Appendix E

Supporting Information

PR&G Analysis Report

Aquatic Resources Report

Biological Assessments

Public Participation Plan

Technical Memorandum for the Tri-Valley Watershed Plan-EA

Cultural Resource Assessment

PR&G Analysis Report

Tri-Valley Watershed Project
Tri-Valley Watershed
Wasatch County, Utah

PR&G Analysis Report

Final

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Prepared for:

USDA United States Department of Agriculture
Natural Resources Conservation Service

Prepared by:

Adaptive Environmental Planning, LLC

Highland ECONOMICS

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Table of Contents

1.0 Introduction 1

2.0 PR&G Evaluation Process Overview 1

3.0 PR&G Eight-Step Evaluation Process 2

3.1 Identify Problems and Opportunities 2

3.2 Inventory Existing Resource Conditions 3

3.3 Forecast Future Conditions 3

3.4 Develop Array of Alternatives 3

3.5 Evaluate Effects of Individual Alternatives 4

3.5.1 Economic Evaluation and Comparison 4

3.5.2 Environmental Evaluation 14

3.6 Compare Alternatives 14

3.7 Identify Recommended Alternative 14

3.8 Implement and Evaluate 15

4.0 References 15

List of Tables

Table 1. Increased Average Annual Yield by Action Alternative, Compared to No Action 10

Table 2. Summary of Per-Acre Hay Net Returns in Daniels Irrigation Service Area 11

Table 3. Avoided Annual Average Damages to Daniel Irrigation Service Area Agriculture 11

Table 4. Pipe Breaks in Daniel Irrigation System 12

Table 5. Estimated Avoided OM&R Costs in Daniel Irrigation System 12

Table 6. Avoided OM&R Costs at Center Creek 13

Table 7. Alternative 2 Incremental Analysis of Annual NEE Costs and Benefits 14

Table 8. Alternative 1 Incremental Analysis of Annual NEE Costs and Benefits 14

Appendices

Appendix A PR&G Framework Table

Appendix B Cost Estimates

Appendix B Economic Evaluation Appendix

1.0 Introduction

A Natural Resources Conservation Service (NRCS) Supplemental Watershed Plan and Environmental Assessment (Plan-EA) is being prepared for the Tri-Valley Watershed Project (Project) located within the Tri-Valley Watershed in Wasatch County, Utah. The Project is authorized under the NRCS Watershed and Flood Prevention Operations Program and funded through the Watershed Protection and Flood Prevention Act of 1954 (PL 83-566). Wasatch County and Utah Department of Agriculture and Food are cooperating in the Project as the Sponsoring Local Organizations (SLOs). The Project consists of water delivery efficiency improvements for the Daniel Irrigation system and flood prevention for ice-induced flood events at the intersection of Center Creek Road and S 2400 E Street.

The intent of this report is to document Project compliance with Principles, Requirements, and Guidelines for Federal Investments in Water Resources (PR&G) per the *Principles and Requirements for Federal Investments in Water Resources* (Council on Environmental Quality [CEQ] 2013), the *Final Interagency Guidelines* (CEQ 2014), and *NRCS Decision Memorandum for the Acting Chief on PR&G for NRCS Watershed Programs* (NRCS 2018).

2.0 PR&G Evaluation Process Overview

The PR&G evaluation process is based on an eight-step watershed planning process and was completed for the Project as described in this section. The NRCS nine-step planning process was also followed in conjunction with the PR&G evaluation process. The PR&G eight-step evaluation process includes consideration of the federal objective, PL 83-566 general purposes, guiding principles, and ecosystem services. Guiding principles were used to assist in decision making and weighing tradeoffs of Project alternatives, and the use of an ecosystem services framework to describe the comprehensive set of benefits that people receive from nature characterized as ecological goods and services provided by a healthy, functioning environment. The guiding principles are outlined in the PR&G documents and include:

1) Healthy and Resilient Ecosystems
2) Sustainable Economic Development
3) Floodplains (avoiding unwise use of floodplains)
4) Public Safety (reducing public health and safety risks)
5) Environmental Justice
6) Watershed Approach

Ecosystem services benefits have been organized into four service categories that are reflected in the Department of Agriculture Departmental Manual (DM9500-13) and include:

1) Provisioning services are tangible goods provided for direct human use and consumption, such as food, fiber, water, timber, or biomass.

2) Regulating services maintain a world in which it is possible for people to live, providing critical benefits that buffer against environmental catastrophe – examples include flood and disease control, water filtrations, climate stabilization or crop pollination.
3) Supporting services refer to the underlying processes maintaining conditions for life on earth, including nutrient cycling, soil formation, and primary production.
4) Culture services make the world a place in which people want to live – recreational use, spiritual, aesthetic viewsheds, or tribal values.

The guiding principles and service categories were evaluated for those that were critical to the decision maker, the analysis, and the stakeholders. A measurement of change in services was determined, where applicable, between the Future without Federal Investment (FWOFI) Alternative, also referred to as the No Action Alternative, and the Future with Federal Investment (FWFI) Alternatives, also referred to as Action Alternatives. An evaluation framework was developed to compare the FWOFI and FWFI Alternatives and is attached in Appendix A. This framework was used to select the "best" alternative that maximized public benefits (environmental, economic, and social goals) with appropriate consideration of costs, and included consideration of the guiding principles and ecosystem services.

3.0 PR&G Eight-Step Evaluation Process

The PR&G eight step evaluation process was used in decision making as outlined in Sections 3.1 through 3.8 below.

3.1 Identify Problems and Opportunities

Problems and opportunities were identified during the Project scoping process. Input from the Sponsors, agencies, the public, organizations, and tribes were solicited as described in Sections 3.0 and Section 7.3.2 of the Plan-EA. A copy of the Scoping Report is provided in Appendix E of the Plan-EA. Engineering analysis was completed to further identify and evaluate problems as documented in the engineering TM attached in Appendix E of the Plan-EA. The purpose and need of the project was formulated with the problems and opportunities in consideration. Where the "purpose" identifies the fundamental reason why the action is being proposed and the "need" describes the problems that the proposed action is intended to address and explains the underlying causes of the problems. The purpose and need of the Project is included in Section 2.1 of the Plan-EA with information supporting the purpose and need and watershed problems in Sections 2.2 of the Plan-EA. The purpose and need of the Project, as stated in the Plan-EA for reference, is included below.

"The purpose of the Project is to improve agricultural water management for the Daniel Irrigation system and to improve flood prevention along Center Creek near the intersection of Center Creek Road and S 2400 E Street in the Tri-Valley Watershed. There is a need to address pressure and velocity deficiencies for improved water delivery efficiency in the Daniel Irrigation System Lower and Middle Pressure Zones; to reduce issues associated with O&M access and brittle Transite pipe (asbestos cement pipe) in the Daniel Irrigation system; and to improve public safety for ice-induced flood hazards to Center Creek Road caused from freezing-specific capacity restraints along Center Creek."

3.2 Inventory Existing Resource Conditions

Resources relevant to the proposed action were determined during the scoping process as described in Section 3.0 of the Plan-EA. The existing conditions of resources determined to be relevant are documented in Section 4.0 (Affected Environment) of the Plan-EA. The Affected Environment section of the Plan-EA provides the environmental baseline conditions for resources to be evaluated against alternative actions. The best available data and science was used to inventory the existing resource conditions at the level and scale of analysis determined reasonable for evaluating alternatives and impacts.

3.3 Forecast Future Conditions

A forecast of future conditions was made for resources, where reasonable to address, in the Affected Environment section (Section 4.0) of the Plan-EA. Additional future conditions forecasting was made for each alternative and associated implementation and O&M costs. Future forecasting of alternative impacts is described in Section 6.0 (Environmental Consequences) of the Plan-EA. The installation and O&M costs for future conditions of each alternative are provided in Section 5.5 of the Plan-EA.

3.4 Develop Array of Alternatives

Project alternatives were formulated following procedures outlined in the National Watershed Program Manual, National Watershed Program Handbook, and PR&G. Alternatives required in the initial consideration per PR&G include the FWOFI Alternative and the FWFI Alternatives consisting of a nonstructural alternative, locally preferred alternative, environmentally preferable alternative, and additional alternatives. Nonstructural alternatives to meet the Project purpose and need, and Project goals were determined not feasible. Therefore, the FWOFI Alternative, which does not include structural measures but rather continues O&M, would be considered the nonstructural alternative.

Eight (8) Action Alternatives were developed for improvements to resolve the problems identified in the Tri-Valley Watershed for reduction of ice-induced flooding and improvements to irrigation water delivery efficiency. Descriptions of alternative measures are provided in Section 5.0 of the Plan-EA. Public Law 83-566 provides for federal assistance for these measures under the authorized purposes of flood prevention (flood damage reduction) and agricultural water management.

Alternatives were removed from further consideration and analysis during the PR&G evaluation if they were determined infeasible, did not meet the purpose and need, conflicted with the federal objective or guiding principles, had exorbitant costs, or determined to be inferior due to other critical factors. In those cases, a brief discussion is included in the evaluation framework table (Attachment A) to identify the reasons for elimination of an alternative. A discussion of the alternatives eliminated and the reasons for elimination are also documented in Section 5.4 of the Plan-EA.

There were two Action Alternatives selected for evaluation in the framework table. These include two different irrigation piping alignments for Daniels Irrigation System improvements and a stormwater conveyance system for decreasing ice-induced flooding on Center Creek Road.

Several alternatives for piping materials were explored to identify the options that maximized the benefits for the least cost, considering feasibility of construction and alignment. HDPE was selected as the best piping material for Project alternatives based on providing the least cost compared to other materials.

The FWOFI Alternative (No Action Alternative) was also evaluated to provide a benchmark for comparison. The FWOFI Alternative consisted of continued O&M for both Daniels Irrigation System and Center Creek Road flooding.

3.5 Evaluate Effects of Individual Alternatives

The guiding principles listed in Section 2.0 above and ecosystem services for provisioning, regulating, cultural, and supporting, as applicable, were assessed for the selected FWFI Alternatives and the FWOFI Alternative. The ecosystem services determined to be applicable to Project measures for evaluation are listed below. Because short-term construction impacts would be avoided or minimized, only measurable long-term effects to ecosystem services are considered for the PR&G framework table and determination of applicability.

Provisioning Services

- Food/Biomass

Regulating Services

- Flood Control

Cultural Services

- Well-being and Safety

An economic analysis was also completed for the FWOFI and FWFI alternatives evaluated in the framework tables for each site as described in Section 3.5.1 below.

3.5.1 Economic Evaluation and Comparison

The economic analysis was completed by Highland Economics. Two FWFI Alternatives and one FWOFI Alternative were included in the detailed economic analysis in this section. The FWFI alternatives include the Daniel Irrigation and Center Creek Improvements Alternative (hereinafter referred to as Alternative 1) and the Daniel Irrigation Modified Alignment and Center Creek Improvements Alternative (hereinafter referred to as Alternative 2). These were the alternatives determined reasonable for evaluation as part of the alternative screening process described in Section 3.4 above.

3.5.1.1 *National Economic Efficiency Analysis Summary*

This NEE analysis evaluates the costs and benefits of Alternative 2 over the No Action Alternative and Alternative 1 for the Project. All economic benefits and costs are provided in 2022 dollars, rounded to the nearest $1,000, and have been expressed in average annual values using the fiscal year 2023 federal water resources planning rate of 2.5 percent.

Alternative 2 would replace or install approximately 4.47 miles of pipe in the Daniel Irrigation

System to improve water supply management and delivery reliability to Daniel Irrigation Company patrons, as well as reduce flooding of Center Creek which has public safety effects on Center Creek Road. In total, the Project is anticipated to cost $4,717,000, which includes construction and construction management ($4,109,000, which includes 20% contingency), engineering ($348,000), project administration ($173,000), property rights acquisition ($60,000) and permitting ($27,000). The total cost equates to an average annual cost of $164,000. PL 83-566 funds would cover $3,550,500 and the canal company, Wasatch County, or other local partners would be required to fund $1,166,500. Please refer to Section 3.5.1.3 below for additional information on cost share for installation costs. Project construction would be completed over approximately 2 years. No other direct costs of the project are expected.

Alternative 2 is expected to provide agricultural, operational, and safety benefits. By replacing and realigning aging pipes and improving operational flexibility, Project Group 1 would enhance the quantity and reliability of the Daniel Irrigation Company water supply, thereby reducing agricultural damages associated with lack of full water supply delivery to meet crop needs. The average annual agricultural damage benefit is estimated at $119,000. Project Group 1 also reduces operations, maintenance, and repair (OM&R) costs, valued at $70,000 on an average annual basis. Project Group 1 may also enhance public safety through reducing potential exposure to asbestos-containing pipe. Project Group 2 enhances public safety and reduces County OM&R costs by reducing flooding from Center Creek to Center Creek Road and S 2400 E Street. The Project Group 2 OM&R avoided costs are estimated at $1,000 annually while the public safety benefits are not quantified.

In sum, the Alternative 2 has an estimated $164,000 in annual average costs and provides an estimated $190,000 in annual average benefits, resulting in annualized net benefits of approximately $31,000.

3.5.1.2 *Introduction*

This section provides a NEE analysis that evaluates the costs and benefits of Alternative 2 over the No Action Alternative and over Alternative 1 for the Tri-Valley Watershed Project. The analysis uses NRCS guidelines for evaluating NEE benefits as outlined in the NRCS Natural Resources Economics Handbook and the U.S. Department of Agriculture's (USDA) Guidance for Conducting Analyses Under the Principles, Requirements, and Guidelines for Water and Land Related Resources Implementation Studies and Federal Water Resource Investments (DM 9500-013).

3.5.1.3 *Analysis Parameters*

This section describes the general parameters of the analysis, including the evaluation unit, the project implementation timeline, the period of analysis, and the project purpose. All economic benefits and costs have been discounted to present value and then amortized over the period of analysis to average annual values using the fiscal year 2023 federal water resources planning rate of 2.5 percent. All values in this analysis are presented in 2022 dollars and rounded to the nearest $1,000.

Funding

Federal assistance for PL 83-566 varies by project authorized purpose. PL 83-566 funds would cover 75 percent construction costs for measures associated with the agricultural water management authorized purpose and 100 percent of the construction costs for measures associated with the flood prevention authorized purpose. Engineering would be funded up to 100 percent for both authorized purposes. The Sponsor is responsible for the remaining construction costs, and the cost for real property rights, permitting, and administrative time to install the measures. Federal assistance would cover approximately $3,390,500 of the installation cost for Daniel Irrigation improvements and $160,000 for Center Creek improvements. Daniel Irrigation Company would be required to fund the remaining $1,152,500 installation costs for Daniel Irrigation improvements. Wasatch County would be required to fund the remaining $14,000 for the Center Creek improvements. A detailed breakout of cost share is provided in Table 8-3 of Section 8.7 in the Plan-EA.

Evaluation Unit

The proposed project is comprised of two project groups, which are the evaluation units for this analysis. Project Group 1, Daniel Irrigation Modified Alignment, consists of replacing and installing new irrigation piping in the Daniel Irrigation system. Project Group 2, Center Creek Improvements, consists of installing a new drainage ditch. Please refer to the Plan-EA for detailed descriptions of alternative measures. Note that for the incremental analysis, costs for constructing any given site would not change if only one project group were to be constructed.

Project implementation Timeline

Daniel Irrigation Company staff indicate that, if PL 83-566 funds are made available, construction of Project Group 1 would likely be completed over approximately 2 years. This analysis assumes that full benefits would be realized the year after construction is completed (e.g., full benefits of Project Group 1 would be realized in Year 3). Construction of Project Group 2 would likely be completed over one month in year 1, with full benefits realized in Year 2.

Analysis Period

The analysis period is defined as the implementation period plus the period of time over which any alternative would have meaningful beneficial or adverse effects (up to a maximum of 100 years). The analysis period for this NEE is 52 years (Year 1 to Year 52) since the installation period is 2 years and 50 years is the expected project life of the pipe, which is expected to provide meaningful benefits throughout its useful life. Construction and installation of Project Group 1 is assumed to start in Year 1 and finish in Year 2, with project life from Year 3 through Year 52.

3.5.1.4 *Alternative Costs*

This section evaluates the costs of Alternative 2 over the No Action Alternative and Alternative 1.

Table 8-2 (NWPM 506.11, Economic Table 1) and Table 8-3 (NWPM 506.12, Economic Table 2) in Section 8.7 of the Plan-EA summarize installation costs and distribution of costs for Alternative 2. Table 8-4 (NWPM 506.18, Economic Table 4) in the Plan-EA summarizes the annualized costs, which are estimated at $164,000 in amortized installation costs. The subsections included in this

report provide detail on the derivation of the values in the tables of the Plan-EA.

Installation Costs

The total installation cost of Project Group 1 for Alternative 2 is projected to be approximately $4,543,000. See Appendix B for detailed cost derivation by pipe size, cost category, etc. determined by Bowen Collins and Associates (BC&A). This total consists of $3,970,000 in construction costs[1], $331,000 in engineering/technical assistance costs, $60,000 in non-shareable real property rights costs (acquisition of 0.54 acres), project administration ($165,000)[2], and permitting costs ($17,000)[3]. The average annual installation cost of Project Group 1 of Alternative 2 is $158,000, and because no other potential costs are expected from the Project, this is also the estimated total annual cost of Group 1 for Alternative 2.

The total installation cost of Project Group 1 for Alternative 1 is projected to be approximately $4,363,000. See Appendix B for detailed cost derivation by pipe size, cost category, etc. determined by BC&A. Total installation costs include $3,864,000 for construction, $322,000 for engineering/technical assistance, $161,000 for project administration, and $16,000 for permitting. The average annual installation cost of Project Group 1 of Alternative 2 is $152,000, and because no other potential costs are expected from the Project, this is also the estimated total annual cost of Group 1 for Alternative 1.

The total installation cost of Project Group 2 for both Alternative 2 and Alternative 1 is projected to be approximately $174,000. See Appendix B for detailed cost derivation by pipe size, cost category, etc. determined by BC&A. This total consists of $139,000 in construction costs[4], $17,000 in engineering/technical assistance costs, project administration ($8,000)[5], and permitting costs ($10,000)[6]. The average annual installation cost of Project Group 2 is $6,000, and because no other potential costs are expected from the Project, this is also the estimated total annual cost of Group 2 for Alternative 1 and 2.

Operations, Maintenance, and Repair Costs

For each Project Group under both Action Alternatives, the OM&R costs are expected to decrease; changes to OM&R are therefore included as a benefit and not a cost of each Action Alternative.

[1] This includes general contracting costs and contingency costs (estimated as 20 percent of construction and general contracting costs).

[2] The total project administration costs consist 2.5% of construction costs for the project sponsor (covered by the Project sponsor), and 2.5% of the construction costs for NRCS (covered by the PL-566 funds).

[3] Estimated at 0.5 percent of all construction costs.

[4] This includes general contracting costs contingency costs (estimated as 20 percent of construction and general contracting costs).

[5] The total project administration costs consist 3.5% of construction costs for the project sponsor (covered by the Project sponsor), and 3.5% of the construction costs for NRCS (covered by the PL-566 funds).

[6] Estimated at 0.5 percent of the sum all construction costs.

Other Direct Costs

No other substantive direct costs are expected from the Project. As discussed in the Plan-EA, there are no expected long-term effects on fish and wildlife, stream flows, water quality, groundwater recharge, water supplies for other users, cultural resources, energy use or greenhouse gas emissions, or air quality. While there may be some impacts to resources during project construction (such as some construction noise, travel delay, and habitat disturbance as summarized in Table S - 4), these are not quantified as they are expected to be minor to negligible (both in terms of magnitude and geographic area of impact) and temporary in nature.

3.5.1.5 *Benefits of the Alternatives Compared to the No Action Alternative*

No Action Alternative Baseline

Several deficiencies have been identified for the No Action Alternative that result in a water deficit for irrigated croplands (990 acres) within the Daniel Irrigation system. Please refer to Map B6 in Appendix B of the Plan-EA that depicts the benefited area containing the 990 acres of irrigated agricultural lands. A water deficit occurs when a crop is irrigated with water below the full requirement for optimal plant growth. Based on information provided by Daniel Irrigation, the water deficits have resulted in loss of crop production in the benefitted area. Daniel Irrigation indicated that two cuttings of hay per season occur under current conditions, but a third cutting could be achieved if there was no water deficit.

The irrigation system is estimated to have a combined irrigation water delivery deficit of 23 percent from pressure deficiencies and water supply reliability issues. Assumptions and calculations for the No Action water deficit and effects on crop production are provided in the descriptions below for Benefits of Project Group 1 and Group 2. Hydraulic modeling of the irrigation system identified pressure and velocity deficiencies that result in an estimated 10 percent water delivery deficit. The system also contains asbestos cement pipe that has degraded over time with increasing pipeline breaks due to pipe softening. The breaks are not only costly to repair, but also result in loss of irrigation water service while they are being repaired. It is estimated that pipe breaks and loss in service to repair them would result in an average water deficit to crops by 8 percent. Loss of water during conveyance to irrigation storage ponds is also an issue. Daniel Irrigation estimates a 5 percent water deficit occurs due to water conveyance issues associated with delivery to the Lower Pond for storage.

Benefits of Project Group 1

Under both Action Alternatives, the benefits of Project Group 1 are expected to be reduced agricultural damages from enhanced water supply, and reduced OM&R in canal company infrastructure due to new pipes replacing aging pipes. Under both Action Alternatives, benefits considered but not quantified include potential public safety benefits from removal/abandonment of asbestos cement pipes and reduced flood damage costs from replacement of degraded pipe that could flood some infrastructure or roads if a break were to occur. These costs were not quantified as the likelihood and extent of avoided damages are not known.

Agricultural Damage Reduction Benefits

Under Alternative 2 and Alternative 1, the supply of irrigation water delivered in the Daniel

Irrigation service area would be improved due to increased operational flexibility, system pressures, and water supply reliability (from reduced pipe breaks). There are 990 irrigated acres in the service area, of which hay is the predominant crop. Alternative 1 is estimated to increase the average water supply by approximately 10% to 20% (depending on the location in the service area) over the No Action Alternative, while Alternative 2 is expected to increase the average water supply by 15% to 25% (depending on the location in the service area) over the No Action Alternative. This section estimates the economic benefits of improved irrigation water supply in terms of the value of increased hay yields. The analysis estimates the economic benefit of the additional water supply in mitigating water shortages and reducing agricultural damages. Specifically, the analysis estimates benefits of additional water that is expected to reduce deficit irrigation on hay acres that causes a loss of the annual yield.

Both Alternative 1 and Alternative 2 replace aging irrigation pipes; under the No Action these pipes would not be replaced. The new pipe and associated conveyance infrastructure improvements of both Action Alternatives will 1) increase water pressure throughout the system, and 2) increase water deliveries by avoiding trunk-line pipe breaks that interrupt irrigation water deliveries. Increasing water pressures throughout the system will increase total annual water deliveries to all 990 acres by an estimated 10% (BC&A 2022). Avoiding trunk-line pipe breaks, which average approximately 1 per year, will increase irrigation water supply by another estimated 10% on affected acres (typically breaks interrupt deliveries for approximately 2 weeks, or approximately 10 percent of the irrigation season). The acreage that is affected by trunk-line pipe breaks depends on the location of the break. In 40% of trunk-line breaks, all 990 acres of the service area are affected; in 30% of trunk-line breaks 814 acres are affected, and in the remaining 30% of trunk-line breaks 638 acres are affected (BC&A 2022). On average, 832 acres are affected annually due to trunk-line breaks.[7] Accordingly, replacing aging irrigation pipes will increase water supply by 20% on 832 acres (10% increase from increasing water pressure, and another 10% increase from avoided water supply interruptions), and increase water supply 10% on the other 158 acres; this results in a weighted average across all service area acres of 18% average annual increase in water supply.

In addition to these water supply improvements, under Alternative 2, there is a water supply benefit of the interconnection that allows more water from the Central Utah Water Conservancy District (CUWCD) to be delivered and stored for use throughout the entire Daniel Irrigation service area. The benefit of this interconnection varies on the water year type, with water supply throughout the service area expected to increase from 1% to 10% each year (BC&A 2022), or an average of approximately 5% water supply increase annually for all 990 acres of the service area. As such, under Alternative 2, the average water supply is expected to increase by 25%[8] on 832 acres, and by 15% on the other 158 acres, or a weighted average of 23% across all acres.[9] These results are shown in Table 1.

[7] The estimate of 832 acres is arrived at by the following equation: 40% X 990 acres+30% X 814 acres + 30% X 638 acres = 832 acres.

[8] This is from 10% increase from increased water pressure, another 10% from reduced water supply interruptions, and 5% from increased water from CUWCD.

[9] This is from 10% increase from increased water pressure, and 5% from increased water from CUWCD.

Table 1. Increased Average Annual Yield by Action Alternative, Compared to No Action

Type of Benefit	Alternative 2		Alternative 1	
	% Increased Water Supply	Average Annual Affected Acreage	% Increased Water Supply	Affected Acreage
Pressure Benefits	10%	990	10%	990
Interconnection Benefits	5%	990	N/A	N/A
Reduced Service Interruption (Reduced Breaks) Benefits				
Average Acres with Reduced Break Benefits	10%	832	10%	832
Average Acres without Reduced Break Benefits	0%	158	0%	158
Weighted Average Reduced Break Benefits	8%	990	8%	990
Total Average Annual Benefits	**23%**	**990**	**18%**	**990**

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Daniel Irrigation Company irrigators report that, currently, a good year results in yields of approximately 3.5 tons per acre (Daniel Irrigation Company 2022). We used this as the full irrigation yield that may be achieved with the Project. Research on the yield response of alfalfa to water indicates that deficit irrigation (when a crop is irrigated with water below the full requirement for optimal plant growth) affects yields approximately linearly (i.e., a 10% deficit irrigation would reduce yields by approximately 10% (Shewmaker et. al 2013). We therefore assumed that for every 10% change in water supply, there is a 0.35 ton per acre change in yield (3.5 tons per acre multiplied by 10% equals 0.35 ton per acre change). As such, for an 18% water supply increase we estimated 0.6 ton per acre yield increase, and for a 23% water supply increase we estimated 0.8 ton per acre yield increase.

For reference, the Utah State hay production budget for Wasatch County (Sulser et al. 2012) estimates potential yield of 5 tons of alfalfa hay, so yields of 3.5 tons per acre with full irrigation is reasonable. Further, according to National Agricultural Statistics Service data (National Agricultural Statistics Service, 2022), alfalfa hay yields in Wasatch County (where Daniels Irrigation service area is located) have averaged 3.2 tons per acre over the last five years, which is just 64% of potential irrigated yields (as indicated by the hay production budget) in the County. Therefore, an average increase of 18% to 23% of irrigated alfalfa hay production (or a yield change of 0.6 ton per acre to 0.8 ton per acre) with increased water deliveries appears reasonable.

To estimate the value of reduced damages from increased water supply, we adapted a published Utah State University crop budget (Sulser et al. 2012) to model the net revenues of agricultural production in Daniels Irrigation service area for alfalfa hay. From this source budget we developed crop budgets to model the net returns to hay under full irrigation and under deficit irrigation. The crop budgets are provided in Appendix C, with detailed explanation of the methods used to update revenues and costs to 2022-dollar values. The crop budget analysis is summarized in Table 2. Note that the fixed costs in the crop budgets, which include machinery, management, and land costs, may be high relative to the actual cash costs faced by growers (for example, growers may be operating and repairing older machines or may own the land and not be paying land rent), which may explain why estimated net returns are negative. However, as the purpose of this

analysis is to estimate the difference in net returns with additional irrigation water and associated yield, the fixed costs (which are essentially the same in all irrigation scenarios) do not affect the magnitude of estimated benefits from additional water. Further, cash returns may also be negative because many farms may have lifestyle benefits to proprietors, with proprietors valuing farm production for non-financial benefits.

Table 2. Summary of Per-Acre Hay Net Returns in Daniels Irrigation Service Area

Economic Variable (Per Acre)	Full Irrigation	Average Annual Change in Irrigation Water Supply	
		18% Deficit	23% Deficit
Estimated Yield (Tons Per Acre)	3.5	2.9	2.7
Estimated Increased Yield (Tons Per Acre)	N/A	0.6	0.8
Production Year 1 Net Returns (2022$)	-$286	-$352	-$371
Production Years 2-7 Net Returns (2022$)	-$114	-$217	-$246
Weighted Average Net Returns[1] (2022$)	-$138	-$237	-$264
Increased Value/Acre[2] (2022$)		$98	$126

Note: Full crop budgets are provided in Appendix C. Prepared December 2022
1 - Averaged over a seven-year stand life with 5 years comprised of Years 2-7 net returns.
2 - Equal to the difference of weighted average net returns between deficit and full irrigation.

Results from the analysis in Appendix C and summarized in Table 3 indicate that the enhanced water supply reliability under Alternative 2 will increase average annual net returns to alfalfa hay production in the Daniel Irrigation service area by $126 per acre and by $98 per acre under Alternative 1. Applying these values 990 acres in the service area, relative to the No Action, and taking account of the timing of benefits, results in expected annual average avoided damages of $119,000 under Alternative 2 and expected avoided damages of $92,000 under Alternative 1, as shown in Table 4.

Table 3. Avoided Annual Average Damages to Daniel Irrigation Service Area Agriculture

Parameter	Alternative 2, Project Group 1	Alternative 1, Project Group 1
Increased Net Returns Per Acre	$126	$98
Affected Acres	990	990
Increased Annual Net Returns in Service Area (Undiscounted)	$125,000	$97,000
Annual Average NEE Benefits[1]	**$119,000**	**$92,000**

Note: Totals may not sum due to rounding. Prepared December 2022
1 - Price Base: 2022 dollars amortized over 50 years at a discount rate of 2.5 percent

Avoided Operations, Maintenance, and Repair Costs

Under the No Action Alternative, no replacement of canal company pipes is expected. As noted above, pipes have broken and required repair in recent years, interrupting water deliveries. The

number and cost of pipe repairs has increased over the last several years as the pipes have increasingly aged (see Table 4). Daniel irrigation has experienced 10 asbestos cement pipe breaks within the last 25 years. The number of breaks has increased over time with four breaks occurring over 15 years (1997 to 2012) and six breaks occurring over the latter 10 years (2012-2022). The canal company expects that these pipes will continue to break with increasing frequency, and increasing associated repair cost, in each passing year under the No Action. Using this data, and assuming increasing frequency of breaks as the pipes age even more, we extrapolate the number of future breaks per year under the No Action Alternative. We estimate approximately 0.75 per year currently, to 0.84 breaks in Project Year 3 (the first year of benefits from Project Group 1 under both Action Alternatives), increasing up to 2.4 breaks per year[10] in 2074 (the end year in our period of analysis, or Project Year 52). Over the last six years, the canal company has incurred an average annual cost of $38,000 to repair pipe breaks, or approximately $50,000 per break event (Daniel Irrigation District 2022). We assume $50,000 per break event and apply this to the number of expected breaks each year under the No Action. With this method, avoided costs rise from $42,000 in Year 3 to $120,000 in Year 52. No pipe repair expenses are expected with the new pipe in the Action Alternatives over the 50-year analysis period, and other District O&M expenses are expected to be the same between the No Action and Action Alternatives. Results from this analysis are shown in Table 5, with an estimated annual average NEE benefit in avoided OM&R cost related to pipe repairs of $70,000 under both Action Alternatives.

