ENGINEERING STUDY
for
SHADOW MOUNTAIN BIKE PARK
CONCEPT MASTER PLAN
WATER SYSTEM IMPROVEMENTS

Prepared For:

Colorado State Land Board
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******APPENDICES******

******LIST OF FIGURES******

Section 1
EXECUTIVE SUMMARY

This report presents the results of the engineering study for water system improvements serving Shadow Mountain Bike Park proposed on State Land Board Shadow Mountain parcels in Jefferson County, Colorado. Shadow Mountain Bike Park is proposed on undeveloped property with a designated address of 29611 Shadow Mountain Drive, Conifer, Colorado 80433.

The proposed parcel currently has no water facilities on site. Shadow Mountain Bike Park proposes construction of a minimum of one water well to provide potable water to the site facilities through a private water system.

Shadow Mountain Bike Park facilities will consist of a Base Lodge operating as a Class III Recreation facility to welcome guests and provide basic needs such as welcoming center including drinking water and restrooms.

The average annual water demand for Shadow Mountain Bike Park is estimated to be 1.57 acre-feet of water per year. Average day usage is estimated to be approximately 1400 gpd or 0.97 gpm. This water will be provided by water wells as permitted by the Colorado State Engineers Office.

To meet Drinking Water Standards water will be filtered (if required) and disinfected prior to storage and will meet Colorado Department of Health and Environment Drinking Water Standards.

Fire Protection is provided by the Elk Creek Fire Protection District. Discussions with District Representatives indicate that they will require on-site fire protection that can provide 1500 gpm for 2 hours. To meet this requirement onsite Fire Storage will need to be 180,000 gallons exclusive of storage required for domestic use. This storage will be provided in a separate Fire Storage only ground storage tank; fire flow will be conveyed to the site through a fire flow distribution system to on-site fire hydrants.

Section 2
INTRODUCTION

2.1 Purpose

The purpose of this report is to present water system improvements recommended to serve Shadow Mountain Bike Park; a proposed recreational development project located in Jefferson County. It is also intended to serve as a guideline for the ensuing design of recommended improvements.

2.2 Scope

The scope of this report includes:

1. The definition of the service areas as well as identification of significant physical and environmental characteristics and constraints.

2. An analysis of available data to determine existing and to project future water supplies, demands and quality.

3. A description of legal, institutional and managerial arrangements that ensure adequate control of the proposed improvements; and,

4. A preliminary recommendation for a selected supply, treatment, pumping and transmission alternatives.

Section 3
EXISTING CONDITIONS

3.1 Description of the Service Area

Shadow Mountain Bike Park consists of approximately 235 acres of Base Lodge (10 acres +/-) and open space uses and is located northwest of Conifer, Colorado, within Township 6 South, Range 71 West, Section 16.

3.2 Land Use

Shadow Mountain Bike Park is in Jefferson County northwest of Conifer, Colorado and about 35 miles southwest of the Denver Metroplex. Surrounding areas are primarily large tract residential properties and large undeveloped tracts.

3.3 Topography and Floodplains

The topography of the service area is typical of a Colorado Front Range Mountain parcel with elevations ranging from 8400 ft. to 9250 ft. above sea level. Existing slopes range from 5% at base camp to 25% or greater in some areas. Vegetation is typical Colorado mountain woodlands with a mix of Ponderosa Pine, Spruce, Fir and ground cover plants and grasses. The area drains generally northeast to North Turkey Creek.

There is no Federal Emergency Management Agency (FEMA 08059CO365F) established floodplain within the boundaries of Shadow Mountain Bike Park. See Appendix A.

3.4 Geology

The site is comprised of several different soil types. From the NRCS Soil Survey of Jefferson County, the site falls into the following soil types:

1.“67” Kittredge-Earcree, 9 to 20 percent slopes; Type A Soil
2.“76” Legault-Hiwan stony loamy sands, 15 to 30 percent slopes; Type D Soil
3.“77” Legault-Hiwan-Rock outcrop complex, 30 to 50 percent slopes; Type D Soil
4.“138” Rock outcrop, igneous and metamorphic; Type D Soil
5.“141” Rogert, very stony-Herbman-Rock outcrop complex, 30 to 70 percent slopes; Type D Soil
Note: “#” indicates Soil Conservation Survey soil classification number.

