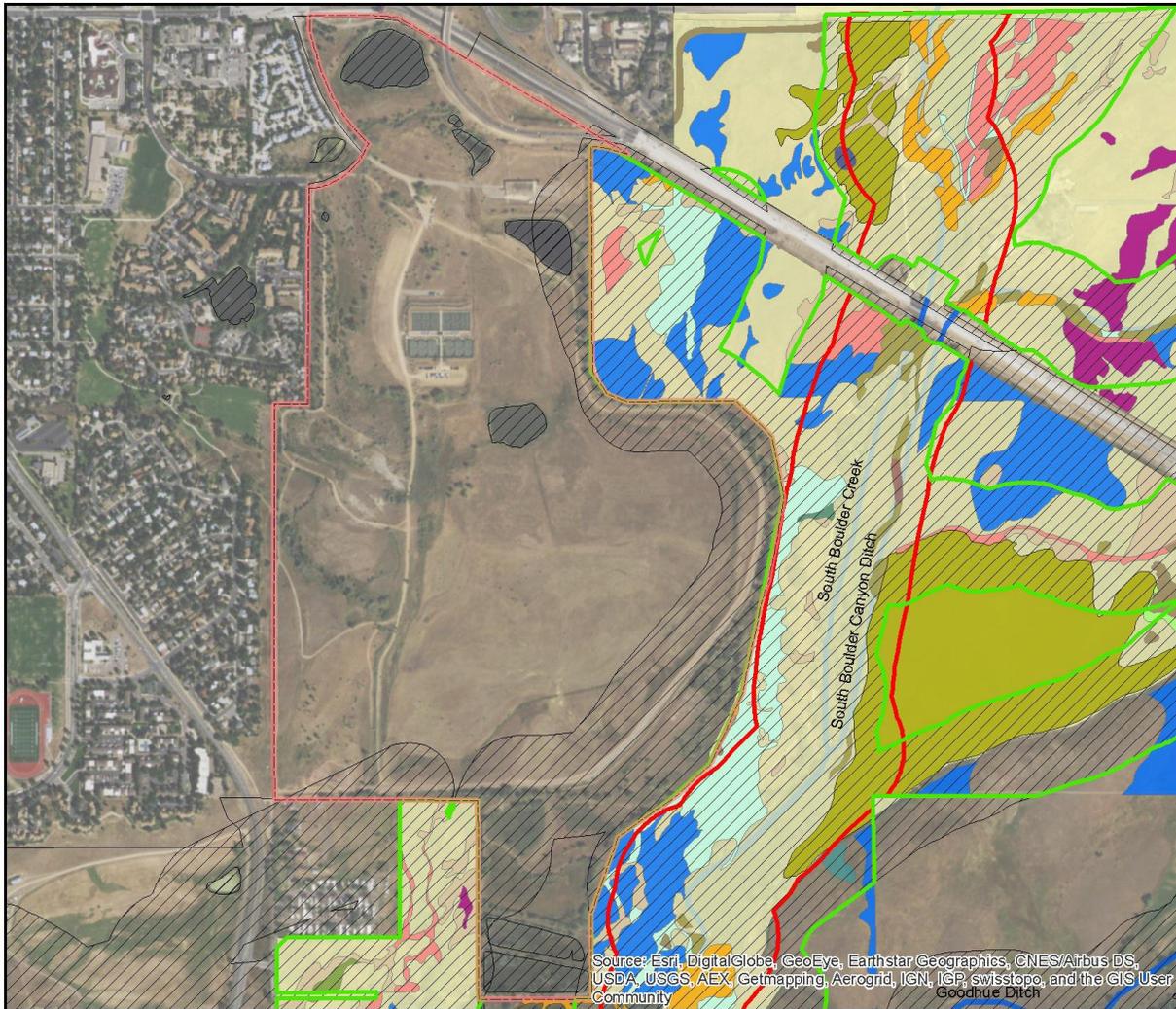
Legend

- CUSouth_Boundary
- Preble's Meadow Jumping Mouse Occupied Range
- Black Bear Fall Concentration
- Black Bear Summer Concentration
- Black Bear Human Conflict Area
- Mule Deer Highway Crossing
- Mule Deer Concentration Area

The entire site is within the overall habitat ranges for black bear, black-tailed prairie dog, mule deer (also summer and winter range), Preble's meadow jumping mouse, reptiles and white tailed deer.