Table 4. Pipe Breaks in Daniel Irrigation System

Year	Cumulative Breaks Since 1997	Average Breaks Per Year
2012	4	0.27
2022	10	0.60

Source: (Daniel Irrigation 2022)
Prepared December 2022

Table 5. Estimated Avoided OM&R Costs in Daniel Irrigation System

Parameter	Alternative 2	Alternative 1
Cost Per Break	$49,000	$49,000
Average Number of Avoided Breaks from Year 3 to Year 72	0.84 to 2.4	0.84 to 2.4
Undiscounted Annual Benefits	$81,000	$81,000
Average Annual NEE Benefit[1]	$70,000	$70,000

1 - Price Base: 2022 dollars amortized over 50 years at a discount rate of 2.5 percent
Prepared December 2022

Benefits of Project Group 2

Under both Action Alternatives, the benefits of Project Group 2 are expected to be improved public safety and reduced County OM&R costs associated with avoided flooding at the intersection of Center Creek Road and S 2400 E Street. This flooding would be avoided under both Action

[10] BC&A estimated the increase in breaks using a polynomial trend line (BC&A 2022).

Alternatives, while the flooding of the roadway would continue under the No Action. The County OM&R costs are quantified below, while public safety benefits were considered but not quantified. There have been no documented transportation accidents or other public safety incidents associated with Center Creek flooding, but when flooding does occur in the winter, the water freezes on the roadway at the intersection of Center Creek Road and S 2400 E Street and could cause an accident. The County flags the danger and motorists likely slow down, with limited change in travel time.

Avoided Operations, Maintenance, and Repair Costs

As described in the previous section, both Action Alternatives are expected to reduce flooding at the intersection of Center Creek Road and S 2400 E Street by Center Creek. This reduction of flooding will decrease County OM&R costs related to debris clearing and flagging. The County estimates this cost savings at $1,000 annually, including equipment and labor costs, as shown in Table 6 (Daniel Irrigation 2022).

Table 6. Avoided OM&R Costs at Center Creek

Parameter	Alternative 2	Alternative 1
Undiscounted Annual Benefits	$1,000	$1,000
Average Annual NEE Benefit[1]	$1,000	$1,000

1 - Price Base: 2022 dollars amortized over 50 years at a discount rate of 2.5 percent Prepared December 2022

3.5.1.6 *Incremental Analysis*

The Action Alternatives are evaluated in Table 7 and Table 8 below using an incremental analysis, which identifies how total costs and benefits change as project groups are added. The construction and engineering cost of each project group is independent of each other, with no change in project group cost if one is done separately from the other.

Table 7. Alternative 2 Incremental Analysis of Annual NEE Costs and Benefits

Project Groups	Total Costs	Incremental Costs	Total Benefits	Incremental Benefits	Net Benefits
1	$158,000		$189,000		$31,000
1, 2	$164,000	$6,000	$1,000	-$5,000	$26,000

1/Price Base: 2022 dollars amortized over 50 years at a discount rate of 2.5 percent Prepared December 2022

Table 8. Alternative 1 Incremental Analysis of Annual NEE Costs and Benefits

Project Groups	Total Costs	Incremental Costs	Total Benefits	Incremental Benefits	Net Benefits
1	$152,000		$162,000		$10,000
1, 2	$158,000	$6,000	$1,000	-$5,000	$5,000

1/Price Base: 2022 dollars amortized over 50 years at a discount rate of 2.5 percent Prepared December 2022

3.5.2 Environmental Evaluation

An environmental evaluation was completed for each alternative included in detailed study. These include the FWOFI Alternative (No Action Alternative) and the FWFI Alternatives (Alternatives 1 and 2). The potential effects of each alternative were determined for relevant resource categories and are documented in Section 6.0 (Environmental Consequences) of the Plan-EA.

3.6 Compare Alternatives

A measurement of change in services was determined, where applicable, between the FWOFI Alternative FWFI Alternatives. The alternatives meeting the guiding principles were noted in the framework table for side-by-side alternative comparison. The ecosystem services were also compared in the framework table. The PR&G evaluation comparison tables for decision making are included in Appendix A.

Alternatives were evaluated to determine the locally, environmentally, and socially preferred alternative plans. The locally preferred alternative was coordinated with the those having local interests and oversight for implementation authorities and responsibilities. The local entities included Wasatch County, Daniel Irrigation Company, and CUWCD. The environmentally preferred alternative was selected based on evaluations and decision making performed during the NEPA process, and from the determination of environmental consequences as documented in Section 6.0 of the Plan-EA. Determination of the socially preferred alternative compared impacts or benefits for each alternative related to the social wellbeing of the community.

3.7 Identify Recommended Alternative

The results of the PR&G evaluations resulted in selection of one alternative that “best” maximized public benefits (environmental, economic, and social goals) with appropriate consideration of costs, guiding principles, and ecosystem services. Alternative 2 (Daniel Irrigation Modified Alignment and Center Creek Improvements Alternative) was selected as the recommended alternative. This alternative was also selected in consideration of the federal objective, as set forth in the Water Resources Development Act of 2007, that reflect national priorities, encourage

economic development, and protect the environment through:

1) Seeking to maximize sustainable economic development.
2) Seeking to avoid the unwise use of floodplains and flood-prone areas and minimizing adverse impacts and vulnerabilities in any case in which a floodplain or flood-prone area must be used.
3) Protecting and restoring the functions of natural systems and mitigating any unavoidable damage to natural systems.

Alternative 2 is in line with the federal objective as outlined above. It maximizes sustainable economic development through improved water delivery increasing agricultural yield. The alternative minimizes vulnerabilities to hazards caused from ice-induced flooding to roadways. The recommended alternative avoids damages to natural systems and no mitigation measures would be required.

The intent of the Project is also in line with the PL 83-566 general purposes to

1) Prevent damage from erosion, floodwater, and sediment.
2) Further the conservation, development, utilization, and disposal of water.
3) Further the conservation and proper utilization of land.

Alternative 2 is considered the National Economic Efficiency (NEE) alternative for the Plan-EA based on the results of the PR&G Analysis. Alternative 2 provided the greatest cost-benefit, met the guiding principles, provided the greatest benefits for ecosystem services, and is in line with the federal objective and PL 83-566 general purposes. The Plan-EA incorporates a description of the decision-making process for selection of the NEE alternative in 8.1 (Rationale for Preferred Alternative Selection).

3.8 Implement and Evaluate

The NEE alternative (Alternative 2) and Alternative 1 were evaluated in the Plan-EA and environmental consequences of the alternatives are included in Section 6.0 of the Plan-EA. The No Action alternative was also evaluated in the Plan-EA to provide a baseline comparison. The effects of alternatives were determined for each resource relevant to the proposed action. The evaluation assessed the proposed alternatives against the baseline data presented in Section 4.0 (Affected Environment) of the Plan-EA.

An additional evaluation of the NEE alternative was completed that included information on implementing the proposed measures. This included recommended measures to be installed, avoidance/minimization measures, required permits and compliance, installation/financing, O&M, costs, cost share, and economic benefits. This is included in Section 8.0 (Preferred Alternative) of the Plan-EA.

4.0 References

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Appendix A

PR&G Framework and Tradeoff Table

PR&G Framework and Tradeoff Table

Tri-Valley Project
Tri-Valley Watershed

Alternatives Considered

Future Without Federal Investment (FWOFI): No Action Alternative
The SLO's most likely course of action would be to continue O&M activities for the Daniel Irrigation System and for flooding along Center Creek Road.

Future With Federal Investment (FWFI): Action Alternatives
Alternative 1: Daniel Irrigation and Center Creek Improvements
Alternative 2: Daniel Irrigation Modified Alignment and Center Creek Improvements
Alternative 3: Daniel Irrigation Install a Booster Station
Alternative 4: Daniel Irrigation Improvements with PVC
Alternative 5: Daniel Irrigation Improvements with Steel Pipe
Alternative 6: Center Creek Raise Road Profile
Alternative 7: Center Creek Pipe Center Creek
Alternative 8: Center Creek Upsize Culvert Under Center Creek Road

Alternatives 3, 4, and 5 were eliminated from evaluation in the table below because the costs to install the measures were greater than the other alternatives without providing any additional benefits. Alternative 6 resulted in adverse flooding to adjoining properties and was eliminated from futher evaluation. Alternative 7 and 8 did not solve the ice-induced flooding issue appropriately and were eliminated from further study.

Alternative 1 and 2 are included in the evaluation table below.

Please refer to Section 5.5 of the Plan-EA for further description of alternatives developed and justification for elimination.

Summary and Comparison

Item	FWOFI	FWFI		Comments
		Alternative 1	Alternative 2	
Alternative Plans				
Locally Preferred			✓	Wasatch County, Daniel Irrigation Company, and UCWCD are in support of Alternative 2.
Nonstructural	✓			There is not a feasible non-structural alternative that would meet the purpose and need, therefore, the FWOFI of maintaining the existing systems would be the nonstructural alternative.
Environmentally Preferred		✓	✓	Neither FWFI alternative has measurable adverse long-term environmental impacts.
Socially Preferred			✓	Alternative 2 would provide the greatest benefit to the agricultural community.
National Economic Efficiency			✓	Alternative 2 was determined to be the combination of measures that provided the greatest benefits and does not have measurable adverse long-term impacts to resources.
Guiding Principles				
Healthy and Resilient Ecosystems	✓	✓	✓	None of the alternatives have measurable adverse long-term environmental impacts to ecosystems.
Sustainable Economic Development			✓	Both FWFI alternatives benefit the economy through improved crop yield, but Alternative 2 provides a greater benefit to better support sustainable economic development.
Floodplains		✓	✓	None of the alternatives have measurable adverse long-term environmental impacts to floodplains.
Public Safety		✓	✓	Both FWFI alternatives improve public saftety equally.
Environmental Justice	✓	✓	✓	There are no disproportionately high or adverse human health or environmental effects on minority or low-income populations.
Watershed Approach		✓	✓	Both FWFI alternatives address the watershed problems identified for Daniel Irrigation System deficiencies and public safety concerns from ice-induced flooding.

Evaluation Framework and Tradeoffs			
Item	**FWOFI**	**FWFI**	
		Alternative 1	**Alternative 2**
Provisioning Services			
Food/Biomass	The community would continue to have irrigation delivery deficiencies resulting in decreased crop production.	Improves irrigation delivery efficiency and increases crop production providing an annual benefit of $92,000	Improves irrigation delivery efficiency and increases crop production providing an annual benefit of $119,000
Regulating Services			
Flood Control	Ice-induced flooding along Center Creek Road would continue	Reduces ice-induced flooding along Center Creek Road.	Same as Alternative 1.
Cultural Services			
Well-being and Safety	Physical well-being would continue to be degraded from the potential for exposure to asbestos as well as the risk of harm from ice flooding hazards along Center Creek Road. Continued decreased crop yield would increase financial stressors degrading the mental well-being of the agricultural community.	Asbestos pipe would no longer be used and the ice flooding hazards reduced which would reduce the risks to physical well-being. Improves the agricutural community mental well-being from a decrease of financial stressors related to crop yeild and improved agricultural sustainability.	Same as Alternative 1 with a greater benefit to crop yiled, further reducing financial stressors and improving mental well-being.

Economic Analysis			
Item	**FWOFI**	**FWFI**	
		Alternative 1	**Alternative 2**
Costs			
Installation Federal PL 83-566	-	$3,460,500	$3,550,500
Installation Sponsor	-	$1,076,500	$1,166,500
Annual Installation Costs	-	$158,000	$164,000
Annual O&M Costs	$71,000	$0	$0
Total Annual Costs	**$71,000**	**$158,000**	**$164,000**
Annual Benefits			
Maintaining Productivity	-	$92,000	$119,000
Avoided Costs	-	$71,000	$71,000
Total Annual Benefits	**-**	**$163,000**	**$190,000**
Cost Benefit Ratio and Net Benefits			
Cost-Benefit Ratio	**-**	**1.0**	**1.2**
Net Benefit	**($71,000)**	**$5,000**	**$26,000**
Decision-Making Conclusion	The FWOFI alternative is provided for comparison purpoes and is not selected as the NEE Alternative.	Alternative 1 has similar benefits to Alternative 2, but has reduced agricultural yield, reduced mental well-being, and less economic benefits when compared to Alternative 2.	**Selected as the NEE Alternative:** Alternative 2 has the greatest benefit to ecosystem services, the greatest economic benefit, and is the locally, socially, and environmentally preferred alternative that meets the purpose and need of the Project.

1 - Due to the alternative measures, O&M would decrease and is therefore a benefit of the project

Appendix B

Cost Estimates

Alternative 1 Cost Estimate

Site 1 (Daniel Irrigation) Construction Cost Estimate

Item	Quantity	Units	Unit Cost	Cost[1]
Mob/Demob	1	LS	$151,000	$151,000
Survey	1	LS	$15,000	$15,000
Traffic Control	1	LS	$25,000	$25,000
6" C-900 PVC Pipe	1,600	LF	$60	$96,000
8" C-900 PVC Pipe	950	LF	$65	$62,000
10" C-900 PVC Pipe	2,700	LF	$70	$189,000
12" C-900 PVC Pipe	2,200	LF	$80	$176,000
16" C-900 PVC Pipe	8,700	LF	$100	$870,000
20" C-900 PVC Pipe	7,350	LF	$125	$919,000
Service Connection	75	EA	$1,300	$98,000
Asphalt Replacement (3" Asphalt over 6" Road Base)	225,000	SF	$2.75	$619,000
			Subtotal	$3,220,000
			Contingency (20%)	$644,000
			TOTAL	**$3,864,000**

1-Rounded to the nearest thousand

Site 2 (Center Creek) Construction Cost Estimate

Item	Quantity	Units	Unit Cost	Cost[1]
Mob/Demob	1	LS	$10,000	$10,000
Survey	1	LS	$5,000	$5,000
SWPPP	1	LS	$10,000	$10,000
Traffic Control	1	LS	$10,000	$10,000
Channel Overflow Pipe (18" Class III Pipe)	450	LF	$110	$50,000
Channel Overflow Inlets	4	EA	$5,000	$20,000
Cross Drain Cutter	450	LF	$25	$11,000
			Subtotal	$116,000
			Contingency (20%)	$23,000
			TOTAL	**$139,000**

1-Rounded to the nearest thousand

Installation Costs

Item	Site 1 Cost	Site 2 Cost	Total Cost
Construction	$3,864,000	$139,000	$4,003,000
Engineering	$322,000	$17,000	$339,000
Permitting	$16,000	$10,000	$26,000
Administrative (Sponsor)	$80,500	$4,000	$84,500
Administrative (NRCS)	$80,500	$4,000	$84,500
TOTAL	**$4,363,000**	**$174,000**	**$4,537,000**

Alternative 2 Cost Estimate

Construction Cost Estimate

Item	Quantity	Units	Unit Cost	Cost[1]
Mob/Demob	1	LS	$156,000	$156,000
Survey	1	LS	$15,000	$15,000
Traffic Control	1	LS	$20,000	$20,000
6" C-900 PVC Pipe	1,750	LF	$60	$96,000
8" C-900 PVC Pipe	950	LF	$65	$62,000
10" C-900 PVC Pipe	4,700	LF	$70	$189,000
12" C-900 PVC Pipe	2,200	LF	$80	$176,000
16" C-900 PVC Pipe	8,700	LF	$100	$870,000
20" C-900 PVC Pipe	4,850	LF	$125	$606,000
30" C-900 PVC Pipe	1,150	LF	$220	$253,000
Valve Vault	2	EA	$100,000	$200,000
Service Connection	75	EA	$1,300	$98,000
Asphalt Replacement (3" Asphalt over 6" Road Base)	206,000	SF	$2.75	$567,000
			Subtotal	$3,308,000
			Contingency (20%)	$662,000
			TOTAL	**$3,970,000**

1-Rounded to the nearest thousand

Site 2 (Center Creek) Construction Cost Estimate

Item	Quantity	Units	Unit Cost	Cost[1]
Mob/Demob	1	LS	$10,000	$10,000
Survey	1	LS	$5,000	$5,000
SWPPP	1	LS	$10,000	$10,000
Traffic Control	1	LS	$10,000	$10,000
Channel Overflow Pipe (18" Class III Pipe)	450	LF	$110	$50,000
Channel Overflow Inlets	4	EA	$5,000	$20,000
Cross Drain Cutter	450	LF	$25	$11,000
			Subtotal	$116,000
			Contingency (20%)	$23,000
			TOTAL	**$139,000**

1-Rounded to the nearest thousand

Installation Costs

Item	Cost	Site 2 Cost	Total Cost
Construction	$3,970,000	$139,000	$4,109,000
Engineering	$331,000	$17,000	$348,000
Real Property Rights	$60,000	-	$60,000
Permitting	$17,000	$10,000	$27,000
Administrative (Sponsor)	$82,500	$4,000	$86,500
Administrative (NRCS)	$82,500	$4,000	$86,500
TOTAL	**$4,543,000**	**$174,000**	**$4,717,000**

Appendix C

Economic Evaluation Appendix

1.0 Economic Evaluation Appendix

This appendix presents the crop enterprise budgets used to estimate the benefits under the Action Alternative of avoiding agricultural damage to Daniels Irrigation service area. The analyses use a total of 6 crop budgets:

Table 1. Summary of Crop Budgets

Scenario	Production Year [1]	Budget Table
18% Deficit Irrigation	Year 1	Table 2
	Years 2-7	Table 3
23% Deficit Irrigation	Year 1	Table 4
	Years 2-7	Table 5
Full Irrigation	Year 1	Table 6
	Years 2-7	Table 7

1/ These refer to years in the alfalfa rotation and are not the same as the years measuring the study period in the analysis.

The costs and benefits of agricultural production are estimated using an enterprise budget that represents typical costs and returns of producing crops in Wasatch County. Enterprise budgets aim to reflect common practices and relevant costs for production in the region, but do not necessarily represent the conditions of any particular farm. As a starting point for the crop budgets in this analysis, we (Highland Economics) used a crop budget for alfalfa hay developed by Utah State University and then adjusted values in the budget to account for changes in prices through time and local conditions in the service area. A more recently published alfalfa hay budget for Wasatch County was not available from Utah State University. The following section outlines the data and assumptions used in adjusting the Utah State alfalfa hay budget.

1.1 Alfalfa Enterprise Budgets

The alfalfa hay enterprise budgets were based on a 2011 budget developed by Utah State University (USU) for establishing and producing alfalfa hay in the Wasatch County (Sulser, Curtis, & Snyder, 2012). We selected these budgets as the basis for service area crop production costs because they are the most recent crop budgets developed for producing alfalfa hay in Wasatch County.

We updated the costs presented in the original budgets to account for changing values over time and to reflect conditions specific to Daniel Irrigation service area. Returns to alfalfa under full irrigation were based on reported good year hay yields in Daniel Irrigation service area and 5-year normalized average hay prices in Utah for the period 2017-2021.1

[1] A normalized average is calculated by removing the highest and lowest values in a set of data and taking the mean of the remaining values.

1.2 Modeled Farm

The modeled farm is 125 acres, of which 80 acres are cultivated for alfalfa. Irrigation is delivered by a wheel line system.

1.3 Input Costs

For fertilizers in the non-establishment budgets, we adjust the amount used proportionally according to differences in yield from the original budget. Since the full irrigation budget yield (3.9 tons/acre) is 78 percent of the original budget yield (5 tons/acre), we have a fertilizer quantity that is 78 percent of the amount in the original budget. The Year 1 Production budgets retain the fertilizer levels from the original budget.

All costs are adjusted from the original values in the USU budget. We used area-specific values for land costs, which we based on rental rates for irrigated cropland in Wasatch County ($77 per acre) (NASS 2022).[2] For other costs, we adjusted the value in the original budget using the national Producer Price Indices (PPI) produced by the NASS, which are published for a variety of farm expenses (NASS 2022). For example, there are price indices for fertilizer, herbicides, supplies, tractors, custom work, as well as one for the farm sector in general. The PPI cost adjustments range from an 11-percent increase in the price of Insecticides to a 69-percent increase in Machinery Totals.

1.3.1 Labor Costs

In the original budget, labor is provided by the operator and hired labor. In our adapted budget, we represent the cost of all labor using the median hourly wage for Agricultural Equipment Operators in Utah in 2021. We adjust this for inflation to 2022 using the GDP Price Deflator and further increase it by 20 percent to account for non-wage employment costs, such as health care and insurance.[3] This brings the total cost of machinery labor to $21.88 per hour.

1.3.2 Revenues

To estimate the gross revenues of alfalfa hay, we use the normalized average price per ton for alfalfa hay in Utah using the NRCS method[4] and data from 2017 to 2021. NRCS has published a price for price for 2022 that is based on data from 2016 to 2020. Because there is more recent data available through 2021, we use the NRCS method to develop a normalized average price for 2017 to 2021 to reflect recent price increases. The normalized average price for alfalfa in Utah for the period 2017 to 2021 is $192, compared to the normalized average price from 2016 to 2020 of $167 per ton.

1.3.3 Alfalfa Enterprise Budget Tables

The tables below present alfalfa hay enterprise budgets used to estimate the costs and returns under different irrigation levels.

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[2] For Wasatch County, we took the normalized average price from 2013-2021. The normalized average is calculated by removing the high and low values from dataset and taking the mean of the remaining values.

[3] This is roughly the average proportion of non-wage labor costs for all private, part-time workers in the U.S. in December 2018 (U.S. Bureau of Labor Statistics, 2019).

[4] The NRCS method adjusts the average price at the state level by the relative change in prices at the national level. This involves taking the most recent 3-year average in the state (in this case, 2019-2021), multiplying it by the most recent 3-year average in the US, and dividing by the most recent 5-year average price in the US (2017-2021) (USDA Economic Research Service, 2022).

Table 2. Alfalfa Net Returns Under 18% Deficit Irrigation, Production Year 1

Item	Quantity	Unit	$/Unit	Total
REVENUE				
Alfalfa Hay	2.3	tons	$192.09	$441.03
VARIABLE COSTS				
Insecticide	1.0	ac	$22.18	$22.18
Herbicide	1.0	ac	$44.95	$44.95
Fertilizer	0.8	ac	$63.30	$51.90
Custom Chemical App	1.0	ac	$18.93	$18.93
Testing (soil & forage)	1.0	ac	$1.63	$1.63
Irrigation	0.8	ac	$64.64	$53.01
Alfalfa seed	1.0	ac	$36.75	$36.75
Labor	1.6	hr	$21.88	$35.88
Operator Labor	1.0	hr	$21.88	$21.88
Fuel & lube	1.0	ac	$51.88	$51.88
Maintenance	1.0	ac	$65.31	$65.31
Miscellaneous	1.0	ac	$6.54	$6.54
Total operating costs				*$410.82*
FIXED COSTS				
Liability/crop insurance	1.0	ac	$9.80	$9.80
Accounting & legal	1.0	ac	$9.77	$9.77
Office & travel	1.0	ac	$10.05	$10.05
Annual investment insurance	1.0	ac	$8.32	$8.32
Annual investment taxes	1.0	ac	$2.16	$2.16
Buildings, improvements, equipment	1.0	ac	$37.77	$37.77
Machinery & vehicles	1.0	ac	$228.08	$228.08
Land rent	1.0	ac	$76.52	$76.52
Total ownership costs				*$382.47*
Total costs				*$793.29*
NET RETURNS PER ACRE				**-$352.26**

Table 3. Alfalfa Net Returns Under 18% Deficit Irrigation, Production Years 2-7

Item	Quantity	Unit	$/Unit	Total
REVENUE				
Alfalfa Hay	2.9	tons	$192.09	$551.29
VARIABLE COSTS				
Insecticide	1.0	ac	$22.18	$22.18
Herbicide	1.0	ac	$17.75	$17.75
Fertilizer	0.6	ac	$63.30	$36.33
Custom Chemical App	1.0	ac	$18.93	$18.93
Testing (soil & forage)	1.0	ac	$1.63	$1.63
Irrigation	0.8	ac	$64.64	$53.01
Labor	1.6	hr	$21.88	$35.88
Operator Labor (changed to machine labor)	1.0	hr	$21.88	$21.88
Fuel & lube	1.0	ac	$51.88	$51.88
Maintenance	1.0	ac	$65.31	$65.31
Miscellaneous	1.0	ac	$6.54	$6.54
Total operating costs				*$331.29*
FIXED COSTS				
Liability/crop insurance	1.0	ac	$9.80	$9.80
Accounting & legal	1.0	ac	$9.77	$9.77
Office & travel	1.0	ac	$10.05	$10.05
Annual investment insurance	1.0	ac	$8.32	$8.32
Annual investment taxes	1.0	ac	$2.16	$2.16
Buildings, improvements, equipment	1.0	ac	$37.77	$37.77
Machinery & vehicles	1.0	ac	$228.08	$228.08
Land rent	1.0	ac	$76.52	$76.52
Amortized establishment costs	1.0	ac	$54.95	$54.95
Total ownership costs				*$437.43*
Total costs				*$768.72*
NET RETURNS PER ACRE				**-$217.43**

Table 4. Alfalfa Net Returns Under 23% Deficit Irrigation, Production Year 1

Item	Quantity	Unit	$/Unit	Total
REVENUE				
Alfalfa Hay	2.2	tons	$192.09	$414.14
VARIABLE COSTS				
Insecticide	1.0	ac	$22.18	$22.18
Herbicide	1.0	ac	$44.95	$44.95
Fertilizer	0.8	ac	$63.30	$48.74
Custom Chemical App	1.0	ac	$18.93	$18.93
Testing (soil & forage)	1.0	ac	$1.63	$1.63
Irrigation	0.8	ac	$64.64	$49.77
Alfalfa seed	1.0	ac	$36.75	$36.75
Labor	1.5	hr	$21.88	$33.69
Operator Labor	1.0	hr	$21.88	$21.88
Fuel & lube	1.0	ac	$51.88	$51.88
Maintenance	1.0	ac	$65.31	$65.31
Miscellaneous	1.0	ac	$6.54	$6.54
Total operating costs				*$402.24*
FIXED COSTS				
Liability/crop insurance	1.0	ac	$9.80	$9.80
Accounting & legal	1.0	ac	$9.77	$9.77
Office & travel	1.0	ac	$10.05	$10.05
Annual investment insurance	1.0	ac	$8.32	$8.32
Annual investment taxes	1.0	ac	$2.16	$2.16
Buildings, improvements, equipment	1.0	ac	$37.77	$37.77
Machinery & vehicles	1.0	ac	$228.08	$228.08
Land rent	1.0	ac	$76.52	$76.52
Total ownership costs				*$382.47*
Total costs				*$784.71*
NET RETURNS PER ACRE				**-$370.57**

Table 5. Alfalfa Net Returns Under 23% Deficit Irrigation, Production Years 2-7

Item	Quantity	Unit	$/Unit	Total
REVENUE				
Alfalfa Hay	2.7	tons	$192.09	$517.67
VARIABLE COSTS				
Insecticide	1.0	ac	$22.18	$22.18
Herbicide	1.0	ac	$17.75	$17.75
Fertilizer	0.5	ac	$63.30	$34.12
Custom Chemical App	1.0	ac	$18.93	$18.93
Testing (soil & forage)	1.0	ac	$1.63	$1.63
Irrigation	0.8	ac	$64.64	$49.77
Labor	1.5	hr	$21.88	$33.69
Operator Labor (changed to machine labor)	1.0	hr	$21.88	$21.88
Fuel & lube	1.0	ac	$51.88	$51.88
Maintenance	1.0	ac	$65.31	$65.31
Miscellaneous	1.0	ac	$6.54	$6.54
Total operating costs				*$323.66*
FIXED COSTS				
Liability/crop insurance	1.0	ac	$9.80	$9.80
Accounting & legal	1.0	ac	$9.77	$9.77
Office & travel	1.0	ac	$10.05	$10.05
Annual investment insurance	1.0	ac	$8.32	$8.32
Annual investment taxes	1.0	ac	$2.16	$2.16
Buildings, improvements, equipment	1.0	ac	$37.77	$37.77
Machinery & vehicles	1.0	ac	$228.08	$228.08
Land rent	1.0	ac	$76.52	$76.52
Amortized establishment costs	1.0	ac	$57.81	$57.81
Total ownership costs				*$440.28*
Total costs				*$763.94*
NET RETURNS PER ACRE				**-$246.26**

Table 6. Alfalfa Net Returns Under Full Irrigation, Production Year 1

Item	Quantity	Unit	$/Unit	Total
REVENUE				
Alfalfa Hay	2.8	tons	$192.09	$537.84
VARIABLE COSTS				
Insecticide	1	ac	$22.18	$22.18
Herbicide	1	ac	$44.95	$44.95
Fertilizer	1	ac	$63.30	$63.30
Custom Chemical App	1	ac	$18.93	$18.93
Testing (soil & forage)	1	ac	$1.63	$1.63
Irrigation	1	ac	$64.64	$64.64
Alfalfa seed	1	ac	$36.75	$36.75
Labor	2	hr	$21.88	$43.75
Operator Labor	1	hr	$21.88	$21.88
Fuel & lube	1	ac	$51.88	$51.88
Maintenance	1	ac	$65.31	$65.31
Miscellaneous	1	ac	$6.54	$6.54
Total operating costs				*$441.73*
FIXED COSTS				
Liability/crop insurance	1	ac	$9.80	$9.80
Accounting & legal	1	ac	$9.77	$9.77
Office & travel	1	ac	$10.05	$10.05
Annual investment insurance	1	ac	$8.32	$8.32
Annual investment taxes	1	ac	$2.16	$2.16
Buildings, improvements, equipment	1	ac	$37.77	$37.77
Machinery & vehicles	1	ac	$228.08	$228.08
Land rent	1	ac	$76.52	$76.52
Total ownership costs				*$382.47*
Total costs				*$824.20*
NET RETURNS PER ACRE				**-$286.36**

Table 7. Alfalfa Net Returns Under Full Irrigation, Production Years 2-7

Item	Quantity	Unit	$/Unit	Total
REVENUE				
Alfalfa Hay	3.5	tons	$192.09	$672.30
VARIABLE COSTS				
Insecticide	1.0	ac	$22.18	$22.18
Herbicide	1.0	ac	$17.75	$17.75
Fertilizer	0.7	ac	$63.30	$44.31
Custom Chemical App	1.0	ac	$18.93	$18.93
Testing (soil & forage)	1.0	ac	$1.63	$1.63
Irrigation	1.0	ac	$64.64	$64.64
Labor	2.0	hr	$21.88	$43.75
Operator Labor (changed to machine labor)	1.0	hr	$21.88	$21.88
Fuel & lube	1.0	ac	$51.88	$51.88
Maintenance	1.0	ac	$65.31	$65.31
Miscellaneous	1.0	ac	$6.54	$6.54
Total operating costs				*$358.78*
FIXED COSTS				
Liability/crop insurance	1.0	ac	$9.80	$9.80
Accounting & legal	1.0	ac	$9.77	$9.77
Office & travel	1.0	ac	$10.05	$10.05
Annual investment insurance	1.0	ac	$8.32	$8.32
Annual investment taxes	1.0	ac	$2.16	$2.16
Buildings, improvements, equipment	1.0	ac	$37.77	$37.77
Machinery & vehicles	1.0	ac	$228.08	$228.08
Land rent	1.0	ac	$76.52	$76.52
Amortized establishment costs	1.0	ac	$44.67	$44.67
Total ownership costs				*$427.14*
Total costs				*$785.92*
NET RETURNS PER ACRE				**-$113.62**

Aquatic Resources Report

Tri-Valley Watershed EA
Aquatic Resources
Report

Prepared for:

Wasatch County

Attn: Brandon Cluff
55 South 500 East
Heber City, UT 84032
435-657-3205

Prepared by:

BOWEN COLLINS & ASSOCIATES

154 East 14075 South
Draper, UT 84020
801-495-2224

March 2022

Executive Summary

The Tri-Valley Watershed EA wetland delineation was conducted according to the Corps of Engineers Wetlands Delineation Manual (ACOE 1987) and the Arid West Supplement (ACOE 2008).

