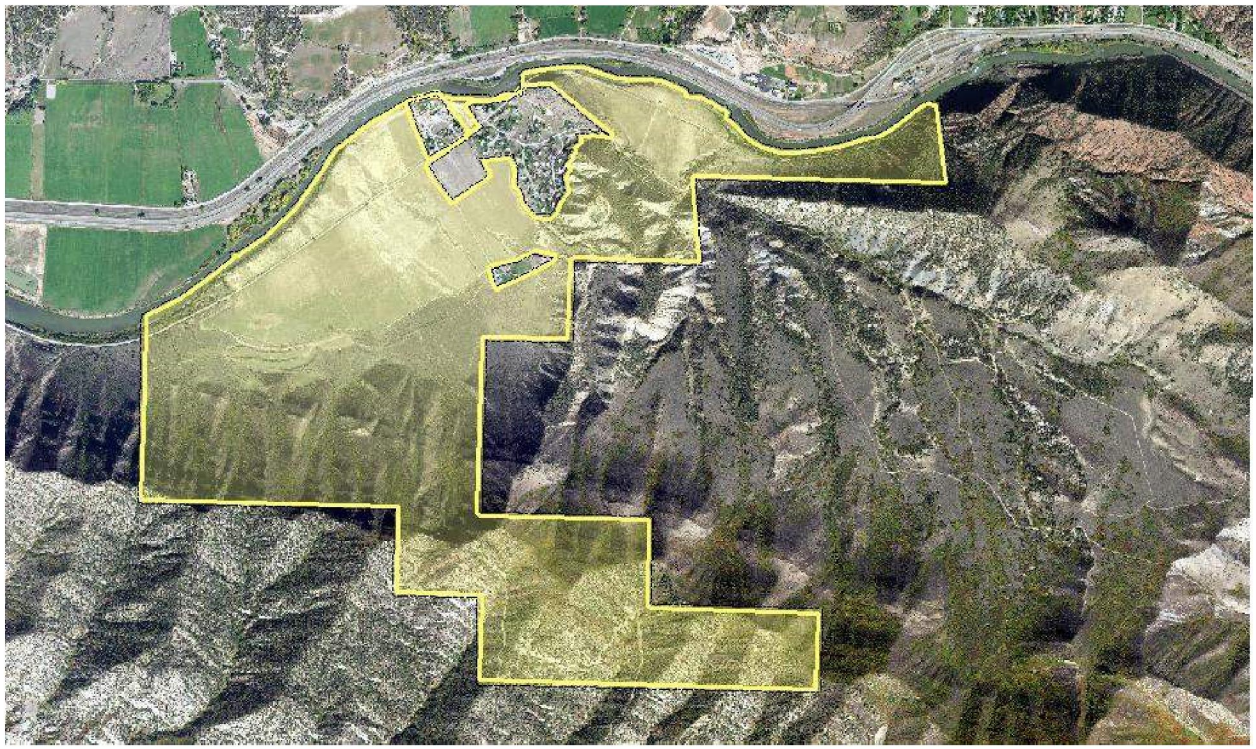
# WATER ADEQUACY REPORT FOR PROPOSED DEVELOPMENT

## NUTRIENT FARM



September 2020

**Prepared by**

SGM

118 West Sixth Street, Suite 200
Glenwood Springs, CO 81601
970.945.1004
970.945.5948 fax

# WATER ADEQUACY REPORT FOR PROPOSED DEVELOPMENT

## NUTRIENT FARM

PREPARED BY

BAILEY LEPPEK, P.E.

**REVIEWED BY**

**BRENDON LANGENHUIZEN, P.E.**

SGM Project # 2018-271.002

I:\2018\2018-271-RIVERBENDRCH\002- PUDAMENDMENT\E-REPORTS\SGM\SUPPLYADEQUACY

# Table of Contents

1.0 Introduction ..... 1
2.0 Project Location, Description, and Background ..... 1
2.1 Project Location ..... 1
2.2 Background and History of Riverbend Development ..... 1
2.3 Water Rights Background and History ..... 2
2.4 Planned Land Use Areas ..... 3
2.4.1 Water supply from connection to Riverbend HOA System ..... 3
2.4.2 Water supply from Vulcan Ditch ..... 3
2.4.3 Water supply from New Exempt Well ..... 3
3.0 Estimated Water Demands ..... 7
3.1 Potable Indoor Demands ..... 8
3.2 Outdoor Demands ..... 12
3.2.1 Unit Consumptive Use ..... 12
3.2.2 Outdoor Use Efficiency ..... 13
3.2.3 Irrigated Area, Pond Area, and Number of Livestock ..... 15
3.3 Fire Flow ..... 16
3.4 Water Conservation Measures ..... 17
4.0 Water Quantity ..... 17
4.1 Legal Supply ..... 17
4.1.1 Vulcan Ditch Legal Supply ..... 17
4.1.2 Riverbend System Legal Supply ..... 19
4.2 Physical Water Supply ..... 21
4.2.1 Vulcan Ditch Physical Water Supply ..... 21
4.2.2 Riverbend System Physical Supply ..... 26
5.0 Water Quality ..... 26
5.1 Water Supply Quality ..... 27
6.0 Summary of Findings ..... 28
6.1 Conclusions ..... 28
7.0 References ..... 31

# Table of Tables

Table 2-1: Overview of Planned Uses for Nutrient Farm Areas 1 - 8 ..... 4
Table 3-1: Nutrient Farm Buildout Demand Summary ..... 7
Table 3-2: Potable Indoor Demands Served by New Exempt Well (Area 5) ..... 9
Table 3-3: Potable Indoor Demands Served by Riverbend System (Areas 1, 3, 4) ..... 9
Table 3-4: Potable Indoor Demands Served by Treated Vulcan Ditch Water (Areas 2, 5, 6, 7, & 8) ..... 10
Table 3-5: Outdoor Demands Served by Riverbend System (Areas 1, 3, 4) ..... 12
Table 3-6: Non-Potable (Outdoor) Demands Served by Vulcan Ditch (Areas 2, 5, 6, 7, & 8) ..... 12
Table 4-1: Vulcan Ditch Water Rights Summary ..... 18

# Table of Figures

Figure 2-1: Nutrient Farm Water Rights Location Map ..... 5
Figure 2-2: Nutrient Farm Planned Land Use Areas Map ..... 6
Figure 4-1: Canyon Creek Physical and Legal Supply Map ..... 20
Figure 4-2: Canyon Creek Stream Flow Analysis Above Vulcan Ditch Headgate ..... 23
Figure 4-3: Colorado River Streamflow Analysis ..... 25

# 1.0 Introduction

SGM was engaged by Nutrient Holdings, LLC to complete a water supply adequacy report for the proposed development plans for the Nutrient Farm (Farm) property along the south bank of the Colorado River in Garfield County between the towns of New Castle and Glenwood Springs. The Farm is located approximately 2 miles east of New Castle, Colorado along Colorado River Road (County Road 335). The Farm is bordered on the north by the Colorado River and on the south by the steep hillsides of Coal Ridge, part of the Grand Hogback. The Riverbend Homeowners' Association (HOA) is located between the Farm and the Colorado River.

The Farm is mostly undeveloped except for one ranch house and historical irrigation ditches. The proposed development includes limited residential development, an existing ranch house, a working farm with irrigated crops and livestock, several farm-related tourism businesses (such as a farm store, adventure farm, and a u-pick orchard), commercial and professional buildings, several other tourist attractions (such as an off-road adventure park, campground, water pond park, music and performing arts venues, and a retreat), and open spaces.

This water supply adequacy assessment presents a summary of SGM's investigation of the water supply along with SGM's estimated water demands for the Farm.

# 2.0 Project Location, Description, and Background

## 2.1 Project Location

The entire Farm property covers approximately 1,140 acres (1.8 square miles). Of the total area, approximately 640 acres (1 square mile) is hilly terrain along Coal Ridge with sparse sage and scrubland cover, which is currently planned as open space. The Vulcan Ditch cuts through the property, with historically irrigated hay fields sloping gently from the ditch toward the Colorado River. **Figure 2-1** is an overview of the Farm location and associated water rights.

## 2.2 Background and History of Riverbend Development

The first Sketch Plan for the Riverbend planned unit development (PUD) was reviewed and approved by the Board of Garfield County Commissioners on June 26, 1973. This first plan was for a 617 residential dwelling unit community, including an outdoor education center, riding stables, open space, pasture, and a demonstration cattle ranch. A Preliminary Plat for that first plan was reviewed and approved by the Planning Commission on January 14, 1974. After this approval, the County adopted new zoning regulations, which mandated that later changes to the plan included a formal PUD zone change.

The second iteration of the PUD was documented in the Preliminary Map of the Riverbend Planned Unit Development dated August 1976. The August 1976 Map showed the 1,180.83-acre development would include 198 residential units (118 single family and 80 multi-family units), a school site, a commercial site, community center/common area, park/playground, stable, a sewage treatment area, and a 376-acre agricultural area, which was intended to operate as a working ranch and had sufficient water rights for planned irrigation.

The 1,180.83-acre property was divided into 11 development blocks, including the agricultural/open space area. At the time, the developer envisioned the PUD as homes for local working families and anticipated build-out of the PUD within 10 years. Only a few of the residential areas identified in the August 1976 Map have since been subdivided and developed with homes. Of the 1,180.83 acres, 1,140 acres not yet developed have been transferred and are now the Farm property.

## 2.3 Water Rights Background and History

Vulcan Ditch and Riverbend Wells

The property sale included significant ownership in the Vulcan Ditch as well as Coal Ridge Pump & Pipeline and associated Coal Ridge Reservoir. The Vulcan Ditch was decreed in 1908 for diversion from Canyon Creek, a tributary on the north (opposite) side of the Colorado River from the Farm. The Vulcan Ditch historically passed through an inverted siphon across the Colorado River, emerging high on the hillside on the south side of the River on the Farm property. From there the Vulcan Ditch cuts through the Farm property, terminating toward the western property boundary. The Vulcan Ditch was historically used to irrigate the hay fields on the Farm property. The Farm plans to make necessary repairs to the Vulcan Ditch and to replace the siphon across the Colorado River with an overpass to carry the ditch over the River to the Farm.

In the 1970s, the Farm property was owned by the Riverbend Development Corporation. At the time, 600 acres were slated to become a residential development with approximately 160 residential units and 120 acres of irrigated hay meadows. Riverbend Development Corporation obtained a Water Court decree, Case No. W2127, for a change of water rights from the Vulcan Ditch to supply the planned uses for the development. Case No. W2127 quantified the historical consumptive use of the Vulcan Ditch water rights (first and second priorities) to be 440 acre-feet (AF) per year in dry years. This quantification has been relied upon in subsequent Water Court cases.

Potable water supply for the PUD was to be supplied by five wells called Riverbend Well Nos. 1 through 5 (Riverbend Wells). The Riverbend Wells were awarded their own water right priority in W2125, for 0.67 cfs from each well with a cumulative volumetric limit of 340 AF/year from all five wells. The Riverbend Wells were also decreed in Case No. 2127 as alternate points of diversion for the changed 440 AF of Vulcan Ditch HCU credits. The maximum allowable diversion from each of the Riverbend Wells as alternate points is 0.67 cfs of Vulcan Ditch first and second priorities. Wastewater for the development was planned to be treated in a central treatment plant and then stored onsite for irrigation reuse.

The development plans in W2127 were never fully realized. The Riverbend Wells decreed in W2125 are now understood to be owned by the Riverbend Water Company and supply the Riverbend HOA located between the Farm and the Colorado River. The Riverbend HOA and Riverbend Wells are shown on **Figure 2-1.**

Of the Vulcan Ditch 440 AF of historical consumptive use quantified in W2127, 393 AF is now owned by the Farm and available for use in the Farm's water supply. Proposed Farm water use is consistent with the terms and conditions in the W2127 decree. In an effort to remain consistent with the W2127 decreed augmentation plan, SGM referenced many of the same demand and depletion factors when applicable.