Figure 8a
Select Wildlife Ranges (regional data)
CU Property
Source :Colorado Parks and Wildlife



Legend

- CUSouth_Boundary
- South Boulder Creek State Natural Area
- Prebles Conservation Zones
- Prebles Critical Habitat
- Prebles Conservation Zones regional

OSMP_TrackedVegAssociations_S1_S3

Associations

- American Mannagrass Herbaceous Vegetation
- Big Bluestem - Prairie Dropseed Western Foothills Herbaceous Vegetation
- Big Bluestem - Yellow Indiangrass Western Great Plains Herbaceous Vegetation
- Big Bluestem Colorado Front Range Xeric Tallgrass Herbaceous Vegetation
- Clustered Field Sedge Herbaceous Vegetation
- Eastern Cottonwood - (Peachleaf Willow) / (Coyote Willow, Sandbar Willow) Woodland
- Nebraska Sedge Herbaceous Vegetation
- Prairie Cordgrass Herbaceous Vegetation
- Threesquare Wet Meadow Herbaceous Vegetation
- Woolly Sedge Herbaceous Vegetation

CNHP_TrackedVegAssociations_S1_S5

Associations

- (Broadleaf / Narrowleaf) Cattail Western Herbaceous Vegetation
- American Mannagrass Herbaceous Vegetation
- Big Bluestem - Prairie Dropseed Western Foothills Herbaceous Vegetation
- Big Bluestem - Yellow Indiangrass Western Great Plains Herbaceous Vegetation
- Clustered Field Sedge Herbaceous Vegetation
- Coyote Willow / Mesic Graminoids Shrubland
- Eastern Cottonwood - (Peachleaf Willow) / (Coyote Willow, Sandbar Willow) Woodland
- Marsh Spikerush Herbaceous Vegetation
- Narrowleaf Cottonwood / Coyote Willow Woodland
- Nebraska Sedge Herbaceous Vegetation
- Prairie Cordgrass Herbaceous Vegetation
- Threesquare Wet Meadow Herbaceous Vegetation
- Western Wheatgrass - Blue Grama Herbaceous Vegetation
- Woolly Sedge Herbaceous Vegetation



Note: Local Preble's data shown here provided by city was used in suitability analysis.



Figure 8b
Habitat Connectivity Considerations
CU Property

which were present in multiple locations, in large numbers, and with a diverse age structure. Such robust bullfrog populations would likely prevent the success of native frogs in those areas.

- Potential for the northern leopard frog (*Rana pipiens*), a species of concern, to breed within the CU South property would be highest in years of high water. Such conditions would create open water on the edges of ponds and wetlands, where larvae are deposited. The current year (2016) did not foster these conditions. More intensive surveys may be needed to confirm their presence on the CU South property.
- South Boulder Creek is a known corridor for northern leopard frog migration, and adjacent OSMP property to the south (Fancher Ponds) has supported northern leopard frog breeding for the past four years. Thus, the proximity of the CU South property to known northern leopard frog habitat increases the likelihood of CU South being used for some behaviors and/or life stages.
- Over 100 bird species have been observed at CU South since 2011, over half of which were confirmed to be breeding (a comprehensive list is attached as Table A-2). Many of these, including the American kestrel, western meadowlark, common nighthawk, dickcissel, horned lark, lark sparrow, loggerhead shrike, vesper sparrow, grasshopper sparrow, and blue grosbeak, are included in OSMP's grassland conservation targets. These observations indicate that the available habitat at CU South is of sufficient size and condition to support a diverse assemblage of native species. A subset of examples is:
 - Dickcissel is a sensitive breeding bird whose presence indicates breeding habitat (OSMP 2010).
 - Blue grosbeak indicates breeding habitat effectiveness and diversity (OSMP 2010).
 - Horned lark is a common prairie dog associate whose presence indicates prey (i.e., insect and seed) availability (OSMP 2010).

The above examples focus on grassland species as a basis for including grassland in the suitability analysis. Numerous wetland bird species have also been observed at CU South, but are not discussed in detail here as their habitat was incorporated into the GIS suitability analysis and was already valued as high-quality for the purposes of the assessment.