A total of 61 acres were surveyed as part of this delineation. Seven (7) aquatic resources were identified during the delineation, for a total of 0.62 acres of wetlands, 0.7 acres of open water (freshwater and excavated ponds), and 647 feet of streams, plus 10,665 feet of excavated ditches. The dominant aquatic resource classification for the project area were palustrine emergent wetlands (PEM1E), open water detention ponds (PABFx), creeks (R4SBC), and irrigation ditches (R5UBFx) and the condition of these resources were typical at the time of the delineation.

TABLE OF CONTENTS

Page No.

INTRODUCTION **1**

SITE LOCATION AND METHODOLOGY **1**

Hydrophytic Vegetation 2

Wetland Hydrology 2

Hydric Soils 2

RESULTS **2**

Vegetation 2

Hydrology 3

Soils 3

Sample Points 4

Wetland Boundaries 5

REFERENCES **7**

LIST OF TABLES

Table 1 - Plants Observed in the Daniel Irrigation Delineation Area 3

Table 2 - Wetland Delineation Sample Point Summary and Determination Matrix 4

Table 3 - Aquatic Resources Within the Survey Area 6

APPENDICES

Appendix A - Site Location Maps

Appendix B - National Wetland Inventory

Appendix C - Wetland Determination Data Forms & Photographs

Appendix D - Soil Map & NRCS Custom Soils Resource Report

Appendix E - Wetland Delineation Results Figures

Appendix F - Aquatic Resources Spreadsheet

Appendix G - Additional Photos

Appendix H - Access Waiver

INTRODUCTION

This document presents results of a delineation of jurisdictional waters of the United States conducted for the Wasatch County (County) by Bowen Collins & Associates (BC&A) for the Tri-Valley Watershed Environmental Assessment. The County is evaluating plans to update the piping and pumping system to improve irrigation delivery methods and allow better access for pipe maintenance in this area. Additionally, they would like to address flooding of Center Creek near Center Creek Road and 2400 East with an overflow pipe and several catch basins. The purpose of this delineation is to determine potential wetland impacts as part of the proposed rehabilitation project.

SITE LOCATION AND METHODOLOGY

The project area is located in Wasatch County, Utah, Sections 16, 17, 18, 20, 21, and 22, Township 4S, Range 5E. Directions to the site are as follows: From Salt Lake City, take Interstate 80 up Parley's Canyon. Travel 18.3 miles to Exit 146 for US-189 toward Heber/Vernal. Continue south on US-189 got 17.5 miles through Heber City. Turn east onto 1300 S for 0.1 miles then south onto Daniel Rd/Daniels Canyon Road. Continue 0.5 miles to arrive at the northern point of the project area (See Site Location Figures, Appendix A).

The wetlands delineated are along Daniels Creek, which flows from Daniels Canyon and runs along Highway 40. Daniels Creek originates from multiple drainages within the canyon and terminates in Deer Creek Reservoir. A small section of Center Creek is also within the delineated area, adjacent to Center Creek Road. Irrigation detention ponds and ditches were also observed in the project area, which are used for flood irrigation practices. There is no interstate or foreign commerce taking place on or within the delineated wetlands or associated waters.

Field work for this delineation was conducted on October 31, 2020 by Merissa Davis of BC&A. The total area delineated was approximately 61 acres and this entire area was observed during the site visits. Field conditions during the survey were clear and the area had not received precipitation for several weeks prior.

The Soil Survey for Heber Valley Area, Utah (Parts of Wasatch and Utah Counties) (NRCS 2020) was used to determine soil types for the area. National Wetlands Inventory (NWI) data was also examined to obtain the location of possible jurisdictional wetlands on the site (see NWI figure, Appendix B). The wetland delineation was conducted according to the Corps of Engineers Wetlands Delineation Manual (ACOE 1987), Arid West Supplement (ACOE 2008), with a minimum of one sampling point per wetland area. Upland points were also sampled to further confirm wetland boundaries. A total of five points were sampled to delineate the wetlands on the site, and these were sufficient to determine the location of the wetland boundaries. Points and boundaries were recorded ArcGIS Collector and ArcSurvey 123 connected to a Trimble R1 GNSS receiver with sub-meter accuracy.

Based on the Manual, jurisdictional wetlands were identified using three criteria:

- Hydrophytic Vegetation
- Wetlands Hydrology
- Hydric Soils

All three criteria must be present for a wetland to be considered jurisdictional. An explanation of these wetland criteria follows.

Hydrophytic Vegetation

Hydrophytic plants are plants that are adapted to wet conditions. The National Wetland Plant List for the Arid West Region (ACOE 2012) was used to determine the wetland indicator status of dominant plant species encountered on sample plots. Sight-identification was used to determine most plant species.

Wetland Hydrology

Wetland hydrology is present when an area is inundated either permanently or periodically at mean water depths of two meters, or the soil is saturated to the surface at some time during the growing season of the prevalent vegetation. Primary hydrologic indicators also include high water tables, oxidized root channels, and sediment and drift deposits. Common secondary hydrologic indicators include watermarks, drainage patterns, and the FAC neutral test.

Hydric Soils

In Field Indicators of Hydric Soils in the U.S. (NRCS 2010) the Natural Resources Conservation Service (NRCS) defines hydric soils as soils that are formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the top 12 to 20 inches of soil, depending on soil texture. Hydric properties of soils were assessed using a spade to excavate the soil pit, and Munsell soil color charts to determine soil color.

RESULTS

Vegetation

Vegetation was identified primarily based on flowering parts and structural characteristics. Vegetation data collected and photos of the general vegetation for each sample point can be found in the Wetland Determination Data Forms (see Appendix C). The delineated area is dominated by sage and native grasses in the uplands and typical emergent plants in the wetland areas including rushes, horsetails, and cottonwoods. Dominant plants that occur at the sampling locations are listed in Table 1 below.

Table 1
Plants Observed in the Daniel Irrigation Delineation Area

Latin Binomial	Common Name	Region 8 Indicator Status
Equisetum hyemale	Scouringrush Horsetail	FACW
Juncus articus	Mountain Rush	FACW
Juncus balticus	Baltic Rush	FACW
Populus angustifolia	Narrowleaf Cottonwood	FACW
Salix exigua	Narrowleaf Willow	FACW
Pascopyrum smithii	Western Wheatgrass	FAC
Poa pratensis	Kentucky Bluegrass	FAC
Cirsium arvense	Canada Thistle	FACU
Sisymbrium altissimum	Tumble Mustard	FACU
Phleum pratense	Timothy	FACU
Thlaspi arvense	Pennycress Mustard	UPL
Carex geyeri	Geyer's Sedge	UPL
Bromus marginatus	Mountain Brome	UPL
Salcia officinalis	Sage	UPL

Note: Hydrophytic plant species are shaded gray.

Hydrology

The main water source that creates the hydrologic zone at the project site is Daniels Creek and its floodplain which flows south to north runs through the delineated area. Ordinary high water mark for Daniels Creek was approximately 5,831 feet at the south end of the delineated area and dropped down to 5,819 feet at the north end (See Figure 4B). Finally, there are several other man-made irrigation detention ponds that provide hydrology to the irrigation ditches throughout the project area.

Primary hydrologic indicators at the site included surface water, high water tables, and soil saturation. Hydrologic data collected at the sample points can be found in the Wetland Determination Data Forms (see Appendix C).

Soils

The site landforms include alluvial fans, flood plains, and stream terraces. The Heber Valley Area (Parts of Wasatch and Utah Counties), Utah Soil Survey (NRCS 2021) was referenced to determine soil types for the area. In addition to areas with water, the following soil types occur within the delineated area:

- Center Creek loam (1-3% slopes), somewhat poorly drained, no flooding
- Clegg loam (1-3% slopes), well drained, no flooding
- Clegg loam (3-6% slopes), well drained, no flooding

- Clegg loam (6-15% slopes), well drained, no flooding
- Henefer silt loam (1-3% slopes), well drained, no flooding
- Holmes cobbly sandy loam, well drained, no flooding
- Holmes gravelly loam, well drained, no flooding
- Kovich loam, deep water table variant, somewhat poorly drained, rare to no flooding
- Manila loam (3-6% slopes), well drained, no flooding
- Steed loam, cold variant, well drained, no flooding
- Yeats Hollow loam (2-5% slopes), well drained, no flooding

The Kovich loam soil is on the national and Utah hydric soils lists (NRCS 2015). Soil properties such as texture and Munsell soil color generally matched the soil descriptions found in the Soil Survey for Heber Valley Area, Utah (Parts of Wasatch, and Utah Counties) (NRCS 2021). The soils were classified as 10YR 2/1, 10YR 2/2, and 10YR 3/2. The soil textures were sandy loam, fine loam, fine silt loam, and cobble & small rocks. Soil data collected at the sample points and photos of the soil pits dug at each sample point can be found in the Wetland Determination Data Forms (see Appendix C). Additionally, a custom soil resource report from the NRCS for the site is located in Appendix D.

Sample Points

Of the five sample points taken at the site, two were located in wetlands. The wetland delineation results figure in Appendix E displays the sample point locations, Table 2 summarizes the sample point data.

Table 2
Wetland Delineation Sample Point Summary and Determination Matrix

Sample Point	Hydrophytes Dominant?	Hydric Soils Present?	Primary Hydrologic Indicator(s) Present?	Is the Sample Point in a Wetland?
1	Yes	Yes	Yes	Yes
2	No	Yes	No	No
3	Yes	Yes	No	Yes
4	Yes	Yes	Yes	Yes
5	Yes	No	No	No

Wetland Boundaries

The wetlands in the area are typically saturated and/or inundated depending on the season. Daniels Creek creates a wide network of wetlands and seasonal hydrology. Irrigation runoff from the adjacent farmlands often adds additional hydrology to this system. Overall, the wetland lines in these areas were distinct due to vegetation and hydrology.

A total of 0.62 acres of palustrine emergent wetlands (W2 & W3) were identified within the delineation areas. These are sourced from Daniels Creek (W1), which meanders through the project area. These are classified as Palustrine Emergent Wetlands Persistent, Seasonally flooded/saturated (PEM1E) by the NWI classification system and have potential to be jurisdictional.

Irrigation ponds were observed within the delineation area, totaling to 0.7 acres (W4 & W5). Water was present during the investigation and both ponds are classified as Palustrine Aquatic Bed Semipermanent Flooded, Excavated (PABFx) by the NWI classification system. These excavated ponds had distinct changes in soil color and topography that allowed for identification of the ordinary high water mark, as shown in the delineation figures located in Appendix E. These irrigation detention ponds are not expected to be jurisdictional however that is a determination to be made the U.S. Army Corps of Engineers.

Both Daniels Creek (W1) and Center Creek (W6) run within the delineation area, totaling to 647 linear feet of Water of the U.S. Both Daniels Creek and Center Creek are sourced from canyon snowmelt and stormwater drainage. Center Creek is located in the northern portion of the delineation area and merges with the Timpanogos Canal. Daniels Creek is in the southern portion of the delineation area and drains into Deer Creek Reservoir. Changes in soil and vegetation clearly defined the ordinary high water mark of these channels, as shown in the delineation figures located in Appendix E. These Waters of the U.S. are both classified as Riverine Intermittent Streambed, Seasonally Flooded (R4SBC) by the NWI classification system and have potential to be jurisdictional.

Excavated irrigation ditches are present within the project area, totaling to 10,665 linear feet (W7). Some of these are still in use, while other sections have been abandoned and replaced by pipelines in the past. According to the NWI classification system, these irrigation ditches are classified as Riverine Unknown Perennial Unconsolidated Bottom Semi Permanently Flooded, Excavated (R5UBFx). The ditches were dry at the time of the delineation and no potential wetlands were present in or around them. The ditches are not expected to be jurisdictional however that is a determination to be made the U.S. Army Corps of Engineers.

Indicators for vegetation, hydrology, and hydric soils were clear and easily identified. The identified wetlands are classified as palustrine emergent wetlands (PEM1E), irrigation detention ponds (PABFx), intermittent streams (R4SBC), and irrigation ditches (R5UBFx) according to the NWI classification system. Boundaries for these wetlands and waters are shown in the wetland delineation figures located in Appendix E, listed in the Aquatic Resources spreadsheet in Appendix F, and shown in Table 3 on the next page.

Table 3
Aquatic Resources Within the Survey Area

Aquatic Resource Name	Aquatic Resources Classification		Aquatic Resource Size (acres)	Aquatic Resource Size (linear feet)
	Cowardin*	Location (UTM)		
W1	R4SBC	40.461668 / -111.395007	(0.1)	310
W2	PEM1E	40.461902 / -111.394104	0.05	
W3	PEM1E	40.461257 / -111.393154	0.57	
W4	PABFx	40.456585 / -111.391213	0.09	
W5	PABFx	40.456585 / -111.373421	0.61	
W6	R4SBC	40.478259 / -111.376361	(0.03)	337
W7	R5UBFx	40.464576 / -111.376361	(0.74)	10,665

*Cowardin Codes:
PEM1E - Palustrine Emergent Persistent, Seasonally Flooded/Saturated
R4SBC - Riverine Intermittent Streambed, Seasonally Flooded
PABFx – Palustrine Aquatic Bed, Semi permanently Flooded, Excavated
R5UBFx - Riverine Unknown Perennial Unconsolidated Bottom, Semi permanently Flooded, Excavated

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Appendix A

Site Location Maps

Heber

Daniel

189

40

LEGEND

Project Boundary (61 acres)

SCALE: 0 5001,000 Feet

NORTH: NORTH

SITE LOCATION

WASATCH COUNTY
TRI-VALLEY
WATERSHED EA

BOWEN COLLINS & ASSOCIATES

FIGURE NO.
1A

Figure Created By
Marilyn Rice 11/13/2020
Imagery: Hexagon 2018

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LEGEND

Project Boundary (61 acres)

SCALE: 0 5001,000 Feet

NORTH: NORTH

SITE LOCATION

WASATCH COUNTY
TRI-VALLEY
WATERSHED EA

BOWEN COLLINS & ASSOCIATES

FIGURE NO.
1B

Figure Created By
Marilyn Rice 11/13/2020
USGS Quads: Charleston, Center Creek

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Appendix B

National Wetland Inventory

L E G E N D

Project Boundary (61 acres)

National Wetland Inventory

- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake
- Riverine

PEM1C
R4SBC
R5UBFx
R4SBC
R5UBFx
R5UBFx
PFOAx
PFOA
PABFx
R4SBC
PEM1C
R4SBC
PABFx
PFOA
R4SBC
PUSCh

Figure Created By
Marilyn Rice 11/13/2020
Imagery: Hexagon 2018

SCALE: 1 in. = 1,000 ft.

NORTH: NORTH

NATIONAL WETLANDS INVENTORY

WASATCH COUNTY
TRI-VALLEY
WATERSHED EA

BOWEN COLLINS & ASSOCIATES

FIGURE NO.
2

P:\Wasatch County\627-19-01 Tri-Valley Watershed Plan EA\4.0 GIS\4.1 Projects\Environmental\Figs_NWI.mxd cgilabau 8/29/2021

Appendix C

Wetland Determination Data Forms & Photographs

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Daniel Irrigation City/County: Daniel/Wasatch Sampling Date: 10/30/2020

Applicant/Owner: Wasatch County State: UT Sampling Point: SP1

Investigator(s): Merissa Davis Section, Township, Range: Section 21, Township 4, Range 5E

Landform (hillslope, terrace, etc.): depression Local relief (concave, convex, none): _____ Slope (%): _____

Subregion (LRR): D - Interior Deserts Lat: 4,479,106.10 Long: 466,582.85 Datum: UTM

Soil Map Unit Name: Steed Loam, Cold Variant NWI classification: N/A

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✓ No _____ (If no, explain in Remarks.)

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes ✓ No _____

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ✓	No _____	**Is the Sampled Area within a Wetland?** Yes ✓ No _____
Hydric Soil Present?	Yes ✓	No _____	
Wetland Hydrology Present?	Yes ✓	No _____	

Remarks:

Depression near creek, standing water, ponded from high ground water or seep.

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: _____)	Absolute % Cover	Dominant Species?	Indicator Status
1. Populus angustifolia (Narrowleaf Cottonwood)	25	YES	FACW
2.			
3.			
4.			
	25 = Total Cover		
Sapling/Shrub Stratum (Plot size: _____)			
1. Salix exigua (Narrowleaf willows)	10	YES	FACW
2.			
3.			
4.			
5.			
	10 = Total Cover		
Herb Stratum (Plot size: _____)			
1. Juncus articus (Mountain Rush)	70	YES	FACW
2. Pascopyrum smithii (Western wheatgrass)	15		FAC
3. Poa pratensis (Kentucky bluegrass)	10		FAC
4. Equisetum hyemale (Scouringrush Horsetail)	5		FACW
5.			
6.			
7.			
8.			
	100 = Total Cover		
Woody Vine Stratum (Plot size: _____)			
1.			
2.			
	_____ = Total Cover		

% Bare Ground in Herb Stratum 0 % Cover of Biotic Crust _____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 3 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 % (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	0	x 1 =	0
FACW species	110	x 2 =	220
FAC species	25	x 3 =	75
FACU species	0	x 4 =	0
UPL species	0	x 5 =	0
Column Totals:	135 (A)		295 (B)

Prevalence Index = B/A = 2.18

Hydrophytic Vegetation Indicators:

✓ Dominance Test is >50%

✓ Prevalence Index is ≤3.0[1]

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ✓ No _____

Remarks:

Grasses on fringe but some mixed in.

SOIL

Sampling Point: SP1

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
0-6	10 YR 2/1	100					Fine	silty loam
6-16	-						cobble	& small rocks

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) (**LRR C**)
- ___ 1 cm Muck (A9) (**LRR D**)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) (**LRR C**)
- ___ 2 cm Muck (A10) (**LRR B**)
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: _____

Depth (inches): _____

Hydric Soil Present? Yes ✓ **No** _____

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1) (**Nonriverine**)
- ___ Sediment Deposits (B2) (**Nonriverine**)
- ___ Drift Deposits (B3) (**Nonriverine**)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Salt Crust (B11)
- ___ Biotic Crust (B12)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water Marks (B1) (**Riverine**)
- ___ Sediment Deposits (B2) (**Riverine**)
- ___ Drift Deposits (B3) (**Riverine**)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ✓ No _____ Depth (inches): _____

Water Table Present? Yes _____ No _____ Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes ✓ No _____ Depth (inches): 0

Wetland Hydrology Present? Yes ✓ **No** _____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

Standing (ponded water) on w. side. Saturated to surface in remainder.

Daniel Irrigation Delineation Photos
October 30, 2020



Sample Point #1 Wetland



Sample Point #1 Area

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Daniel Irrigation City/County: Daniel/Wasatch Sampling Date: 10/30/2020

Applicant/Owner: Wasatch County State: UT Sampling Point: SP2

Investigator(s): Merissa Davis Section, Township, Range: Section 21, Township 4, Range 5E

Landform (hillslope, terrace, etc.): _____ Local relief (concave, convex, none): _____ Slope (%): _____

Subregion (LRR): D - Interior Deserts Lat: 4,479,108.92 Long: 466,582.72 Datum: UTM

Soil Map Unit Name: Steed Loam, Cold Variant NWI classification: R4SBC

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✓ No _____ (If no, explain in Remarks.)

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes ✓ No _____

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes _____	No ✓	**Is the Sampled Area within a Wetland?** Yes _____ No ✓
Hydric Soil Present?	Yes ✓	No _____	
Wetland Hydrology Present?	Yes _____	No ✓	

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: _____)	Absolute % Cover	Dominant Species?	Indicator Status
1. Populus angustifolia (Narrowleaf Cottonwood)	20	YES	FACW
2.			
3.			
4.			
	20 = Total Cover		
Sapling/Shrub Stratum (Plot size: _____)			
1.			
2.			
3.			
4.			
5.			
	0 = Total Cover		
Herb Stratum (Plot size: _____)			
1. Thlaspi arvense (Pennycress mustard)	5	YES	UPL
2. Pascopyrum smithii (Western wheatgrass)	30		FAC
3. Poa pratensis (Kentucky bluegrass)	15		FAC
4. Equisetum hyemale (Scouringrush Horsetail)	5		FACW
5.			
6.			
7.			
8.			
	55 = Total Cover		
Woody Vine Stratum (Plot size: _____)			
1.			
2.			
	_____ = Total Cover		

% Bare Ground in Herb Stratum 45 % Cover of Biotic Crust _____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 50% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	0	x 1 =	0
FACW species	25	x 2 =	50
FAC species	45	x 3 =	135
FACU species	0	x 4 =	0
UPL species	5	x 5 =	25
Column Totals:	75 (A)		210 (B)

Prevalence Index = B/A = 2.8

Hydrophytic Vegetation Indicators:

___ Dominance Test is >50%

✓ Prevalence Index is ≤3.0[1]

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes _____ No ✓

Remarks:

No hydrology to support prevalence index

SOIL

Sampling Point: SP2

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
0-4	10 YR 2/1	100					Sandy	loam
4-16	-						cobble	& small rocks

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) (**LRR C**)
- ___ 1 cm Muck (A9) (**LRR D**)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) (**LRR C**)
- ___ 2 cm Muck (A10) (**LRR B**)
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: _____

Depth (inches): _____

Hydric Soil Present? Yes ✓ **No** _____

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1) (**Nonriverine**)
- ___ Sediment Deposits (B2) (**Nonriverine**)
- ___ Drift Deposits (B3) (**Nonriverine**)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Salt Crust (B11)
- ___ Biotic Crust (B12)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water Marks (B1) (**Riverine**)
- ___ Sediment Deposits (B2) (**Riverine**)
- ___ Drift Deposits (B3) (**Riverine**)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes _____ No ✓ Depth (inches): _____

Water Table Present? Yes _____ No ✓ Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No ✓ Depth (inches): _____

Wetland Hydrology Present? Yes _____ **No** ✓

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

Daniel Irrigation Delineation Photos
October 30, 2020



Sample Point #2 Upland



Sample Point #2 Area

Daniel Irrigation Delineation Photos
October 30, 2020



Sample Point #2 Area

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Daniel Irrigation City/County: Daniel/Wasatch Sampling Date: 10/30/2020

Applicant/Owner: Wasatch County State: UT Sampling Point: SP3

Investigator(s): Merissa Davis Section, Township, Range: Section 21, Township 4, Range 5E

Landform (hillslope, terrace, etc.): _____ Local relief (concave, convex, none): _____ Slope (%): _____

Subregion (LRR): D - Interior Deserts Lat: 4,479,079.60 Long: 466,619.08 Datum: UTM

Soil Map Unit Name: Steed Loam, Cold Variant NWI classification: N/A

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✓ No _____ (If no, explain in Remarks.)

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes ✓ No _____

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ✓	No _____	**Is the Sampled Area within a Wetland?** Yes ✓ No _____
Hydric Soil Present?	Yes ✓	No _____	
Wetland Hydrology Present?	Yes _____	No ✓	

Remarks:

Check the topo of this area with other large wetland. If elevations are the same, might lean towards wetland

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: _____)	Absolute % Cover	Dominant Species?	Indicator Status
1. Populus angustifolia (Narrowleaf Cottonwood)	5	YES	FACW
2.			
3.			
4.			
	5 = Total Cover		
Sapling/Shrub Stratum (Plot size: _____)			
1.			
2.			
3.			
4.			
5.			
	0 = Total Cover		
Herb Stratum (Plot size: _____)			
1. Juncus balticus (Baltic Rush)	10		UPL
2. Pascopyrum smithii (Western wheatgrass)	20	YES	FAC
3. Poa pratensis (Kentucky bluegrass)	20	YES	FAC
4. Equisetum hyemale (Scouringrush Horsetail)	10		FACW
5. Cirsium aryense (Canadian Thistle)	5		FACU
6. Phleum pratense (Timothy)	15	YES	FACU
7. Carex geyeri (Geyer's sedge)	5		UPL
8.			
	85 = Total Cover		
Woody Vine Stratum (Plot size: _____)			
1.			
2.			
	_____ = Total Cover		

% Bare Ground in Herb Stratum 15 % Cover of Biotic Crust _____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 3 (A)

Total Number of Dominant Species Across All Strata: 4 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 75% (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species 0	x 1 = 0
FACW species 15	x 2 = 30
FAC species 40	x 3 = 120
FACU species 20	x 4 = 80
UPL species 15	x 5 = 75
Column Totals: 90 (A)	305 (B)

Prevalence Index = B/A = 3.39

Hydrophytic Vegetation Indicators:

✓ Dominance Test is >50%

___ Prevalence Index is ≤3.0[1]

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes _____ No _____

Remarks:

SOIL

Sampling Point: SP3

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
0-4	10 YR 2/2	100					Fine	loam

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) (**LRR C**)
- ___ 1 cm Muck (A9) (**LRR D**)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) (**LRR C**)
- ___ 2 cm Muck (A10) (**LRR B**)
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: _____

Depth (inches): _____

Hydric Soil Present? Yes ✓ No ___

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1) (**Nonriverine**)
- ___ Sediment Deposits (B2) (**Nonriverine**)
- ___ Drift Deposits (B3) (**Nonriverine**)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Salt Crust (B11)
- ___ Biotic Crust (B12)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water Marks (B1) (**Riverine**)
- ___ Sediment Deposits (B2) (**Riverine**)
- ___ Drift Deposits (B3) (**Riverine**)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ___ No ✓ Depth (inches): _____

Water Table Present? Yes ___ No ✓ Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes ___ No ✓ Depth (inches): _____

Wetland Hydrology Present? Yes ___ No ✓

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

Could be more ground water earlier in the season, but dominance of grasses make me think it's marginal at best

Daniel Irrigation Delineation Photos
October 30, 2020



Sample Point #3 Upland (Marginal)



Sample Point #3 Area

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Daniel Irrigation City/County: Daniel/Wasatch Sampling Date: 10/30/2020

Applicant/Owner: Wasatch County State: UT Sampling Point: SP4

Investigator(s): Merissa Davis Section, Township, Range: Section 21, Township 4, Range 5E

Landform (hillslope, terrace, etc.): _____ Local relief (concave, convex, none): _____ Slope (%): _____

Subregion (LRR): D - Interior Deserts Lat: 4,479,051.58 Long: 466,707.58 Datum: UTM

Soil Map Unit Name: Steed Loam, Cold Variant NWI classification: N/A

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✓ No _____ (If no, explain in Remarks.)

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes ✓ No _____

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ✓ No _____	**Is the Sampled Area within a Wetland?** Yes ✓ No _____
Hydric Soil Present?	Yes ✓ No _____	
Wetland Hydrology Present?	Yes ✓ No _____	

Remarks:

Check the topo of this area with other large wetland. If elevations are the same, might lean towards wetland

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: _____)	Absolute % Cover	Dominant Species?	Indicator Status
1. Populus angustifolia (Narrowleaf Cottonwood)	5	YES	FACW
2.			
3.			
4.			
	5 = Total Cover		
Sapling/Shrub Stratum (Plot size: _____)			
1.			
2.			
3.			
4.			
5.			
	0 = Total Cover		
Herb Stratum (Plot size: _____)			
1. Juncus balticus (Baltic Rush)	95	YES	FACW
2. Equisetum hyemale (Scouringrush Horsetail)	5		FACW
3.			
4.			
5.			
6.			
7.			
8.			
	100 = Total Cover		
Woody Vine Stratum (Plot size: _____)			
1.			
2.			
	_____ = Total Cover		

% Bare Ground in Herb Stratum 0 % Cover of Biotic Crust _____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100% (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species 0	x 1 = 0
FACW species 105	x 2 = 210
FAC species 0	x 3 = 0
FACU species 0	x 4 = 0
UPL species 0	x 5 = 0
Column Totals: 105 (A)	210 (B)

Prevalence Index = B/A = 2

Hydrophytic Vegetation Indicators:

✓ Dominance Test is >50%

✓ Prevalence Index is ≤3.0[1]

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ✓ No _____

Remarks:

SOIL

Sampling Point: SP4

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-16	10 YR 2/1	95	5YR 5/8	5			Fine	loam

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) (**LRR C**)
- ___ 1 cm Muck (A9) (**LRR D**)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) (**LRR C**)
- ___ 2 cm Muck (A10) (**LRR B**)
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: _____

Depth (inches): _____

Hydric Soil Present? Yes ✓ No _____

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1) (**Nonriverine**)
- ___ Sediment Deposits (B2) (**Nonriverine**)
- ___ Drift Deposits (B3) (**Nonriverine**)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Salt Crust (B11)
- ___ Biotic Crust (B12)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water Marks (B1) (**Riverine**)
- ___ Sediment Deposits (B2) (**Riverine**)
- ___ Drift Deposits (B3) (**Riverine**)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes _____ No ✓ Depth (inches): _____

Water Table Present? Yes _____ No ✓ Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes ✓ No _____ Depth (inches): 0

Wetland Hydrology Present? Yes ✓ No _____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

Could be higher water table earlier in season.

Daniel Irrigation Delineation Photos
October 30, 2020



Sample Point #4 Wetland



Sample Point #4 (Redoxed Soil)

Daniel Irrigation Delineation Photos
October 30, 2020



Sample Point #4 Area, facing west



Sample Point #4 Area, facing east

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Daniel Irrigation City/County: Daniel/Wasatch Sampling Date: 10/30/2020

Applicant/Owner: Wasatch County State: UT Sampling Point: SP5

Investigator(s): Merissa Davis Section, Township, Range: Section 21, Township 4, Range 5E

Landform (hillslope, terrace, etc.): _____ Local relief (concave, convex, none): _____ Slope (%): _____

Subregion (LRR): D - Interior Deserts Lat: 4,479,058.24 Long: 466,707.56 Datum: UTM

Soil Map Unit Name: Steed Loam, Cold Variant NWI classification: N/A

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✓ No _____ (If no, explain in Remarks.)