Coal Ridge Pump & Pipeline and Coal Ridge Reservoir

The Coal Ridge Pump and Pipeline was decreed as an alternate point of diversion for the Vulcan Ditch first and second priorities in Case No. 84CW349. In addition, the Coal Ridge Pump and Pipeline has its own junior (1983 priority date) water right for 2.0 cfs, conditional, for municipal, commercial, industrial, domestic, irrigation, and recreation purposes, decreed in Case No. 83CW367. Coal Ridge Reservoir is a 2,000 AF conditional storage right that was decreed in 83CW368 for municipal, commercial, industrial, domestic, irrigation, and recreation purposes. Coal Ridge Reservoir was to be filled with the Coal Ridge Pump and Pipeline and/or the Vulcan Ditch. The two Coal Ridge water rights were owned by the Storm King Mines Inc. and were also transferred with the Farm property.

This report discusses the potential for diversions of the Farm's Vulcan Ditch ownership at the Coal Ridge Pump and Pipeline alternate point of diversion per Case No. 84CW349. The Farm may use the junior water rights in the Coal Ridge Pump and Pipeline and Coal Ridge Reservoir for supplemental or additional water supply. However, for the purposes of this Water Supply Adequacy Report these junior water rights are not relied upon to prove supply.

## 2.4 Planned Land Use Areas

Proposed uses for Nutrient Farm are divided into eight land use areas. **Figure 2-2** is a map of the Farm showing the eight land use areas. **Table 2-1** describes each land use area and its proposed uses for residential or commercial development. As planned, each residential lot will allow one residential dwelling plus one accessory dwelling unit (ADU).

### 2.4.1 Water supply from connection to Riverbend HOA System

The proposed residential developments in Areas 1, 3, and 4 will connect to the existing Riverbend Water Company potable water system (Riverbend System), which currently serves the Riverbend HOA. Riverbend System will provide all indoor and outdoor water use to these Areas through the potable water system.

### 2.4.2 Water supply from Vulcan Ditch

Areas 2, 5, 6, 7, and 8 will be entirely served by the Vulcan Ditch for indoor and outdoor water needs, with the exception of Area 5 receiving potable indoor supply from a new well to be drilled on the Farm. Water will be conveyed to the Farm through the Vulcan Ditch (which will eventually be piped) to the Supply Pond on the Farm. All outdoor (irrigation, livestock watering, and pond filling) uses in these areas will be served with raw water either directly from the Vulcan Ditch or untreated water from the Supply Pond.

Potable water for Area 2 and Areas 6 through 8 will be provided from the Supply Pond through individual water treatment systems to fit the specific water quality needs.

### 2.4.3 Water supply from New Exempt Well

In addition to the Working Farm East, Area 5 is also slated to have a farmhouse. All outdoor water demands for the farmhouse will be served by the Vulcan Ditch. A new well will be drilled and permitted to supply potable water (indoor uses only) to the farmhouse. This well will mostly likely qualify as an exempt well and would not need a new water right or augmentation. However, to be conservative for the purposes of planning water

supply adequacy, this plan assumes that a portion of the Farm's Vulcan Ditch consumptive use credits will be assigned to meet the depletions of this well.

**Table 2-1: Overview of Planned Uses for Nutrient Farm Areas 1 - 8**

| Area | Proposed Uses |
|---|---|
| Area 1 | Residential: 5 half-acre lots with single-family home + ADU |
| Area 2 | Residential: Farmhouse (1 single-family home + ADU) |
| Area 3 | Residential: 10 half-acre lots with single-family home + ADU |
| Area 4 | Residential: 2 half-acre lots with single-family home + ADU |
| Area 5 | Working Farm East: hay irrigation, cattle grazing, livestock pond.<br>Working Farm East Farmhouse (1 single-family home + ADU) |
| Area 6 | • Adventure farm (tourist attraction with amenities such as pavilion, picnic area, petting zoo)<br>• Farm store<br>• Working Farm West: irrigation of vegetables, fruit, and orchard (includes a U-pick orchard)<br>• Greenhouse (indoor year-round irrigation of vegetables)<br>• Utilities building (planned to house renewable energy operations and possibly water treatment operations)<br>• Farm processing building (produce washing and food processing for agricultural products)<br>• Restaurant<br>• Supply pond (attenuation for supply from Vulcan Ditch)<br>• Pond for irrigation and/or cooling<br>• Ponds for aesthetic and/or waterfowl purposes |
| Area 7 | Commercial, retail, and professional buildings |
| Area 8 | • Off-road adventure park<br>• Water park (recreational ponds for outdoor water sports, such as stand-up paddle boarding)<br>• Campground (tent sites, cabins, and RV spaces)<br>• Tree nursery<br>• Music festival (outdoor lawn-based festival space, will occupy same area as tree nursery after trees are harvested)<br>• Performing arts center (indoor and outdoor performing space)<br>• Retreat center (small lodge with space for workshops and group activities) |

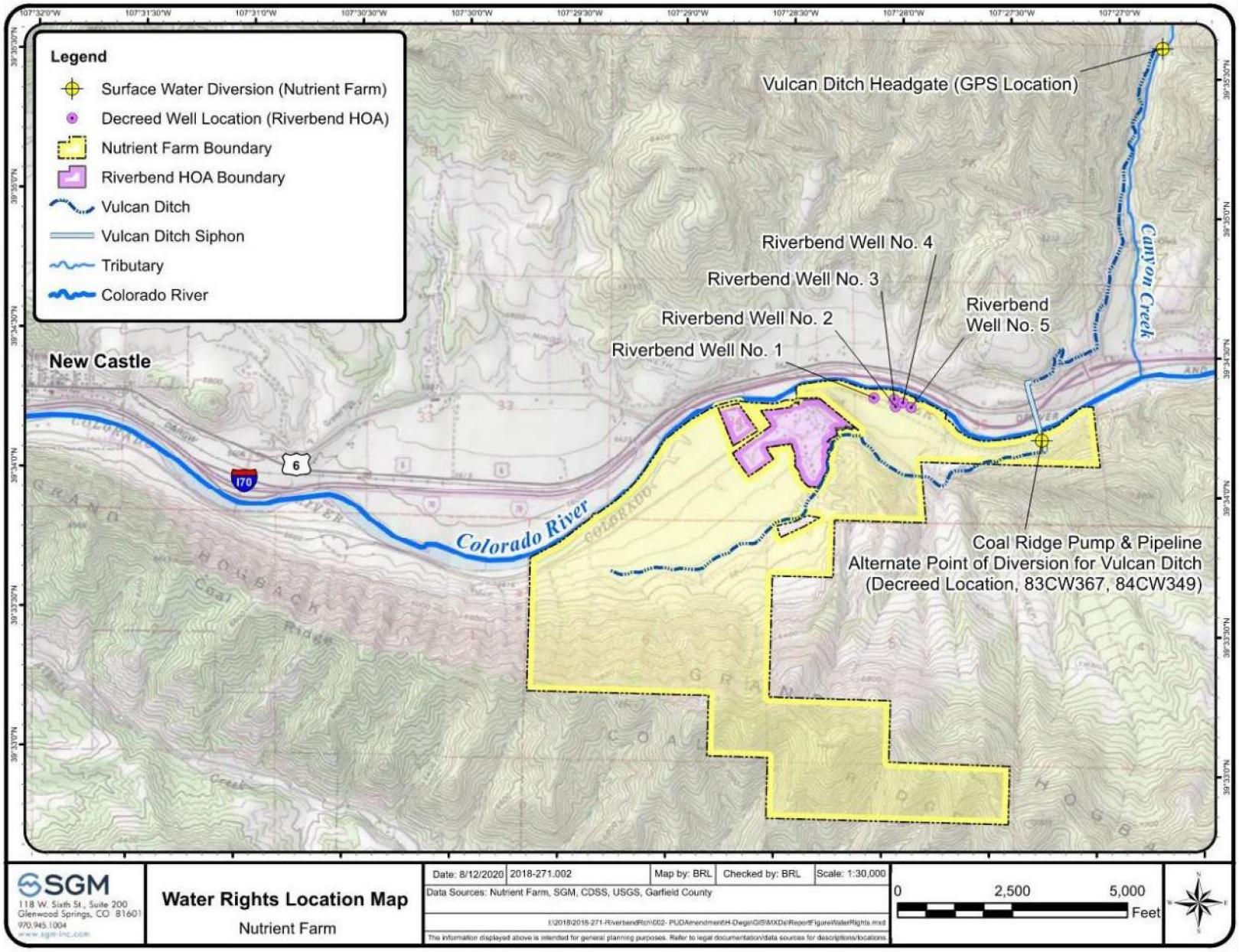



**Figure 2-1: Nutrient Farm Water Rights Location Map**

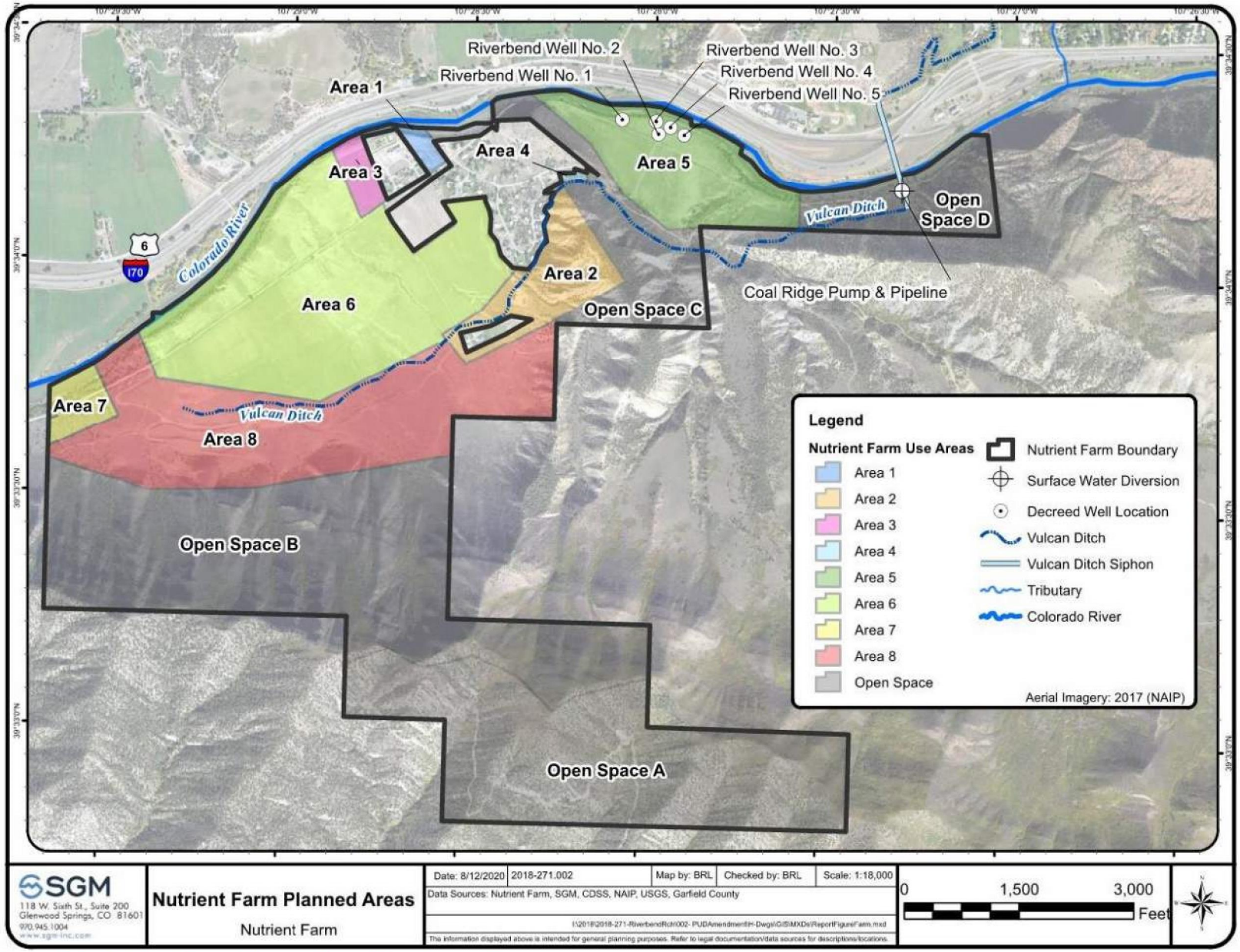



**Figure 2-2: Nutrient Farm Planned Land Use Areas Map**

# 3.0 Estimated Water Demands

To assess demands and peaking factors, SGM referred to the water adequacy requirements for Garfield County Land Use and Development Code, Section 4-203, Paragraph M: Water Supply and Distribution Plan.