Habitat Connectivity

As noted previously, sensitive plant and animal habitat areas have been identified on the protected OSMP lands to the east and south of the property by both the Colorado Natural Heritage Program (CNHP), the Colorado State Natural Areas Program, and OSMP. On the adjacent OSMP property, OSMP has identified ecologically significant wetlands as well as habitat for sensitive species including Preble's meadow jumping mouse (*Zapus hudsonius preblei*), Ute ladies' tresses orchid (*Spiranthes diluvialis*), northern leopard frog (*Rana pipiens*), bobolink (*Dolichonyx oryzivorus*), plains topminnow (*Fundulus sciadicus*), and orangespotted sunfish (*Lepomis humilis*).

Preble's meadow jumping mouse and Ute ladies' tresses orchid are federally threatened under the Endangered Species Act, and the northern leopard frog is considered a Tier 1 species (i.e., of greatest conservation need) by Colorado Parks and Wildlife. In addition, these OSMP properties support the majority of the city's mesic tallgrass prairie, a globally threatened plant community.

Figure 8b shows the designated conservation areas for the Preble's meadow jumping mouse along with the plant communities that are tracked by CNHP and OSMP. Preble's was positively located within ca. 300 meters of the property as recently as 2014. Preble's meadow jumping mouse (Preble's) habitat is a riparian ecosystem characterized by a high cover of shrubs, grasses, and forbs, and adjacent uplands that are used for foraging and hibernation. Typical habitat is found in the foothills of the Front Range ranging from southeastern Wyoming to Colorado Springs. Preble's is primarily nocturnal and a true hibernator, entering hibernation in early fall (Sept-Oct) and emerging in May. Its diet, comprised of insects, seeds, fungus, moss, pollen, and fruit, changes seasonally according to the availabilities of different foods.

3.2 Conservation Suitability Mapping

The preliminary results of the weighted-sum GIS conservation suitability (sensitivity) analysis (described in Section 2.2) are presented in Figure 9. Darker areas reflect a higher number of good quality attributes for conservation, while lighter areas would be more likely to be compatible with development. The mapping suggests that the eastern perimeter and southern wetlands have the largest contiguous, higher ranked areas of sensitivity to disturbance or development. The water resources and the wetlands, as well as a mosaic area in the northwest, also are higher value areas based on the GIS analysis. The central portion of the property and western edge have lower rankings for conservation values as indicated by their lighter color.

3.3 Secondary Considerations

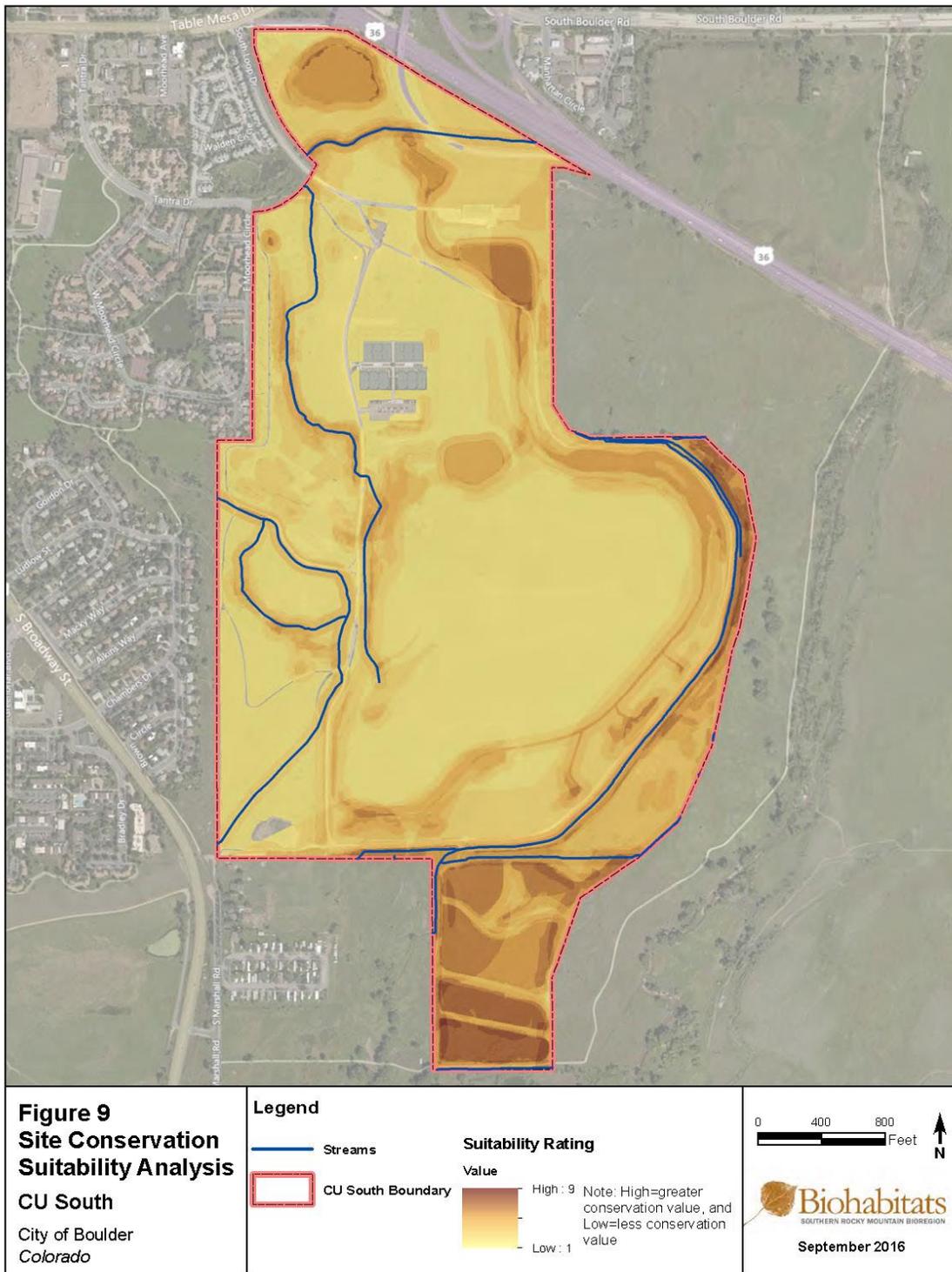
Secondary suitability criteria were evaluated including landscape character views and potential habitat connectivity.