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes ✓ No _____

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ✓	No _____	**Is the Sampled Area within a Wetland?** Yes _____ No ✓
Hydric Soil Present?	Yes _____	No ✓	
Wetland Hydrology Present?	Yes _____	No ✓	

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: _____)	Absolute % Cover	Dominant Species?	Indicator Status
1. Populus angustifolia (Narrowleaf Cottonwood)	5	YES	FACW
2.			
3.			
4.			
	5 = Total Cover		
Sapling/Shrub Stratum (Plot size: _____)			
1. Salcia officinalis (Sage)	5	YES	UPL
2.			
3.			
4.			
5.			
	5 = Total Cover		
Herb Stratum (Plot size: _____)			
1. Cirsium aryense (Canadian Thistle)	5		FACU
2. Pascopyrum smithii (Western wheatgrass)	20	YES	FAC
3. Bromus marginatus (Mountain brome)	20	YES	UPL
4. Poa pratensis (Kentucky bluegrass)	20	YES	FAC
5. Equisetum hyemale (Scouringrush Horsetail)	10		FACW
6. Sisymbrium altissimum (Tumble mustard)	5		FACU
7.			
8.			
	80 = Total Cover		
Woody Vine Stratum (Plot size: _____)			
1.			
2.			
	_____ = Total Cover		

% Bare Ground in Herb Stratum 20 % Cover of Biotic Crust _____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 3 (A)

Total Number of Dominant Species Across All Strata: 5 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 60% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	0	x 1 =	0
FACW species	15	x 2 =	30
FAC species	40	x 3 =	120
FACU species	10	x 4 =	40
UPL species	25	x 5 =	125
Column Totals:	90 (A)		315 (B)

Prevalence Index = B/A = 3.5

Hydrophytic Vegetation Indicators:

✓ Dominance Test is >50%

___ Prevalence Index is ≤3.0[1]

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ✓ No _____

Remarks:

SOIL

Sampling Point: SP5

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
0-16	10 YR 3/2	100					Fine	loam

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) (**LRR C**)
- ___ 1 cm Muck (A9) (**LRR D**)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) (**LRR C**)
- ___ 2 cm Muck (A10) (**LRR B**)
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: _____

Depth (inches): _____

Hydric Soil Present? Yes _____ No ✓

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1) (**Nonriverine**)
- ___ Sediment Deposits (B2) (**Nonriverine**)
- ___ Drift Deposits (B3) (**Nonriverine**)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Salt Crust (B11)
- ___ Biotic Crust (B12)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water Marks (B1) (**Riverine**)
- ___ Sediment Deposits (B2) (**Riverine**)
- ___ Drift Deposits (B3) (**Riverine**)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes _____ No ✓ Depth (inches): _____

Water Table Present? Yes _____ No ✓ Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No ✓ Depth (inches): _____

Wetland Hydrology Present? Yes _____ No ✓

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

Daniel Irrigation Delineation Photos
October 30, 2020



Sample Point #5 Upland



Sample Point #5 Area, facing west

Daniel Irrigation Delineation Photos
October 30, 2020



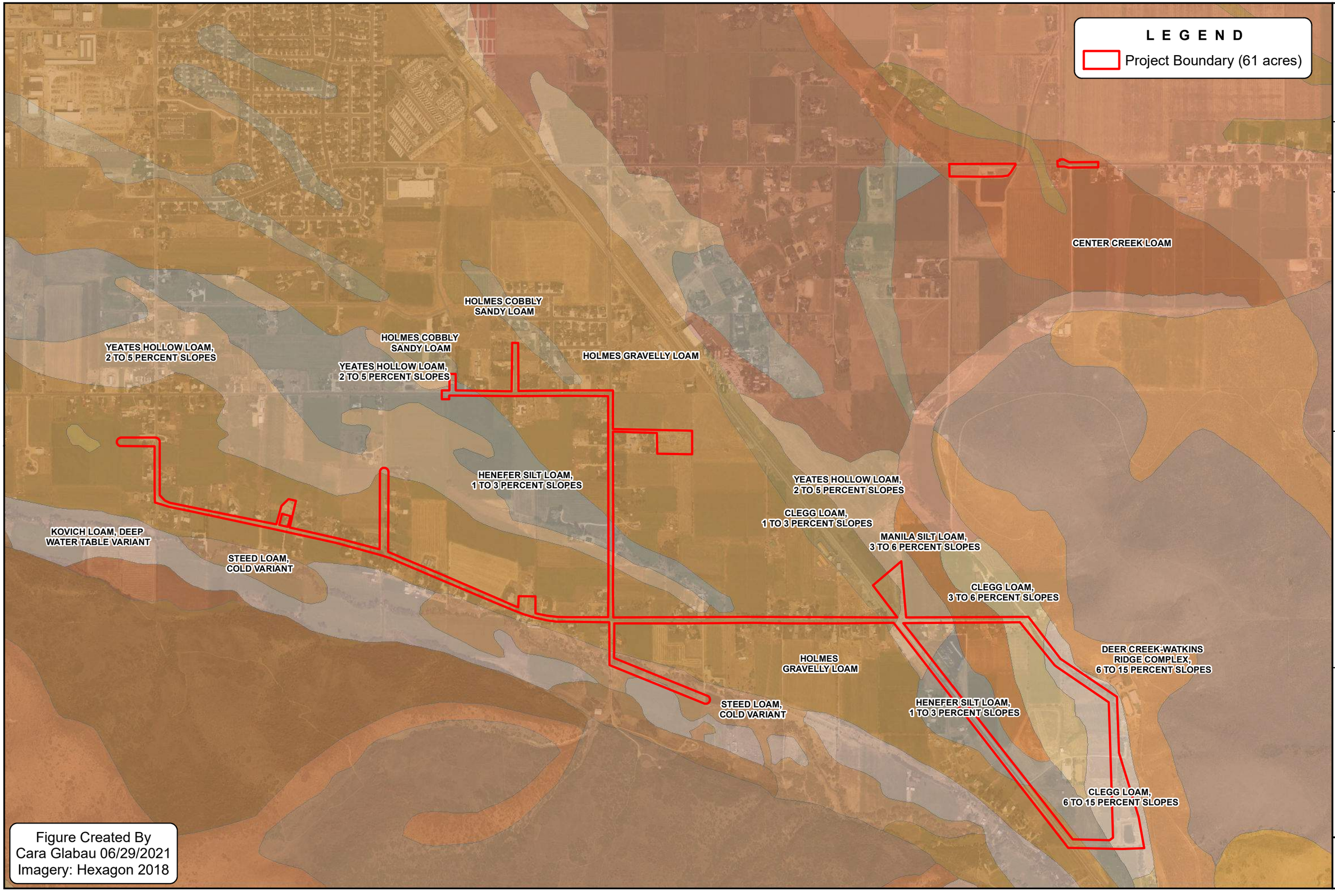
Sample Point #5 Area, facing north



Sample Point #5 Area, facing east

Appendix D

Soil Map & NRCS Custom Soils Resource Report


LEGEND
Project Boundary (61 acres)
CENTER CREEK LOAM
HOLMES COBBLY SANDY LOAM
HOLMES COBBLY SANDY LOAM
YEATES HOLLOW LOAM, 2 TO 5 PERCENT SLOPES
HOLMES GRAVELLY LOAM
YEATES HOLLOW LOAM, 2 TO 5 PERCENT SLOPES
HENEFER SILT LOAM, 1 TO 3 PERCENT SLOPES
YEATES HOLLOW LOAM, 2 TO 5 PERCENT SLOPES
CLEGG LOAM, 1 TO 3 PERCENT SLOPES
KOVICH LOAM, DEEP WATER TABLE VARIANT
MANILA SILT LOAM, 3 TO 6 PERCENT SLOPES
STEED LOAM, COLD VARIANT
CLEGG LOAM, 3 TO 6 PERCENT SLOPES
DEER CREEK-WATKINS RIDGE COMPLEX, 6 TO 15 PERCENT SLOPES
HOLMES GRAVELLY LOAM
STEED LOAM, COLD VARIANT
HENEFER SILT LOAM, 1 TO 3 PERCENT SLOPES
CLEGG LOAM, 6 TO 15 PERCENT SLOPES
Figure Created By
Cara Glabau 06/29/2021
Imagery: Hexagon 2018
SCALE:
1 in. = 1,000 ft.
NORTH:
NORTH
SOILS
WASATCH COUNTY
TRI-VALLEY
WATERSHED EA
BOWEN COLLINS & ASSOCIATES
FIGURE NO.
3
P:\Wasatch County\627-19-01 Tri-Valley Watershed Plan EA\4.0 GIS\4.1 Projects\Environmental\Fig3_Soils.mxd cglabau 6/29/2021

United States Department of Agriculture

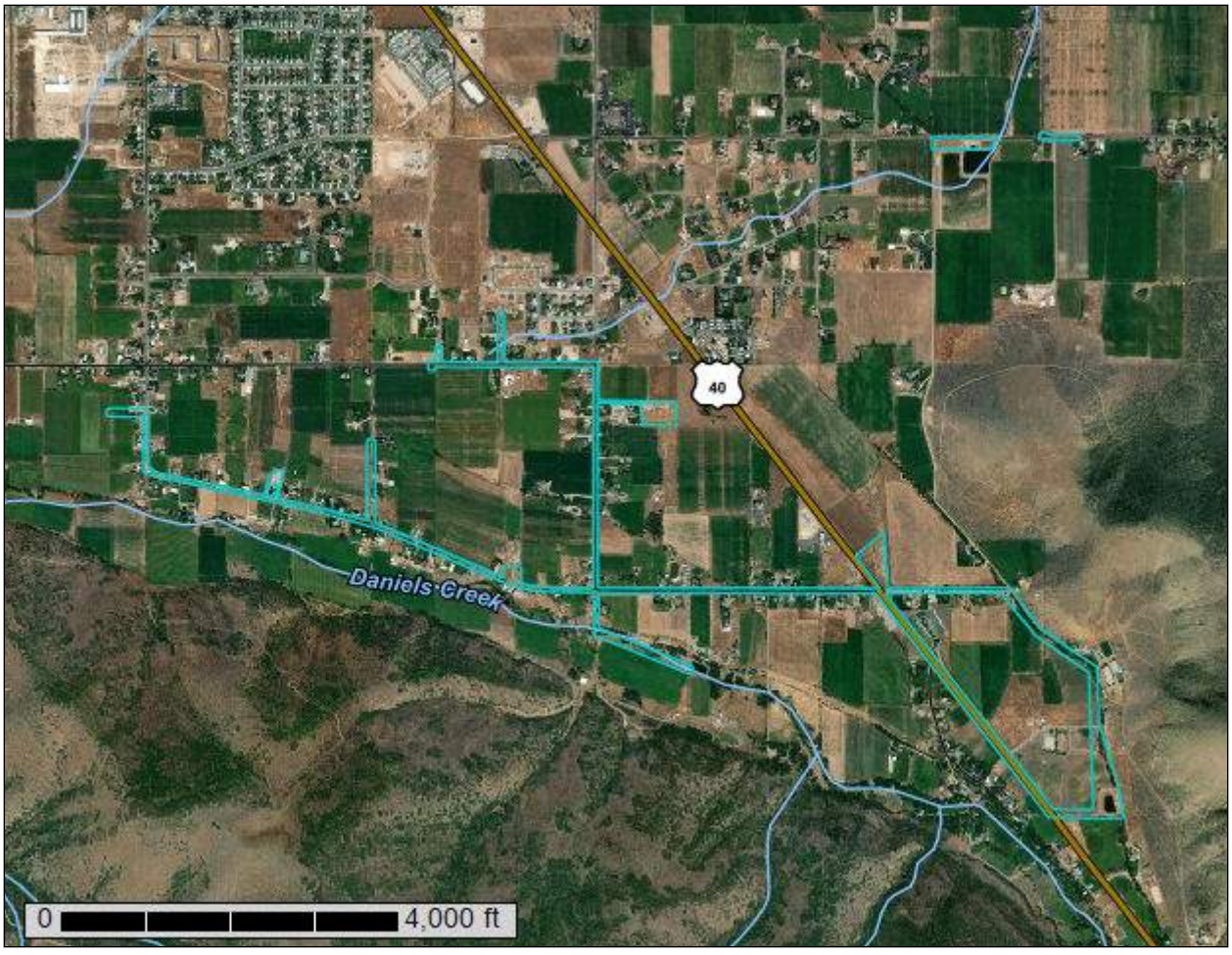
NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Heber Valley Area, Utah - Parts of Wasatch and Utah Counties

Tri-Valley Watershed EA



July 1, 2021

Contents

Preface.....2
How Soil Surveys Are Made.....5
Soil Map.....8
Soil Map.....9
Legend.....10
Map Unit Legend.....11
Map Unit Descriptions.....11
Heber Valley Area, Utah - Parts of Wasatch and Utah Counties.....13
Ca—Center Creek loam.....13
CgA—Clegg loam, 1 to 3 percent slopes.....14
CgB—Clegg loam, 3 to 6 percent slopes.....15
CgC—Clegg loam, 6 to 15 percent slopes.....16
HeA—Henefer silt loam, 1 to 3 percent slopes.....17
Hk—Holmes cobbly sandy loam.....18
Hr—Holmes gravelly loam.....19
Km—Kovich loam, deep water table variant.....20
MaB—Manila silt loam, 3 to 6 percent slopes.....21
St—Steed loam, cold variant.....22
YaB—Yeates Hollow loam, 2 to 5 percent slopes.....23
References.....25

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map



MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Map Unit Polygons

Soil Map Unit Lines

Soil Map Unit Points

Special Point Features

Blowout

Borrow Pit

Clay Spot

Closed Depression

Gravel Pit

Gravelly Spot

Landfill

Lava Flow

Marsh or swamp

Mine or Quarry

Miscellaneous Water

Perennial Water

Rock Outcrop

Saline Spot

Sandy Spot

Severely Eroded Spot

Sinkhole

Slide or Slip

Sodic Spot

Spoil Area

Stony Spot

Very Stony Spot

Wet Spot

Other

Special Line Features

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Heber Valley Area, Utah - Parts of Wasatch and Utah Counties
Survey Area Data: Version 11, Jun 8, 2020

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jun 14, 2016—Nov 8, 2017

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
Ca	Center Creek loam	3.2	5.3%
CgA	Clegg loam, 1 to 3 percent slopes	2.1	3.5%
CgB	Clegg loam, 3 to 6 percent slopes	1.3	2.2%
CgC	Clegg loam, 6 to 15 percent slopes	10.4	17.2%
HeA	Henefer silt loam, 1 to 3 percent slopes	5.9	9.8%
Hk	Holmes cobbly sandy loam	0.1	0.2%
Hr	Holmes gravelly loam	29.8	49.0%
Km	Kovich loam, deep water table variant	0.2	0.4%
MaB	Manila silt loam, 3 to 6 percent slopes	0.9	1.4%
St	Steed loam, cold variant	2.7	4.5%
YaB	Yeates Hollow loam, 2 to 5 percent slopes	3.9	6.4%
Totals for Area of Interest		**60.7**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different

management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Heber Valley Area, Utah - Parts of Wasatch and Utah Counties

Ca—Center Creek loam

Map Unit Setting

National map unit symbol: jxp1
Elevation: 5,480 to 6,310 feet
Mean annual precipitation: 16 to 22 inches
Mean annual air temperature: 40 to 45 degrees F
Frost-free period: 70 to 90 days
Farmland classification: Prime farmland if irrigated and drained

Map Unit Composition

Center creek and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Center Creek

Setting

Landform: Stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Concave

Typical profile

A12 - 0 to 5 inches: loam
B1 - 5 to 12 inches: loam
B21t - 12 to 20 inches: loam
B22t - 20 to 33 inches: clay loam
B3 - 33 to 40 inches: very gravelly coarse sandy loam
C1 - 40 to 50 inches: very gravelly sandy loam
C2 - 50 to 60 inches: extremely gravelly coarse sandy loam

Properties and qualities

Slope: 1 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: About 36 to 60 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 10 percent
Available water capacity: Moderate (about 6.9 inches)

Interpretive groups

Land capability classification (irrigated): 3w
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: C
Ecological site: R047XA006UT - Semiwet Fresh Streambank (Narrowleaf Cottonwood)
Hydric soil rating: No

Minor Components

Poorly drained soils

Percent of map unit: 5 percent
Landform: Depressions
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Other soils

Percent of map unit: 5 percent

CgA—Clegg loam, 1 to 3 percent slopes

Map Unit Setting

National map unit symbol: jxp2
Elevation: 5,460 to 6,230 feet
Mean annual precipitation: 16 to 22 inches
Mean annual air temperature: 40 to 45 degrees F
Frost-free period: 70 to 90 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Clegg and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Clegg

Setting

Landform: Alluvial fans
Down-slope shape: Concave
Across-slope shape: Convex

Typical profile

A11,A12 - 0 to 9 inches: loam
B21tB22tB23t - 9 to 30 inches: loam
Ck1,Ck2,Ck3 - 30 to 66 inches: loam

Properties and qualities

Slope: 1 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 40 percent

Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water capacity: High (about 9.6 inches)

Interpretive groups

Land capability classification (irrigated): 3c
Land capability classification (nonirrigated): 4c
Hydrologic Soil Group: B
Ecological site: R047XA430UT - Mountain Loam (Mountain Big Sagebrush)
Hydric soil rating: No

Minor Components

Deer creek

Percent of map unit: 5 percent

CgB—Clegg loam, 3 to 6 percent slopes

Map Unit Setting

National map unit symbol: jxp3
Elevation: 5,460 to 6,690 feet
Mean annual precipitation: 16 to 22 inches
Mean annual air temperature: 40 to 45 degrees F
Frost-free period: 70 to 90 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Clegg and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Clegg

Setting

Landform: Alluvial fans
Down-slope shape: Concave
Across-slope shape: Convex

Typical profile

A11, A12 - 0 to 9 inches: loam
B21tB22tB23t - 9 to 30 inches: loam
Ck1,Ck2,Ck3 - 30 to 66 inches: loam

Properties and qualities

Slope: 3 to 6 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None

Calcium carbonate, maximum content: 40 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water capacity: High (about 9.6 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B
Ecological site: R047XA430UT - Mountain Loam (Mountain Big Sagebrush)
Hydric soil rating: No

Minor Components

Deer creek

Percent of map unit: 5 percent

CgC—Clegg loam, 6 to 15 percent slopes

Map Unit Setting

National map unit symbol: jxp4
Elevation: 5,410 to 6,410 feet
Mean annual precipitation: 16 to 22 inches
Mean annual air temperature: 40 to 45 degrees F
Frost-free period: 70 to 90 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Clegg and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Clegg

Setting

Landform: Alluvial fans
Down-slope shape: Concave
Across-slope shape: Convex

Typical profile

A11, A12 - 0 to 9 inches: loam
B21tB22tB23t - 9 to 30 inches: loam
Ck1,Ck2,Ck3 - 30 to 66 inches: loam

Properties and qualities

Slope: 6 to 15 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None

Calcium carbonate, maximum content: 40 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water capacity: High (about 9.6 inches)

Interpretive groups
Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Ecological site: R047XA430UT - Mountain Loam (Mountain Big Sagebrush)
Hydric soil rating: No

HeA—Henefer silt loam, 1 to 3 percent slopes

Map Unit Setting
National map unit symbol: jxqc
Elevation: 5,490 to 5,990 feet
Mean annual precipitation: 16 to 22 inches
Mean annual air temperature: 40 to 45 degrees F
Frost-free period: 70 to 90 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition
Henefer and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Henefer

Setting
Landform: Alluvial fans
Down-slope shape: Concave
Across-slope shape: Convex

Typical profile
A11, A12 - 0 to 12 inches: silt loam
B1 - 12 to 20 inches: cobbly silt loam
B21t - 20 to 36 inches: cobbly clay
B22t - 36 to 48 inches: extremely cobbly clay
B3 - 48 to 60 inches: extremely cobbly clay loam

Properties and qualities
Slope: 1 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Moderate (about 7.2 inches)

Interpretive groups
Land capability classification (irrigated): 3c

Land capability classification (nonirrigated): 3s
Hydrologic Soil Group: C
Ecological site: R047XA430UT - Mountain Loam (Mountain Big Sagebrush)
Hydric soil rating: No

Minor Components

Manila
Percent of map unit: 5 percent

Deer creek
Percent of map unit: 5 percent

Hk—Holmes cobbly sandy loam

Map Unit Setting
National map unit symbol: jxqk
Elevation: 5,460 to 6,660 feet
Mean annual precipitation: 16 to 22 inches
Mean annual air temperature: 40 to 45 degrees F
Frost-free period: 70 to 90 days
Farmland classification: Farmland of statewide importance

Map Unit Composition
Holmes and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Holmes

Setting
Landform: Alluvial fans, stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Concave, linear
Across-slope shape: Convex, concave

Typical profile
Ap, A12 - 0 to 11 inches: cobbly sandy loam
B2t, B3 - 11 to 28 inches: extremely cobbly sandy loam
C - 28 to 60 inches: extremely gravelly loamy coarse sand

Properties and qualities
Slope: 1 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Very low (about 2.2 inches)

Interpretive groups

Land capability classification (irrigated): 4s
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: A
Ecological site: R047XA461UT - Mountain Stony Loam (Mountain Big Sagebrush)
Hydric soil rating: No

Hr—Holmes gravelly loam

Map Unit Setting

National map unit symbol: jxqn
Elevation: 5,410 to 6,900 feet
Mean annual precipitation: 16 to 22 inches
Mean annual air temperature: 40 to 45 degrees F
Frost-free period: 70 to 125 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Holmes and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Holmes

Setting

Landform: Alluvial fans, stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Concave, linear
Across-slope shape: Convex, concave

Typical profile

Ap, A12 - 0 to 11 inches: gravelly loam
B2t - 11 to 21 inches: very gravelly loam
B3 - 21 to 28 inches: extremely gravelly coarse sandy loam
C - 28 to 60 inches: extremely gravelly loamy coarse sand

Properties and qualities

Slope: 1 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 3.3 inches)

Interpretive groups

Land capability classification (irrigated): 4s
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: B
Ecological site: R047XA461UT - Mountain Stony Loam (Mountain Big Sagebrush)

Hydric soil rating: No

Minor Components

Rasband
Percent of map unit: 5 percent

Center creek
Percent of map unit: 5 percent

Steed cold variant
Percent of map unit: 5 percent

Km—Kovich loam, deep water table variant

Map Unit Setting
National map unit symbol: jxqs
Elevation: 5,500 to 6,200 feet
Mean annual precipitation: 16 to 20 inches
Mean annual air temperature: 43 to 45 degrees F
Frost-free period: 70 to 90 days
Farmland classification: Farmland of statewide importance

Map Unit Composition
Kovich and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Kovich

Setting
Landform: Flood plains, stream terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Linear
Across-slope shape: Concave

Typical profile
A1p, A12 - 0 to 16 inches: loam
C1 - 16 to 27 inches: silt loam
C2, C3 - 27 to 60 inches: loam

Properties and qualities
Slope: 2 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: About 30 to 42 inches
Frequency of flooding: RareNone
Frequency of ponding: None
Available water capacity: High (about 9.7 inches)

Interpretive groups

Land capability classification (irrigated): 3w
Hydrologic Soil Group: C
Ecological site: R047XA004UT - Interzonal Cold Semiwet Fresh Meadow (Meadow Sedge/Tufted Hairgrass)
Hydric soil rating: No

Minor Components

Poorly drained soils

Percent of map unit: 5 percent
Landform: Depressions
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

MaB—Manila silt loam, 3 to 6 percent slopes

Map Unit Setting

National map unit symbol: jxr5
Elevation: 5,440 to 6,260 feet
Mean annual precipitation: 16 to 22 inches
Mean annual air temperature: 40 to 45 degrees F
Frost-free period: 70 to 90 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Manila and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Manila

Setting

Landform: Alluvial fans
Down-slope shape: Concave
Across-slope shape: Convex

Typical profile

Ap - 0 to 10 inches: silt loam
A12 - 10 to 18 inches: silt loam
B1 - 18 to 26 inches: silty clay loam
B21tB22tB31 - 26 to 72 inches: silty clay loam
H5 - 72 to 97 inches: silty clay loam

Properties and qualities

Slope: 3 to 6 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained

Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 3 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water capacity: High (about 10.9 inches)

Interpretive groups
Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Ecological site: R047XA432UT - Mountain Loam (Oak)
Hydric soil rating: No

Minor Components

Deer creek
Percent of map unit: 5 percent

Moderately eroded soils
Percent of map unit: 5 percent

St—Steed loam, cold variant

Map Unit Setting
National map unit symbol: jxrv
Elevation: 5,400 to 6,200 feet
Mean annual precipitation: 16 to 22 inches
Mean annual air temperature: 40 to 45 degrees F
Frost-free period: 70 to 90 days
Farmland classification: Farmland of statewide importance

Map Unit Composition
Steed and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Steed

Setting
Landform: Alluvial fans, flood plains, stream terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Concave, linear
Across-slope shape: Convex, concave

Typical profile
A11, A12 - 0 to 7 inches: loam
C1 - 7 to 12 inches: very cobbly loam
R - 12 to 60 inches: extremely gravelly loamy sand

Properties and qualities

Slope: 1 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 3.5 inches)

Interpretive groups

Land capability classification (irrigated): 4s
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: B
Ecological site: R047XA416UT - Mountain Loamy Bottom (Basin Big Sagebrush)
Hydric soil rating: No

Minor Components

Cobbly surface soils

Percent of map unit: 5 percent

YaB—Yeates Hollow loam, 2 to 5 percent slopes

Map Unit Setting

National map unit symbol: jxsh
Elevation: 5,560 to 6,380 feet
Mean annual precipitation: 16 to 22 inches
Mean annual air temperature: 40 to 45 degrees F
Frost-free period: 70 to 90 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Yeates hollow and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Yeates Hollow

Setting

Landform: Alluvial fans
Down-slope shape: Concave
Across-slope shape: Convex

Typical profile

A11, A12 - 0 to 9 inches: loam
B1 - 9 to 12 inches: very cobbly clay loam
B21t - 12 to 26 inches: very cobbly sandy clay
B22t, B23t - 26 to 60 inches: extremely cobbly clay

Properties and qualities

Slope: 2 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 4.6 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: C
Ecological site: R047XA463UT - Mountain Stony Loam (Gambel oak)
Hydric soil rating: No

Minor Components

Cobbly surface soils

Percent of map unit: 5 percent

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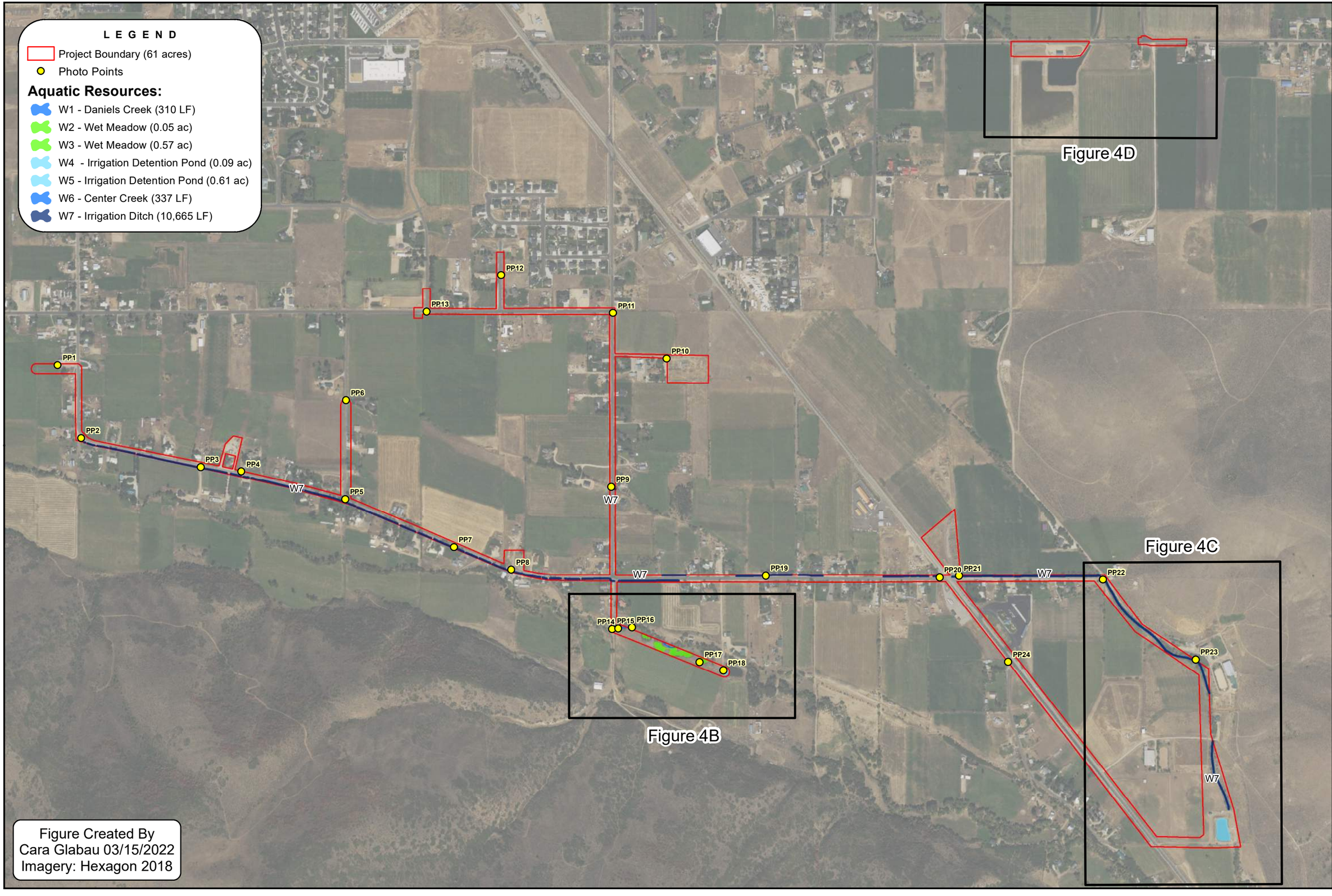
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Appendix E

Wetland Delineation Results Figures



SCALE: 1 in. = 850 ft.