Full buildout demands and consumptive use for Nutrient Farm are summarized by source (Riverbend Water Company or treated Vulcan Ditch water) in **Table 3-1**. Potable and non-potable demand calculations and assumptions are documented in the following sections for each Farm area by each respective planned land use.

**Table 3-1: Nutrient Farm Buildout Demand Summary**

| | | Served by Riverbend (Areas 1, 3, 4) | Served by Vulcan Ditch (Areas 2, 5, 6, 7, 8) | Served by New Exempt Well (Area 5) | Total for Farm (Areas 2, 5, 6, 7, 8) |
|---|---|---|---|---|---|
| **Total Annual Consumptive Use** | | **2.31 AF/year** | 391.7 AF/year | 0.07 AF/year | **391.8 AF/year** |
| **Indoor** | **Annual Consumptive Use** | **0.36 AF/year** | 2.7 AF/year | 0.07 AF/year | **2.8 AF/year** |
| | **Annual Demand** | **12.00 AF/year** | 27.5 AF/year | 0.7 AF/year | **28 AF/year** |
| | **Average Day Demand** | **0.033 AF/day** | 0.075 AF/day | 0.002 AF/day | **0.08 AF/day** |
| | **Max Day Demand [1]** | **0.099 AF/day**<br>**0.050 cfs** | 0.226 AF/day<br>0.114 cfs | 0.006 AF/day<br>0.003 cfs | **0.23 AF/day**<br>**0.12 cfs** |
| | **Peak Hour Demand [2]** | **0.099 cfs** | 0.23 cfs | 0.01 cfs | **0.24 cfs** |
| **Outdoor** | **Annual Consumptive Use** | **1.95 AF/year** | 389.0 AF/year | - | **389 AF/year** |
| | **Annual Demand** | **2.60 AF/year** | 595.4 AF/year | - | **595 AF/year** |
| | **Average Day Demand** | **0.012 AF/day** | 2.78 AF/day | - | **2.78 AF/day** |
| | **Peak Month (July) Average Day Demand** | **0.02 AF/day** | 5.75 AF/day | - | **5.75 AF/day** |
| **Non-Irrigation Season (Nov-Mar)** | **Average Day Demand** | **0.033 AF/day**<br>**0.017 cfs** | 0.087 AF/day<br>0.044 cfs | 0.002 AF/day<br>0.001 cfs | **0.09 AF/day**<br>**0.05 cfs** |
| **Irrigation Season (April - October)** | **Average Day Demand** | **0.045 AF/day**<br>**0.023 cfs** | 2.86 AF/day<br>1.44 cfs | 0.002 AF/day<br>0.001 AF/day | **2.9 AF/day**<br>**1.4 cfs** |
| | **Max Day Demand [1]** | **0.135 AF/day**<br>**0.068 cfs** | 8.570 AF/day<br>4.32 cfs | 0.006 AF/day<br>0.003 cfs | **8.6 AF/day**<br>**4.32 cfs** |
| | **Peak Hour Demand [2]** | **0.136 cfs** | 8.64 cfs | 0.01 cfs | **8.7 cfs** |

Notes: AF – acre-feet; cfs – cubic feet per second

Peaking factors are from Garfield County Land Use and Development Code, Section 4-203:

1. Maximum daily demand is calculated as 3.0 times the average day demand.
2. Peak hour demand is calculated as 6.0 times the average day demand.

Annual potable demands were distributed across the entire year (365 days) to get indoor average day demand. Year-round outdoor demands (greenhouse and livestock watering) were also distributed across the entire year (365 days). For other outdoor demands, the annual demand was distributed across the irrigation season (April through October, 214 days) to get the outdoor average day demand. Average day demand for the non-irrigation season, November through March, is equal to the average day

demand for potable use, livestock watering, and greenhouse irrigation. Average day demand for the irrigation season is equal to the potable average day demand plus the non-potable average day demand. Peaking factors were then applied to the average day demand to calculate maximum day demand and peak hour demand.

The Farm's peak hour demand from the Vulcan Ditch is 8.7 cfs (including non-potable irrigation), which is within the legal capacity of 8.93 cfs based on the Farm's Vulcan Ditch ownership. The annual consumptive use of Vulcan Ditch water is 391.8 AF (2.8 AF of potable and 389.0 AF of non-potable), within the Farm's ownership of 393 AF.

## 3.1 Potable Indoor Demands

For Areas 1, 3, and 4, potable indoor demands will be provided from the Riverbend System, and wastewater will be treated by a central wastewater collection and treatment facility. These demands are therefore assumed to have a consumptive use of 3%, consistent with the decreed factors in Case No. W2127 which contemplated wastewater to be treated with a centralized plant.

For Areas 2 and 5-8, potable indoor demands will be provided from separate potable systems maintained by the Farm, and wastewater will be treated by onsite wastewater treatment systems, likely septic system(s) with leach field(s), which typically have a higher consumptive use than central plants. Indoor demands for Areas 2 and 5 – 8 use an estimated 10% consumptive use. This indoor consumptive use factor differs from the factor of 3% consumptive use used in Case No. W2127 because of the difference in planned wastewater collection and disposal methods.

Areas 1 – 5: Residential Indoor Demands

To calculate potable indoor demands for residential uses, SGM used the definition of an equivalent residential unit (EQR) as a single-family dwelling with 3.5 people using 100 gallons per day (gpd) per person, equal to 350 gpd per EQR. This indoor demand is consistent with the decreed factors in Case No. W2127, which specifies 350 gpd/EQR as indoor demands, with demands for lawn and landscaping calculated separately. Garfield County Land Use and Development Code, Section 4-203.M, and Town of New Castle Municipal Code, Section 13.24.030 both also reference demand of 350 gpd/EQR, but these demands include 2,500 square feet of lawn and landscaping. To be consistent with Case No. W2127, this Report used an indoor demand of 350 gpd/EQR for residences, and separately calculated outdoor demands for irrigated lawn and landscaping. Each accessory dwelling unit (ADU) is considered 0.8 EQR, consistent with New Castle Municipal Code 13.20.060, with an additional indoor demand of 280 gpd.

Areas 6 – 8: Non-Residential Indoor Demands

SGM estimated potable indoor water demands for non-residential uses by relying on Water Quality Control Division (WQCD) Regulation No. 43, Table 6-2: Estimated Daily Wastewater Flow For Design Purposes, supplemented with planned number of employees or average public occupancy as provided by the Nutrient Farm planning team. Table 6-2 does not have flows tabulated for each exact use contemplated by the Farm, so SGM used the closest available use shown in the table.

Starting with these design standards, SGM converted from unit daily wastewater flow to unit daily water demands using 10% consumptive use for indoor purposes. Daily

demand was then converted to annual demand based on information from Nutrient Farm about planned seasonality and/or frequency of use.

Total Potable Demands

Potable demand calculations and assumptions are detailed for each business or land use type in **Table 3-2, Table 3-3,** and **Table 3-4**. Each table shows the annual total demand (or required diversions) and the consumptive use (CU) calculated for each use type.

Onsite potable water storage will be required to meet Garfield County water system requirements. Potable water storage will allow the Farm to handle peak potable water demands and daily and seasonal variations. Fire flow will be provided from non-potable storage and via dry hydrants, rather than from potable storage. Water storage requirements and preliminary siting of storage facilities are not addressed in this report.

**Table 3-2: Potable Indoor Demands Served by New Exempt Well (Area 5)**

| Business or Land Use Type | Indoor Potable Demand Calculations | | | | | | | | Annual (AF/year) | | Note |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Indoor Potable Unit Demand (gpd/unit) | | x | # Units (buildout/max) | | x | Days/ year | (Seasonality) | Demand | CU | |
| Area 5 (Residential) | 630 | gpd/lot | x | 1 | lot | x | 365 | (Year Round) | 0.71 | 0.071 | 1 |
| **Sum of Indoor Potable Demands Served by New Exempt Well:** | | | | | | | | | **0.71** | **0.071** | |

Notes: gpd – gallons per day; AF – acre-feet; SF – square foot; CU – consumptive use (depletions)
Calculations assume indoor water use is 10% consumptive (90% returns as wastewater).

1. Each lot as planned has one single-family home (1 EQR, 350 gpd) and one ADU (0.8 EQR, 280 gpd) for an indoor demand of 630 gpd per lot and will be occupied year-round.

**Table 3-3: Potable Indoor Demands Served by Riverbend System (Areas 1, 3, 4)**

| Business or Land Use Type | Indoor Potable Demand Calculations | | | | | | | | Annual (AF/year) | | Note |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Indoor Potable Unit Demand (gpd/unit) | | x | # Units (buildout/ max) | | x | Days/ year | (Seasonality) | Demand | CU | |
| **Area 1, 3, 4** | | | | | | | | | | | |
| Area 1 (Residential) | 630 | gpd/lot | x | 5 | lots | x | 365 | (Year Round) | 3.53 | 0.106 | 1 |
| Area 3 (Residential) | 630 | gpd/lot | x | 10 | lots | x | 365 | (Year Round) | 7.06 | 0.212 | 1 |
| Area 4 (Residential) | 630 | gpd/lot | x | 2 | lots | x | 365 | (Year Round) | 1.41 | 0.042 | 1 |
| **Sum of Indoor Potable Demands Served by Riverbend System (Areas 1, 3, 4):** | | | | | | | | | **12.00** | **0.360** | |

Notes: gpd – gallons per day; AF – acre-feet; SF – square foot; CU – consumptive use (depletions)
Calculations assume indoor water use for areas served by the Riverbend System is 3% consumptive (97% returns as wastewater), consistent with the decreed factors in Case No. W2127.

1. Each lot as planned has one single-family home (1 EQR, 350 gpd) and one ADU (0.8 EQR, 280 gpd) for an indoor demand of 630 gpd per lot and will be occupied year-round.

**Table 3-4: Potable Indoor Demands Served by Treated Vulcan Ditch Water (Areas 2, 5, 6, 7, & 8)**

| Business or Land Use Type | Indoor Potable Demand Calculations | | | | | | | | Annual (AF/year) | | Note |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Indoor Potable Unit Demand (gpd/unit) | | x | # Units (buildout/max) | | x | Days/ year | (Seasonality) | Demand | CU | |
| **Area 2** | | | | | | | | | | | |
| Area 2 (Farmhouse) | 630 | gpd/lot | x | 1 | lot | x | 365 | (Year Round) | 0.71 | 0.071 | 1 |
| | | | | | | | | **Sum of Area 2:** | **0.71** | **0.071** | |
| **Area 5** | **No Vulcan Ditch potable indoor demands, see Table 3-3** | | | | | | | **Sum of Area 5:** | **0.00** | **0.00** | |
| **Area 6** | | | | | | | | | | | **2** |
| Working Farm, U-Pick Orchard | 5.6 | gpd/visitor | x | 25 | visitors | x | 214 | (Summer, 7 mo.) | 0.09 | 0.009 | a |
| | 22 | gpd/employee | x | 4 | Employees | X | 214 | (Summer, 7 mo.) | 0.06 | 0.006 | b |
| Farm Store | 0.11 | gpd/SF | x | 4,000 | SF | x | 365 | (Year Round) | 0.49 | 0.049 | c |
| Adventure Farm | 5.6 | gpd/visitor | x | 118 | visitors | x | 214 | (Summer, 7 mo.) | 0.43 | 0.043 | a |
| Restaurant | 56 | gpd/seat | x | 180 | seats | x | 365 | (Year Round) | 11.29 | 1.129 | e |
| Utilities Bldg., Greenhouse, Processing Building | 22 | gpd/employee | x | 27 | employees | x | 313 | (Year round, 6 days/week) | 0.57 | 0.057 | b |
| | 5,000 | gpd processing water | | | | x | 313 | | 4.80 | 0.480 | f |
| | | | | | | | | **Sum of Area 6:** | **17.74** | **1.77** | |
| **Area 7** | | | | | | | | | | | **2** |
| Commercial, professional, retail buildings | 5.6 | gpd/visitor | x | 50 | visitors | x | 365 | (Year Round) | 0.31 | 0.031 | a |
| | 17 | gpd/employee | x | 50 | employees | x | 365 | (Year Round) | 0.95 | 0.095 | d |
| | | | | | | | | **Sum of Area 7:** | **1.27** | **0.13** | |

Notes: gpd – gallons per day; AF – acre-feet; SF – square foot; CU – consumptive use (depletions); mo. – month
Calculations assume indoor water use is 10% consumptive (90% returns as wastewater).