Habitat connectivity to adjoining properties

Figure 10 is a sketch depicting connectivity potential between the CU South property and nearby areas containing native plant associations and Preble's meadow jumping mouse habitat. Connectivity potential was based generally on proximity, potential for seed dispersal, and wildlife usage. As indicated in the figure, the highest potential areas for connectivity are to the south and east of the CU property where OSMP-protected areas adjoin the property.

Landscape character viewshed features

Figure 11 presents a conceptual sketch of photopoint values, depicting the areas of the site with view features based on the assessment detailed in Section 2.3 above (further detail in Table A-1, attached). The outline of the point and the color reflect an initial value of key landscape characteristics at these points. This is a preliminary exercise which may need refinement once stakeholder input is gathered.



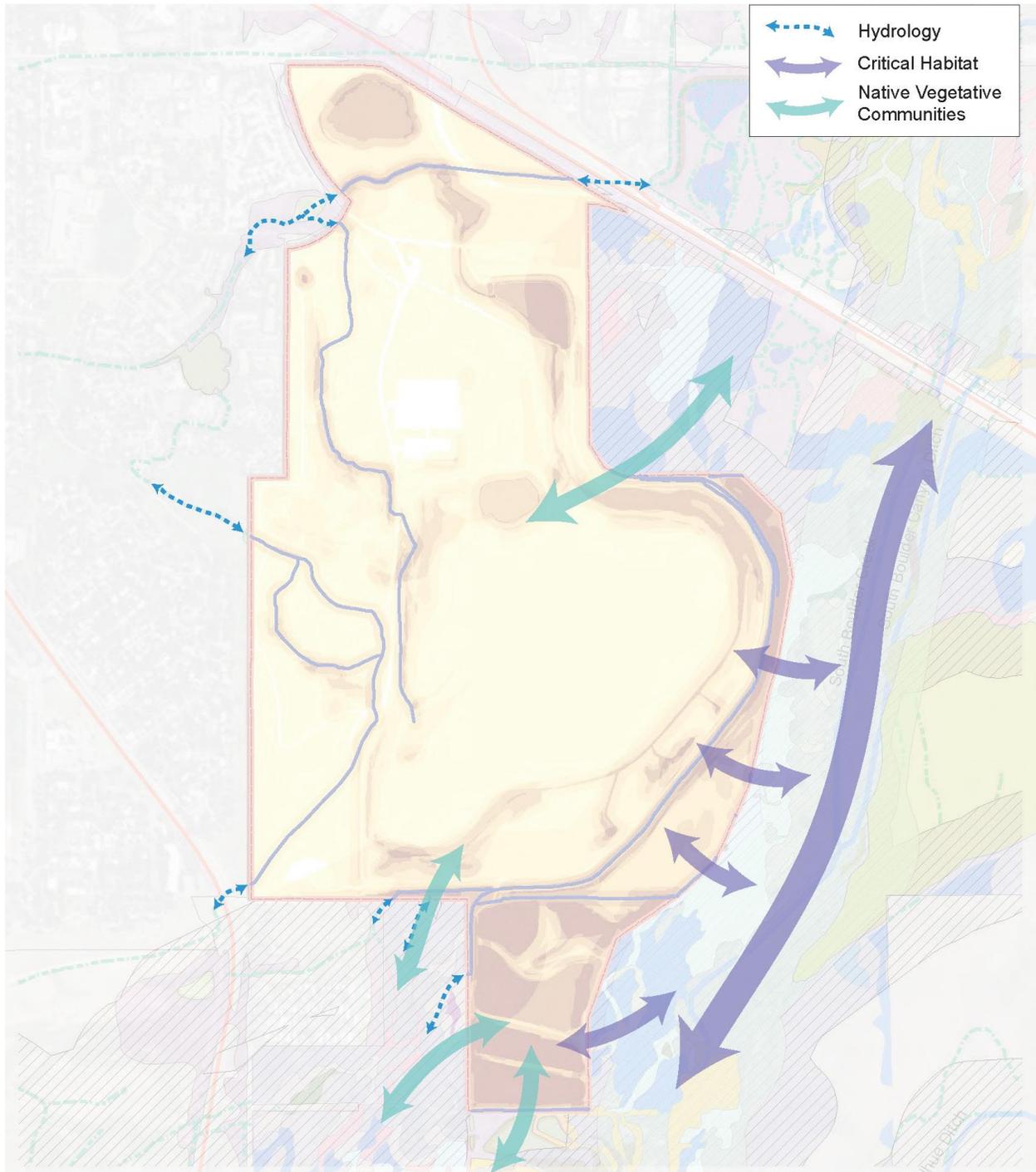
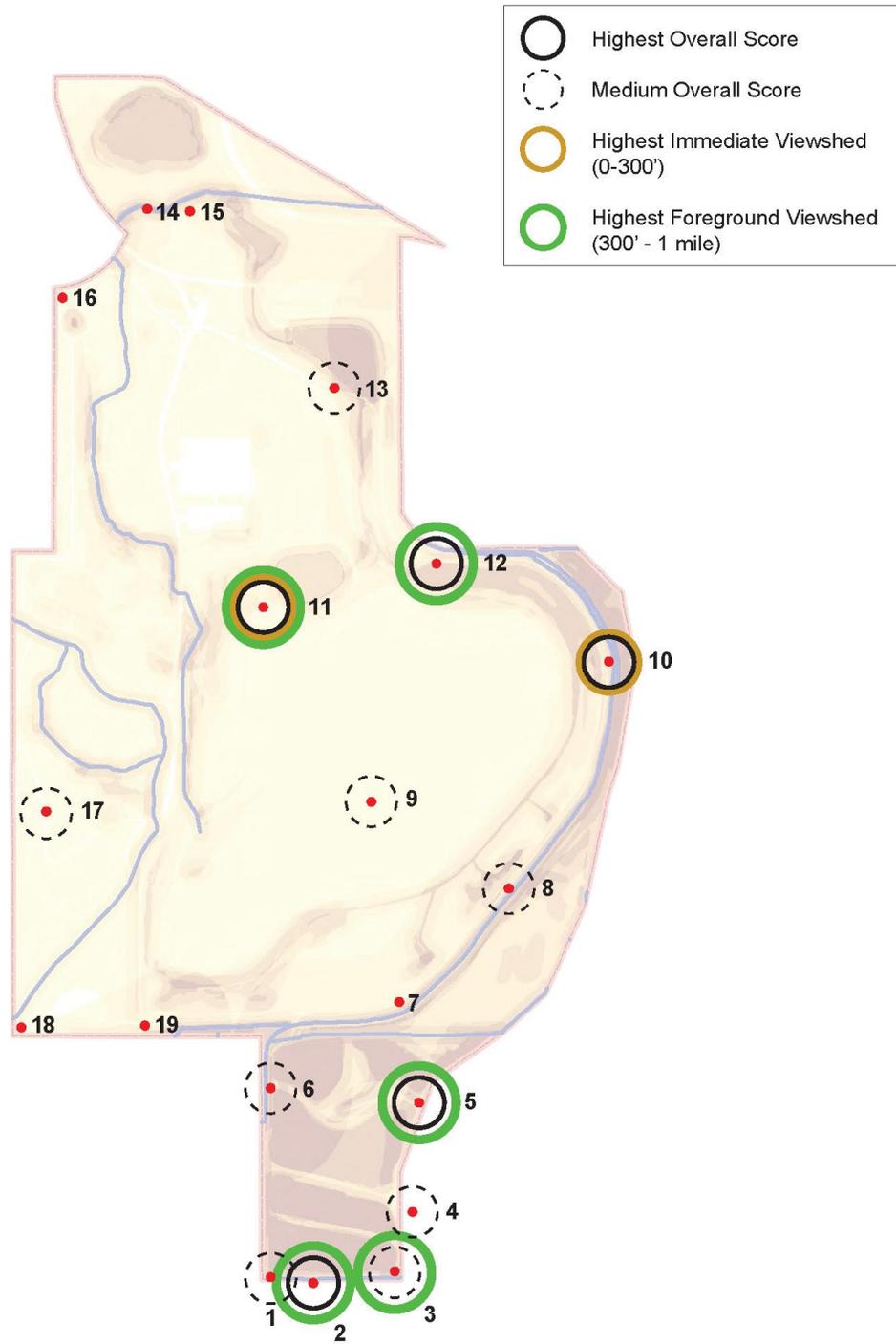