3.5 Groundwater

The proposed water supply for the Shadow Mountain Bike Park is an onsite water well. The applicant has been in discussion with the State Engineers Office concerning a well permit for the site including the type of permit and the uses permitted to ensure proper permitting. There are numerous wells in the area and discussions with the State indicate issuance of a permit could be made based on water rights associated with the property without injury to adjacent water rights.

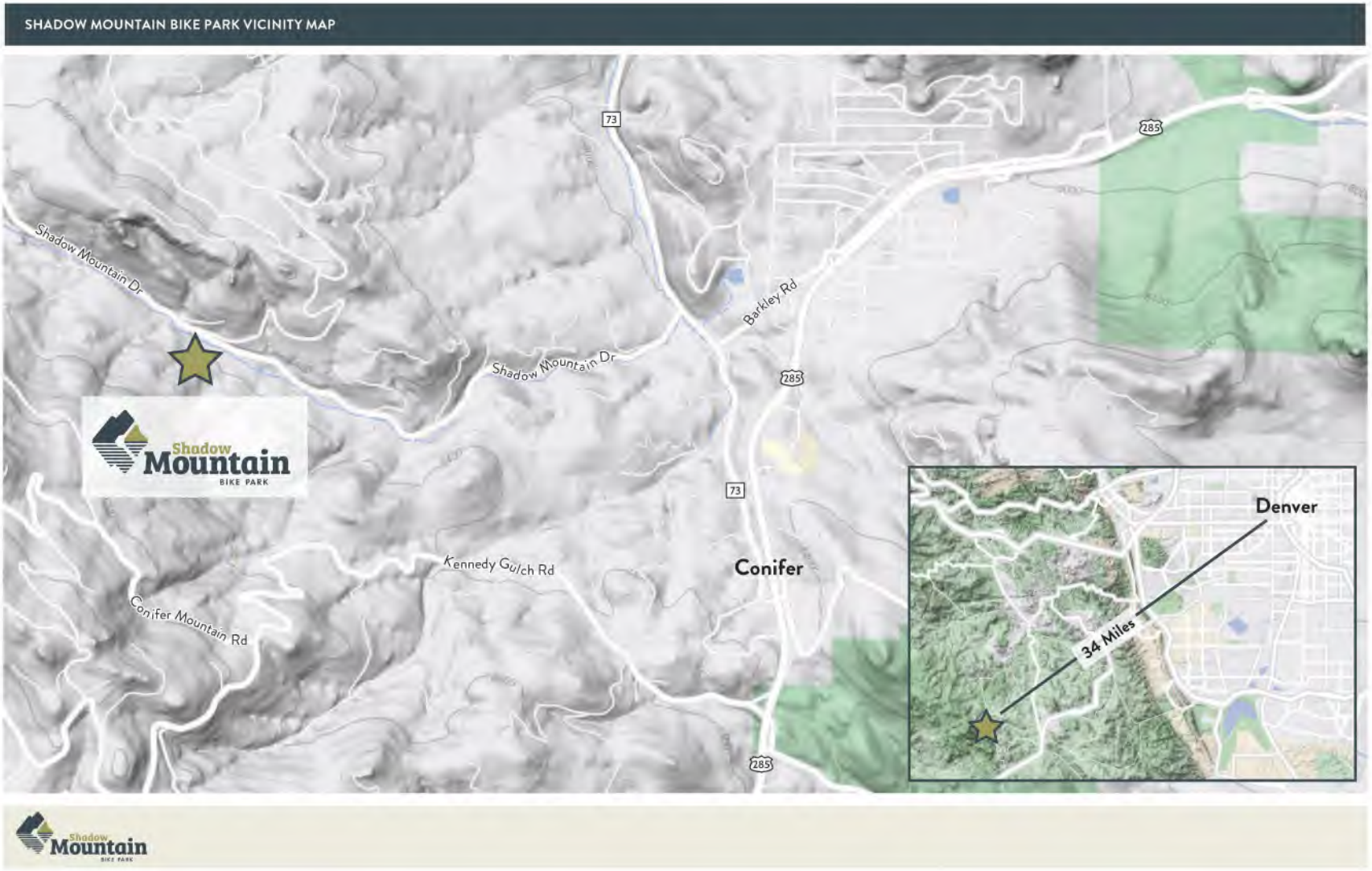


Figure 1: Vicinity Map

3.6 Climate

The climate of the study area is characterized by mild summers and moderately severe winters, moderate precipitation, high evaporation, and moderately high wind velocities.