1. Each lot as planned has one single-family home (1 EQR, 350 gpd) and one ADU (0.8 EQR, 280 gpd) for a demand of 630 gpd per lot and will be occupied year-round.
2. Demands based on WQCD Regulation No. 43, Table 6-2: Estimated Daily Wastewater Flow For Design Purposes:
   a. Demand of 5.6 gpd/visitor (5 gpd wastewater) is typical for facilities with short-term or transient visitors. Examples: fairgrounds, ball parks, racetracks, stadiums, theaters, airports, etc.
   b. Demand of 22 gpd/employee/8hr shift (20 gpd wastewater) is typical of factories and plants exclusive of industrial wastewater, no showers provided.
   c. Demand of 0.11 gpd/SF of retail space (0.1 gpd wastewater) is typical of stores and shopping centers.
   d. Demand of 17 gpd/employee (15 gpd wastewater) is typical for offices or businesses (no kitchens or showers).
   e. Demand of 56 gpd/seat (50 gpd wastewater) is typical for restaurants.
   f. Processing building water demands (produce washing, food processing, etc.) are estimated based on 50% of the daily potable water demand at the restaurant. This assumes that in addition to washing and processing water in the restaurant kitchen for prepared meals, a similar amount of water is used for processing and washing for farm goods for sale.

**Table and notes continued on following page.**

**Table 3-4 (cont.): Potable Demands Served by Treated Vulcan Ditch Water (Areas 2, 5, 6, 7, & 8)**

| Business or Land Use Type | Indoor Potable Demand Calculations | | | | | | | | Annual (AF/year) | | Note |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Indoor Potable Unit Demand (gpd/unit) | | x | # Units (buildout/max) | | x | Days/ year | (Seasonality) | Demand | CU | |
| **Area 8** | | | | | | | | | | | **2** |
| Off-road Park | 5.6 | gpd/visitor | x | 25 | visitors | x | 365 | (Year Round) | 0.16 | 0.016 | a |
| Concessions | 28 | gpd/seat | x | 13 | seats | x | 365 | (Year Round) | 0.41 | 0.041 | g |
| Water Park | 5.6 | gpd/visitor | x | 50 | visitors | x | 153 | (Summer, 5 mo.) | 0.13 | 0.013 | a |
| Campground & Cabins | 56 | gpd/camp site | x | 36 | camp sites | x | 214 | (Summer, 7 mo.) | 1.32 | 0.132 | h |
| | 111 | gpd/cabin | x | 13 | cabins | x | 365 | (Year Round) | 1.62 | 0.162 | i |
| | 111 | gpd/RV spot | x | 18 | RV spots | x | 365 | (Year Round) | 2.24 | 0.224 | i |
| | 444 | gpd/laundry machine | x | 2 | laundry machines | x | 365 | (Year Round) | 0.99 | 0.099 | j |
| Campground pool | 11 | gpd/person | x | 50 | person capacity | x | 214 | (Summer, 7 mo.) | 0.36 | 0.036 | k |
| Music Festival | 5.6 | gpd/visitor | x | 350 | visitors | x | 28 | (Summer, 7 mo. 4 events/mo.) | 0.17 | 0.017 | l |
| Performing Arts Center | 5.6 | gpd/visitor | x | 100 | visitors | x | 28 | (Summer, 7 mo. 4 events/mo.) | 0.05 | 0.005 | a |
| Retreat | 83 | gpd/room | x | 12 | rooms (1 person per room) | x | 96 | (Year Round, two 4-day retreats/mo.) | 0.29 | 0.029 | m |
| | | | | | | | | **Sum of Area 8:** | **7.74** | **0.77** | |
| **Sum of Indoor Potable Demand Served by Treated Vulcan Ditch Water (Areas 2, 5, 6, 7, & 8):** | | | | | | | | | **27.45** | **2.75** | |

Notes Continued: gpd – gallons per day; AF – acre-feet; SF – square foot; CU – consumptive use (depletions)
Calculations assume indoor water use is 10% consumptive (90% returns as wastewater).

g. Demand of 28 gpd/seat (25 gpd wastewater) is typical for restaurant with paper service only.
h. Demand of 56 gpd/campsite (50 gpd wastewater) is typical for campsites (laundry calculated separately).
i. Demand of 111 gpd/unit (100 gpd wastewater) is typical for travel trailer parks with individual water and sewage hookup, also used for plumbed cabins (laundry calculated separately).
j. Demand of 444 gpd/commercial washing machine (400 gpd wastewater) is typical for self-service laundry.
k. Demand of 11 gpd/person capacity (10 gpd wastewater) is typical for swimming pools and bathhouses.
l. Music festival plans include portable restrooms. Demand per visitor is for drinking water only.
m. Demand of 83 gpd/room (75 gpd wastewater) is typical for hotels and motels.

## 3.2 Outdoor Demands

SGM estimated outdoor demands for irrigation, pond evaporation, and stock watering based on unit demands for each type of use, multiplied by the quantity (acres of irrigation or pond surface or the number of animals). Outdoor unit demands, consumptive use, and diversions are summarized by source (Riverbend potable system or Vulcan Ditch water) in **Table 3-5** and **Table 3-6.**

Calculations and assumptions are described for unit consumptive use in **Section 3.2.1**, for efficiency in **Section 3.2.2**, and for acreage and number of animals are in **Section 3.2.3**.

**Table 3-5: Outdoor Demands Served by Riverbend System (Areas 1, 3, 4)**

| Type of Unit Demand (Crop or Use) | Annual Unit CU (AF/unit) | Number of Units (buildout/max) | | Total Consumptive Use (AF) | Efficiency (% Consumptive) | Demand Diversions (AF/year) |
|---|---|---|---|---|---|---|
| **Lawn / Landscaping** | 2.00 | 0.98 | acres | 1.95 | 75% | 2.60 |
| | | | **SUM** | **1.95** | | **2.60** |

**Table 3-6: Non-Potable (Outdoor) Demands Served by Vulcan Ditch (Areas 2, 5, 6, 7, & 8)**

| Type of Unit Demand (Crop or Use) | Annual Unit CU (AF/unit) | Number of Units (buildout/max) | | Total Consumptive Use (AF/year) | Efficiency (% Consumptive) | Demand Diversions (AF/year) |
|---|---|---|---|---|---|---|
| **Lawn / Landscaping** | 2.00 | 12.67 | acres | 25.33 | 75% | 33.78 |
| **Hay / Native Grass** | 2.00 | 43.00 | acres | 86.00 | 60% | 143.33 |
| **Orchard (with ground-cover)** | 2.44 | 46.00 | acres | 112.24 | 75% | 149.65 |
| **Orchard (without ground-cover)** | 1.87 | 2.00 | acres | 3.74 | 75% | 4.98 |
| **Tree Nursery** | 1.87 | 2.50 | acres | 4.67 | 43% | 10.86 |
| **Corn & Vegetables** | 1.48 | 96.00 | acres | 142.27 | 60% | 237.12 |
| **Vegetables Greenhouse** | 6.53 | 0.25 | acres | 1.63 | 65% | 2.51 |
| **Evaporation** | 1.00 | 11.46 | acres | 11.46 | 100% | 11.46 |
| **Livestock Watering** | 0.01 | 130.00 | livestock | 1.60 | 100% | 1.60 |
| **Fowl Watering** | 0.07 | 1.00 | 1,000 fowl | 0.07 | 100% | 0.07 |
| | | | **SUM** | **389.01** | | **595.37** |

### 3.2.1 Unit Consumptive Use

Methodology for determining the annual unit consumptive use for each crop or use type is summarized in **Table 3-6**, and is described in this section.

Unit Irrigation Water Requirement for Irrigation

Monthly crop unit irrigation water requirement (IWR) is the portion of total crop evapotranspiration (on a per acre basis) which is not supplied by effective precipitation. It is determined for a specific crop and a specific location. IWR represents the consumptive use (CU) of a crop. Annual values of IWR for each crop type are given in **Table 3-6**.

Where possible, SGM used CU factors from Case No. W2127, the original change of use case for the Vulcan Ditch, for consistency. The W2127 Decree specifies a unit IWR of 2.0 AF/acre annually for lawn/landscaping and for hay/pasture grass. Because monthly distribution was not specified in W2127, the annual IWR of lawn and pasture grass obtained from the W2127 Decree was distributed monthly using the seasonal distribution from SGM's modified Blaney-Criddle analysis.

For crops not contemplated in Case No. W2127, SGM calculated monthly crop IWR using the Modified Blaney-Criddle method using the State's StateCU software. IWR was calculated over a 30-year study period of 1988 - 2017. Climate station data (temperature and precipitation) is from the Glenwood Springs No. 2 climate station (the closest climate station to the Farm with an adequate period of record). Gaps in climate data were filled with historical averages. An orographic temperature adjustment of 3.6 °F / 1,000 feet was applied from the climate station elevation to the approximate elevation of the Vulcan Ditch headgate, 5,850 feet. SGM selected elevation-adjusted TR-21 crop coefficients specific to each crop type (such as corn and vegetables, orchard, etc.). For vegetables grown in the greenhouse, the total crop evapotranspiration is used to determine consumptive use, rather than IWR, to account for the fact that no natural precipitation falls in the greenhouse. Because the greenhouse is productive year-round, consumptive use of greenhouse-grown vegetables for each month is set equal to the maximum month (July) evapotranspiration.

Unit Evaporation Demands

The W2127 Decree also specifies a unit evaporation rate of 1.0 AF/acre of pond surface annually. The annual evaporation for pond surfaces is distributed monthly using the evaporation distribution pattern for elevations below 6,500 feet from the Colorado State Engineer's Office (SEO) General Guidelines for Substitute Water Supply Plans for Sand and Gravel Pits (version 4/1/2011).

Unit Livestock Demands

Demands for livestock watering are based on 11 gpd per head (annual unit CU of 0.012 AF per head), the typical livestock water demands used by the Division 5 State Engineer's Office. The Farm also plans to have a small number of livestock for the petting zoo, but the exact type of animals is not yet known; for simplicity SGM assumed the same demands for all mammals. The farm also plans to have fowl, such as chickens and ducks. Demands for all fowl are estimated at 66 gpd per 1,000 birds (annual unit CU of 0.07 AF per 1,000 birds), based on resources from PoultryHub on caring for chickens.

### 3.2.2 Outdoor Use Efficiency

Once unit consumptive use is calculated, it must be converted to demands (diversions). Outdoor use efficiency is the portion of demands which are consumptively used. The portion of demands which is not consumptively used returns to the stream either as surface water runoff or delayed groundwater return flows.