Figure 10
Connectivity - Critical Habitat, Native
Vegetative Communities & Hydrology
August 2016
CU Property



0 400 800 feet



Figure 11
Preliminary Viewshed Analysis
August 2016
CU Property

4 Next steps

The following potential action items are suggested as next steps to refine and finalize this conservation suitability analysis and incorporate the findings into the decision-making process.

Collect and Synthesize Stakeholder Comments

The public and city and Boulder County boards and commissions will have opportunities to review and comment in September. Additionally, city and CU staff may have additional comments and questions for consideration in future analyses.

Revise Conservation Suitability Mapping

Depending on the nature and extent of the comments received during outreach efforts, it may be desirable to re-run the GIS analysis to adjust certain inputs and compare to the original output. For example, adding new criteria such as the potential for wetland mitigation or restoration potential could be useful. Additionally, the current qualitative analyses of habitat connectivity could be made quantitative, for example, by incorporating a layer showing buffers around tracked plant community resources found on adjoining properties (monitored by the Colorado Natural Heritage Program and OSMP). Finally, additional qualitative analyses based on viewsheds may be developed based on stakeholder input.

Integrate Comments and Additional Suitability Analyses for Transportation and Services

Environmental considerations for conservation are only a subset of the issues that the city and CU are evaluating. Other suitability analyses of transportation and city services are being conducted separately.

Collaborate with Flood Control Design Process

The current analysis of the property allows the quantification of acres of the site with various ranking values (1-8) to be tallied. By overlaying the proposed floodplain mitigation features (berm, fill, detention basin), it would be possible to quantify the areas of various ranked areas that will be impacted. Similarly, as the design engineers consider variations of the layout, it will be possible to compare the impacts to select a layout that maintains the most ecological function.

Inform Land Use Changes and Agreements

As noted in the introduction of this report, while the BVCP was updated multiple times between 200-2015, land use designations of CU South did not change during either of those updates. The BVCP is currently being updated and land use designations of the parcel are expected to change in part to accommodate the mitigation for South Boulder Creek flood earthwork on the site and to address CU's long term planning needs and other community goals. This update will be done with input from the City of Boulder, CU, and the public to determine the most appropriate updates to land use designations, and this suitability study can help inform agreements between the city and CU about future development and conservation of the site.

References

CH2MHill. 2015. Final South Boulder Creek Major Drainageway Plan – Alternatives Analysis Report.

City of Boulder Open Space and Mountain Parks. 2010. Grassland Ecosystem Management Plan.