The average annual monthly temperature is 43.5 F with an average monthly low of 10.3 F in the winter and an average monthly high of 76.1 F in the summer.

Precipitation averages 17.3 inches annually, with 50% of this falling as snow. August is the wettest month and January is the driest. The average annual Class A pan evaporation is 45 inches.

3.7 Natural Hazards Analysis

Natural hazards analysis indicates that no unusual surface or subsurface hazards are located in the service area. However, because the soils are cohesionless, sloughing of steep banks during drilling and/or excavation could occur. By siting improvements in a manner that provides an opportunity to lay the banks of excavations back at a 1:1 slope during construction, the problems associated with sloughing soils can be minimized.

3.8 Organizational Context

Shadow Mountain Bike Park is situated within the North Turkey Creek basin of Jefferson County. The closest public water supplier would be Mountain Water and Sanitation District in Conifer, Colorado. The distance and topography to Conifer in general is cost prohibitive in terms of a water supplier for the bike park.

The amount of water required for the facility and the distance to other providers makes an onsite private water system the best for meeting on-site demands. The Mountain Shadow Bike Park will be the entity responsible to finance, construct and ensure the continuing operation and maintenance of improvements.

3.9 Water Facilities

The proposed water system will consist of a minimum of one water well onsite and water treatment and disinfection based on source water conditions and Colorado Department of Health and Environment requirements. In addition, there will be a 6-inch water transmission line from the water well to the storage tank. Water will be stored to provide peak hour demand and fire sprinkler water for the onsite Base Lodge.

3.10 Relationship to Neighboring Water and Wastewater Facilities

Mountain Water and Sanitation District near Conifer, Colorado is the closest potential provider of water and wastewater facilities. The distance and topography between the site and the town make any connection cost prohibitive.

3.11 Water Demand

The Shadow Mountain Bike Park recreational development will be serviced by a private water system constructed by the developer of the bike park. The projected water demand for the facility is calculated in Section 4.3 Water Demand based on uses recorded at other Bike Park facilities.

Section 4
DEVELOPED CONDITIONS

4.1 Land Use

Mountain Shadow Bike Park consists of approximately 235 acres of State Land Board undeveloped property. Most of the site will be left undeveloped except for the addition of Bike Trails, a bike lift and development of approximately 10 acres for a base lodge including one building for welcoming, ticketing, water facilities and restrooms.

Assumptions: Employees water usage is estimated to be 10 gallons per day (gpd)
Guest Water Usage is estimated to be 4 gpd
Irrigation will be minimal or not required with xeriscape or extensions of the natural surroundings.

4.2 Population and Employment

The applicant estimates that there will be 20 onsite employees in a given day. The average day guest population is estimated to be 300.

4.3 Water Demand

Water demand is estimated to be as follows:

Employees	20 x 10 gpd =	200 gpd
Guests	300 x 4 gpd =	1200 gpd
	Total =	1400 gpd =511,000 gallons/year =1.57 ac-ft/year

Unit water demands are based on the applicants' experience at other similar facilities.

Water demand is calculated in acre-feet per year (AFY) to determine water supply needs. This value is then factored to determine the average daily demand (ADD) in gallons per minute (gpm), which is used to project maximum day and peak hour demands as well as to estimate revenues and operating costs. Maximum day demand (MDD) and peak hour demand (PHD) have been determined by applying accepted peaking factors of 2.5 and 4.0 to the ADD, respectively. The MDD is used to determine storage needs and the PHD is used for modeling system delivery pressures and to size distribution piping.