- **Pond evaporation and livestock** are both considered to be 100% consumptive in this analysis, as is typically done.
- **Hay, corn, and vegetable** irrigation are assumed to be 60% efficient, which is a typical efficiency for flood irrigation. The Farm plans to convert much of the hay irrigation to more efficient sprinkler irrigation in the future and plans to convert much of the vegetable irrigation to a more efficient method such as sprinklers, micro-emitters, or drip irrigation. However, to represent the higher diversions required for initial less-efficient flood irrigation plans, SGM used 60% efficiency.
- **Lawn and landscaping** are assumed to have an irrigation efficiency of 75%, which is typical of sprinkler irrigation. While some landscaping may have more efficient drip irrigation systems, 75% is used for a conservative approach.
- **Orchard trees** are estimated at 75% efficiency, which is typical of sprinkler irrigation, although more efficient micro-emitter and/or drip systems will likely be installed eventually.
- **Greenhouse-grown vegetables** and other plants can have varying efficiencies depending on the irrigation methods. Nutrient Farm is considering hydroponic, aquaponic, drip, or other highly water efficient methods that can have efficiency as high as 90-percent. However, if overhead sprinklers are used, as much as 50-percent of water applied can fall between the containers, depending on container spacing [(1)], with 50-percent reaching the container. A typical leaching fraction of 20-percent represents water applied to container plants which leaches or drains out of the container [(2)], with 80-percent used by the plant. A resulting low-end estimate for efficiency if overhead sprinkler irrigation is used is 40-percent (50-percent of water applied reaching the container * 80-percent retained by the plant). Greenhouse irrigation methods have not yet been determined. Therefore, a mid-range estimate of 65-percent efficiency is used for greenhouse demands to represent a mix of overhead sprinkler irrigation and more efficient drip or hydroponic irrigation practices.
- **Nursery trees** have significantly lower irrigation efficiency than mature orchards for several reasons. Part of this difference is due to the roots being contained (either by a container or by the root-ball size for balled and burlapped trees grown in the ground) and therefore do not have the same ability to absorb water compared to trees grown in the ground with established and fully developed root structures. Recently planted trees require frequent irrigation and consistent soil moisture to allow for proper root absorption and to prevent disease, pests, and branch dieback[(3)]. Additional water is also often applied to leaves as pest control. Tree nursery irrigation efficiency is estimated at 43-percent, using similar concepts described for greenhouse-grown vegetables: (60-percent of water applied reaches the root-ball or container) * (80-percent of water retained by the plant) * (90-percent to reflect an additional 10-percent application for pest control).

---

[1] University of Tennessee Extension, Institute of Agriculture. PB 1836 - Nursery Irrigation: A Guide for Reducing Risk and Improving Production.
[2] University of Tennessee Extension, Institute of Agriculture. Sustainable Nursery Irrigation Management Series Part II: Strategies to Increase Nursery Crop Irrigation Efficiency.
[3] Colorado State Forest Service & Colorado State University, 2020. Watering. https://csfs.colostate.edu/colorado-trees/selecting-planting-and-caring-for-trees/watering/

### 3.2.3 Irrigated Area, Pond Area, and Number of Livestock

SGM estimated irrigated acreage and number of livestock for each Farm Area at buildout in coordination with the Nutrient Farm planning team.

Area 2: Farmhouse

- The Farmhouse is planned to have 2,500 square feet of irrigated lawn and landscaping.

Area 5: Working Farm East

- Demands are estimated for 120 head of livestock.
- The livestock pond on Area 5 has been designed with a surface area of 0.25 acre.
- Irrigated area of pasture grass is estimated at 43 acres. Portions of Area 5 will not be irrigated pasture grass due to hilly terrain or because of ponds, paddocks, barns, and road cover.
- Area 5 will also have a farmhouse, for which indoor demands will be supplied by an exempt well and outdoor demands will be supplied by the Vulcan Ditch. The Area 5 farmhouse is estimated to have 2,500 square feet of irrigated lawn and landscaping, and no additional irrigated hay or livestock.

Area 6: Working Farm West and Farm Related Attractions

- Pond surface area for Area 6, based on information from the Nutrient Farm planning team, includes: 5 acres of surface area at buildout for both the Supply Pond and an irrigation and cooling pond, and 1.5 acres for planned ponds for waterfowl, aesthetics, and possible collaboration with Colorado Parks and Wildlife for ponds related to the wildlife mitigation plan.
- The total planned area of lawn and landscaping in Area 6 is 3.23 acres. This includes 3 acres of lawn and landscaping for the adventure farm, which would include picnic and pavilion areas and landscaping beds. This also includes an estimated 2,500 square feet of lawn and landscaping around each building: the utilities building, processing building, farm store, and restaurant.
- Greenhouse irrigation is assumed to be non-potable. The planned irrigated area within the greenhouse is 0.25 acres.
- Demands for outdoor-grown vegetables and corn were grouped together, as the exact planting types are not yet known. These planting types may include corn (for corn maze), pumpkins (for u-pick pumpkins), other squash and melons, flower and herb gardens, and any other vegetables. A total area of 96 acres is planned for corn and vegetables at buildout.
- The planned area of orchard is estimated at 46 acres, including berries and the area designated as u-pick orchard (part of the adventure farm attraction). Orchard areas will also have groundcover.
- Livestock watering demands for the petting zoo are estimated at 10 livestock, as the exact number and type of animals are not yet known.
- Fowl watering demands are conservatively based 1,000 birds, which would include any petting zoo fowl and planned uses for ducks and egg-laying hens.

Area 7: Commercial, Retail, and Professional Buildings

- The only planned outdoor demand for Area 7 is lawn and landscaping around the buildings. Demands are based on an estimated 5,000 square feet (0.11 acres) total of irrigated lawn and landscaping for Area 7.

Area 8: Campground, Water Park, Off-Road Park, Festival, Performing Arts, Retreat, Tree Nursery

- Pond surface area for Area 8, based on information from the Nutrient Farm planning team, includes 4 acres for the water park recreational ponds plus an estimated 0.08 acres for evaporation from the campground swimming pool.
- Lawn and landscaping for the off-road adventure park are assumed to be a small portion of the overall area. Demands are based on 2 acres of lawn and landscaping and 2 acres of non-native trees requiring irrigation (uses crop coefficients of orchard trees). Of the roughly 70 acres of total footprint of the off-road adventure park, most of the area will be dirt/gravel roadways for motor sports. Other landscaping is assumed to be non-irrigated native vegetation.
- Demands for the campground assume 900 square feet of lawn and landscaping for each of 59 sites (including tent sites, RV sites, and cabins), plus 8,100 square feet each for eight group sites, for a total of 2.71 acres. Remaining campground area is assumed to be non-irrigated native vegetation.
- The performing arts center is planned to have indoor and outdoor performing space within its approximately four-acre footprint, so demands are conservatively based on 1 acre of irrigated lawn and landscaping.
- The retreat is planned to have a lodge with space for workshops and group activities. Because this may include significant outdoor space for events such as yoga retreats, this area is conservatively estimated to have 1 acre of irrigated lawn and landscaping.
- The plan for the music festival and tree farm is to start the approximately 5-acre area as a tree nursery, raising trees to be used for landscaping elsewhere on the property. As the trees are moved from the nursery to other areas of the Farm, space would be made for lawn, eventually leaving an outdoor festival venue of lawn surrounded by trees. Buildout demands were based on 2.5 acres of lawn and 2.5 acres of trees (nursery trees).

Augmentation Pond

- Because onsite augmentation may be required, evaporation demands conservatively included approximately 0.6 acres of augmentation pond surface area (which would allow for a 5 AF pond 8-feet deep).

## 3.3 Fire Flow

Garfield County requires that developments properly address fire flow needs through storage or water supplies and infrastructure sizing. Water supply for fire flows at the Farm will be provided from non-potable storage (rather than potable storage tanks) and through dry hydrants. The Farm will incorporate the necessary storage and flow requirements to address the required fire flows during the design process.

### 3.4 Water Conservation Measures

Historical irrigation on the property has been flood irrigation, which is relatively inefficient. While initial irrigation on the Farm will likely be largely flood irrigation, the Farm anticipates converting to more efficient irrigation practices (such as sprinklers, micro-emitters, and drip irrigation). Efficient irrigation methods will reduce the diversions required to deliver the needed consumptive use water to crops. The Farm also plans to pipe major sections of the Vulcan Ditch, reducing losses along the length of piped ditch due to seepage and evaporation.

During times of water shortage in Canyon Creek or the Colorado River, Farm staff can prioritize irrigation of key crops while reducing irrigation of lawns and landscaping. Farm staff can also use deficit irrigation or rotational irrigation as a tool for reducing demands while keeping the farm operational during a critical water shortage.

## 4.0 Water Quantity

Based on the quantity and seniority of the Vulcan Ditch water rights associated with the Farm property and the analysis of streamflow availability in Canyon Creek and the Colorado River, SGM believes that there is sufficient supply for the projected demand of Nutrient Farm. The physical and legal supply is sufficient to support both for the annual consumptive use and the peak hourly demands.

### 4.1 Legal Supply

Legal supply is discussed for the Vulcan Ditch and for the Riverbend system. Based on a comparison of the Farm's water rights to anticipated demands and consumptive use, the Farm's legal supply is sufficient.

#### 4.1.1 Vulcan Ditch Legal Supply

Nutrient Farm owns the right to 393 AF of consumptive use (CU) in the Vulcan Ditch. Nutrient Farm's Vulcan Ditch water can be taken either from Canyon Creek at the headgate of the Vulcan Ditch or from the Colorado River at the Coal Ridge Pump and Pipeline, an alternate point of diversion for the Vulcan Ditch decreed in Case No. 84CW349.

The total historical consumptive use of the Vulcan Ditch first and second priorities was quantified in Case No. W2127 to be 440 AF per year in dry years. Subsequent cases have relied upon this quantification. As documented in Case No. 84CW349, 395 AF of the total 440 AF of CU were conveyed to Storm King Mines, Inc. Of the 395 AF of CU, 2 AF now belongs to Chris Lake, a property owner located along the Vulcan Ditch alignment south of the Riverbend Development. The remaining 393 AF of CU, along with the Coal Ridge Pump and Pipeline and Coal Ridge Reservoir water rights, were transferred to APB Holdings, LLC (the owner of Nutrient Farm) via special warranty deed dated November 8, 2018, included in **Appendix A**.

The Vulcan Ditch has three water right priorities as outlined in **Table 4-1**. Nutrient Farm's ownership of 393 AF of the total 440 AF of CU entitles it to 8.93 cfs of the total 10 cfs in the Vulcan Ditch under the first and second priorities, as detailed in **Table 4-1** below. Nutrient Farm does not own any of the third priority (Temple Enlargement).

The Farm's peak hour demand is calculated at 8.7 cfs, based on the peaking factors identified in Garfield County Land Use and Development Code, Section 4-203.M. The peak hour demand is within the Farm's legal ownership of 8.93 cfs in the Vulcan Ditch. The annual consumptive use of Vulcan Ditch water is 391.8 AF (2.8 AF of potable and 389.0 AF of non-potable), which is within the Farm's ownership of 393 AF of the Vulcan Ditch HCU credits quantified in W2127.

**Table 4-1: Vulcan Ditch Water Rights Summary**

| Water Right Priority Name | Adjudication Date | Appropriation Date | Administration Number | Case No. Originally Decreed Amount | Total Amount Decreed (cfs) | Amount Owned by Nutrient Farm * (cfs) |
|---|---|---|---|---|---|---|
| **First (Senior)** | 9/14/1908 | 4/1/1907 | 21000.20909 | CA1319 | 6 | 5.36 |
| **Second (Junior)** | 9/5/1952 | 10/8/1942 | 33978.33883 | CA4004 | 4 | 3.57 |
| **Third (Temple Enlargement)** | 12/31/1993 | 9/4/1980 | 52230.47729 | 93CW91 | 0.13 | 0.00 |
| | | | | **Sum of three priorities:** | **10.13** | **8.93** |
| Notes: Nutrient Farm owns 393 AF of the 440 AF of CU quantified under the Vulcan Ditch first and second priorities per Case No. W2127; its ownership in the first and second priorities corresponds to the 393/440. | | | | | | |

Case No. 84CW349 also explicitly states the right to use these Vulcan Ditch credits year-round:

> *"The Court also finds that Applicant's water rights in the Vulcan Ditch …may be used for year-round municipal use (including commercial, industrial, domestic, irrigation incident thereto, and sewage treatment including land disposal) irrigation, recreation, fish wildlife propagation, and all other beneficial purposes, including storage for each of the above purposes."*

Canyon Creek Calls

There are no decreed Colorado Water Conservation Board (CWCB) instream flow rights on Canyon Creek downstream of the Vulcan Ditch.

A formal call had not been recorded on Canyon Creek until 2018, when a call was placed by the Williams Canal, which is located on Canyon Creek above the Vulcan Ditch headgate. Williams Canal was on call between August 13, 2018 and October 5, 2018, and is senior to the Vulcan Ditch first priority. The swing right (most senior water right that was curtailed due to the call) during this time frame was also senior to the Vulcan Ditch first priority. The Williams Canal is located above the Canyon Creek stream gage that is used in **Section 4.2.1** to evaluate physical supply; therefore, the physical supply analysis already reflects the availability after senior diversions by the Williams Canal. Between the Williams Canal point of diversion and the Vulcan Ditch headgate, three other tributaries join Canyon Creek and contribute flow that would be available to the Vulcan Ditch: East Canyon Creek, Possum Creek, and Bearwallow Creek. Williams Canal and other key water rights on Canyon Creek and its tributaries are shown in **Figure 4-1**.