City of Boulder Open Space and Mountain Parks (no date). US 36 Mobility Project: 4(F) Eligibility Recommendations.

ERO Resources Corp. 2013. University of Colorado South Campus (Deep Farm and Turnpike Properties) Wetland Delineation Report, Boulder County, Colorado.

Moore , DA,,, AW Straub, ME Berry, ML Baker, and TR Brandt. 2001. Geologic map of the Denver 1x2 degree quadrangle, northeast Colorado. US Geological Survey, Denver CO.

Shapins Associates, Inc., Washington Infrastructure, Inc., Matrix Design Group, Inc., and Love & Associates, Inc. 2002. CU-Boulder South: Conceptual Land Use Assessment.

USDA Forest Service. 1995. Landscape Aesthetics: A Handbook for Scenery Management. Agriculture Handbook Number 701.

Attachments

Table A-1. List of viewshed features

Immediate View (0-300')	Foreground View (300'-1 mi)	Middle Ground (1-4 mi)	Background (4 mi-horizon)
<ul style="list-style-type: none"> • Sounds of water • View in shady spot across open sunny area • Accessibility over wetland, e.g., boardwalk crossing • No dirt road visible 	<ul style="list-style-type: none"> • Mixed grassland with shrubs • Two-track road/trail • Native plants/meadow fields • Diverse plant palette • Rural/agricultural fields • Trees line long views • Mature trees • Unimpeded view across open water • Unimpeded view across wetland/seep 	<ul style="list-style-type: none"> • Some distant views visible 	<ul style="list-style-type: none"> • Mountains partially visible on horizon • Unimpeded view of mountains • Wide Views

Table A-2. Bird species observed on the CU South property, 2011-2016.

Species	Status				Habitat Associate			Where observed							Status Notes	
	Resident Breeder	Migrant	Neotropical Migrant	Generalist	Wetland	Grassland	Riparian	N. Ponds	Non-Native Grassland (N)	Non-Native Grassland (S)	W. Mosaic	Inner Perimeter	Outer Perimeter	S. Wetlands		
American Bittern	X	X			X										X	The Southern Wetlands cattail marshes are a well-known location for American Bitterns if the water level is appropriate
American Crow				X												
American Goldfinch	X			X			X	X	X	X	X	X	X	X	X	
American Kestrel	X	X				X	X	X	X	X	X	X	X	X	X	
American Pipit		X														
American Robin	X			X			X	X	X	X	X	X	X	X	X	
American White Pelican		X														
American Wigeon		X			X			X								
Bank Swallow		X	X		X											
Barn Swallow	X	X	X	X	X	X		X	X	X	X	X	X	X	X	
Belted Kingfisher					X			X								
Black-billed Magpie	X			X												
Black-capped Chickadee	X			X							X	X	X	X		
Black-chinned Hummingbird	X	X	X				X				X	X	X	X		
Black-throated Sparrow		X							X							One sighting 4-22-11
Blue Grosbeak	X	X	X			X			X	X	X	X	X			
Blue Jay	X			X			X				X		X			
Blue-gray Gnatcatcher		X	X				X				X					
Brewer's Sparrow		X				X				X	X					
Broad-tailed Hummingbird		X	X								X					
Brown-headed Cowbird	X	X		X							X		X			
Bufflehead		X			X			X								

Species	Status				Habitat Associate			Where observed							Status Notes
	Resident Breeder	Migrant	Neotropical Migrant	Generalist	Wetland	Grassland	Riparian	N. Ponds	Non-Native Grassland (N)	Non-Native Grassland (S)	W. Mosaic	Inner Perimeter	Outer Perimeter	S. Wetlands	
Bullock's Oriole	X	X	X		X		X	X			X		X	X	
Canada Goose	X	X		X	X			X							
Cassin's Kingbird		X	X							X					
Cedar Waxwing	X	X					X				X		X	X	
Chipping Sparrow		X		X					X	X	X		X		
Cliff Swallow		X		X					X	X	X				
Common Grackle	X	X		X				X	X	X	X	X	X	X	
Common Nighthawk	X	X	X			X			X	X			X		
Common Raven				X											
Common Yellowthroat	X	X	X		X							X	X	X	nest in cattail stands in ditches and ponds
Cooper's Hawk				X			X			X	X		X		
Dark-eyed Junco		X		X				X	X	X	X				
Dickcissel	X	X	X			X				X		X			several singing males in the area in 2012
Downy Woodpecker	X			X							X		X		
Eastern Kingbird	X	X	X					X	X			X	X		
Eurasian Collared-Dove	X			X											
European Starling	X			X											
Gadwall		X			X			X							
Grasshopper Sparrow	X	X	X			X				X					singing males in the southern grassland one summer
Gray Catbird		X	X				X				X				
Gray Flycatcher		X	X								X				one individual in April 2011
Great Blue Heron		X			X			X							
Greater Yellowlegs		X	X		X			X							
Green-tailed Towhee		X	X								X				