Demand	
Ac-Ft/Year =	1.57
Gallons/day=	1400
ADD gpm=	0.97
MDD gpm=	2.43
PHD gpm=	3.8

Estimated Building Sprinkler demand is 20 gpm for 2 hours or 2400 gallons.

4.4 Water Supply

The proposed water supply for the Shadow Mountain Bike Park is an onsite water well. The applicant has been in discussion with the State Engineers Office concerning a well permit for the site including the type of permit and the uses permitted to ensure proper permitting. There are numerous wells in the area and discussions with the State indicate issuance of a permit could be made based on water rights associated with the property without injury to adjacent water rights. Most of the wells in the area range between 350 ft to over 600 ft. in depth. The nearby wells all indicate access to an "unnamed" aquifer and are all located in a "non-designated" basin.

Based on information from adjacent properties we would anticipate construction and completion of a water well between 500 and 600 ft. in depth in an unnamed aquifer.

The water well permit should be for a well capable of producing at a minimum the anticipated Peak Hour Demand and overall, yearly withdraw limits should exceed 2 ac-ft (651,657 gallon) annually.

4.5 Water Quality

The water quality and any mitigation required will be determined after construction of the well based on the permit obtained from the State Engineers Office. Mitigation anticipated may include filtering and disinfection. Anticipated treatments expected would be easily obtained with standard readily available locally provided treatment and disinfection equipment.

4.5 Fire Flow

Fire Protection is provided by the Elk Creek Fire Protection District. Discussions with District Representatives indicate that they will require on-site fire protection that can provide 1500 gpm for 2 hours. To meet this requirement onsite Fire Storage will need to be 180,000 gallons exclusive of storage required for domestic use.

In most domestic water systems, the Fire Storage component is 20 to 30% of the overall storage requirement. In this case the Fire Storage component is 92%. Storing water for long periods of time can lead to water quality issues primarily related to taste. Because of this concern, the domestic storage and the fire storage will likely need to be separated.

Fire Storage can be addressed in one of two ways and evaluation of the best alternative will need to continue through the Design Phase to determine the most economical and efficient system.

<u>Ground Storage or Cistern with a Fire Pump</u>

This system would require a 180,000-ground storage tank approximately 30 feet in diameter and approximately 30 feet tall. Or alternatively a below grade 180,000 gallon cistern approximately 50 feet x 50 feet x 10 feet deep. Along with the storage there would be a requirement to install a 1500 gpm fire pump to deliver water at 20 psi. This type fire pump would require a 25 HP motor. Included with the design would be a backup generator and fuel storage to provide electricity to the pump if the power failed during a fire.

<u>Ground storage/elevated Fire Storage.</u>

This system would require a 180,000-gallon storage tank approximately 30 feet in diameter and 30 feet tall located at an elevation approximately 50 feet higher than the facility. No fire pump or backup generator

would be required, but approximately 2100 feet of transmission pipe would be required to convey water from the site to the tank.

In both cases some pipe would need to be located around the site to distribute to fire hydrant locations (2 maximum).

It would take a 10 gpm well approximately 12.5 days to fill the fire storage tank.

Some type of disinfection and/or aeriation may be required in either system to prevent growth of bacteria that could interfere with the distribution of fire flow.

Evaluation of the two potential fire storage options will continue with final design. However, in order to avoid the expense of a large fire pump and backup generator and to use the advantage of gravity flow this report will assume the use of the second option; a ground storage elevated tank.

Section 5
WATER SYSTEM IMPROVEMENTS

5.1 General

The water system would be operated by the Shadow Mountain Bike Park and would be classified as a private water system and would be operated to meet the applicable requirements of the Colorado Department of Health and Environment (CDHE). The system may be operated by a third party contracted by Shadow Mountain Bike Park and licensed by the State of Colorado.

Filtration and disinfection facilities provide treatment of the raw water sources to ensure good water quality. In addition, storage facilities and distribution piping will be provided to ensure that residual pressure requirements are achieved both during peak hour demands and during maximum day demands. The system will also by designed to deliver the required fire sprinkler water to the onsite building.