The first priority in the Vulcan Ditch is relatively senior on Canyon Creek, and a call has not historically been placed by a downstream senior diverter; however, there are water rights senior to the Vulcan Ditch that are located downstream that could place a call.

Ditches located on Canyon Creek downstream of the Vulcan Ditch which have senior water rights are:

- Canon Creek Ditch: Historical structure only, all Canon Creek Ditch water rights have been transferred to the Williams Canal upstream on Canyon Creek.
- Mings-Chenoweth-Wolverton Ditch
- Wolverton Ditch
- Johnson Ditch

The availability of Canyon Creek physical supply to support diversions by the Vulcan Ditch and other senior diverters is discussed in more detail in **Section 4.2.1.**

Colorado River Calls

The Colorado River typically calls every year near the Grand Junction area by a collection of irrigation and power water rights commonly referred to as the Cameo Call. Water rights that were perfected before October 16, 1977 are beneficiaries of the Green Mountain Reservoir Historic Users Pool (HUP). HUP-protected water rights benefit from replacement water releases from Green Mountain Reservoir which allows them to divert during times of a Cameo Call.

While even the first priority under the Vulcan Ditch is junior to the Cameo Call, both the first and second priorities are HUP-protected and may therefore divert even during times of a Cameo Call.

### 4.1.2 Riverbend System Legal Supply

Nutrient Farm residential developments in Areas 1, 3, and 4 will be connected to the existing Riverbend Water Company's potable water distribution system and wastewater collection system. The Riverbend HOA's potable water supply comes from the five Riverbend Wells. The Riverbend Wells were awarded their own water rights in W2125, for 0.67 cfs from each well with a cumulative volumetric limit of 340 AF/year from all five wells.

The anticipated additional demand on the Riverbend System (including indoor use and outdoor use) is estimated at average day demand of 0.02 cfs and a peak hour demand of 0.14 cfs based on a peaking factor of six times the average daily demand (as specified in Garfield County Land Use and Development Code, Section 4-203). The annual demands are estimated at 14.6 AF, with 2.3 AF of consumptive use. These demands include indoor and outdoor demands, as Areas 1, 3 and 4 will have potable irrigation. Initial assessment of the Riverbend Water Company water rights shows it has sufficient water to supply the proposed 17 lots.

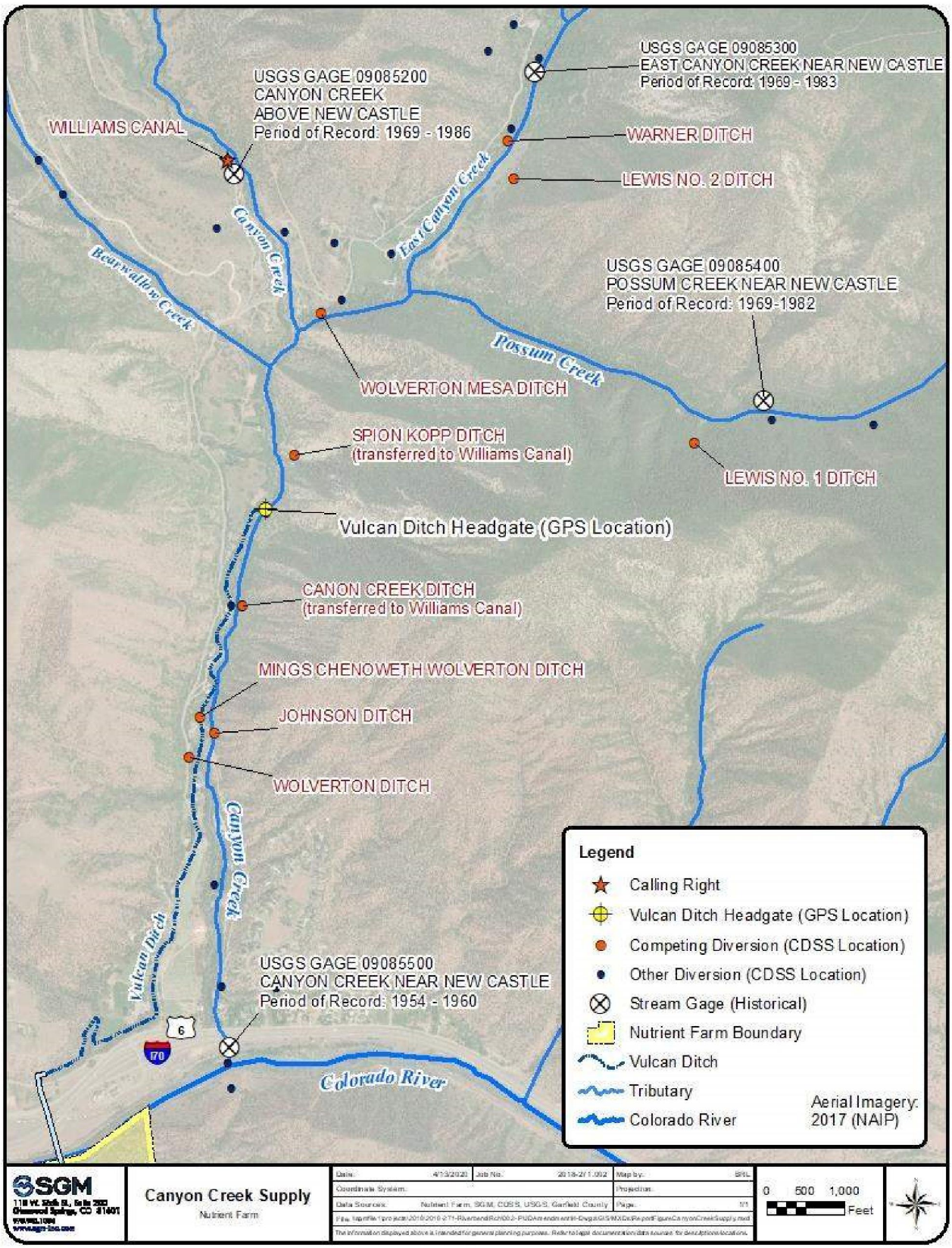



**Figure 4-1: Canyon Creek Physical and Legal Supply Map**

## 4.2 Physical Water Supply

Physical water supply is discussed for each of the two proposed sources: the Vulcan Ditch which will serve Areas 2, 5, 6, 7, and 8, and the Riverbend System which will serve Areas 1, 3, and 4. Based on the analysis of stream flow, the Farm's Vulcan Ditch physical supply can support anticipated demands. Based on analysis of streamflow and hydrogeology near the Riverbend Wells, there is sufficient supply to support the additional demands to the Riverbend System from Areas 1, 3, and 4.

### 4.2.1 Vulcan Ditch Physical Water Supply

The Farm's Vulcan Ditch water can legally be taken at the Vulcan Ditch headgate or at its decreed alternate point of diversion at the Coal Ridge Pump and Pipeline.

The Vulcan Ditch headgate is located on Canyon Creek approximately 1.5 miles north of the confluence of Canyon Creek and the Colorado River as shown in **Figure 2-1**. The Vulcan Ditch historically crossed the Colorado River in an inverted siphon and flowed through the Nutrient Farm property; however, the siphon and other areas of the ditch need repair. Necessary repairs are planned to re-establish the historical ditch and replace the siphon with a hanging pipeline over the Colorado River allowing delivery of Vulcan Ditch water to the Farm.

The Coal Ridge Pump and Pipeline diverts from the south bank of the Colorado River on the eastern portion of the Farm property. Until the planned repairs and replacement of the Vulcan Ditch and siphon are complete, the Farm plans to pump water to the property from the Coal Ridge Pump and Pipeline for immediate irrigation needs in Area 5. In the future, the Coal Ridge Pump and Pipeline will remain an alternate point of diversion.

Because the Farm's water supply may be diverted from either Canyon Creek or the Colorado River, physical water supply adequacy is discussed for both sources.

Canyon Creek Physical Water Supply

There are no currently recording stream gages on Canyon Creek. Historical data was available from 1970 through 1982 for Canyon Creek above the Vulcan Ditch and for two tributaries that flow into Canyon Creek below that gage and above the Vulcan Ditch, East Canyon Creek and Possum Creek. To accurately represent the total flow available at the Vulcan Ditch headgate, SGM added together the daily flow for each of these three gages: Canyon Creek Above New Castle (USGS Gage 09085200), East Canyon Creek Near New Castle (USGS Gage 09085300), and Possum Creek near New Castle (USGS Gage 09085400). Bearwallow Creek also flows into Canyon Creek above the Vulcan Ditch headgate, as shown in **Figure 4-1,** but streamflow in this tributary is not gaged. A historical gage was also located downstream of the Vulcan Ditch headgate (USGS Gage 0908550) but was not used due to limited period of record and its downstream location. The stream gages are shown on **Figure 4-1**.

**Figure 4-2** shows the average Canyon Creek streamflow above the Vulcan Ditch headgate (sum of flow at the three gages) for each month of the year, for the average of wet years, normal years, and dry years. Dry years were defined as the lowest yielding 25 percentile years during the period of record for the total annual streamflow for the sum of the three gages. Wet years were defined as the highest yielding 75 percentile during the period of record. Normal years were defined as the middle 50 percentile during the period of record.

The Vulcan Ditch is subordinate to other senior diverters for use of the physically available water in Canyon Creek. To account for this, SGM summarized the water rights which are senior to the Vulcan ditch first and second priorities and which divert below the three gages and above the confluence of Canyon Creek and the Colorado River; these senior diverters are shown on **Figure 4-1** as "competing diversions" because they are competing for the water physically available based on SGM's streamflow analysis. Competing diverters located downstream of the Vulcan Ditch headgate could place a call on Canyon Creek limiting available diversions by the Vulcan Ditch. Competing diverters located upstream of the Vulcan Ditch headgate but downstream of the gages could divert water upstream and the Vulcan Ditch could not call them out. Any diversions by senior diverters located above these three gages are already reflected in the physical water availability measured by the gages.

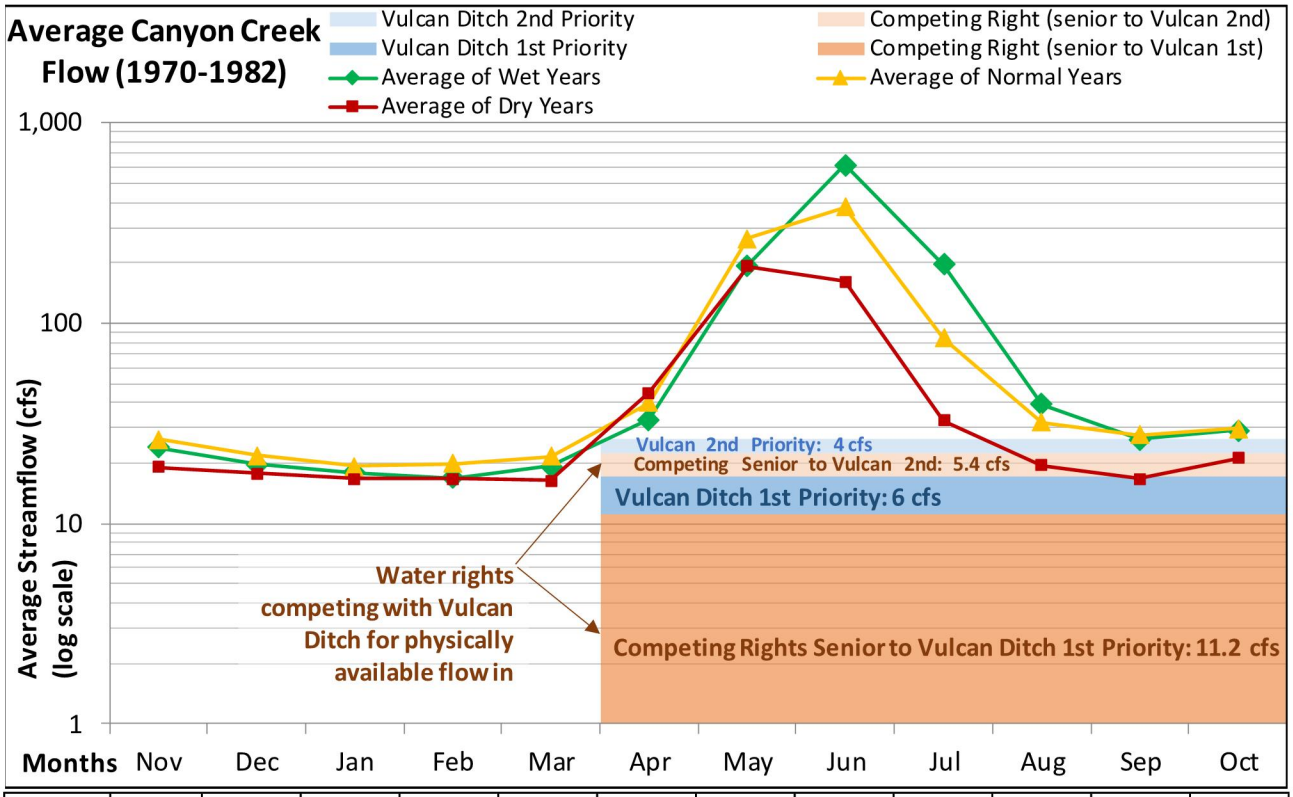
In addition to showing the average Canyon Creek streamflow, **Figure 4-2** shows an overlay of the competing water rights: other water rights which divert in the stretch between the stream gages and the Colorado River confluence and which would be competing with the Vulcan Ditch for physically available water supply.