NORTH: NORTH

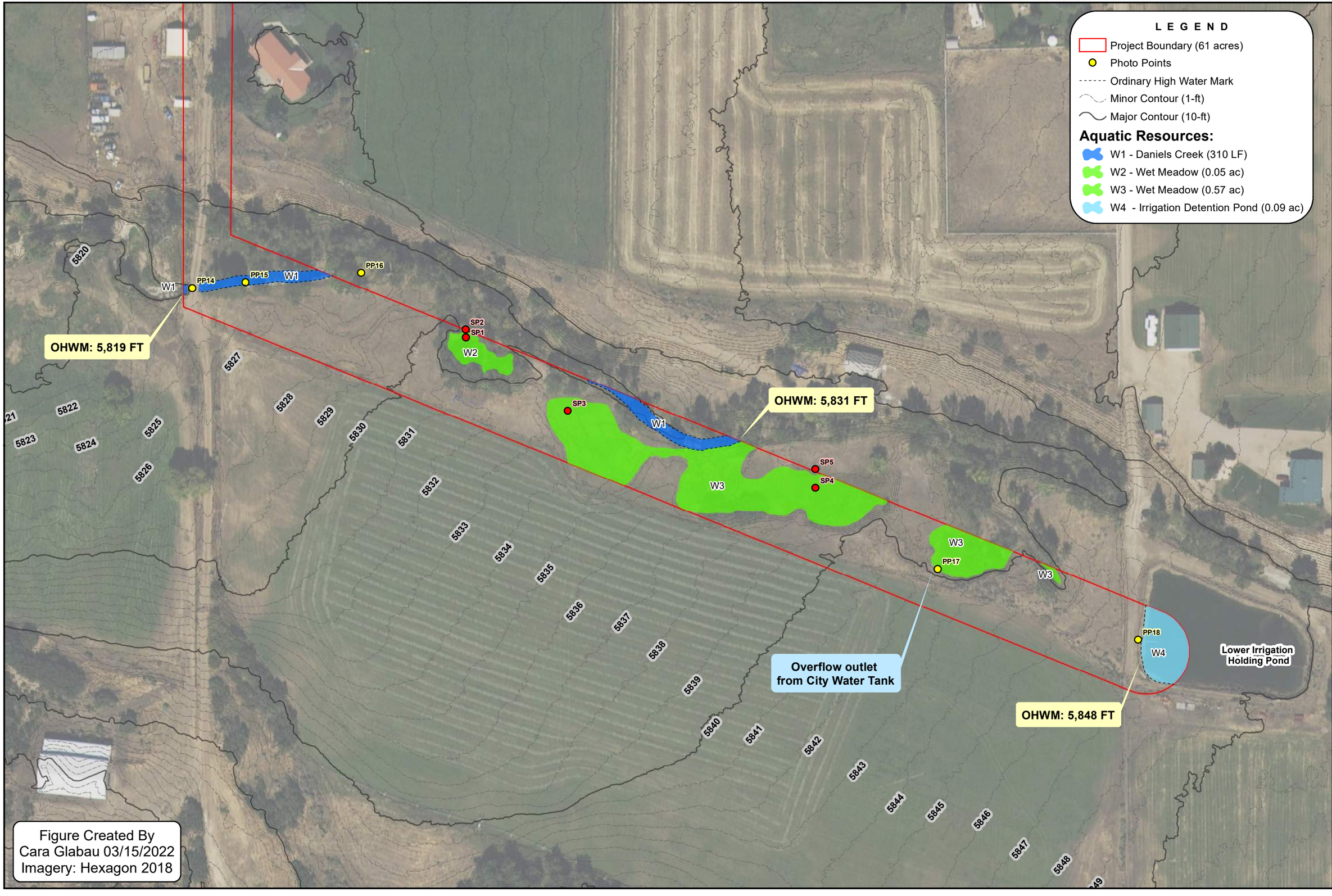
DELINEATION RESULTS

WASATCH COUNTY
TRI-VALLEY
WATERSHED EA

BOWEN COLLINS & ASSOCIATES

FIGURE NO.
4A

P:\Wasatch County\627-71901 Tri-Valley Watershed Plan EA\4.0 GIS\4.1 Projects\Environmental\Fig4A_DelineationResults.mxd cglabau 3/15/2022



SCALE: 1 in. = 100 ft.

NORTH: NORTH

DELINEATION RESULTS

WASATCH COUNTY
TRI-VALLEY
WATERSHED EA

BOWEN COLLINS & ASSOCIATES

FIGURE NO.
4B

P:\Wasatch County\627-19-01 Tri-Valley Watershed Plan EA\4.0 GIS\4.1 Projects\Environmental\Fig4B_DelineationResults.mxd cglabau 3/15/2022

OHWM: 5,939 FT

OHWM: 5,942 FT

OHWM: 6,002 FT

OHWM: 6,002 FT

Middle Irrigation Holding Pond

W7

PP22

PP23

W5

5950
5960
5970
5980
5990
6000
6010
6020
6030
6040
6050
6060

L E G E N D

- Project Boundary (61 acres)
- Photo Points
- Minor Contour (1-ft)
- Major Contour (10-ft)
- Ordinary High Water Mark

Aquatic Resources:

- W5 - Irrigation Detention Pond (0.61 ac)
- W7 - Irrigation Ditch (10,665 LF)

Figure Created By
Cara Glabau 03/15/2022
Imagery: Hexagon 2018

BOWEN COLLINS & ASSOCIATES

WASATCH COUNTY
TRI-VALLEY WATERSHED EA

DELINEATION RESULTS

NORTH:

SCALE: 0 100 200 Feet

FIGURE NO. 4C

P:\Wasatch County\627-19-01 Tri-Valley Watershed Plan EA\4.0 GIS\4.1 Projects\Environmental\Fig4C_DelineationResults.mxd cglabau 3/15/2022



SCALE: 1 in. = 150 ft.

NORTH: NORTH

DELINEATION RESULTS

WASATCH COUNTY
TRI-VALLEY
WATERSHED EA

BOWEN COLLINS & ASSOCIATES

FIGURE NO.
4D

P:\Wasatch County\627-71901 Tri-Valley Watershed Plan EA\4.0 GIS\4.1 Projects\Environmental\Fig4D_DelineationResults.mxd cglabau 3/15/2022

Appendix F

Aquatic Resources Spreadsheet

Tri-Valley Watershed Wetland Delineation
Aquatic Resources

Waters Name	State	Cowadin Code	HGM Code	Measurement Type	Amount	Units	Waters Type	Latitude	Longitude	Local Waterway
W1	Utah	R4SBC	Riverine	Linear	310	Feet	RPW	40.461668	-111.395007	Daniel Creek
W2	Utah	PEM1E	Riverine	Area	0.05	Acre	RPWWN	40.461902	-111.394104	Daniel Creek/High Groundwater
W3	Utah	PEM1E	Riverine	Area	0.57	Acre	RPWWD	40.461257	-111.393154	Daniel Creek/City Overflow Outlet
W4	Utah	PABFx	Depress	Area	0.09	Acre	IMPNDMNT	40.456585	-111.391213	Irrigation Detention Pond
W5	Utah	PABFx	Depress	Area	0.61	Acre	IMPNDMNT	40.456585	-111.373421	Irrigation Detention Pond
W6	Utah	R4SBC	Riverine	Linear	337	Feet	RPW	40.478259	-111.376361	Center Creek
W7	Utah	R5UBFx	Riverine	Linear	10665	Feet	ISOLATE	40.464576	-111.376361	Irrigation Ditch

Appendix G

Additional Photos

Daniel Irrigation Delineation Photos
October 30, 2020



Photo Point # 1 (270°)



Photo Point #1 (90°)

Daniel Irrigation Delineation Photos
October 30, 2020



Photo Point #2 (350°)



Photo Point #2 (100°)

Daniel Irrigation Delineation Photos
October 30, 2020



Photo Point #3 (280°)



Photo Point #3 (105°)

Daniel Irrigation Delineation Photos
October 30, 2020



Photo Point #4 (330°)



Photo Point #5 (280°)

Daniel Irrigation Delineation Photos
October 30, 2020



Photo Point #5 (280°)



Photo Point #5 (110°)

Daniel Irrigation Delineation Photos
October 30, 2020



Photo Point #6 (180°)



Photo Point #7 (290°)

Daniel Irrigation Delineation Photos
October 30, 2020



Photo Point #7 (115°)



Photo Point #8 (0°)

Daniel Irrigation Delineation Photos
October 30, 2020



Photo Point #9 (0°)



Photo Point #9 (100°)

Daniel Irrigation Delineation Photos
October 30, 2020



Photo Point #9 (180°)



Photo Point # (290°)

Daniel Irrigation Delineation Photos
October 30, 2020



Photo Point #9 (Remains of former ditch system)



Photo Point #10 (100°)

Daniel Irrigation Delineation Photos
October 30, 2020



Photo Point #11 (180°)



Photo Point # (270°)

Daniel Irrigation Delineation Photos
October 30, 2020



Photo Point #12 (0°)



Photo Point #12 (90°)

Daniel Irrigation Delineation Photos
October 30, 2020



Photo Point #12 (180°)



Photo Point #12 Photo Point # (270°)

Daniel Irrigation Delineation Photos
October 30, 2020



Photo Point #13 (0°)



Photo Point #13 (90°)

Daniel Irrigation Delineation Photos
October 30, 2020



Photo Point #13 (180°)



Photo Point #13 (270°)

Daniel Irrigation Delineation Photos
October 30, 2020



Photo Point #14 (0°)



Photo Point #14 (100°) Daniel

Daniel Irrigation Delineation Photos
October 30, 2020



Photo Point #14 (180°)



Photo Point #14 (280°)

Daniel Irrigation Delineation Photos
October 30, 2020



Photo Point #15 (0°)



Photo Point #15 (110°)

Daniel Irrigation Delineation Photos
October 30, 2020



Photo Point #15 (180°)



Photo Point #15 (290°)

Daniel Irrigation Delineation Photos
October 30, 2020



Photo Point #16 (80°)



Photo Point #17 (0°

Daniel Irrigation Delineation Photos
October 30, 2020



Photo Point #17 (90°)



Photo Point #17 (90°)

Daniel Irrigation Delineation Photos
October 30, 2020



Photo Point #18 (0°)



Photo Point #18 (90°)

Daniel Irrigation Delineation Photos
October 30, 2020



Photo Point #18 (180°)



Photo Point #18 (270°)

Daniel Irrigation Delineation Photos
October 30, 2020



Photo Point #18 (60°)



Photo Point #19 (340°)

Daniel Irrigation Delineation Photos
October 30, 2020



Photo Point #19 (90°)



Photo Point #19 (180°)

Daniel Irrigation Delineation Photos
October 30, 2020



Photo Point #19 (270°)



Photo Point #20 (0°)

Daniel Irrigation Delineation Photos
October 30, 2020



Photo Point #20 (90°)



Photo Point #20 (180°)

Daniel Irrigation Delineation Photos
October 30, 2020



Photo Point #20 (270°)



Photo Point #21 (0°)

Daniel Irrigation Delineation Photos
October 30, 2020



Photo Point #21 (90°)



Photo Point #22 (180°)

Daniel Irrigation Delineation Photos
October 30, 2020



Photo Point #23 (160°)



Photo Point #23 (310°)

Daniel Irrigation Delineation Photos
October 30, 2020



Photo Point #24 (320°)



Photo Point #24 (60°)

Daniel Irrigation Delineation Photos
October 30, 2020



Photo Point #24 (145°)



Photo Point #24 (180°)

Daniel Irrigation Delineation Photos
October 30, 2020



Photo Point #



Photo Point #24 (300°)

Appendix H

Access Waiver

Property Access Statement

Wasatch County hereby allows U.S. Army Corps of Engineers personnel to enter the property described in the attached delineation report for the Tri-Valley Watershed EA project to collect samples as needed.

Name (print) __Brandon Cluff_____

Title __County Planner_____

Signature _____

Date _____

Phone Number __(435) 657-3205_____

Biological Assessment

BIOLOGICAL ASSESSMENT OF THE TRI-VALLEY WATERSHED EA WASATCH COUNTY, UTAH

Prepared for:

Wasatch County
Attn: Brandon Cluff
55 South 500 East
Heber City, UT 84032
435-657-3205

Prepared by:

BOWEN COLLINS & ASSOCIATES

154 East 14075 South
Draper, UT 84020
(801) 495-2224

November 2024

TABLE OF CONTENTS

TABLE OF CONTENTS i
INTRODUCTION 1
PURPOSE 1
BACKGROUND 2
PROPOSED ACTIONS 2
ACTION AREA 3
LISTED SPECIES & CRITICAL HABITAT IN THE ACTION AREA 3
BASELINE CONDITIONS 4
EFFECTS 4
CONSERVATION COMMITMENTS 6
CONCLUSIONS 7
LITERATURE CITED 8

LIST OF TABLES

Table 1 ESA Listed Species Potentially Occurring in the Project Area 1
Table 2 Potential TES Species in the Tri-Valley Valley Project Area 4

LIST OF APPENDICES

APPENDIX A – Site Location, Action Area with Staging, & Habitat Analysis Figures
APPENDIX B – Official USFWS TES Species List
APPENDIX C – Utah Natural Heritage Program Species Report
APPENDIX D – Plan Figures
APPENDIX E – USFWS Project Recommendations for Migratory Bird Conservation
APPENDIX F – Site Photos

ACRONYMS & ABBREVIATIONS

BA – Biological Assessment
BC&A - Bowen Collins & Associates
County – Wasatch County
DWR - Utah Division of Wildlife Resources
ESA – Endangered Species Act
NRCS – National Resource Conservation Service
UNHP - Utah Natural Heritage Program
USFWS/Service - U.S. Fish & Wildlife Service
WMA – Wildlife Management Area

INTRODUCTION

This Biological Assessment has been prepared by Bowen Collins & Associates (BC&A), on behalf of Wasatch County (County) and the National Resource Conservation Service (NRCS) for the Tri-Valley Watershed Plan Environmental Assessment (EA) in Wasatch County, Utah (See Site Location Maps, Appendix A). The County is evaluating plans to update the piping and pumping system to improve irrigation delivery methods and allow better access for pipe maintenance in this area. Additionally, they would like to address flooding of Center Creek near Center Creek Road and 2400 East with an overflow pipe and several catch basins.

PURPOSE

The purpose of this biological assessment (BA) is to assess the potential environmental impacts of the proposed project on federally-listed plant and animal species in accordance with the requirements of Section 7 of the Endangered Species Act (ESA; 16 U.S.C. 460 et seq., as amended) (See official species list in Appendix B). The federal action agency is the NRCS who is providing funding for the proposed project.

The objective of the proposed action is to make irrigation delivery more efficient and accessible and address flooding. Additional details about the proposed action are included below but in general the project includes updating the irrigation piping and pumping system in Daniel, Utah and adding an overflow pipe and catch basin on Center Creek. These actions have the potential to impact the ESA-listed species that occur in the action area as listed in Table 1 below:

Table 1
ESA Listed Species Potentially Occurring in the Project Areas

Common Name	Scientific Name	Critical Habitat
Canada Lynx	*Lynx canadensis*	-
North American Wolverine	*Gulo gulo luscus*	-
Yellow-billed Cuckoo	*Coccyzus amercanus*	-
Monarch Butterfly	*Danaus plexippus*	-

This BA, prepared by BC&A, addresses the proposed action in compliance with Section 7 of the ESA. Section 7 assures that, through consultation (or conferencing for proposed species) with the Service, federal actions do not jeopardize the continued existence of any threatened, endangered, or proposed species, or result in the destruction or adverse modification of critical habitat.

BACKGROUND

The purpose of the Tri-Valley Watershed Plan EA is to evaluate structural measures that will increasing the irrigation efficiency in the Daniel area through improved water delivery methods and pipeline maintenance access. The EA also evaluates structural measures to address flooding of Center Creek near Center Creek Road and 2400 East.

The majority of the project is located in the Town of Daniel, in the southern portion of Wasatch County, just south of Heber City. The Daniel Irrigation Company (DIC) delivers irrigation water to users in and around Daniel. The current system is a pressurized irrigation system, which was converted from open canals for flood irrigation as part of the Wasatch County Water Efficiency Project. Central Utah Water Conservancy District (CUWCD) is the wholesale water provider to the system and operates and maintains the main trunkline of the system, while DIC operates and maintains the distribution laterals.

The existing main trunk line as well as a lower line are made of transite material. This pipe material, otherwise known as asbestos cement, was a popular pipe material in the mid-1900s due to its light weight and resistance to corrosion. However, since that time it has been discovered that asbestos is a carcinogen and health issues can arise from high levels of asbestos in the drinking water. Additionally, because of the health hazards and brittle nature of the pipe, it is known to be potentially dangerous and difficult to repair or maintain. For these reasons it is generally recommended to replace or abandon in place transite pipe whenever possible.

PROPOSED ACTIONS

The proposed Tri-Valley Watershed Project actions are displayed on Figures 8 & 11 of Appendix D. The proposed actions include the following:

- Install new valve vault to control water delivery at the trunkline tie in
- Replace existing transite pipe along Little Sweden Road from Hwy 40 west
- Replace existing transite pipe from Lower Pond to Little Sweden Road
- Abandon in place 10,940 feet of existing transite pipe
- Install new pipe in previous gaps along Little Sweden Road as well us add new sections along Mill Road, 3000 South, 600 East, and Timpview Drive
- Install approximately 75 service connections consisting of a tee, short length of pipe, and a valve.
- Install an interconnection to the Center Creek pressure zones for additional operational flexibility.
- Install 400 feet of 18” channel overflow pipe with four catch basin inlets and a roadside ditch adjacent to Center Creek Road near 2400 East.

These proposed actions will be accomplished with the use of heavy equipment which is likely to include backhoes, dump trucks, and front-end loaders. As most of the new pipelines will be installed within existing paved roads, asphalt restoration is also expected using pavers, dump

trucks, and steam rollers. Staging of equipment and machinery will take place in adjacent parking lots and open spaces as shown in Figure 2, Appendix A.

ACTION AREA

The action area includes the 61 acres of project area, plus a half-mile buffer as required by the 2017 Guidelines for Identification and Evaluation of Suitable Habitat for Western Yellow-billed Cuckoo in Utah (USFWS, 2017). The natural terrain of the area slopes gently downwards from southeast to northwest and averages around 5,6850 feet in elevation. The steep slopes of the Wasatch Mountain climb quickly upward just south of the project area. The southeast corner of the project area is the at the mouth of Daniels Canyon, a along narrow drainage connecting the Heber Valley to the Strawberry Valley. Daniels Creek flows through the project area, exiting the canyon and wrapping around the foothills to the northwest.

Most of the action area is located on private property or on roadways within the town of Daniel, including Little Sweden Road, Mill Road, 3000 South, 600 East, and Timpview Drive. About 40 acres within the half-acre buffer evaluated for cuckoo also overlaps onto the Wallsburg Wildlife Management Area (WMA) which the State of Utah has set aside to preserve and protect big game summer and winter range and reduce depredation by deer and elk on surrounding private lands (See State-owned lands displayed on Figure 3, Appendix A).

The Wallsburg WMA was originally purchased for its big game habitat values and is a winter home to approximately 300 elk and 2,000 mule deer. It also provides habitat for sage grouse, chukar partridge, blue grouse, ruffed grouse, mourning dove, Hungarian partridge, turkey, cottontail rabbit, white-tailed and black-tailed jackrabbit, golden eagle, bear, mountain lion, bobcat coyote, and neotropical birds.

LISTED SPECIES & CRITICAL HABITAT IN THE ACTION AREA

The purpose of this section is to identify protected species and critical habitat that may be present within the action area. Table 2 on the next page includes all potential species as listed on the official Service list of TES that may occur in or be affected by the proposed project (See Official List, Appendix B).

Table 2
Potential TES Species in the Tri-Valley Watershed Project Area

Species	Status	Habitat in Action Area	Critical Habitat in Action Area
Mammals			
Canada Lynx *Lynx canadensis*	Threatened	No	No
North American Wolverine *Gulo gulo luscus*	Threatened	No	No
Birds			
Yellow-billed Cuckoo *Coccyzus americanus*	Threatened	No	No
Insects			
Monarch Butterfly *Danaus plexippus*	Candidate	No	No

BASELINE CONDITIONS

The action area focuses on a series of open ditches traveling adjacent to county and city roads or directly through open pastures or farmland. U.S. Highway 40 crosses through a portion of the action area and a short stretch of Daniel Creek (~1,000) feet also flows through the action area on the south boundary of the project.

Daniel is a small rural town, and the project area is not densely developed. The pasture/farmed areas are open with little to no trees. There are some ornamental trees at the residences located along the action area and Daniel Creek has a narrow riparian corridor of cottonwoods and some adjacent wetlands. Livestock are often present in the pastures and deer from the adjacent foothills likely pass through the area regularly. Pheasant and wild turkey were also observed near Daniel Creek during the site visit.

The nearby Wallsburg WMA provides habitat for a variety of wildlife species as described above, most notable elk and deer. The WMA's proximity to the town of Daniel which itself contains a great deal of open space makes wildlife more likely in the project area. The WMA is expected to remain protected in the future.

EFFECTS

Canada Lynx

Canada lynx (*Lynx canadensis*) is a medium-sized cat mostly found in montane coniferous forests, much of which has been diminished due to logging, clearing, roads, and development. Canada lynx are a nocturnal and solitary species, feeding mostly on snowshoe hare (USFWS, 2021c). Sightings of Canada lynx are exceedingly rare in Utah and there are no state records of them occurring within two miles of the action area (UNHP, 2022).

The Wasatch foothills south of the Tri-Valley Watershed Project area offer marginal forested habitat for Canada lynx but based on a site visit by BC&A biologist, Merissa Davis on October 30, 2020, there is no suitable habitat within the action area. This species is not expected to be present in the action area and therefore, there should be *no effect* on Canada Lynx as part of the proposed action.

North American Wolverine

North American Wolverine (*Gulo gulo luscus*) is a medium-sized mammal that is found in montane forests. They rely on deep snowpack for natal denning that persists through mid-April or mid-May. Wolverines have wide home ranges but are generally reclusive and found in forested areas away from roads and other human activity.

The project area is valley-bottom agricultural land, and snow generally retreats from the project area before the beginning of April (NOAA 2024). These factors make it unsuitable for reproduction. Although they are known to travel far distances while foraging, they generally stay in the mountains and are not expected to be present during construction when the ground is snow-free and human activity is present. As the project area has no suitable habitat for reproduction or foraging, it is expected that the project will have *no effect* on wolverines.

Yellow-billed Cuckoo

Currently, the range of the western yellow-billed cuckoo (*Coccyzus americanus*) is limited to disjunct fragments of riparian habitats from northern Utah, western Colorado, southwestern Wyoming, and southeastern Idaho southward into northwestern Mexico and westward into southern Nevada and California. Yellow-billed cuckoos prefer nesting habitat within 100 meters of water classified as lowland riparian characterized by a dense sub-canopy or shrub layer (cottonwood/willow habitats) and are considered riparian obligates. They arrive late in the spring for breeding in late May or early June and breed through late June to July. Cuckoos may require large tracts (several hundred acres) of contiguous riparian nesting habitat; however, they are not strongly territorial and home ranges may overlap during the breeding season. (UDWR, 2021d)

There are no state records of yellow-billed cuckoo within two miles of the action area (UNHP, 2021). Prior to field investigations, aerial photography was reviewed for riparian treed habitat patches within half a mile of the project area that might be suitable for yellow-billed cuckoo per the Utah guidelines (USFWS, 2017). Despite a narrow band of treed riparian habitat along Daniel Creek, nowhere within the project area where there patches large enough (at least 12 acers) or wide and long enough (100 meters x 100 meters) to support nesting and breeding cuckoo (See Habitat Analysis Figure 3, Appendix A). These findings were confirmed during the October 30, 2020 site visit conducted by BC&A biologist Merissa Davis. As no habitat is present within the action area, the project should have *no effect* on yellow-billed cuckoo.

Monarch Butterfly

Monarch butterfly, *Danaus plexippus*, is a candidate species for federal listing under the ESA due to a more than 99% decline in the western population since the 1980s (USFWS, 2021c). A number

of factors have contributed to the extreme population decline including the loss and degradation of overwintering groves; pesticide use, loss of breeding and migratory habitat, climate change, and parasites or disease. Monarch butterflies are typically found in Utah during the summer breeding months and are dependent on open fields and meadows with milkweed plants which are both a source of nectar and an egg laying site for the insects.

During the site visits, no milkweed was observed, nor were other flowering plants capable of providing a significant nectar source for monarch butterfly. Due to a lack of suitable habitat in the action area this species is not expected to be present and as such, it is anticipated that the proposed actions would have *no effect* on the candidate species.

Migratory Birds

Migratory birds are protected under the Migratory Bird Treaty Act (MBTA; 16 U.S.C., §703, Supp. I, 1989). The MBTA prohibits killing, possessing, or trading of migratory birds except in accordance with regulations prescribed by the Secretary of the Interior. This act encompasses whole birds, parts of birds, and bird nests and eggs. A list of potential migratory birds in the WVDS area is included in the list of species that may be affected by the proposed project included in Appendix B (USFWS 2022).

Bird nesting habitat is present in the residential landscape trees and in the riparian trees along Daniel Creek. The project timing is expected to take place outside of nesting and breeding season (Fall 2022) and tree removal is not expected as part of the construction, but should it become necessary during the general migratory bird nesting season (April – August), a preconstruction survey will be completed to determine whether nesting birds are present (no more than five days prior to construction). If migratory birds are found nesting in trees that would be removed, construction activities will be postponed until the non-nesting season or until nestlings have fledged and/or the nest fails, or breeding behaviors are no longer observed.

CONSERVATION COMMITMENTS

The following conservation commitments are expected as part of the proposed actions.

1. Migratory Bird Conservation Recommendations made by the USFWS Utah Field office will be used as part of the project requirements (See Appendix E). Accordingly, the project is planned outside of nesting and breeding seasons, however, if construction should extend into migratory bird breeding and nesting season (February through September) and tree removal should become necessary, a pre-construction surveys should take place (no more than 7-days prior). If active nests are found, construction activities will be postponed until after the nesting season or until nestlings have fledged and/or the nest fails, or breeding behaviors are no longer observed.
2. Best management practices will be used throughout the action area to reduce impacts to channels including using silt fencing and wattles for erosion and storm water control.

CONCLUSIONS

The proposed actions are expected to take place in the fall of 2022 pending environmental clearances, permitting, contracts and agreements. No suitable habitat exists for Canada Lynx, North American Wolverine, or Yellow-billed cuckoo within the action area or within the half-mile buffer evaluated for habitat, therefore it is expected there will be *no effect* to any federally listed species with potential to occur in this area. Conservation commitments have been made to further minimize impacts as much as possible.

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Appendix A

Site Location, Action Area, and Habitat Analysis Figures

Heber

Daniel

189

40

LEGEND

Project Boundary (61 acres)

SCALE: 0 5001,000 Feet

NORTH: NORTH

SITE LOCATION

WASATCH COUNTY
TRI-VALLEY
WATERSHED EA

BOWEN COLLINS & ASSOCIATES

FIGURE NO.
1A

Figure Created By
Marilyn Rice 11/13/2020
Imagery: Hexagon 2018

P:\Wasatch County\627-19-01 Tri-Valley Watershed Plan EA\4.0 GIS\4.1 Projects\Environmental\Fig1A_Site Location.mxd cgiabau 6/29/2021

LEGEND

Project Boundary (61 acres)

SCALE: 0 5001,000 Feet

NORTH: NORTH

SITE LOCATION

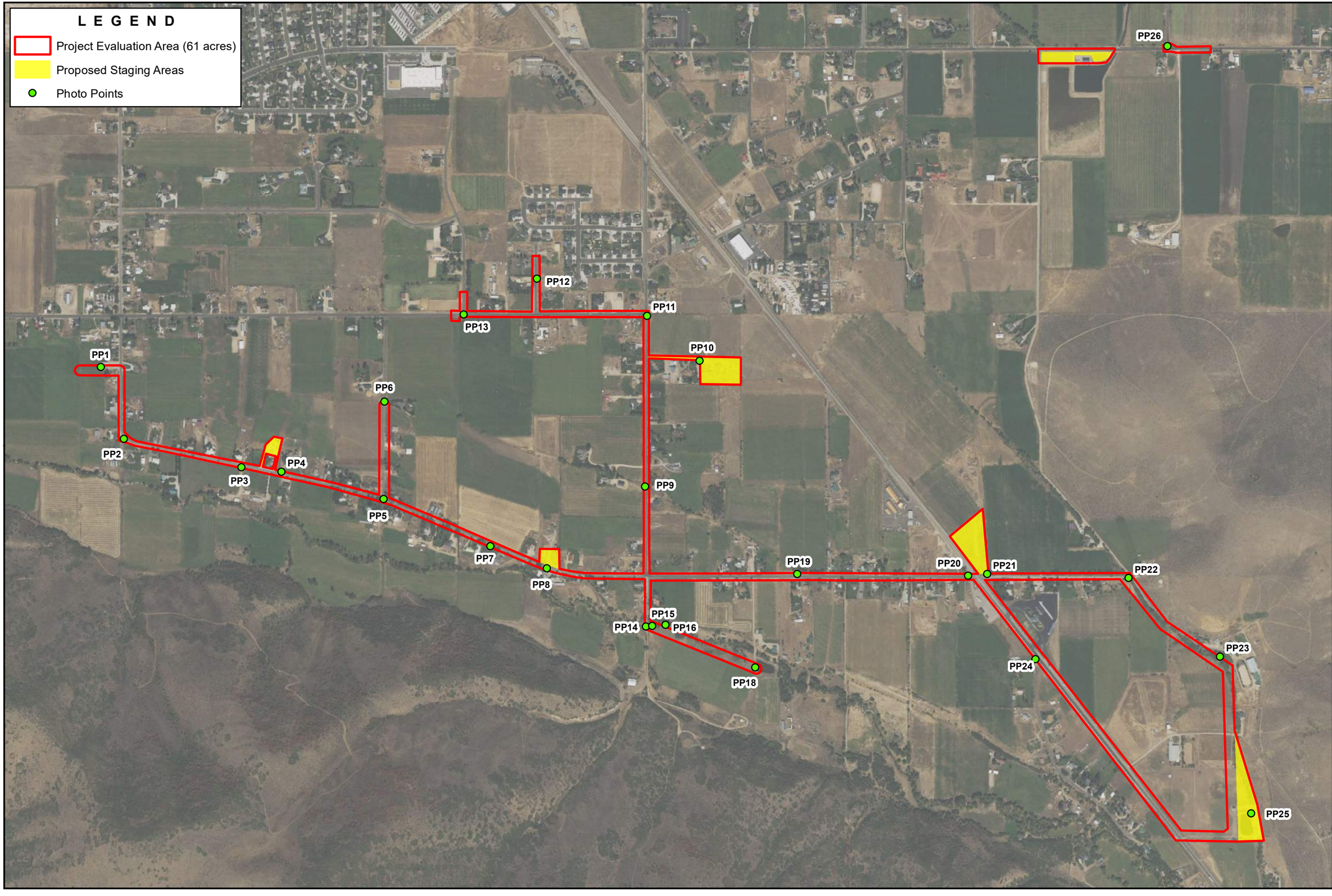
WASATCH COUNTY
TRI-VALLEY
WATERSHED EA

BOWEN COLLINS & ASSOCIATES

FIGURE NO.
1B

Figure Created By
Marilyn Rice 11/13/2020
USGS Quads: Charleston, Center Creek

P:\Wasatch County\627-19-01 Tri-Valley Watershed Plan EA\4.0 GIS\4.1 Projects\Environmental\Fig1B_Site Location.mxd cgalbau 02/9/2021



SCALE: 1 in. = 863 ft.

NORTH: NORTH

ACTION AREA WITH STAGING

WASATCH COUNTY
TRI-VALLEY WATERSHED EA

BOWEN COLLINS & ASSOCIATES

FIGURE NO.
2

P:\Wasatch County\627-19-01 Tri-Valley Watershed Plan EA\4.0 GIS\4.1 Projects\Environmental\Fig2_ActionArea_BA.mxd mdavis 9/2/2021

L E G E N D

- Project Evaluation Area (61 acres)
- 1/2-mile Cuckoo Habitat Analysis Buffer
- State Lands

Wallsburg State Wildlife Area

Figure Created By
Merissa Davis 08/26/21
Imagery: Hexagon 2018

SCALE: 1 in. = 1,400 ft.