5.2 Groundwater Wells

The proposed water supply for the Shadow Mountain Bike Park is an onsite water well. As mentioned previously, the applicant has been in contact with the State Engineers Office concerning the parameters of a permit.

The water well permit should be for a well capable of producing at a minimum the anticipated Peak Hour Demand and overall, yearly withdraw limit should exceed 2 ac-ft annually.

The well will be equipped with a submersible well pump capable of delivering in excess of the Peak Hour Demand of 3.8 gpm. The well pump would be designed to deliver water to the domestic storage tank and fire tank.

5.3 Water Treatment

Treating and filtering of the water sources will meet CDHE Drinking Water Standards.

In addition, CDHE standards require that the water supply be disinfected and that the supply receives minimum chlorine contact time of 30 minutes before first use.

5.4 Storage

Storage reservoirs will be ground mounted and elevated steel tanks designed in accordance with CDHE and AWWA Standards.

Potable Water Storage is sized to provide a minimum of 30% of maximum day demand. Required storage is calculated as follows:

Maximum Day Demand is 3.8 gpm. 3.8 x 60 x 24 = 5,472 gallons

Estimated Storage Requirement = 5,472 gallons say 7,500 gallons

Tank size could be doubled to allow for special events. Normal operation would be between 5000 and 7500 gallons. Actual storage requirements and operational characteristics will be addressed as final design proceeds.

Fire Demand Storage will be 180,000 gallons as stated in section **4.5 Fire Flow**. Water stored for fire flow will not be considered potable due to disinfection required to maintain functional fire flow storage for long periods of time without use.

5.5 Distribution

The water distribution system provides water at a maximum static pressure of 45 psi during periods of low use and at a minimum residual pressure of 40 psi during peak hour demand. The storage tank will be located at an elevation sufficient to meet these pressure requirements along with associated distribution and conveyance piping. Anticipated transmission and distribution piping is 6-inch.

Fire flow will be conveyed in its own distribution system to 2 fire hydrants located with the fire district input around the site near the building during final design. Each fire hydrant will be capable of conveying 1500 gpm at a minimum pressure of 20 psi. The anticipated fire system piping will be 6-inch minimum diameter.

5.6 Estimated Costs

Estimated Costs

Item	Units	Quantity	Unit Price	Extension
Shadow Mountain Bike Park				
Water Well	LS	1	$50,000	$50,000
Well Pump and Controls	LS	1	$15,000	$15,000
Potable Water Transmission	LF	5,800	$35	$203,000
Potable Storage	Gallons	15,000	$3	$45,000
Fire Storage Transmission	LF	2,500	$35	$87,500
Fire Storage	Gallons	180,000	$2	$360,000
Treatment	LS	1	$40,000	$40,000
Total Estimated Cost				*$800,500*

The above system improvements are all constructed as part of Shadow Mountain Bike Park. These costs do not include other costs or gains that may be incurred in the acquisition of land, financing, investment, local distribution, the salvage value of equipment or other necessary infrastructure, among others, unless specifically noted. The above costs are estimated, actual costs may differ depending upon numerous factors including supply chain, and cost increases at time of bidding.