A total of 11.2 cfs of competing water rights are senior to the Vulcan Ditch first priority. All of these senior water rights are decreed for irrigation use only (resulting in diversions from April through October only) with the exception of 1.0 cfs in the Mings Chenoweth Wolverton Ditch, which is decreed for domestic use. These competing water rights including:

- Mings Chenoweth Wolverton Ditch: 9.0 cfs from Canyon Creek
- Wolverton Ditch: 0.4 cfs from Canyon Creek
- Johnson Ditch: 0.56 from Canyon Creek
- Wolverton Mesa Ditch: 0.32 cfs from Canyon Creek
- Warner Ditch: 0.40 cfs from East Canyon Creek
- Lewis No. 1 Ditch 0.44 cfs from Possum Creek
- Lewis No. 2 Ditch 0.04 cfs from East Canyon Creek

A total of 5.4 cfs of competing water rights are senior to the Vulcan Ditch second priority, all of which are decreed for irrigation only. These competing water rights include:

- Mings Chenoweth Wolverton Ditch: 5.2 cfs from Canyon Creek
- Warner Ditch, Lewis No. 1 Ditch, or Lewis No. 2 Ditch: 0.243 cfs, with each headgate decreed as alternate points of diversion for the same water right.




| Avg of: | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wet | 24 | 20 | 18 | 17 | 19 | 33 | 195 | 616 | 196 | 39 | 26 | 29 |
| Normal | 26 | 22 | 19 | 20 | 22 | 40 | 265 | 378 | 84 | 32 | 28 | 30 |
| Dry | 19 | 18 | 17 | 17 | 16 | 45 | 192 | 161 | 33 | 20 | 17 | 21 |

**Figure 4-2: Canyon Creek Stream Flow Analysis Above Vulcan Ditch Headgate**

The Canyon Creek hydrograph follows the typical pattern of a snowmelt-driven stream. Flows rise steeply during runoff season, typically April through June, and then taper back down to base flow by the fall. Flows are higher in April for normal years and dry years than for wet years, likely related to warmer temperatures and earlier runoff. Peak flow occurs in May for dry years and in June for wet and normal years. From April through July there is enough water in Canyon Creek during wet, normal, and dry years to provide for the 10 cfs of Vulcan Ditch first and second priority water rights and for all of the competing water rights.

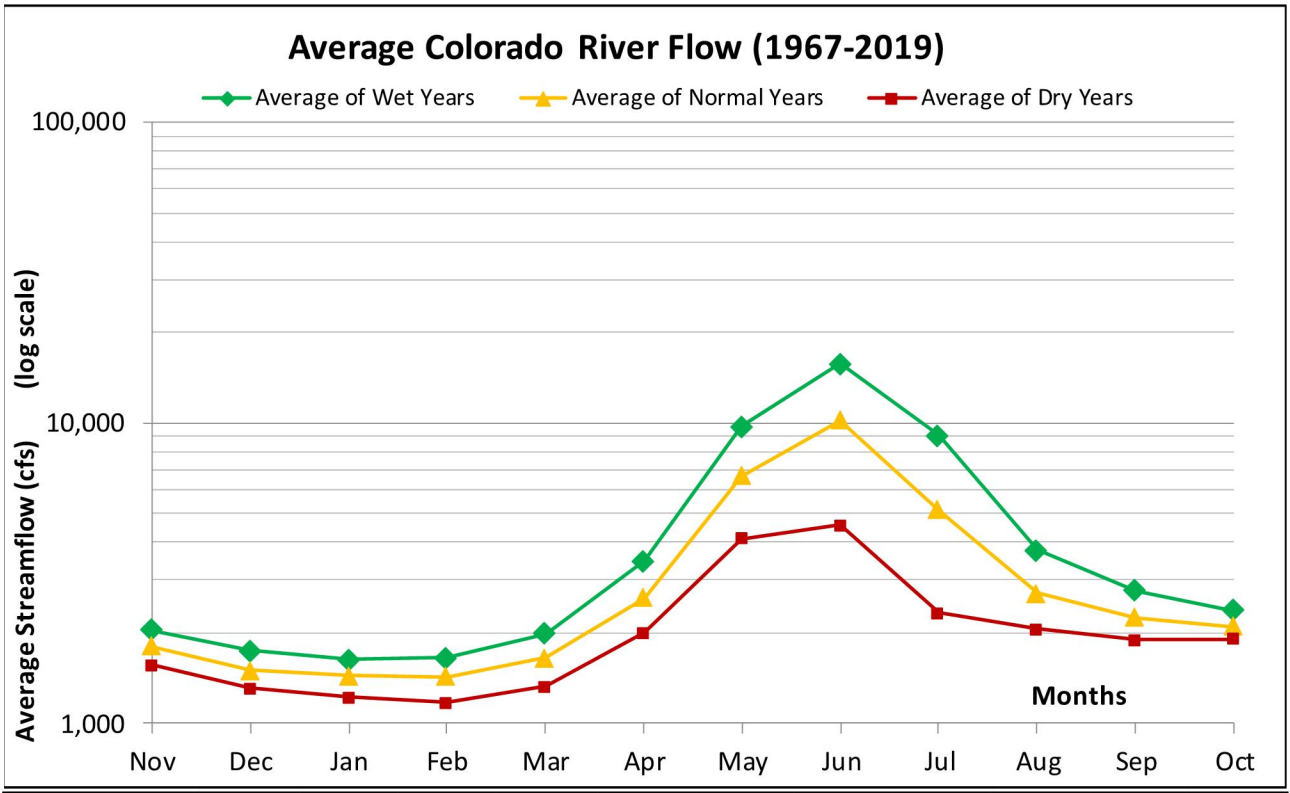
During late irrigation season, August through October, Canyon Creek flows are declining toward base flows. During late irrigation season of wet and normal years there is enough flow in Canyon Creek to provide for the 10 cfs of Vulcan Ditch first and second priority water rights and for all of the competing water rights. However, during late irrigation season of a dry year, Canyon Creek flows will be restricted, and there may only be enough physical and legal availability for the Farm to divert under the Vulcan Ditch first priority (6 cfs total, 5.36 cfs owned by the Farm). This amount of water would be enough to supply peak hour demands for the potable systems and the maximum day demand for the non-potable system. If supply is limited for the non-potable system, the Farm can reduce irrigation of lawn and landscaping and prioritize irrigation of key crops or can rotate irrigation of different areas.

Flows are typically lowest between January and March when other senior irrigation water rights holders on Canyon Creek are not diverting. During dry years, the average streamflow is at its lowest in March, at 16 cfs. During the period of record, flow only dropped below 10 cfs twice, in January of 1979 and in August of 1979 (the driest year during the period of record). Typically, even during low flow times of dry years, Canyon Creek can supply more than the total 10 cfs of water rights under the Vulcan Ditch first and second priority. The peak hour demand during non-irrigation season (to supply the potable needs) is less than 1 cfs. Canyon Creek flow during non-irrigation is sufficient to provide for the Farm's potable demands.

In summary, the Canyon Creek physical and legal supply is sufficient to provide for the Farm's demands during all months in wet and normal years, and during November through July of dry years. During late irrigation season of dry years, the Canyon Creek physical and legal supply is sufficient to provide for the Farm's peak hour potable demands. However, dry year supply available for non-potable demands may be limited to the Farm's 5.36 cfs in the Vulcan Ditch first priority. The Farms 5.36 cfs is sufficient to meet max day demand but may require some irrigation reductions or storage to meet peak hour demand.

Colorado River Physical Supply

SGM summarized daily flow in the Colorado River at the gage located below Glenwood Springs (USGS Gage 09085100) for the entire available period of record, 1967 through 2019. **Figure 4-3** shows average Colorado River streamflow for each month of the year, for the average of wet years, normal years, and dry years. Dry years were defined as the lowest yielding 25 percentile years during the period of record. Wet years were defined as the highest yielding 75 percentile, and normal years as the middle 50 percentile during the period of record. The 53-year period of record had 13 dry years, 13 wet years, and 27 normal years.




| Avg of: | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wet | 2,050 | 1,747 | 1,636 | 1,652 | 1,991 | 3,484 | 9,726 | 15,752 | 9,064 | 3,774 | 2,765 | 2,388 |
| Normal | 1,808 | 1,507 | 1,441 | 1,437 | 1,651 | 2,616 | 6,691 | 10,192 | 5,128 | 2,722 | 2,262 | 2,106 |
| Dry | 1,568 | 1,313 | 1,220 | 1,177 | 1,331 | 2,010 | 4,117 | 4,564 | 2,341 | 2,064 | 1,896 | 1,907 |

**Figure 4-3: Colorado River Streamflow Analysis**

As seen in **Figure 4-3,** average flow in the Colorado River stays above 1,000 cfs even during the winter, largely due to the influence of the Shoshone Power Plant located upstream in Glenwood Canyon. The senior 1905 Shoshone water right for 1,250 cfs and junior 1941 water right for 158 cfs effectively "pull" water to the plant's diversion point and past other upstream diverters (including transmountain diversions). As the hydroelectric use is non-consumptive, this operation ensures adequate Colorado River flows in the Middle Colorado River, where the Farm is located. Physical supply from the Colorado River is adequate. Supply availability from the Colorado River is more driven by the water rights (legal availability).

Diversions at the Coal Ridge Pump and Pipeline alternate point of diversion will be limited to the amount of water physically and legally available at the original point of diversion at the Vulcan Ditch headgate on Canyon Creek. Based on SGM's analysis, the physical and legal availability at the Vulcan Ditch headgate is adequate, as described previously in **Section 4.2.1.** To confirm in real time that water is physically available at the original point of diversion and allow for diversions at the Coal Ridge Pump and Pipeline from the Colorado River, the Division of Water Resources may require the Farm to install a measuring structure in Canyon Creek near the Vulcan Ditch headgate.

### 4.2.2 Riverbend System Physical Supply

Based on previous use, and based on the hydrogeology of the setting in which the Riverbend Wells are drilled, these wells are not likely to be limited by physical supply as long as they have sufficient water rights to allow them to continue diverting. A new well drilled for the Area 5 farmhouse would also be in the Colorado River alluvium and would also not likely be limited by physical supply.

Hydrogeology

The Riverbend Wells are drilled between 43 feet and 61 feet deep in the Colorado River alluvium, and all of the five wells are located within 300 feet of the south bank of the Colorado River. Based on well completion and pump installation report for Riverbend Well Nos. 3 and 4 (Permit Nos. 018146-F and 018147-F, respectively), the entire drilled depth of the wells is boulders and gravels, alluvial type deposits which allow relatively easy transmission of groundwater. Water was found at 22 feet below ground surface for Well No. 4, and 5 feet below ground surface for Well No. 3, indicating that the elevation of the groundwater table is similar to the elevation of surface water in the Colorado River.