NORTH: NORTH

TES HABITAT ANALYSIS

WASATCH COUNTY
TRI-VALLEY WATERSHED EA

BOWEN COLLINS & ASSOCIATES

FIGURE NO.
3

P:\Wasatch County\627-19-01 Tri-Valley Watershed Plan EA\4.0 GIS\4.1 Projects\Environmental\fig3_TES_BA.mxd mdavis 8/30/2021

Appendix B

USFWS Official TES Potential Species List

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Utah Ecological Services Field Office
2369 West Orton Circle, Suite 50
West Valley City, UT 84119-7603
Phone: (801) 975-3330 Fax: (801) 975-3331

In Reply Refer To: 11/13/2024 21:58:01 UTC
Project Code: 2022-0022283
Project Name: Tri-Valley Watershed Plan EA

Subject: List of threatened and endangered species that may occur in your proposed project location or may be affected by your proposed project

To Whom It May Concern:

The enclosed species list identifies threatened, endangered, proposed, and candidate species, as well as proposed and final designated critical habitat, that may occur within the boundary of your proposed project and/or may be affected by your proposed project. The species list fulfills the requirements of the U.S. Fish and Wildlife Service (Service) under section 7(c) of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 *et seq.*).

New information based on updated surveys, changes in the abundance and distribution of species, changed habitat conditions, or other factors could change this list. Please feel free to contact us if you need more current information or assistance regarding the potential impacts to federally proposed, listed, and candidate species and federally designated and proposed critical habitat. Please note that under 50 CFR 402.12(e) of the regulations implementing section 7 of the Act, the accuracy of this species list should be verified after 90 days. This verification can be completed formally or informally as desired. The Service recommends that verification be completed by visiting the IPaC website at regular intervals during project planning and implementation for updates to species lists and information. An updated list may be requested through the IPaC system by completing the same process used to receive the enclosed list.

The purpose of the Act is to provide a means whereby threatened and endangered species and the ecosystems upon which they depend may be conserved. Under sections 7(a)(1) and 7(a)(2) of the Act and its implementing regulations (50 CFR 402 *et seq.*), Federal agencies are required to utilize their authorities to carry out programs for the conservation of threatened and endangered species and to determine whether projects may affect threatened and endangered species and/or designated critical habitat.

A Biological Assessment is required for construction projects (or other undertakings having similar physical impacts) that are major Federal actions significantly affecting the quality of the human environment as defined in the National Environmental Policy Act (42 U.S.C. 4332(2)(c)). For projects other than major construction activities, the Service suggests that a biological

evaluation similar to a Biological Assessment be prepared to determine whether the project may affect listed or proposed species and/or designated or proposed critical habitat. Recommended contents of a Biological Assessment are described at 50 CFR 402.12.

If a Federal agency determines, based on the Biological Assessment or biological evaluation, that listed species and/or designated critical habitat may be affected by the proposed project, the agency is required to consult with the Service pursuant to 50 CFR 402. In addition, the Service recommends that candidate species, proposed species and proposed critical habitat be addressed within the consultation. More information on the regulations and procedures for section 7 consultation, including the role of permit or license applicants, can be found in the "Endangered Species Consultation Handbook" at:

https://www.fws.gov/sites/default/files/documents/endangered-species-consultation-handbook.pdf

Migratory Birds: In addition to responsibilities to protect threatened and endangered species under the Endangered Species Act (ESA), there are additional responsibilities under the Migratory Bird Treaty Act (MBTA) and the Bald and Golden Eagle Protection Act (BGEPA) to protect native birds from project-related impacts. Any activity, intentional or unintentional, resulting in take of migratory birds, including eagles, is prohibited unless otherwise permitted by the U.S. Fish and Wildlife Service (50 C.F.R. Sec. 10.12 and 16 U.S.C. Sec. 668(a)). For more information regarding these Acts, see https://www.fws.gov/program/migratory-bird-permit/what-we-do.

The MBTA has no provision for allowing take of migratory birds that may be unintentionally killed or injured by otherwise lawful activities. It is the responsibility of the project proponent to comply with these Acts by identifying potential impacts to migratory birds and eagles within applicable NEPA documents (when there is a federal nexus) or a Bird/Eagle Conservation Plan (when there is no federal nexus). Proponents should implement conservation measures to avoid or minimize the production of project-related stressors or minimize the exposure of birds and their resources to the project-related stressors. For more information on avian stressors and recommended conservation measures, see https://www.fws.gov/library/collections/threats-birds.

In addition to MBTA and BGEPA, Executive Order 13186: *Responsibilities of Federal Agencies to Protect Migratory Birds*, obligates all Federal agencies that engage in or authorize activities that might affect migratory birds, to minimize those effects and encourage conservation measures that will improve bird populations. Executive Order 13186 provides for the protection of both migratory birds and migratory bird habitat. For information regarding the implementation of Executive Order 13186, please visit https://www.fws.gov/partner/council-conservation-migratory-birds.

We appreciate your concern for threatened and endangered species. The Service encourages Federal agencies to include conservation of threatened and endangered species into their project planning to further the purposes of the Act. Please include the Consultation Code in the header of this letter with any request for consultation or correspondence about your project that you submit to our office.

Attachment(s):

- Official Species List

OFFICIAL SPECIES LIST

This list is provided pursuant to Section 7 of the Endangered Species Act, and fulfills the requirement for Federal agencies to "request of the Secretary of the Interior information whether any species which is listed or proposed to be listed may be present in the area of a proposed action".

This species list is provided by:

Utah Ecological Services Field Office
2369 West Orton Circle, Suite 50
West Valley City, UT 84119-7603
(801) 975-3330

PROJECT SUMMARY

Project Code: 2022-0022283
Project Name: Tri-Valley Watershed Plan EA
Project Type: Irrigation
Project Description: The County is planning upgrades to their irrigation system in the Daniel area to improve water conservation and delivery. They are also addressing some nearby flood issues along Center Creek.

Project Location:

The approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/@40.477996950000005,-111.37964945541222,14z



Counties: Wasatch County, Utah

ENDANGERED SPECIES ACT SPECIES

There is a total of 4 threatened, endangered, or candidate species on this species list.

Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fish may appear on the species list because a project could affect downstream species.

IPaC does not display listed species or critical habitats under the sole jurisdiction of NOAA Fisheries[1], as USFWS does not have the authority to speak on behalf of NOAA and the Department of Commerce.

See the "Critical habitats" section below for those critical habitats that lie wholly or partially within your project area under this office's jurisdiction. Please contact the designated FWS office if you have questions.

---

1. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

MAMMALS

NAME	STATUS
Canada Lynx *Lynx canadensis* Population: Wherever Found in Contiguous U.S. There is **final** critical habitat for this species. Your location does not overlap the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/3652	Threatened
North American Wolverine *Gulo gulo luscus* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/5123	Threatened

BIRDS

NAME	STATUS
Yellow-billed Cuckoo *Coccyzus americanus* Population: Western U.S. DPS There is **final** critical habitat for this species. Your location does not overlap the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/3911	Threatened

INSECTS

NAME	STATUS
Monarch Butterfly *Danaus plexippus* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/9743	Candidate

CRITICAL HABITATS

THERE ARE NO CRITICAL HABITATS WITHIN YOUR PROJECT AREA UNDER THIS OFFICE'S JURISDICTION.

YOU ARE STILL REQUIRED TO DETERMINE IF YOUR PROJECT(S) MAY HAVE EFFECTS ON ALL ABOVE LISTED SPECIES.

IPAC USER CONTACT INFORMATION

Agency: Bowen Collins & Associates
Name: Merissa Davis
Address: 154 East 14075 South
City: Draper
State: UT
Zip: 84020
Email mdavis@bowencollins.com
Phone: 8014952224

LEAD AGENCY CONTACT INFORMATION

Lead Agency: Department of Agriculture

Appendix C

UNHP Species Report

Utah Division of Wildlife Resources
Utah Natural Heritage Program
1594 W. North Temple
PO Box 146301
Salt Lake City, UT 84116

Report Number: 13127
March 21, 2022

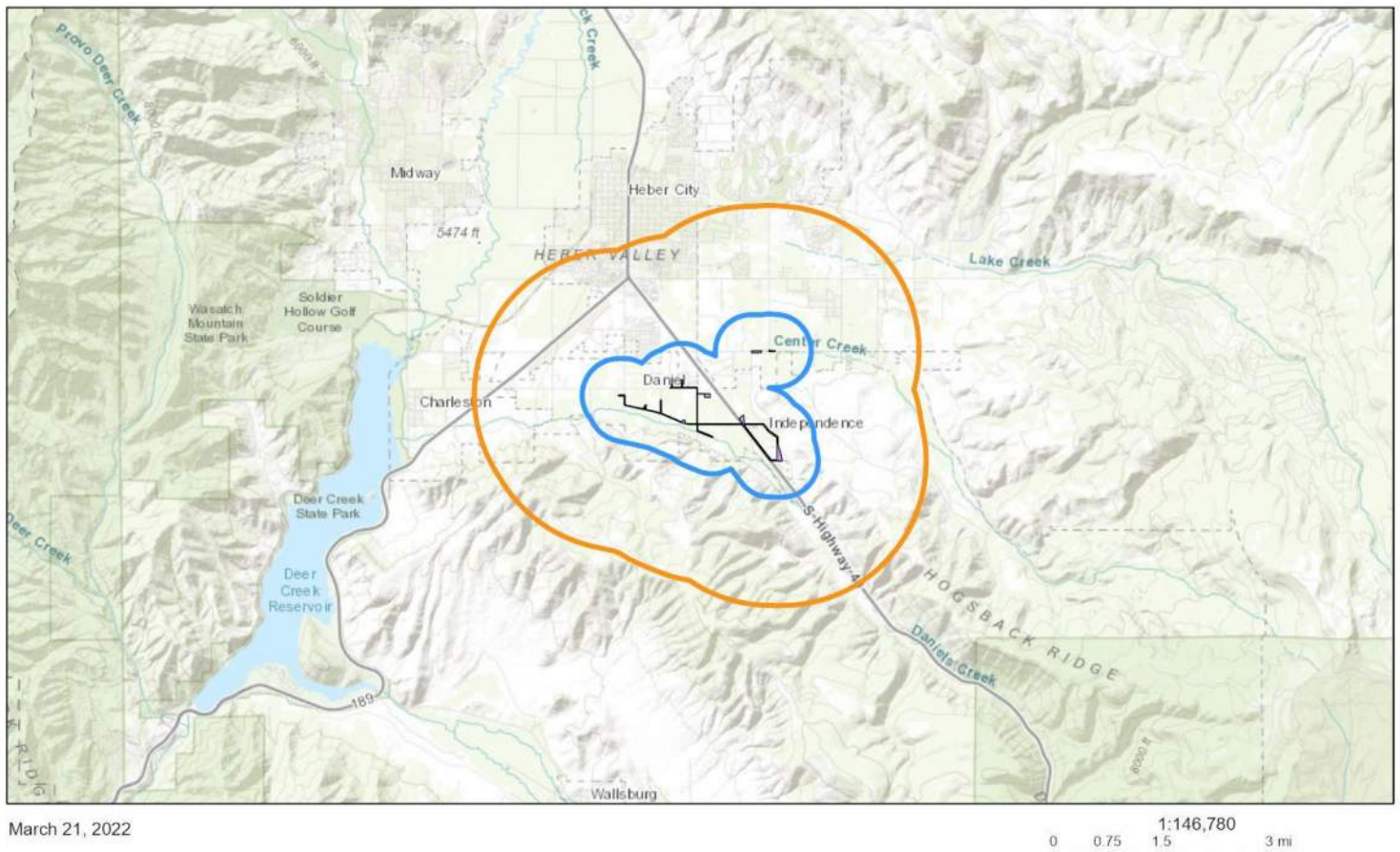
Utah Natural Heritage Program Online Species Search Report

Project Information

Project Name
Tri-Valley Watershed Plan EA

Project Description
Irrigation efficiency updates in the Daniel area plus flood control project along Center Creek

Location Description
Daniel, Utah area (see map)



March 21, 2022

1:146,780
0 0.75 1.5 3 mi
0 1.5 3 6 km
County of Utah, Bureau of Land Management, Utah AGRC, Esri, HERE, Garmin, USGS, NGA, EPA, USDA, NPS

Animals within a ½ mile radius

Common Name	Scientific Name	State Status	U.S. ESA Status	Last Observation Year
No Species Found				

Plants within a ½ mile radius

Common Name	Scientific Name	State Status	U.S. ESA Status	Last Observation Year
No Species Found				

Animals within a 2 mile radius

Common Name	Scientific Name	State Status	U.S. ESA Status	Last Observation Year
Greater Sage-grouse	Centrocercus urophasianus	SGCN		2000
Band-tailed Pigeon	Patagioenas fasciata	SGCN		1970

Plants within a 2 mile radius

Common Name	Scientific Name	State Status	U.S. ESA Status	Last Observation Year
No Species Found				

Definitions

State Status

SGCN	Species of greatest conservation need listed in the Utah Wildlife Action Plan

U.S. Endangered Species Act

LE	A taxon that is listed by the U.S. Fish and Wildlife Service as "endangered" with the probability of worldwide extinction
LT	A taxon that is listed by the U.S. Fish and Wildlife Service as "threatened" with becoming endangered
LE;XN	An "endangered" taxon that is considered by the U.S. Fish and Wildlife Service to be "experimental and nonessential" in its designated use areas in Utah
C	A taxon for which the U.S. Fish and Wildlife Service has on file sufficient information on biological vulnerability and threats to justify it being a "candidate" for listing as endangered or threatened
PT/PE	A taxon "proposed" to be listed as "endangered" or "threatened" by the U.S. Fish and Wildlife Service

Disclaimer

The information provided in this report is based on data existing in the Utah Division of Wildlife Resources' central database at the time of the request. It should not be regarded as a final statement on the occurrence of any species on or near the designated site, nor should it be considered a substitute for on-the-ground biological surveys. Moreover, because the Utah Division of Wildlife Resources' central database is continually updated, any given response is only appropriate for its respective request.

The UDWR provides no warranty, nor accepts any liability, occurring from any incorrect, incomplete, or misleading data, or from any incorrect, incomplete, or misleading use of these data.

The results are a query of species tracked by the Utah Natural Heritage Program, which includes all species listed under the U.S. Endangered Species Act and species on the Utah Wildlife Action Plan. Other significant wildlife values might also be present on the designated site. Please contact UDWR's regional habitat manager if you have any questions.

Contact the U.S. Fish and Wildlife Service at (801) 975-3330 for the purpose of consultation under the Endangered Species Act.

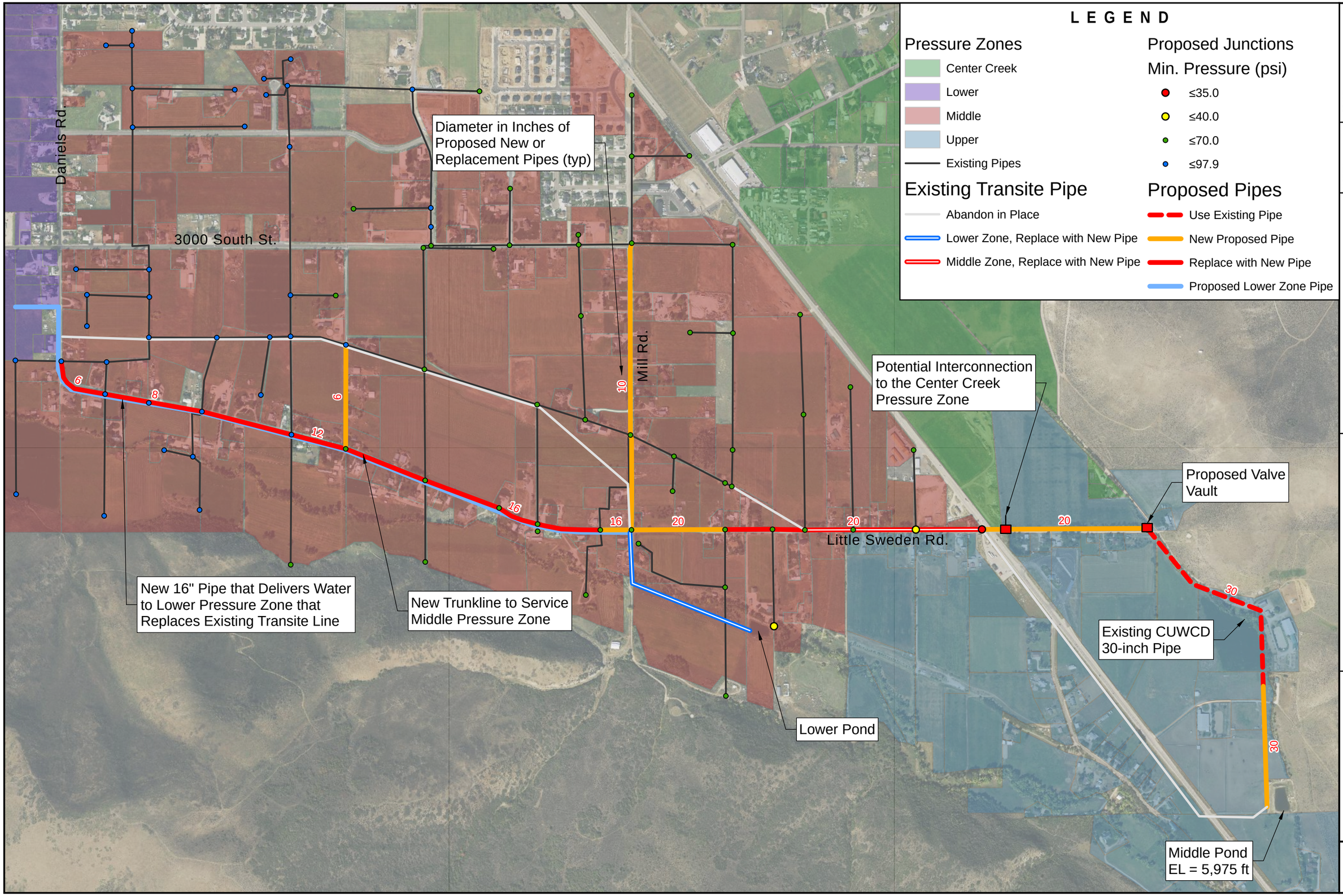
Please contact our office at (801) 538-4759 or habitat@utah.gov if you require further assistance.

Your project is located in the following UDWR region(s): Central region

Report generated for:
Merissa Davis
Bowen Collins & Associates
154 East 14075 South
Draper, UT 84020
(801) 495-2224
mdavis@bowencollins.com

Appendix D

Plan Figures



LEGEND

Pressure Zones
- Center Creek
- Lower
- Middle
- Upper
- Existing Pipes

Proposed Junctions
Min. Pressure (psi)
- ≤35.0
- ≤40.0
- ≤70.0
- ≤97.9

Existing Transite Pipe
- Abandon in Place
- Lower Zone, Replace with New Pipe
- Middle Zone, Replace with New Pipe

Proposed Pipes
- Use Existing Pipe
- New Proposed Pipe
- Replace with New Pipe
- Proposed Lower Zone Pipe

SCALE: 1 in = 800 ft

NORTH: NORTH

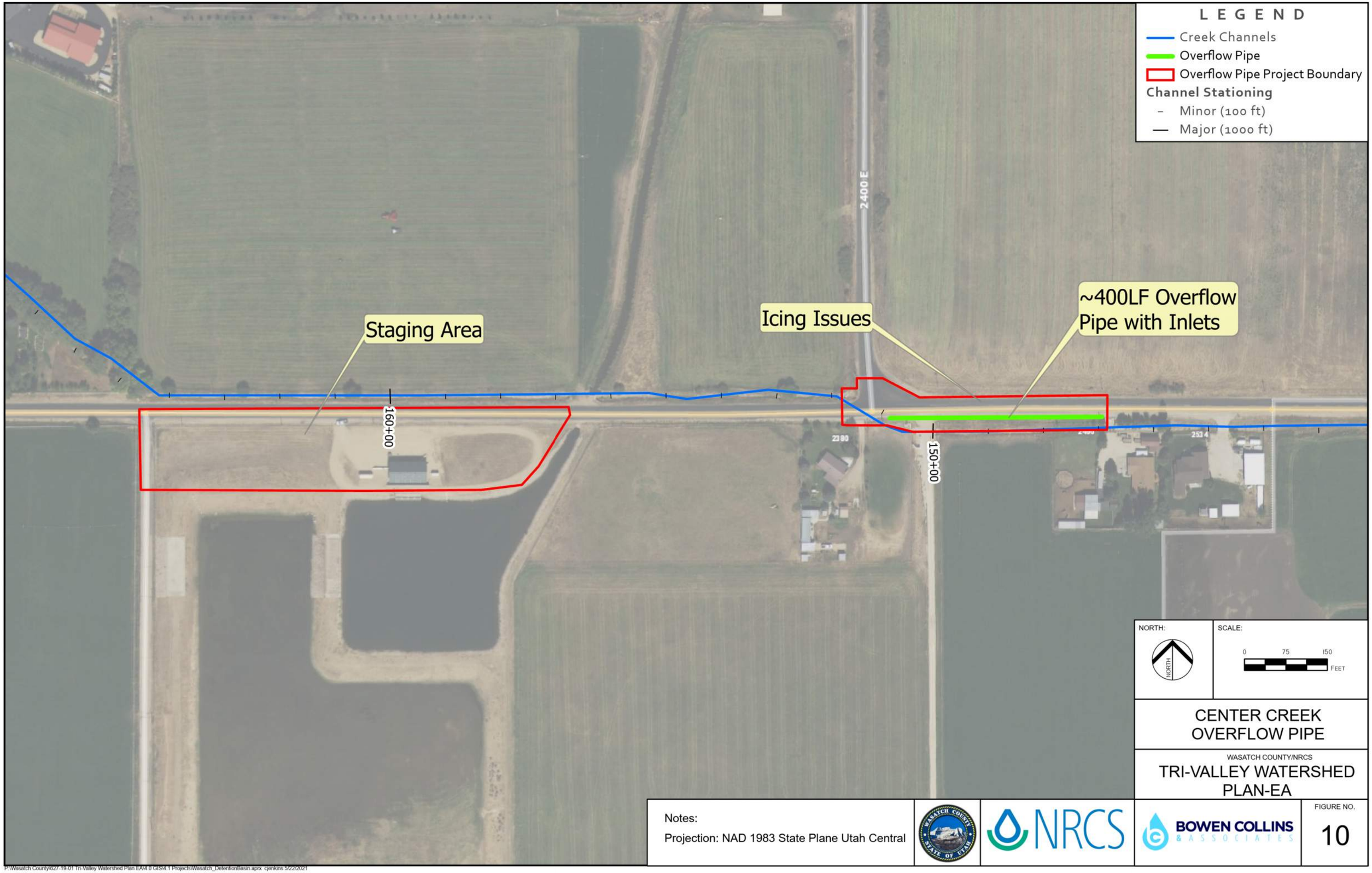
ALTERNATIVE 2
PROPOSED PIPES

WASATCH COUNTY
DANIEL IRRIGATION PROJECT

BOWEN COLLINS & ASSOCIATES

FIGURE NO.
8

P:\Wasatch County\627-19-01 Tri-Valley Watershed Plan EA\6.0 Reports\01 - Daniels Irrigation\GIS\DanielsIrrigation\DanielsIrrigation.aprx cmoultrie 11/13/2022



NORTH:

SCALE: 0 75 150 FEET

CENTER CREEK OVERFLOW PIPE

WASATCH COUNTY/NRCS

TRI-VALLEY WATERSHED PLAN-EA

Notes:

Projection: NAD 1983 State Plane Utah Central

BOWEN COLLINS & ASSOCIATES

FIGURE NO. 10

P:\Wasatch County\627-19-01 Tri-Valley Watershed Plan EA\4.0 GIS\4.1 Projects\Wasatch_DetentionBasin.aprx cjenkins 5/22/2021

Appendix E

USFWS Project Recommendations for Migratory Bird Conservation

Project Recommendations for Migratory Bird Conservation
U.S. Fish and Wildlife Service, Utah Field Office (May 2020)

The Migratory Bird Treaty Act (MBTA) is the cornerstone of migratory bird conservation and protection in the United States. The MBTA implements four treaties that provide for international protection of migratory birds. The USFWS maintains a list of all species protected by the MBTA at 50 C.F.R. § 10.13. This list includes over one thousand species of migratory birds, including eagles and other raptors, waterfowl, shorebirds, seabirds, wading birds, and songbirds. The MBTA does not protect introduced species such as the house (English) sparrow, European starling, rock dove (pigeon), Eurasian collared-dove, and non-migratory upland game birds.

The U.S. Fish and Wildlife Service (USFWS) recommends that the following migratory bird conservation measures be implemented as you complete your project:

a. Wherever possible we recommend that projects be completed outside the migratory bird nesting season to avoid and minimize impacts to migratory birds.

b. If the project includes the loss or degradation of migratory bird habitat then complete all portions of the project that could impact migratory birds outside the maximum migratory bird nesting season. This includes ground-disturbing activities, habitat removal, clearing or cutting of vegetation, grubbing, burning, etc. If that is not feasible, we recommend that you complete the project outside the minimum migratory bird nesting season.

    The time period associated with the maximum migratory bird nesting season is approximately December to August. The time period associated with the minimum migratory bird nesting season is April 1 to July 15 (time-frame when the majority of annual bird nesting occurs).

c. If the project needs to occur during the migratory bird nesting season, impacts to birds can be avoided or minimized by completing vegetation treatments and vegetation clearing and removal actions during the fall and winter (outside the migratory bird nesting season per above) prior to the nesting season when the project will begin.

d. If a project may impact migratory birds and/or cause the loss or degradation of migratory bird habitat, and such work cannot occur outside the migratory bird nesting season, we recommend surveying impacted portions of the project area to determine if migratory birds are present and nesting. Surveys should emphasize detecting presence of USFWS Birds of Conservation Concern, take place during the nesting season the year before the nesting season in which project is scheduled to occur, and should document presence of migratory birds at least throughout the entire minimum migratory bird nesting season (April 1 to July 15). Nest surveys should be conducted by qualified biologists using accepted survey protocols.

e. If your project must occur during the maximum migratory bird nesting season, implement measures to prevent migratory birds from establishing nests in the potential impact

Appendix F

Photos

Tri-Valley Watershed EA
Site Photos



Photo Point # 1 (270°)



Photo Point #2 (350°)

Tri-Valley Watershed EA
Site Photos



Photo Point #3 (280°)



Photo Point #4 (330°)



Photo Point #5 (280°)



Photo Point #6 (180°)

Tri-Valley Watershed EA
Site Photos



Photo Point #7 (290°)



Photo Point #8 (0°)

Tri-Valley Watershed EA
Site Photos



Photo Point #9 (180°)



Photo Point #10 (100°)



Photo Point # 11 (270°)



Photo Point #12 (0°)

Tri-Valley Watershed EA
Site Photos



Photo Point #13 (0°)



Photo Point #14 (280°)



Photo Point #15 (110°)



Photo Point #16 (80°)

Tri-Valley Watershed EA
Site Photos



Photo Point #18 (90°)



Photo Point #18 (270°)



Photo Point #19 (340°)



Photo Point #19 (270°)



Photo Point #20 (0°)



Photo Point #20 (180°)



Photo Point #21 (0°)



Photo Point #22 (180°)



Photo Point #23 (160°)



Photo Point #24 (320°)



Photo Point #25 (220°)



Photo Point #26 (270°)

BIOLOGICAL ASSESSMENT OF THE TRI-VALLEY WATERSHED EA WASATCH COUNTY, UTAH

Prepared for:

Wasatch County
Attn: Brandon Cluff
55 South 500 East
Heber City, UT 84032
435-657-3205

Prepared by:

BOWEN COLLINS & ASSOCIATES

154 East 14075 South
Draper, UT 84020
(801) 495-2224

March 2022

TABLE OF CONTENTS

TABLE OF CONTENTS i
INTRODUCTION 1
PURPOSE 1
BACKGROUND 2
PROPOSED ACTIONS 2
ACTION AREA 3
LISTED SPECIES & CRITICAL HABITAT IN THE ACTION AREA 3
BASELINE CONDITIONS 4
EFFECTS 4
CONSERVATION COMMITMENTS 6
CONCLUSIONS 6
LITERATURE CITED 7

LIST OF TABLES

Table 1 ESA Listed Species Potentially Occurring in the Project Area 1
Table 2 Potential TES Species in the Tri-Valley Valley Project Area 4

LIST OF APPENDICES

APPENDIX A – Site Location, Action Area with Staging, & Habitat Analysis Figures
APPENDIX B – Official USFWS TES Species List
APPENDIX C – Utah Natural Heritage Program Species Report
APPENDIX D – Plan Figures
APPENDIX E – USFWS Project Recommendations for Migratory Bird Conservation
APPENDIX F – Site Photos

ACRONYMS & ABBREVIATIONS

BA – Biological Assessment
BC&A - Bowen Collins & Associates
County – Wasatch County
DWR - Utah Division of Wildlife Resources
ESA – Endangered Species Act
NRCS – National Resource Conservation Service
UNHP - Utah Natural Heritage Program
USFWS/Service - U.S. Fish & Wildlife Service
WMA – Wildlife Management Area

INTRODUCTION

This Biological Assessment has been prepared by Bowen Collins & Associates (BC&A), on behalf of Wasatch County (County) and the National Resource Conservation Service (NRCS) for the Tri-Valley Watershed Plan Environmental Assessment (EA) in Wasatch County, Utah (See Site Location Maps, Appendix A). The County is evaluating plans to update the piping and pumping system to improve irrigation delivery methods and allow better access for pipe maintenance in this area. Additionally, they would like to address flooding of Center Creek near Center Creek Road and 2400 East with an overflow pipe and several catch basins.

PURPOSE

The purpose of this biological assessment (BA) is to assess the potential environmental impacts of the proposed project on federally-listed plant and animal species in accordance with the requirements of Section 7 of the Endangered Species Act (ESA; 16 U.S.C. 460 et seq., as amended) (See official species list in Appendix B). The federal action agency is the NRCS who is providing funding for the proposed project.

The objective of the proposed action is to make irrigation delivery more efficient and accessible and address flooding. Additional details about the proposed action are included below but in general the project includes updating the irrigation piping and pumping system in Daniel, Utah and adding an overflow pipe and catch basin on Center Creek. These actions have the potential to impact the ESA-listed species that occur in the action area as listed in Table 1 below:

Table 1
ESA Listed Species Potentially Occurring in the Project Areas

Common Name	Scientific Name	Critical Habitat
Canada Lynx	*Lynx canadensis*	-
Yellow-billed Cuckoo	*Coccyzus amercanus*	-
Monarch Butterfly	*Danaus plexippus*	-

This BA, prepared by BC&A, addresses the proposed action in compliance with Section 7 of the ESA. Section 7 assures that, through consultation (or conferencing for proposed species) with the Service, federal actions do not jeopardize the continued existence of any threatened, endangered, or proposed species, or result in the destruction or adverse modification of critical habitat.

BACKGROUND

The purpose of the Tri-Valley Watershed Plan EA is to evaluate structural measures that will increasing the irrigation efficiency in the Daniel area through improved water delivery methods and pipeline maintenance access. The EA also evaluates structural measures to address flooding of Center Creek near Center Creek Road and 2400 East.