5.7 Rates and Charges

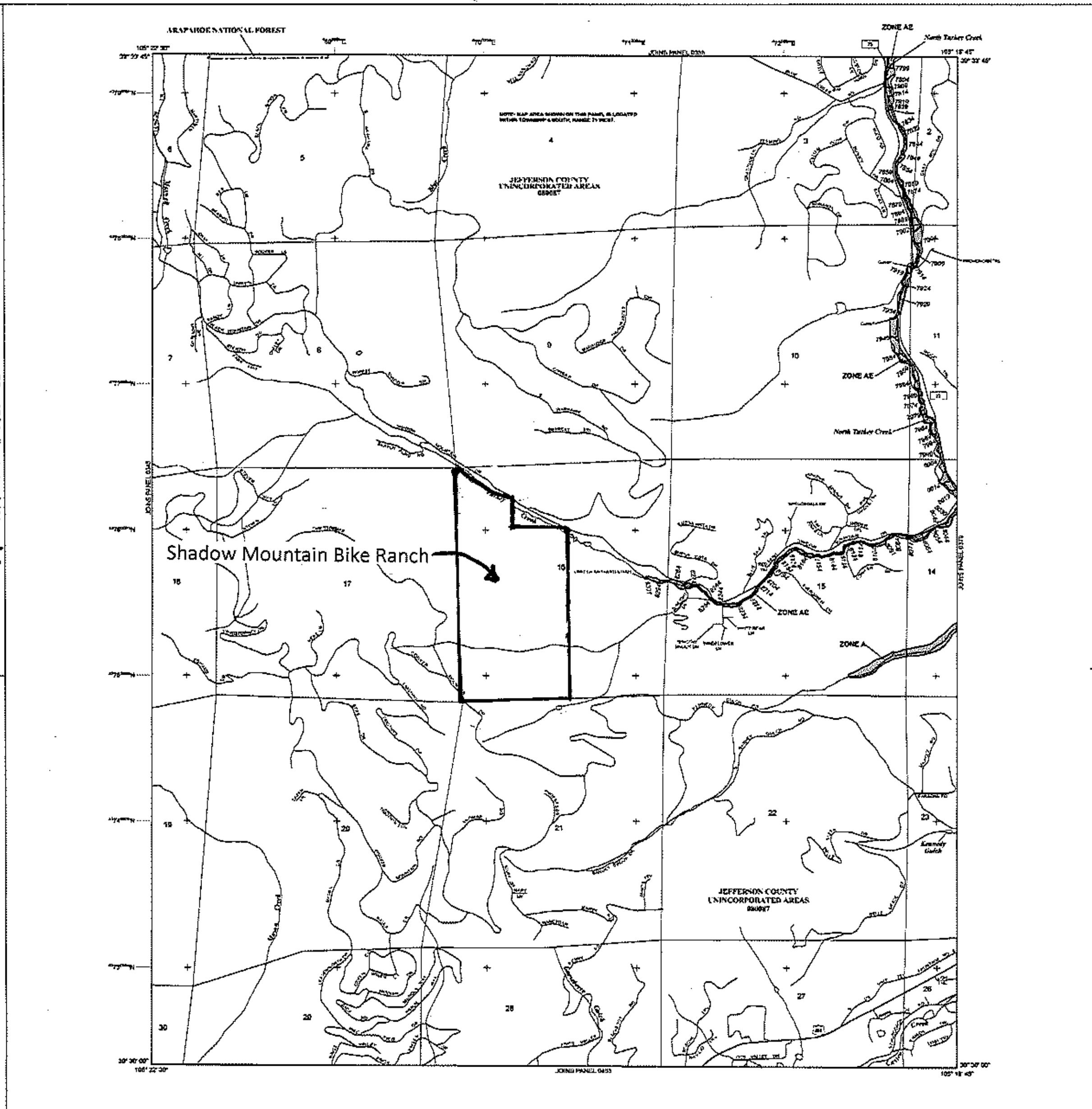
The waters system will be operated within the overall operation of the Shadow Mountain Bike Park through user fees charged to guests for the recreational facility.

Appendix A

100 Year Flood Plain Certification

NOTES TO USERS

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242



LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

ZONE A
ZONE AE
ZONE AH
ZONE AO
ZONE AR
ZONE A99
ZONE V
ZONE VE

FLOODWAY AREAS IN ZONE AE

OTHER FLOOD AREAS

ZONE X

OTHER AREAS

ZONE X
ZONE D

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

MAP SCALE 1" = 1000'