Species	Status				Habitat Associate			Where observed							Status Notes
	Resident Breeder	Migrant	Neotropical Migrant	Generalist	Wetland	Grassland	Riparian	N. Ponds	Non-Native Grassland (N)	Non-Native Grassland (S)	W. Mosaic	Inner Perimeter	Outer Perimeter	S. Wetlands	
Harris's Sparrow		X									X				
Hermit Thrush		X	X										X		
Horned Lark		X				X				X					
House Finch	X			X				X	X	X	X	X	X		
House Sparrow	X			X											
House Wren	X	X	X								X		X		
Killdeer	X	X	X		X			X	X	X					
Lark Sparrow	X	X				X			X	X	X				
Lazuli Bunting		X	X									X	X		
Least Flycatcher		X	X								X				
Lesser Goldfinch	X	X	X	X				X	X	X	X		X	X	
Lesser Yellowlegs		X	X		X			X							
Lincoln's Sparrow		X	X								X	X	X	X	
Loggerhead Shrike		X				X				X					
Mallard	X	X			X			X							
Merlin		X									X				
Mountain Bluebird		X							X	X					
Mountain Chickadee		X									X				
Mourning Dove	X	X		X				X	X	X	X	X	X	X	
Northern Flicker	X			X				X			X		X		
Northern Rough-winged Swallow															
Northern Shrike		X									X				
Orange-crowned Warbler		X									X				
Osprey		X						X							

Species	Status				Habitat Associate			Where observed							Status Notes
	Resident Breeder	Migrant	Neotropical Migrant	Generalist	Wetland	Grassland	Riparian	N. Ponds	Non-Native Grassland (N)	Non-Native Grassland (S)	W. Mosaic	Inner Perimeter	Outer Perimeter	S. Wetlands	
Red-tailed Hawk	X	X		X			X	X	X	X			X		
Red-winged Blackbird	X	X			X			X			X			X	
Ring-billed Gull		X						X							
Ring-necked Duck		X			X			X							
Rock Pigeon	X			X											
Ruby-crowned Kinglet		X									X				
Savannah Sparrow	X	X	X			X		X		X		X	X	X	
Say's Phoebe	X	X	X					X	X	X	X				
Sharp-shinned Hawk		X									X				
Solitary Sandpiper		X			X			X							
Song Sparrow	X	X			X			X		X	X			X	
Sora	X	X			X									X	
Spotted Towhee		X									X				
Swainson's Thrush		X	X										X		
Tree Swallow		X	X					X							
Turkey Vulture		X	X						X	X					
Vesper Sparrow	X	X				X		X	X	X	X	X	X		
Virginia Rail	X	X			X									X	
Warbling Vireo	X	X	X				X						X	X	
Western Kingbird	X	X	X					X	X	X	X	X	X	X	
Western Meadowlark	X	X				X			X	X		X			
Western Tanager		X	X								X		X		
Western Wood-Pewee		X	X								X		X		
White-breasted Nuthatch	X						X				X		X		

Species	Status				Habitat Associate			Where observed						Status Notes	
	Resident Breeder	Migrant	Neotropical Migrant	Generalist	Wetland	Grassland	Riparian	N. Ponds	Non-Native Grassland (N)	Non-Native Grassland (S)	W. Mosaic	Inner Perimeter	Outer Perimeter		S. Wetlands
White-crowned Sparrow		X									X				
White-throated Swift		X							X	X					
Wilson's Snipe	X	X			X			X			X	X		X	
Wilson's Warbler		X	X								X				
Wood Duck		X			X			X							
Yellow Warbler	X	X	X				X				X		X	X	
Yellow-rumped Warbler		X	X					X			X		X		