The majority of the project is located in the Town of Daniel, in the southern portion of Wasatch County, just south of Heber City. The Daniel Irrigation Company (DIC) delivers irrigation water to users in and around Daniel. The current system is a pressurized irrigation system, which was converted from open canals for flood irrigation as part of the Wasatch County Water Efficiency Project. Central Utah Water Conservancy District (CUWCD) is the wholesale water provider to the system and operates and maintains the main trunkline of the system, while DIC operates and maintains the distribution laterals.

The existing main trunk line as well as a lower line are made of transite material. This pipe material, otherwise known as asbestos cement, was a popular pipe material in the mid-1900s due to its light weight and resistance to corrosion. However, since that time it has been discovered that asbestos is a carcinogen and health issues can arise from high levels of asbestos in the drinking water. Additionally, because of the health hazards and brittle nature of the pipe, it is known to be potentially dangerous and difficult to repair or maintain. For these reasons it is generally recommended to replace or abandon in place transite pipe whenever possible.

PROPOSED ACTIONS

The proposed Tri-Valley Watershed Project actions are displayed on Figures 8 & 11 of Appendix D. The proposed actions include the following:

- Install new valve vault to control water delivery at the trunkline tie in
- Replace existing transite pipe along Little Sweden Road from Hwy 40 west
- Replace existing transite pipe from Lower Pond to Little Sweden Road
- Abandon in place 10,940 feet of existing transite pipe
- Install new pipe in previous gaps along Little Sweden Road as well us add new sections along Mill Road, 3000 South, 600 East, and Timpview Drive
- Install approximately 75 service connections consisting of a tee, short length of pipe, and a valve.
- Install an interconnection to the Center Creek pressure zones for additional operational flexibility.
- Install 400 feet of 18” channel overflow pipe with four catch basin inlets and a roadside ditch adjacent to Center Creek Road near 2400 East.

These proposed actions will be accomplished with the use of heavy equipment which is likely to include backhoes, dump trucks, and front-end loaders. As most of the new pipelines will be installed within existing paved roads, asphalt restoration is also expected using pavers, dump

trucks, and steam rollers. Staging of equipment and machinery will take place in adjacent parking lots and open spaces as shown in Figure 2, Appendix A.

ACTION AREA

The action area includes the 61 acres of project area, plus a half-mile buffer as required by the 2017 Guidelines for Identification and Evaluation of Suitable Habitat for Western Yellow-billed Cuckoo in Utah (USFWS, 2017). The natural terrain of the area slopes gently downwards from southeast to northwest and averages around 5,6850 feet in elevation. The steep slopes of the Wasatch Mountain climb quickly upward just south of the project area. The southeast corner of the project area is the at the mouth of Daniels Canyon, a along narrow drainage connecting the Heber Valley to the Strawberry Valley. Daniels Creek flows through the project area, exiting the canyon and wrapping around the foothills to the northwest.

Most of the action area is located on private property or on roadways within the town of Daniel, including Little Sweden Road, Mill Road, 3000 South, 600 East, and Timpview Drive. About 40 acres within the half-acre buffer evaluated for cuckoo also overlaps onto the Wallsburg Wildlife Management Area (WMA) which the State of Utah has set aside to preserve and protect big game summer and winter range and reduce depredation by deer and elk on surrounding private lands (See State-owned lands displayed on Figure 3, Appendix A).

The Wallsburg WMA was originally purchased for its big game habitat values and is a winter home to approximately 300 elk and 2,000 mule deer. It also provides habitat for sage grouse, chukar partridge, blue grouse, ruffed grouse, mourning dove, Hungarian partridge, turkey, cottontail rabbit, white-tailed and black-tailed jackrabbit, golden eagle, bear, mountain lion, bobcat coyote, and neotropical birds.

LISTED SPECIES & CRITICAL HABITAT IN THE ACTION AREA

The purpose of this section is to identify protected species and critical habitat that may be present within the action area. Table 2 on the next page includes all potential species as listed on the official Service list of TES that may occur in or be affected by the proposed project (See Official List, Appendix B).

Table 2
Potential TES Species in the Tri-Valley Watershed Project Area

Species	Status	Habitat in Action Area	Critical Habitat in Action Area
Mammals			
Canada Lynx *Lynx canadensis*	Threatened	No	No
Birds			
Yellow-billed Cuckoo *Coccyzus americanus*	Threatened	No	No
Insects			
Monarch Butterfly *Danaus plexippus*	Candidate	No	No

BASELINE CONDITIONS

The action area focuses on a series of open ditches traveling adjacent to county and city roads or directly through open pastures or farmland. U.S. Highway 40 crosses through a portion of the action area and a short stretch of Daniel Creek (~1,000) feet also flows through the action area on the south boundary of the project.

Daniel is a small rural town, and the project area is not densely developed. The pasture/farmed areas are open with little to no trees. There are some ornamental trees at the residences located along the action area and Daniel Creek has a narrow riparian corridor of cottonwoods and some adjacent wetlands. Livestock are often present in the pastures and deer from the adjacent foothills likely pass through the area regularly. Pheasant and wild turkey were also observed near Daniel Creek during the site visit.

The nearby Wallsburg WMA provides habitat for a variety of wildlife species as described above, most notable elk and deer. The WMA's proximity to the town of Daniel which itself contains a great deal of open space makes wildlife more likely in the project area. The WMA is expected to remain protected in the future.

EFFECTS

Canada Lynx

Canada lynx (*Lynx canadensis*) is a medium-sized cat mostly found in montane coniferous forests, much of which has been diminished due to logging, clearing, roads, and development. Canada lynx are a nocturnal and solitary species, feeding mostly on snowshoe hare (USFWS, 2021c). Sightings of Canada lynx are exceedingly rare in Utah and there are no state records of them occurring within two miles of the action area (UNHP, 2022).

The Wasatch foothills south of the Tri-Valley Watershed Project area offer marginal forested habitat for Canada lynx but based on a site visit by BC&A biologist, Merissa Davis on October 30, 2020, there is no suitable habitat within the action area. This species is not expected to be present in the action area and therefore, there should be *no effect* on Canada Lynx as part of the proposed action.

Yellow-billed Cuckoo

Currently, the range of the western yellow-billed cuckoo (*Coccyzus americanus*) is limited to disjunct fragments of riparian habitats from northern Utah, western Colorado, southwestern Wyoming, and southeastern Idaho southward into northwestern Mexico and westward into southern Nevada and California. Yellow-billed cuckoos prefer nesting habitat within 100 meters of water classified as lowland riparian characterized by a dense sub-canopy or shrub layer (cottonwood/willow habitats) and are considered riparian obligates. They arrive late in the spring for breeding in late May or early June and breed through late June to July. Cuckoos may require large tracts (several hundred acres) of contiguous riparian nesting habitat; however, they are not strongly territorial and home ranges may overlap during the breeding season. (UDWR, 2021d)

There are no state records of yellow-billed cuckoo within two miles of the action area (UNHP, 2021). Prior to field investigations, aerial photography was reviewed for riparian treed habitat patches within half a mile of the project area that might be suitable for yellow-billed cuckoo per the Utah guidelines (USFWS, 2017). Despite a narrow band of treed riparian habitat along Daniel Creek, nowhere within the project area where there patches large enough (at least 12 acers) or wide and long enough (100 meters x 100 meters) to support nesting and breeding cuckoo (See Habitat Analysis Figure 3, Appendix A). These findings were confirmed during the October 30, 2020 site visit conducted by BC&A biologist Merissa Davis. As no habitat is present within the action area, the project should have *no effect* on yellow-billed cuckoo.

Monarch Butterfly

Monarch butterfly, *Danaus plexippus*, is a candidate species for federal listing under the ESA due to a more than 99% decline in the western population since the 1980s (USFWS, 2021c). A number of factors have contributed to the extreme population decline including the loss and degradation of overwintering groves; pesticide use, loss of breeding and migratory habitat, climate change, and parasites or disease. Monarch butterflies are typically found in Utah during the summer breeding months and are dependent on open fields and meadows with milkweed plants which are both a source of nectar and an egg laying site for the insects.

During the site visits, no milkweed was observed, nor were other flowering plants capable of providing a significant nectar source for monarch butterfly. Due to a lack of suitable habitat in the action area this species is not expected to be present and as such, it is anticipated that the proposed actions would have *no effect* on the candidate species.

Migratory Birds

Migratory birds are protected under the Migratory Bird Treaty Act (MBTA; 16 U.S.C., §703, Supp. I, 1989). The MBTA prohibits killing, possessing, or trading of migratory birds except in accordance with regulations prescribed by the Secretary of the Interior. This act encompasses whole birds, parts of birds, and bird nests and eggs. A list of potential migratory birds in the WVDS area is included in the list of species that may be affected by the proposed project included in Appendix B (USFWS 2022).

Bird nesting habitat is present in the residential landscape trees and in the riparian trees along Daniel Creek. The project timing is expected to take place outside of nesting and breeding season (Fall 2022) and tree removal is not expected as part of the construction, but should it become necessary during the general migratory bird nesting season (April – August), a preconstruction survey will be completed to determine whether nesting birds are present (no more than five days prior to construction). If migratory birds are found nesting in trees that would be removed, construction activities will be postponed until the non-nesting season or until nestlings have fledged and/or the nest fails, or breeding behaviors are no longer observed.

CONSERVATION COMMITMENTS

The following conservation commitments are expected as part of the proposed actions.

1. Migratory Bird Conservation Recommendations made by the USFWS Utah Field office will be used as part of the project requirements (See Appendix E). Accordingly, the project is planned outside of nesting and breeding seasons, however, if construction should extend into migratory bird breeding and nesting season (February through September) and tree removal should become necessary, a pre-construction surveys should take place (no more than 7-days prior). If active nests are found, construction activities will be postponed until after the nesting season or until nestlings have fledged and/or the nest fails, or breeding behaviors are no longer observed.
2. Best management practices will be used throughout the action area to reduce impacts to channels including using silt fencing and wattles for erosion and storm water control.

CONCLUSIONS

The proposed actions are expected to take place in the fall of 2022 pending environmental clearances, permitting, contracts and agreements. No suitable habitat exists for Canada Lynx or Yellow-billed cuckoo within the action area or within the half-mile buffer evaluated for habitat, therefore it is expected there will be *no effect* to any federally listed species with potential to occur in this area. Conservation commitments have been made to further minimize impacts as much as possible.

LITERATURE CITED

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Appendix A

Site Location, Action Area, and Habitat Analysis Figures

Heber

Daniel

189

40

LEGEND

Project Boundary (61 acres)

SCALE: 0 5001,000 Feet

NORTH: NORTH

SITE LOCATION

WASATCH COUNTY
TRI-VALLEY
WATERSHED EA

BOWEN COLLINS & ASSOCIATES

FIGURE NO.
1A

Figure Created By
Marilyn Rice 11/13/2020
Imagery: Hexagon 2018

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LEGEND

Project Boundary (61 acres)

SCALE: 0 5001,000 Feet

NORTH: NORTH

SITE LOCATION

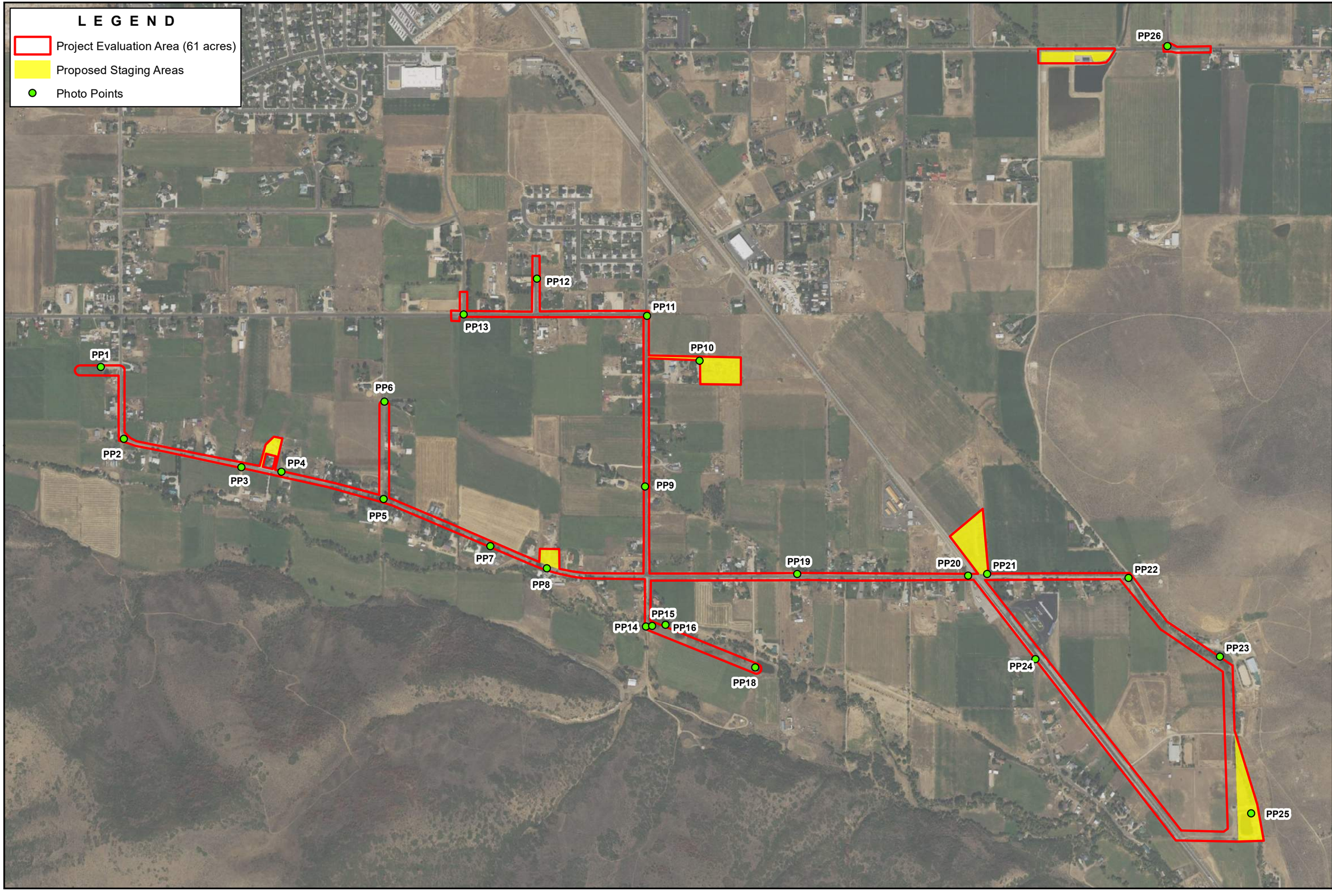
WASATCH COUNTY
TRI-VALLEY
WATERSHED EA

BOWEN COLLINS & ASSOCIATES

FIGURE NO.
1B

Figure Created By
Marilyn Rice 11/13/2020
USGS Quads: Charleston, Center Creek

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SCALE: 1 in. = 863 ft.

NORTH: NORTH

ACTION AREA WITH STAGING

WASATCH COUNTY
TRI-VALLEY WATERSHED EA

BOWEN COLLINS & ASSOCIATES

FIGURE NO.
2

P:\Wasatch County\627-19-01 Tri-Valley Watershed Plan EA\4.0 GIS\4.1 Projects\Environmental\Fig2_ActionArea_BA.mxd mdavis 9/2/2021

L E G E N D

- Project Evaluation Area (61 acres)
- 1/2-mile Cuckoo Habitat Analysis Buffer
- State Lands

Wallsburg State Wildlife Area

Figure Created By
Merissa Davis 08/26/21
Imagery: Hexagon 2018

SCALE: 1 in. = 1,400 ft.

NORTH: NORTH

TES HABITAT ANALYSIS

WASATCH COUNTY
TRI-VALLEY WATERSHED EA

BOWEN COLLINS & ASSOCIATES

FIGURE NO.
3

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Appendix B

USFWS Official TES Potential Species List

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Utah Ecological Services Field Office
2369 West Orton Circle, Suite 50
West Valley City, UT 84119-7603
Phone: (801) 975-3330 Fax: (801) 975-3331
http://www.fws.gov
http://www.fws.gov/utahfieldoffice/

In Reply Refer To: March 21, 2022
Project Code: 2022-0022283
Project Name: Tri-Valley Watershed Plan EA

Subject: List of threatened and endangered species that may occur in your proposed project location or may be affected by your proposed project

To Whom It May Concern:

The enclosed species list identifies threatened, endangered, proposed and candidate species, as well as proposed and final designated critical habitat, that may occur within the boundary of your proposed project and/or may be affected by your proposed project. The species list fulfills the requirements of the U.S. Fish and Wildlife Service (Service) under section 7(c) of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 *et seq.*).

New information based on updated surveys, changes in the abundance and distribution of species, changed habitat conditions, or other factors could change this list. Please feel free to contact us if you need more current information or assistance regarding the potential impacts to federally proposed, listed, and candidate species and federally designated and proposed critical habitat. Please note that under 50 CFR 402.12(e) of the regulations implementing section 7 of the Act, the accuracy of this species list should be verified after 90 days. This verification can be completed formally or informally as desired. The Service recommends that verification be completed by visiting the ECOS-IPaC website at regular intervals during project planning and implementation for updates to species lists and information. An updated list may be requested through the ECOS-IPaC system by completing the same process used to receive the enclosed list.

The purpose of the Act is to provide a means whereby threatened and endangered species and the ecosystems upon which they depend may be conserved. Under sections 7(a)(1) and 7(a)(2) of the Act and its implementing regulations (50 CFR 402 *et seq.*), Federal agencies are required to utilize their authorities to carry out programs for the conservation of threatened and endangered species and to determine whether projects may affect threatened and endangered species and/or designated critical habitat.

A Biological Assessment is required for construction projects (or other undertakings having similar physical impacts) that are major Federal actions significantly affecting the quality of the human environment as defined in the National Environmental Policy Act (42 U.S.C. 4332(2)(c)). For projects other than major construction activities, the Service suggests that a biological evaluation similar to a Biological Assessment be prepared to determine whether the project may affect listed or proposed species and/or designated or proposed critical habitat. Recommended contents of a Biological Assessment are described at 50 CFR 402.12.

If a Federal agency determines, based on the Biological Assessment or biological evaluation, that listed species and/or designated critical habitat may be affected by the proposed project, the agency is required to consult with the Service pursuant to 50 CFR 402. In addition, the Service recommends that candidate species, proposed species and proposed critical habitat be addressed within the consultation. More information on the regulations and procedures for section 7 consultation, including the role of permit or license applicants, can be found in the "Endangered Species Consultation Handbook" at:

http://www.fws.gov/endangered/esa-library/pdf/TOC-GLOS.PDF

Migratory Birds: In addition to responsibilities to protect threatened and endangered species under the Endangered Species Act (ESA), there are additional responsibilities under the Migratory Bird Treaty Act (MBTA) and the Bald and Golden Eagle Protection Act (BGEPA) to protect native birds from project-related impacts. Any activity, intentional or unintentional, resulting in take of migratory birds, including eagles, is prohibited unless otherwise permitted by the U.S. Fish and Wildlife Service (50 C.F.R. Sec. 10.12 and 16 U.S.C. Sec. 668(a)). For more information regarding these Acts see https://www.fws.gov/birds/policies-and-regulations.php.

The MBTA has no provision for allowing take of migratory birds that may be unintentionally killed or injured by otherwise lawful activities. It is the responsibility of the project proponent to comply with these Acts by identifying potential impacts to migratory birds and eagles within applicable NEPA documents (when there is a federal nexus) or a Bird/Eagle Conservation Plan (when there is no federal nexus). Proponents should implement conservation measures to avoid or minimize the production of project-related stressors or minimize the exposure of birds and their resources to the project-related stressors. For more information on avian stressors and recommended conservation measures see https://www.fws.gov/birds/bird-enthusiasts/threats-to-birds.php.

In addition to MBTA and BGEPA, Executive Order 13186: *Responsibilities of Federal Agencies to Protect Migratory Birds*, obligates all Federal agencies that engage in or authorize activities that might affect migratory birds, to minimize those effects and encourage conservation measures that will improve bird populations. Executive Order 13186 provides for the protection of both migratory birds and migratory bird habitat. For information regarding the implementation of Executive Order 13186, please visit https://www.fws.gov/birds/policies-and-regulations/executive-orders/e0-13186.php.

We appreciate your concern for threatened and endangered species. The Service encourages Federal agencies to include conservation of threatened and endangered species into their project planning to further the purposes of the Act. Please include the Consultation Code in the header of

this letter with any request for consultation or correspondence about your project that you submit to our office.

Attachment(s):

- Official Species List
- USFWS National Wildlife Refuges and Fish Hatcheries
- Migratory Birds

Official Species List

This list is provided pursuant to Section 7 of the Endangered Species Act, and fulfills the requirement for Federal agencies to "request of the Secretary of the Interior information whether any species which is listed or proposed to be listed may be present in the area of a proposed action".

This species list is provided by:

Utah Ecological Services Field Office
2369 West Orton Circle, Suite 50
West Valley City, UT 84119-7603
(801) 975-3330

Project Summary

Project Code: 2022-0022283
Event Code: None
Project Name: Tri-Valley Watershed Plan EA
Project Type: Irrigation
Project Description: The County is planning upgrades to their irrigation system in the Daniel area to improve water conservation and delivery. They are also addressing some nearby flood issues along Center Creek.

Project Location:

Approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/@40.477996950000005,-111.37964945541222,14z



Counties: Wasatch County, Utah

Endangered Species Act Species

There is a total of 3 threatened, endangered, or candidate species on this species list.

Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fish may appear on the species list because a project could affect downstream species.

IPaC does not display listed species or critical habitats under the sole jurisdiction of NOAA Fisheries[1], as USFWS does not have the authority to speak on behalf of NOAA and the Department of Commerce.

See the "Critical habitats" section below for those critical habitats that lie wholly or partially within your project area under this office's jurisdiction. Please contact the designated FWS office if you have questions.

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1. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

Mammals

NAME	STATUS
Canada Lynx *Lynx canadensis* Population: Wherever Found in Contiguous U.S. There is **final** critical habitat for this species. The location of the critical habitat is not available. Species profile: https://ecos.fws.gov/ecp/species/3652	Threatened

Birds

NAME	STATUS
Yellow-billed Cuckoo *Coccyzus americanus* Population: Western U.S. DPS There is **final** critical habitat for this species. The location of the critical habitat is not available. Species profile: https://ecos.fws.gov/ecp/species/3911	Threatened

Insects

NAME	STATUS
Monarch Butterfly *Danaus plexippus* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/9743	Candidate

Critical habitats

THERE ARE NO CRITICAL HABITATS WITHIN YOUR PROJECT AREA UNDER THIS OFFICE'S JURISDICTION.

USFWS National Wildlife Refuge Lands And Fish Hatcheries

Any activity proposed on lands managed by the National Wildlife Refuge system must undergo a 'Compatibility Determination' conducted by the Refuge. Please contact the individual Refuges to discuss any questions or concerns.

THERE ARE NO REFUGE LANDS OR FISH HATCHERIES WITHIN YOUR PROJECT AREA.

Migratory Birds

Certain birds are protected under the Migratory Bird Treaty Act[1] and the Bald and Golden Eagle Protection Act[2].

Any person or organization who plans or conducts activities that may result in impacts to migratory birds, eagles, and their habitats should follow appropriate regulations and consider implementing appropriate conservation measures, as described below.

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1. The Migratory Birds Treaty Act of 1918.
2. The Bald and Golden Eagle Protection Act of 1940.
3. 50 C.F.R. Sec. 10.12 and 16 U.S.C. Sec. 668(a)

The birds listed below are birds of particular concern either because they occur on the USFWS Birds of Conservation Concern (BCC) list or warrant special attention in your project location. To learn more about the levels of concern for birds on your list and how this list is generated, see the FAQ below. This is not a list of every bird you may find in this location, nor a guarantee that every bird on this list will be found in your project area. To see exact locations of where birders and the general public have sighted birds in and around your project area, visit the E-bird data mapping tool (Tip: enter your location, desired date range and a species on your list). For projects that occur off the Atlantic Coast, additional maps and models detailing the relative occurrence and abundance of bird species on your list are available. Links to additional information about Atlantic Coast birds, and other important information about your migratory bird list, including how to properly interpret and use your migratory bird report, can be found below.

For guidance on when to schedule activities or implement avoidance and minimization measures to reduce impacts to migratory birds on your list, click on the PROBABILITY OF PRESENCE SUMMARY at the top of your list to see when these birds are most likely to be present and breeding in your project area.

NAME	BREEDING SEASON
Bald Eagle *Haliaeetus leucocephalus* This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities. https://ecos.fws.gov/ecp/species/1626	Breeds Dec 1 to Aug 31
Cassin's Finch *Carpodacus cassinii* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9462	Breeds May 15 to Jul 15

NAME	BREEDING SEASON
Clark's Grebe *Aechmophorus clarkii* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds Jun 1 to Aug 31
Evening Grosbeak *Coccothraustes vespertinus* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds May 15 to Aug 10
Lesser Yellowlegs *Tringa flavipes* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9679	Breeds elsewhere
Lewis's Woodpecker *Melanerpes lewis* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9408	Breeds Apr 20 to Sep 30
Olive-sided Flycatcher *Contopus cooperi* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/3914	Breeds May 20 to Aug 31
Virginia's Warbler *Vermivora virginiae* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9441	Breeds May 1 to Jul 31

Probability Of Presence Summary

The graphs below provide our best understanding of when birds of concern are most likely to be present in your project area. This information can be used to tailor and schedule your project activities to avoid or minimize impacts to birds. Please make sure you read and understand the FAQ "Proper Interpretation and Use of Your Migratory Bird Report" before using or attempting to interpret this report.

Probability of Presence (■)

Each green bar represents the bird's relative probability of presence in the 10km grid cell(s) your project overlaps during a particular week of the year. (A year is represented as 12 4-week months.) A taller bar indicates a higher probability of species presence. The survey effort (see below) can be used to establish a level of confidence in the presence score. One can have higher confidence in the presence score if the corresponding survey effort is also high.

How is the probability of presence score calculated? The calculation is done in three steps:

1. The probability of presence for each week is calculated as the number of survey events in the week where the species was detected divided by the total number of survey events for that week. For example, if in week 12 there were 20 survey events and the Spotted Towhee

was found in 5 of them, the probability of presence of the Spotted Towhee in week 12 is 0.25.

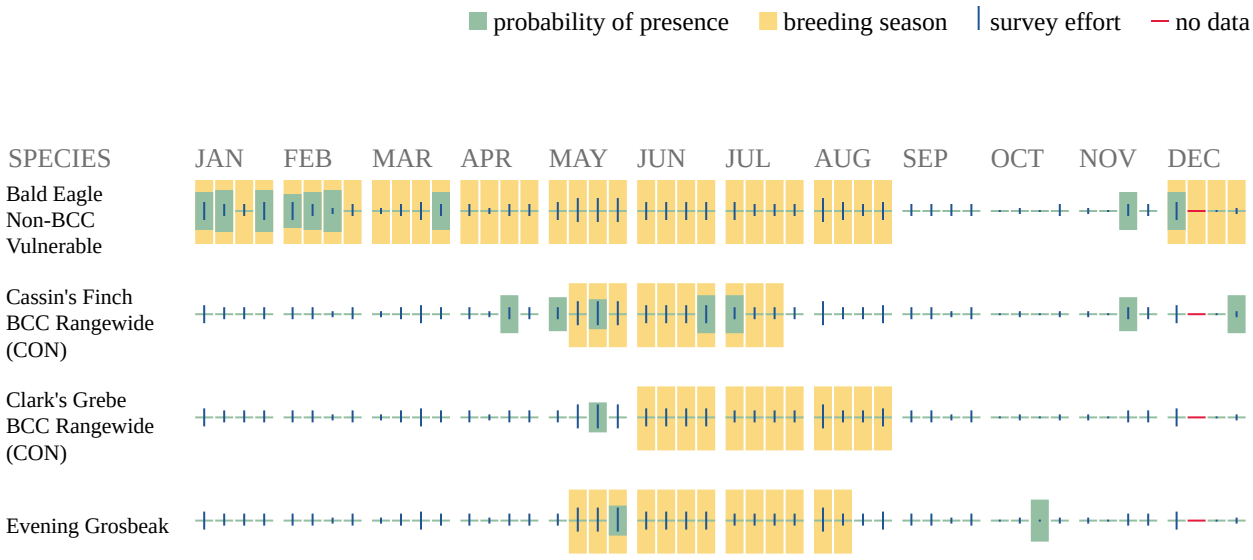
2. To properly present the pattern of presence across the year, the relative probability of presence is calculated. This is the probability of presence divided by the maximum probability of presence across all weeks. For example, imagine the probability of presence in week 20 for the Spotted Towhee is 0.05, and that the probability of presence at week 12 (0.25) is the maximum of any week of the year. The relative probability of presence on week 12 is 0.25/0.25 = 1; at week 20 it is 0.05/0.25 = 0.2.
3. The relative probability of presence calculated in the previous step undergoes a statistical conversion so that all possible values fall between 0 and 10, inclusive. This is the probability of presence score.

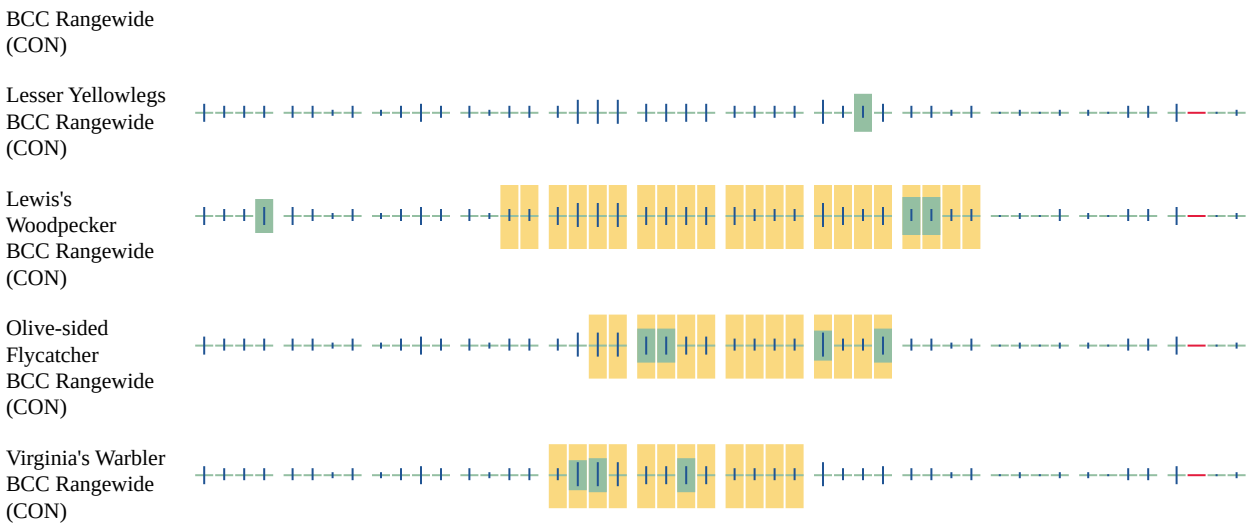
Breeding Season (■)
Yellow bars denote a very liberal estimate of the time-frame inside which the bird breeds across its entire range. If there are no yellow bars shown for a bird, it does not breed in your project area.