PANEL 0365F

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP

JEFFERSON COUNTY, COLORADO
AND INCORPORATED AREAS

PANEL 365 OF 875
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

MAP NUMBER
08059C0365F
MAP REVISED
FEBRUARY 5, 2014

Federal Emergency Management Agency

Appendix B

Water System Improvements

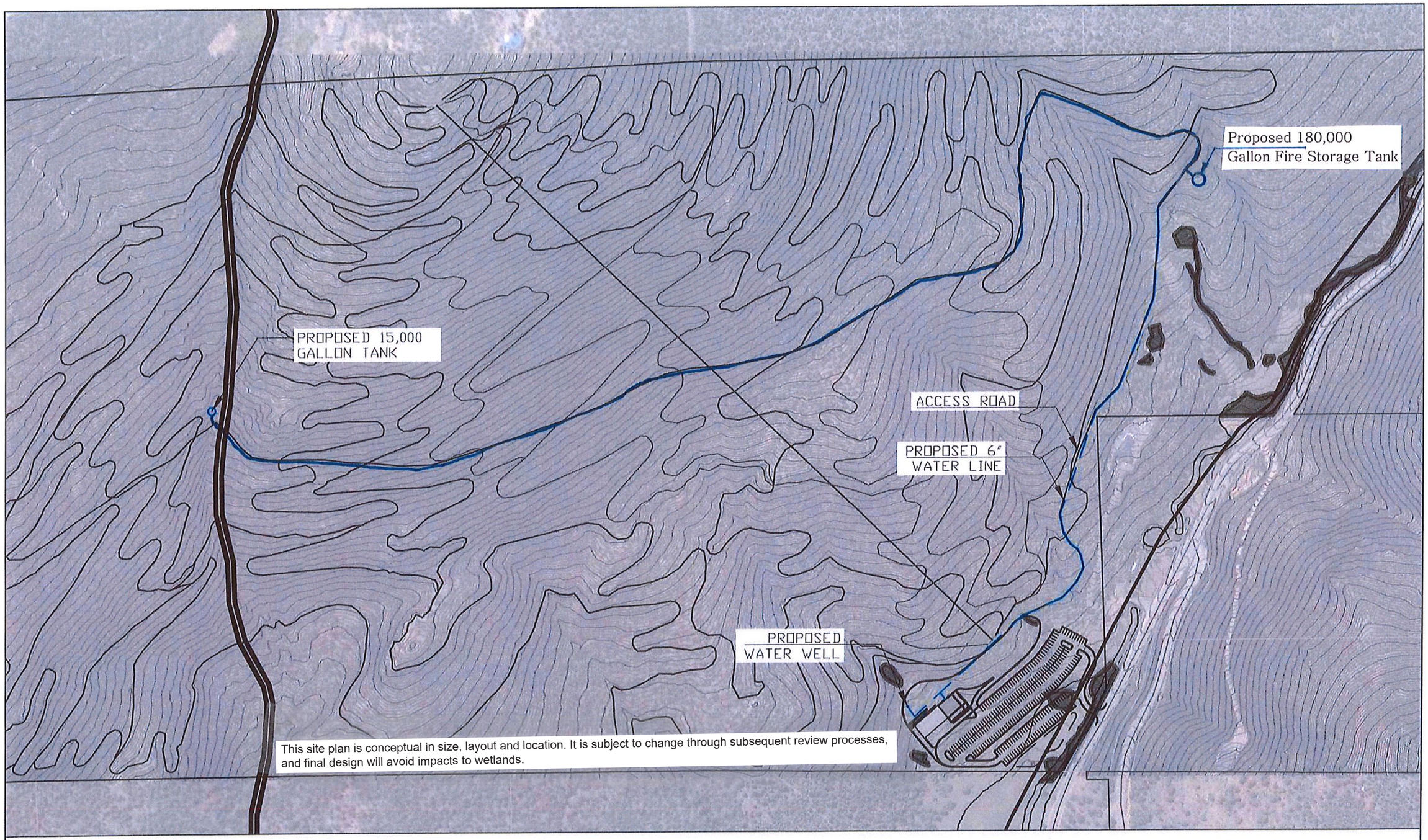
Stantec
2000 S COLORADO BLVD
SUITE 300
DENVER, CO 80222

WATER SYSTEM SITE DRAWING (A)

SHADOW MOUNTAIN BIKE PARK

SCALE: 1"=60'

N



Stantec
2000 S COLORADO BLVD
SUITE 300
DENVER, CO 80222

WATER SYSTEM SITE DRAWING (B)

SHADOW MOUNTAIN BIKE PARK

SCALE: 1"=300'

N