The Riverbend Wells are pulling water from the Colorado River alluvium, in close proximity to the Colorado River and through loose alluvial deposits that allow groundwater to flow relatively quickly. Physical water supply from these wells is therefore not expected to be a limiting factor, compared to the water rights.

Riverbend Wells

All of the Riverbend Wells have been drilled. For Well No. 3, the well test completed on January 14, 1977 during the well completion and pump installation showed a sustained yield of 97 gpm (0.22 cfs) over eight hours. However, Well No. 3 is apparently capable of producing up to 197 gpm (0.44 cfs) as evidenced by the fact that 0.44 cfs have been made absolute from this well. For Well No. 4, the well test completed on June 1, 1975 during well completion and pump installation showed a sustained yield of 75 gpm (0.17 cfs) over four hours. It is expected that when Well Nos. 1, 2, and 5 are developed they can be expected to produce at similar rates due to the loose alluvial aquifer characteristics. Based on the individual observed pumping rates of Well Nos. 3 and 4 (0.44 cfs and 0.17 cfs respectively) and the geology of the area the Riverbend Wells likely would be able to produce up to their decreed rates of 0.67 cfs. Therefore, the Riverbend Wells are not likely to be limited by physical supply, and it is expected that the wells will be able to accommodate the additional demands from the 17 lots in Areas 1, 3, and 4.

## 5.0 Water Quality

Water supply from the Vulcan Ditch may come from either Canyon Creek or the mainstem of the Colorado River. Water quality samples have not been collected. SGM consulted the Colorado Department of Public Health and Environment (CDPHE) Water Quality Control Commission (WQCC) Regulation 93 Section 303(d) list of impaired waters and monitoring and evaluation list, for information about general water quality parameters of concern from each source.

## 5.1 Water Supply Quality

Water quality is discussed for both possible Vulcan Ditch sources, Canyon Creek and the Colorado River.

Canyon Creek

Canyon Creek should be the preferred source for the Farm's water supply from a water quality perspective, based on information available from CDPHE, and because smaller tributaries generally have better water quality and less sediment than the mainstem of the Colorado River. Many existing homes and farms already use Canyon Creek as a water source.

Canyon Creek, segment ID COLCLC07a, is not listed for any parameters under the 303(d) list, either for impairment or for monitoring and evaluation.

Colorado River

The section of the Colorado River that runs past Nutrient Farm is segment ID COLCLC01_A, Colorado River from Paradise Creek to below the confluence with Rifle Creek. COLCLC01_A is on the 303(d) list for arsenic (total) and temperature impairment and is on the monitoring and evaluation list for sediment. Temperature is a problem for aquatic life, but not a concern for the Farm's water supply. Water with arsenic can be treated for potable use by reduction, coagulation, and filtration, depending on its oxidized form, or by membrane filtration. Nutrient Farm should also further investigate arsenic levels with respect to planned agricultural uses if it plans to use Colorado River water. Sediment issues could be mitigated by the Farm's plan to deliver ditch water first to the Supply Pond, allowing some settling of sediment to occur in the pond.

The City of Rifle, located about twenty miles downstream, uses the Colorado River for its municipal supply. The City of Rifle recently constructed a new microfiltration membrane water treatment plant, the Rifle Regional Water Purification Facility. The major water quality issues considered during the design of the new Rifle plant were iron and manganese, which mainly cause issues with taste and color. Iron and manganese will likely also be water quality parameters of concern for the Farm's potable water treatment design. The plant's design also treats the elevated levels of arsenic, but arsenic was not one of the main drivers for the new plant. Rifle also must manage sediment from its Colorado River supply; it does so by settling the river water in settling ponds before treatment. Similarly, settling will occur in the Farm Supply Pond and will help mitigate sediment issues.

# 6.0 Summary of Findings

Based upon Nutrient Farm's development plans and other information considered within this report, SGM has developed the following preliminary conclusions regarding the Farm's water supply adequacy.

## 6.1 Conclusions

1. Nutrient Farm owns 8.93 cfs of diversions and 393 AF of consumptive use in the Vulcan Ditch, which may legally be used year-round for uses including municipal, commercial, industrial, irrigation, domestic, fish, recreational, and others as decreed in W2127 and 84CW349.

2. The total annual consumptive use of Nutrient Farm's anticipated demands is estimated to be 391.8 AF/year. This amount is within the Farm's ownership of 393 AF of Vulcan Ditch consumptive use. The annual demands (diversions) associated with the calculated consumptive use are anticipated to be 623 AF/year. These annual amounts include demands and consumptive use to be served by the Farm's Vulcan Ditch water and by a proposed new well for Area 5, as itemized below:

    a. The annual consumptive use of demands to be supplied by the Farm's Vulcan Ditch water is estimated at 391.7 AF.

    b. The annual consumptive use of indoor demands for the Area 5 farmhouse to be supplied by a new well is 0.07 AF. While this new well will likely qualify as an exempt well (would not require augmentation), Nutrient Farm has conservatively set aside 0.07 AF of Vulcan Ditch HCU credits for this use in the event that the credits are needed to augment the well uses.

3. The Farm's anticipated diversion rates (including demands to be served by the Farm's Vulcan Ditch water and by a proposed new well for Area 5) are within its legal water rights ownership.

    a. The peak hour demand for the Farm during irrigation season is estimated, based on County peaking factors, at 8.7 cfs, which includes non-potable demand for farm irrigation operations. The peak hour demand is within the Farm's legal ownership of 8.93 cfs in the Vulcan Ditch. The peak hour demand on the Farm's potable system for Areas 2 and 5 – 8 is estimated at 0.24 cfs. The Farm's potable treatment and distribution system(s) will be designed to accommodate this peak hour demand.

    b. The maximum day demand for the Farm during irrigation season is estimated at 8.6 AF/day (4.3 cfs), which includes non-potable demand for farm operations such as irrigation. The maximum day demand on the Farm's potable system is estimated at 0.23 AF/day (0.12 cfs).

    c. The entire Farm is estimated to have an average day demand during non-irrigation season (November through March) of 0.09 AF/day (0.05 cfs). The average day demand during irrigation season (April through October) is estimated at 2.9 AF/day (1.4 cfs), which includes non-potable demand for farm operations such as irrigation.

4. The Farm can operate under the decrees for Case No. W2127 and Case No. 84CW349, and does not require additional water rights or augmentation sources.

5. The annual consumptive use of demands to be supplied by the Riverbend System (Areas 1, 3, and 4) is estimated at 2.3 AF, with an annual diversion volume of 14.6 AF. Riverbend Water Company has water rights decreed to the five Riverbend Wells in Case No W2125, with an annual cumulative volumetric limit of 340 AF/year from all five wells. Initial assessment shows that the Riverbend Water Company has enough water to support this added consumptive use from the 17 proposed lots.

6. The anticipated diversion rates for Areas 1, 3, and 4 to be served by connection to the Riverbend System are within the legal diversion rates decreed in W2125 for 0.67 cfs from each of the five Riverbend Wells.

    a. The additional peak hour demand on the Riverbend System from Areas 1, 3 and 4, is estimated at 0.14 cfs (for indoor and outdoor uses).

    b. The additional maximum day demand on the Riverbend System from Areas 1, 3 and 4, is estimated at 0.135 AF/day (0.07 cfs), which occurs during summer and includes irrigation of lawns from the potable system.

    c. The additional average day demand on the Riverbend System from Areas 1, 3 and 4 during non-irrigation season (November through March) is estimated at 0.033 AF/day (0.017 cfs). The average day demand during irrigation season (April through October) is estimated at 0.045 AF/day (0.023 cfs), which includes potable irrigation of lawn and landscaping.

    d. Riverbend Water Company is willing to commit and has the ability to provide an adequate water supply for the proposed development of 17 lots in Areas 1, 3, and 4.

7. Areas 2, 5, 6, 7, and 8 will be supplied from the Vulcan Ditch. Based on the quantity and seniority of the Vulcan Ditch water rights associated with the Farm property and the analysis of streamflow availability in Canyon Creek and the Colorado River, SGM believes that water is physically and legally available to support both for the annual consumptive use (392.7 AF/year) and the peak hourly demands (8.7 cfs) for the areas served directly by the Vulcan Ditch.

    a. Canyon Creek physical and legal supply is adequate for the Farm's peak hour demand during wet and normal years and November through July of dry years.

    b. During late irrigation season (August through October) of dry years, the Canyon Creek physical and legal supply is sufficient to provide for the Farm's peak hour potable demands and max day non-potable demands. During dry years in the late irrigation season available stream flow may be limited to the Farms 5.36 cfs ownership in the first priority due to competing senior diversions and reduced streamflows. Limited diversions of 5.36 cfs is sufficient to meet max day demand of 4.3 cfs, and peak hour non-potable demand can be met with storage and irrigation schedule modifications. If required during times of key supply shortage, Farm staff can prioritize irrigation of key crops while reducing irrigation of lawns and landscaping.

8. The physical supply to the Riverbend Wells is sufficient for the anticipated additional demand from Areas 1, 3, and 4, based on the hydrogeology and measured pumping rates from the drilled wells.

9. The Farm can legally divert its Vulcan Ditch water at the original Vulcan Ditch headgate on Canyon Creek or at the decreed alternate point of diversion at the Coal Ridge Pump and Pipeline on the Colorado River. Diversions at the Coal Ridge Pump and Pipeline will be limited to the amount of water physically and legally available at the original point of diversion at the Vulcan Ditch headgate on Canyon Creek. SGM's streamflow analysis suggests that the physical and legal availability from Canyon Creek is sufficient.

10. Canyon Creek should be the preferred source for the Farm's water supply over the Colorado River from a water quality perspective. Potable use from either source will require treatment.

## 7.0 References


- Garfield County Land Use and Development Code, Section 4-203 Paragraph M: Water Supply and Distribution Plan
- Town of New Castle Municipal Code, Sections 13.24.030 and 13.20.060.
- Water Quality Control Division (WQCD) Regulation No. 43, Table 6-2: Design Wastewater Flow
- Colorado State Engineer's Office (SEO) General Guidelines for Substitute Water Supply Plans for Sand and Gravel Pits (version 4/1/2011)
- PoultryHub. Water consumption rates for chickens. http://www.poultryhub.org/nutrition/nutrient-requirements/water-consumption-rates-for-chickens/
- University of Tennessee Extension, Institute of Agriculture. PB 1836 - Nursery Irrigation: A Guide for Reducing Risk and Improving Production.
- University of Tennessee Extension, Institute of Agriculture. Sustainable Nursery Irrigation Management Series Part II: Strategies to Increase Nursery Crop Irrigation Efficiency.
- Colorado State Forest Service & Colorado State University, 2020. Watering. https://csfs.colostate.edu/colorado-trees/selecting-planting-and-caring-for-trees/watering/
- Colorado Department of Public Health and Environment (CDPHE) Water Quality Control Commission (WQCC). Regulation 93: Section 303(d) list; and Regulation 37: Stream Classifications and water Quality Standards


# APPENDICES

**Appendix A:** Warranty Deeds (Water Rights)

# APPENDIX A

## WARRANTY DEEDS (WATER RIGHTS)

## EXHIBIT A

Coal Ridge Pump and Pipeline: All rights conditionally decreed to the Coal Ridge Pump and Pipeline in Case No. 83CW367, Water Division No. 5, Colorado, to divert 2 cfs of water from the Colorado River, with an appropriation date of September 14, 1983, at a point of diversion located in Garfield County, Colorado on the South Bank of the Colorado River in Section 35, Township 5 South, Range 90 West of the 6th P.M., at a point 1,260 ft. West of the East line and 1840 feet North of the South line of said Section 35.

Coal Ridge Reservoir: The right to store up to 2,000 acre-feet of water, as conditionally decreed in Case No. 83CW368, Water Division No. 5, Colorado, with an appropriation date of September 14, 1983, at a place of storage in Garfield County, Colorado, at which the center of the dam axis is located in Section 35, Township 5 South, Range 90 West of the 6th P.M. at a point 1,900 ft. West of the East line and 210 feet North of the South line of said Section 35.