Survey Effort (|)
Vertical black lines superimposed on probability of presence bars indicate the number of surveys performed for that species in the 10km grid cell(s) your project area overlaps. The number of surveys is expressed as a range, for example, 33 to 64 surveys.

No Data (–)
A week is marked as having no data if there were no survey events for that week.

Survey Timeframe
Surveys from only the last 10 years are used in order to ensure delivery of currently relevant information. The exception to this is areas off the Atlantic coast, where bird returns are based on all years of available data, since data in these areas is currently much more sparse.





Additional information can be found using the following links:

- Birds of Conservation Concern http://www.fws.gov/birds/management/managed-species/birds-of-conservation-concern.php
- Measures for avoiding and minimizing impacts to birds http://www.fws.gov/birds/management/project-assessment-tools-and-guidance/conservation-measures.php
- Nationwide conservation measures for birds http://www.fws.gov/migratorybirds/pdf/management/nationwidestandardconservationmeasures.pdf

Migratory Birds FAQ

Tell me more about conservation measures I can implement to avoid or minimize impacts to migratory birds.

Nationwide Conservation Measures describes measures that can help avoid and minimize impacts to all birds at any location year round. Implementation of these measures is particularly important when birds are most likely to occur in the project area. When birds may be breeding in the area, identifying the locations of any active nests and avoiding their destruction is a very helpful impact minimization measure. To see when birds are most likely to occur and be breeding in your project area, view the Probability of Presence Summary. Additional measures or permits may be advisable depending on the type of activity you are conducting and the type of infrastructure or bird species present on your project site.

What does IPaC use to generate the migratory birds potentially occurring in my specified location?

The Migratory Bird Resource List is comprised of USFWS Birds of Conservation Concern (BCC) and other species that may warrant special attention in your project location.

The migratory bird list generated for your project is derived from data provided by the Avian Knowledge Network (AKN). The AKN data is based on a growing collection of survey, banding, and citizen science datasets and is queried and filtered to return a list of those birds reported as

occurring in the 10km grid cell(s) which your project intersects, and that have been identified as warranting special attention because they are a BCC species in that area, an eagle (Eagle Act requirements may apply), or a species that has a particular vulnerability to offshore activities or development.

Again, the Migratory Bird Resource list includes only a subset of birds that may occur in your project area. It is not representative of all birds that may occur in your project area. To get a list of all birds potentially present in your project area, please visit the AKN Phenology Tool.

What does IPaC use to generate the probability of presence graphs for the migratory birds potentially occurring in my specified location?
The probability of presence graphs associated with your migratory bird list are based on data provided by the Avian Knowledge Network (AKN). This data is derived from a growing collection of survey, banding, and citizen science datasets .

Probability of presence data is continuously being updated as new and better information becomes available. To learn more about how the probability of presence graphs are produced and how to interpret them, go the Probability of Presence Summary and then click on the "Tell me about these graphs" link.

How do I know if a bird is breeding, wintering, migrating or present year-round in my project area?
To see what part of a particular bird's range your project area falls within (i.e. breeding, wintering, migrating or year-round), you may refer to the following resources: The Cornell Lab of Ornithology All About Birds Bird Guide, or (if you are unsuccessful in locating the bird of interest there), the Cornell Lab of Ornithology Neotropical Birds guide. If a bird on your migratory bird species list has a breeding season associated with it, if that bird does occur in your project area, there may be nests present at some point within the timeframe specified. If "Breeds elsewhere" is indicated, then the bird likely does not breed in your project area.

What are the levels of concern for migratory birds?
Migratory birds delivered through IPaC fall into the following distinct categories of concern:

1. "BCC Rangewide" birds are Birds of Conservation Concern (BCC) that are of concern throughout their range anywhere within the USA (including Hawaii, the Pacific Islands, Puerto Rico, and the Virgin Islands);
2. "BCC - BCR" birds are BCCs that are of concern only in particular Bird Conservation Regions (BCRs) in the continental USA; and
3. "Non-BCC - Vulnerable" birds are not BCC species in your project area, but appear on your list either because of the Eagle Act requirements (for eagles) or (for non-eagles) potential susceptibilities in offshore areas from certain types of development or activities (e.g. offshore energy development or longline fishing).

Although it is important to try to avoid and minimize impacts to all birds, efforts should be made, in particular, to avoid and minimize impacts to the birds on this list, especially eagles and BCC species of rangewide concern. For more information on conservation measures you can

implement to help avoid and minimize migratory bird impacts and requirements for eagles, please see the FAQs for these topics.

Details about birds that are potentially affected by offshore projects
For additional details about the relative occurrence and abundance of both individual bird species and groups of bird species within your project area off the Atlantic Coast, please visit the Northeast Ocean Data Portal. The Portal also offers data and information about other taxa besides birds that may be helpful to you in your project review. Alternately, you may download the bird model results files underlying the portal maps through the NOAA NCCOS Integrative Statistical Modeling and Predictive Mapping of Marine Bird Distributions and Abundance on the Atlantic Outer Continental Shelf project webpage.

Bird tracking data can also provide additional details about occurrence and habitat use throughout the year, including migration. Models relying on survey data may not include this information. For additional information on marine bird tracking data, see the Diving Bird Study and the nanotag studies or contact Caleb Spiegel or Pam Loring.

What if I have eagles on my list?
If your project has the potential to disturb or kill eagles, you may need to obtain a permit to avoid violating the Eagle Act should such impacts occur.

Proper Interpretation and Use of Your Migratory Bird Report
The migratory bird list generated is not a list of all birds in your project area, only a subset of birds of priority concern. To learn more about how your list is generated, and see options for identifying what other birds may be in your project area, please see the FAQ "What does IPaC use to generate the migratory birds potentially occurring in my specified location". Please be aware this report provides the "probability of presence" of birds within the 10 km grid cell(s) that overlap your project; not your exact project footprint. On the graphs provided, please also look carefully at the survey effort (indicated by the black vertical bar) and for the existence of the "no data" indicator (a red horizontal bar). A high survey effort is the key component. If the survey effort is high, then the probability of presence score can be viewed as more dependable. In contrast, a low survey effort bar or no data bar means a lack of data and, therefore, a lack of certainty about presence of the species. This list is not perfect; it is simply a starting point for identifying what birds of concern have the potential to be in your project area, when they might be there, and if they might be breeding (which means nests might be present). The list helps you know what to look for to confirm presence, and helps guide you in knowing when to implement conservation measures to avoid or minimize potential impacts from your project activities, should presence be confirmed. To learn more about conservation measures, visit the FAQ "Tell me about conservation measures I can implement to avoid or minimize impacts to migratory birds" at the bottom of your migratory bird trust resources page.

IPaC User Contact Information

Agency: Bowen Collins & Associates
Name: Merissa Davis
Address: 154 East 14075 South
City: Draper
State: UT
Zip: 84020
Email mdavis@bowencollins.com
Phone: 8014952224

Lead Agency Contact Information

Lead Agency: Department of Agriculture

Appendix C

UNHP Species Report

Utah Division of Wildlife Resources
Utah Natural Heritage Program
1594 W. North Temple
PO Box 146301
Salt Lake City, UT 84116

Report Number: 13127
March 21, 2022

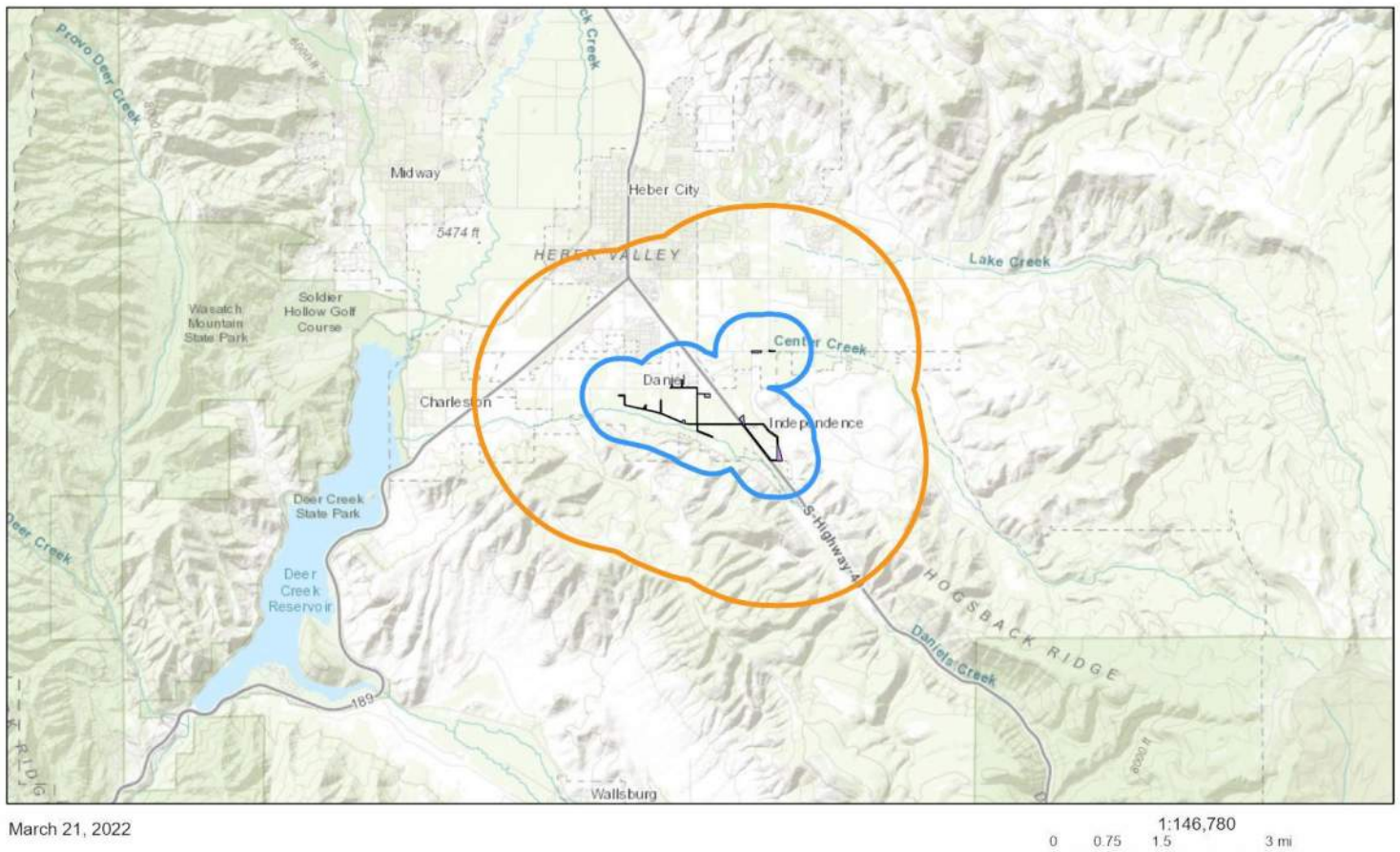
Utah Natural Heritage Program Online Species Search Report

Project Information

Project Name
Tri-Valley Watershed Plan EA

Project Description
Irrigation efficiency updates in the Daniel area plus flood control project along Center Creek

Location Description
Daniel, Utah area (see map)



March 21, 2022

1:146,780
0 0.75 1.5 3 mi
0 1.5 3 6 km
County of Utah, Bureau of Land Management, Utah AGRC, Esri, HERE, Garmin, USGS, NGA, EPA, USDA, NPS

Animals within a ½ mile radius

Common Name	Scientific Name	State Status	U.S. ESA Status	Last Observation Year
No Species Found				

Plants within a ½ mile radius

Common Name	Scientific Name	State Status	U.S. ESA Status	Last Observation Year
No Species Found				

Animals within a 2 mile radius

Common Name	Scientific Name	State Status	U.S. ESA Status	Last Observation Year
Greater Sage-grouse	Centrocercus urophasianus	SGCN		2000
Band-tailed Pigeon	Patagioenas fasciata	SGCN		1970

Plants within a 2 mile radius

Common Name	Scientific Name	State Status	U.S. ESA Status	Last Observation Year
No Species Found				

Definitions

State Status

SGCN	Species of greatest conservation need listed in the Utah Wildlife Action Plan

U.S. Endangered Species Act

LE	A taxon that is listed by the U.S. Fish and Wildlife Service as "endangered" with the probability of worldwide extinction
LT	A taxon that is listed by the U.S. Fish and Wildlife Service as "threatened" with becoming endangered
LE;XN	An "endangered" taxon that is considered by the U.S. Fish and Wildlife Service to be "experimental and nonessential" in its designated use areas in Utah
C	A taxon for which the U.S. Fish and Wildlife Service has on file sufficient information on biological vulnerability and threats to justify it being a "candidate" for listing as endangered or threatened
PT/PE	A taxon "proposed" to be listed as "endangered" or "threatened" by the U.S. Fish and Wildlife Service

Disclaimer

The information provided in this report is based on data existing in the Utah Division of Wildlife Resources' central database at the time of the request. It should not be regarded as a final statement on the occurrence of any species on or near the designated site, nor should it be considered a substitute for on-the-ground biological surveys. Moreover, because the Utah Division of Wildlife Resources' central database is continually updated, any given response is only appropriate for its respective request.

The UDWR provides no warranty, nor accepts any liability, occurring from any incorrect, incomplete, or misleading data, or from any incorrect, incomplete, or misleading use of these data.

The results are a query of species tracked by the Utah Natural Heritage Program, which includes all species listed under the U.S. Endangered Species Act and species on the Utah Wildlife Action Plan. Other significant wildlife values might also be present on the designated site. Please contact UDWR's regional habitat manager if you have any questions.

Contact the U.S. Fish and Wildlife Service at (801) 975-3330 for the purpose of consultation under the Endangered Species Act.

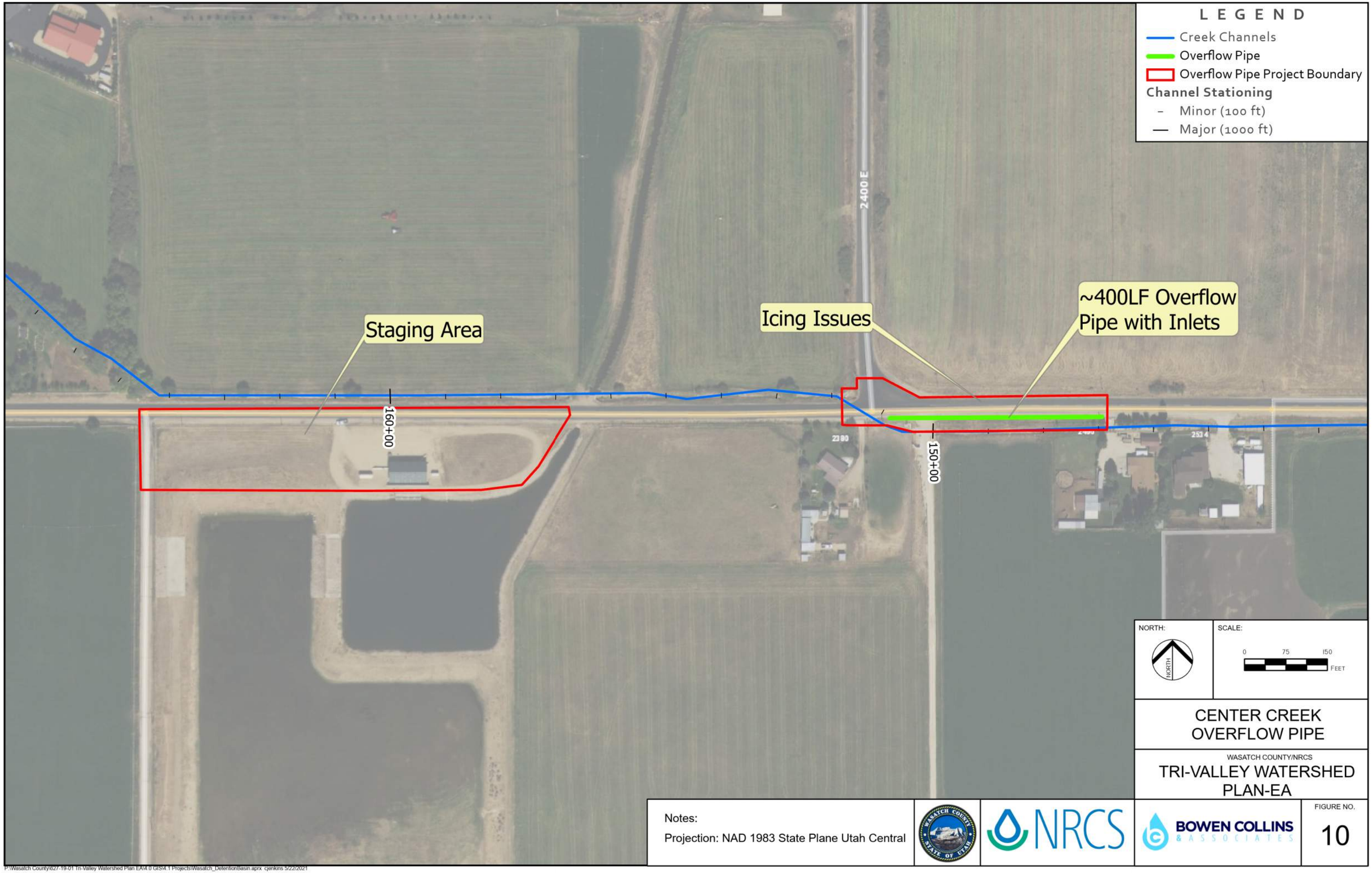
Please contact our office at (801) 538-4759 or habitat@utah.gov if you require further assistance.

Your project is located in the following UDWR region(s): Central region

Report generated for:
Merissa Davis
Bowen Collins & Associates
154 East 14075 South
Draper, UT 84020
(801) 495-2224
mdavis@bowencollins.com

Appendix D

Plan Figures



NORTH:

SCALE: 0 75 150 FEET

CENTER CREEK OVERFLOW PIPE

WASATCH COUNTY/NRCS

TRI-VALLEY WATERSHED PLAN-EA

Notes:

Projection: NAD 1983 State Plane Utah Central

BOWEN COLLINS & ASSOCIATES

FIGURE NO. 10

P:\Wasatch County\627-19-01 Tri-Valley Watershed Plan EA\4.0 GIS\4.1 Projects\Wasatch_DetentionBasin.aprx cjenkins 5/22/2021

Appendix E

USFWS Project Recommendations for Migratory Bird Conservation

Project Recommendations for Migratory Bird Conservation
U.S. Fish and Wildlife Service, Utah Field Office (May 2020)

The Migratory Bird Treaty Act (MBTA) is the cornerstone of migratory bird conservation and protection in the United States. The MBTA implements four treaties that provide for international protection of migratory birds. The USFWS maintains a list of all species protected by the MBTA at 50 C.F.R. § 10.13. This list includes over one thousand species of migratory birds, including eagles and other raptors, waterfowl, shorebirds, seabirds, wading birds, and songbirds. The MBTA does not protect introduced species such as the house (English) sparrow, European starling, rock dove (pigeon), Eurasian collared-dove, and non-migratory upland game birds.

The U.S. Fish and Wildlife Service (USFWS) recommends that the following migratory bird conservation measures be implemented as you complete your project:

a. Wherever possible we recommend that projects be completed outside the migratory bird nesting season to avoid and minimize impacts to migratory birds.

b. If the project includes the loss or degradation of migratory bird habitat then complete all portions of the project that could impact migratory birds outside the maximum migratory bird nesting season. This includes ground-disturbing activities, habitat removal, clearing or cutting of vegetation, grubbing, burning, etc. If that is not feasible, we recommend that you complete the project outside the minimum migratory bird nesting season.

    The time period associated with the maximum migratory bird nesting season is approximately December to August. The time period associated with the minimum migratory bird nesting season is April 1 to July 15 (time-frame when the majority of annual bird nesting occurs).

c. If the project needs to occur during the migratory bird nesting season, impacts to birds can be avoided or minimized by completing vegetation treatments and vegetation clearing and removal actions during the fall and winter (outside the migratory bird nesting season per above) prior to the nesting season when the project will begin.

d. If a project may impact migratory birds and/or cause the loss or degradation of migratory bird habitat, and such work cannot occur outside the migratory bird nesting season, we recommend surveying impacted portions of the project area to determine if migratory birds are present and nesting. Surveys should emphasize detecting presence of USFWS Birds of Conservation Concern, take place during the nesting season the year before the nesting season in which project is scheduled to occur, and should document presence of migratory birds at least throughout the entire minimum migratory bird nesting season (April 1 to July 15). Nest surveys should be conducted by qualified biologists using accepted survey protocols.

e. If your project must occur during the maximum migratory bird nesting season, implement measures to prevent migratory birds from establishing nests in the potential impact

Appendix F

Photos

Tri-Valley Watershed EA
Site Photos



Photo Point # 1 (270°)



Photo Point #2 (350°)

Tri-Valley Watershed EA
Site Photos



Photo Point #3 (280°)



Photo Point #4 (330°)



Photo Point #5 (280°)



Photo Point #6 (180°)

Tri-Valley Watershed EA
Site Photos



Photo Point #7 (290°)



Photo Point #8 (0°)

Tri-Valley Watershed EA
Site Photos



Photo Point #9 (180°)



Photo Point #10 (100°)



Photo Point # 11 (270°)



Photo Point #12 (0°)

Tri-Valley Watershed EA
Site Photos



Photo Point #13 (0°)



Photo Point #14 (280°)



Photo Point #15 (110°)



Photo Point #16 (80°)

Tri-Valley Watershed EA
Site Photos



Photo Point #18 (90°)



Photo Point #18 (270°)



Photo Point #19 (340°)



Photo Point #19 (270°)



Photo Point #20 (0°)



Photo Point #20 (180°)



Photo Point #21 (0°)



Photo Point #22 (180°)



Photo Point #23 (160°)



Photo Point #24 (320°)



Photo Point #25 (220°)



Photo Point #26 (270°)

Public Participation Plan

Tri-Valley Supplemental Watershed Plan and Environmental Assessment

Public Participation Plan

Final

Prepared by:

Adaptive Environmental Planning, LLC

BOWEN COLLINS & ASSOCIATES

March 2022

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Table of Contents

1.0 Introduction 2
1.1 Environmental Review 2
1.1.1 Scoping 3
1.1.2 Draft Plan-EA 3
1.2 Goals and Objectives 4
2.0 Public Participation 5
2.1 Support Mechanisms 5
2.2 Meetings 5
2.2.1 Scoping 5
2.2.2 Draft Plan-EA 6
2.2.3 Stakeholders and Cooperating Agencies 6
2.3 Materials 7
2.3.1 Newsletters and Meeting Announcements 7
2.3.2 Press Releases 7
2.3.3 Website 7
2.3.4 Meeting Materials 8
3.0 Plan Implementation Schedule 9
3.1 Scoping 9
3.2 Draft Plan-EA 9
3.3 Final Plan-EA and FONSI 9
3.4 Public Meeting Agenda 10
4.0 Public Participation Documentation 11
4.1 Comment Tracking and Response Management 11
4.2 Scoping Meeting 11
4.3 Draft Plan-EA Meeting 11
4.4 Agency, Property Owner, and Stakeholder Meetings 11

1.0 Introduction

The United States Department of Agriculture Natural Resources Conservation Service (NRCS), with the project sponsor (Wasatch County) is proposing to partially fund through the Watershed Protection and Flood Prevention Act (Public Law [PL] 83-566) the Tri-Valley Watershed Plan-Environmental Assessment Project in Wasatch County, Utah. The National Environmental Policy Act (NEPA) and the Council on Environmental Quality's regulations at 40 CFR Parts 1500-1508 require an evaluation of potential environmental impacts associated with federal projects and actions. The environmental impacts will be documented in the form of a Watershed Plan and Environmental Assessment (Plan-EA). The Plan-EA will include the elements listed below.

- Alternatives analysis of potential options to meet the general purposes of PL 83-566, which include:
  - Preventing damage from erosion, floodwater, and sediment.
  - Furthering the conservation, development, use, and disposal of water.
  - Furthering the conservation and proper use of land.
- A discussion of resources that might be affected for each of the alternatives included in detailed study for the project.
- Identification of potential avoidance, minimization, and mitigation measures to reduce or eliminate potential impacts.
- A plan of public participation and agency consultation and coordination throughout development of the Plan-EA.

The participation of the public is a vital component of the project so that those who are interested in or potentially affected by proposed project alternatives have an opportunity to share their concerns and provide input regarding the Plan-EA during the initial stages of the planning process. This Public Participation Plan outlines the objectives, strategies, and tools that will be used to engage agencies, stakeholders, affected property owners, and the general public throughout the NEPA process.

1.1 Environmental Review

NEPA is a procedural act aimed at ensuring that information is available to the public, stakeholders, and government agencies before decisions regarding the environment are adopted and constructed. Public participation is a requirement of the NEPA review process. In addition to notifying the public, NEPA regulations require that there be thorough and complete documentation of participation by all involved government agencies and stakeholders. The most practical method for reaching out to the public is to prepare a Public Participation Plan, as well as a Plan-EA, that are viewed as objective with no bias. For the Plan-EA to be viewed as objective, it should meet the guidelines listed below.

- The proposed action under environmental review cannot be perceived as already concluded.
- All reasonable alternatives to the proposed action, including no action and the proposed alternative(s), need to be considered.
- All social, economic, and environmental impacts of the project, both adverse and beneficial, must be identified and analyzed.
- The public must feel like they have been involved in all steps of the NEPA process from beginning to end.

The Public Participation Plan focuses on two points during the NEPA process (scoping and the Draft Plan-EA) at which the public is invited to openly participate.

1.1.1 Scoping

Scoping is used to identify the public, stakeholder, and government agency resource concerns for the project and potential obstacles/controversy/opposition, and to begin to identify proposed alternatives based on the input received. Scoping consists of an open comment period, scoping meeting, and other agency/property owner/stakeholder meetings. A scoping notice is provided to agencies, stakeholders, and the public that introduces the project, project objectives, and project location. The notice also includes notification of the open and close of the comment period, contacts and methods to provide comment, time/day/location for the scoping meeting, and resources/contacts to obtain additional information. A scoping meeting is held for the public, stakeholder, and government agencies interested in the project. The meeting provides the interested parties additional project information and opportunity to comment on the project. The public and government agencies are invited to offer comments on the project, both orally and via written submittal of comments during the scoping period, which lasts for 30 days. The input provided during the scoping process is considered in development of project alternatives and resource concerns to be addressed, and to identify areas of controversy and issues to be resolved.

1.1.2 Draft Plan-EA

After scoping has been completed, a Draft Plan-EA will be prepared that includes an alternatives analysis and analysis of resource impacts. The Draft Plan-EA will consider public, stakeholder, and government agency input obtained during the scoping process. To solicit public participation and obtain interested party feedback, a Draft Plan-EA notice will be distributed, Draft Plan-EA meeting held, and an open comment period provided. The Draft Plan-EA will be published and made available for public and agency review. The Draft Plan-EA notice will include notification of the availability of the Draft Plan-EA for review, open and close of the comment period, contacts and methods to provide comment, time/day/location for the Draft Plan-EA meeting, and resources/contacts to obtain additional information. A Draft Plan-EA meeting is held for the public, stakeholder, and government agencies interested in the project. The meeting provides the interested parties with additional project information and opportunity to comment on the project and Draft Plan-EA. Public and government agencies are invited to offer comments on the project, both orally and via written submittal of comments, during the open comment period, which lasts for 30 days. Following completion of the comment period, a Final Plan-EA document will be prepared that incorporates comments (if applicable) received during the Draft Plan-EA open comment period.

1.2 Goals and Objectives

The Public Participation Plan requires outreach to the general public, recreationists, local businesses, associations, stakeholders, affected property owners, and affected government agencies to effectively engage the public in the planning and resource analysis process. The main goals of public participation are to involve a diverse group of public and government agency participants to solicit input and provide timely information throughout the NEPA review process. Objectives used to accomplish these goals are listed below.

- Establish ongoing, inclusive, and meaningful two-way communication with stakeholders, affected property owners, agencies, and the general public.
- Educate the public about the environmental review process and each party's role.
- Evaluate the effectiveness of public participation activities on a continual basis to refine the Public Participation Plan, as necessary, and use the most effective techniques throughout the NEPA process.
- Document all public and government agency input.

As part of the public participation process, the plan will seek to meaningfully engage minority, low-income, and traditionally underrepresented populations during the NEPA review process. As a general rule, the following principles will be adopted to support involvement of environmental justice populations.

- Documents, notices, and meetings will be concise, understandable, and readily accessible to the public.
- Notices of meetings will also be provided in non-English languages for targeted public audiences, affected owners, and stakeholders, when appropriate or if requested.
- Informational material will be made available through a variety of outlets.
- All public events will be scheduled at convenient, accessible locations.

2.0 Public Participation

McMillen Jacobs Associates (McMillen Jacobs) and Bowen Collins & Associates (BC&A) will manage public participation activities in coordination with NRCS and project sponsors. Flood damage to lands and infrastructure has occurred in the Tri-Valley Watershed. NRCS and the project sponsor have recognized a need to incorporate measures in the watershed to protect these lands and infrastructure from flood damages. Potential alternatives to accomplish this may have impacts to multiple resources, including residents and property owners within the watershed. Involvement of the community, particularly affected property owners and stakeholders, is critical for developing alternatives and ensuring alternative feasibility and advancement. A number of resources will be used, and planning processes completed to achieve public support of the Plan-EA, and to obtain necessary buy-in from the public and agencies. This section describes the planning process and resources to accomplish this.

2.1 Support Mechanisms

The items below identify support mechanisms planned to keep the public, tribes, and agencies informed of the project and to achieve necessary community buy-in for development of project alternatives.

- Project Branding – To assist the public in identifying materials related to the project, the NRCS logo and sponsor logo will be used on all documents.
- Mailing List – A mailing list will be developed in coordination with the project sponsors and NRCS for announcing public meeting opportunities via letters and flyers (hard copy and electronic). The list will be composed of agencies, tribes, area residents, businesses, civic associations, community groups, recreationists, etc. Multiple copies of meeting notices and other project documents will be distributed to libraries and community gathering places in the affected watershed (when appropriate). This mailing list will be updated throughout the NEPA process for any new parties that request information on the project. Each mailing recipient will be coded according to group type (private party, government agency, non-profit, etc.).

2.2 Meetings

Multiple meetings will be conducted throughout the planning process to coordinate with the public, stakeholders, property owners, and agencies. Sections 2.2.1 through 2.2.3 below describe the meetings that may be held during development of the Plan-EA.

2.2.1 Scoping

The primary purpose of scoping is to introduce the project; identify the public, stakeholder, and government agency resource concerns; and identify potential obstacles, controversy, and opposition. The anticipated meetings associated with the scoping process are listed below.

- Public Scoping Meeting – There will be one public scoping meeting held for all interested parties, including but not limited to government agencies, the public, and private property owners. The public scoping meetings will be open to anyone who would like to find out more about the project and express their questions, comments, and/or concerns. The public meetings will be held in the middle of the comment period to ensure adequate time for the public and agencies to file comments. The comments received during the scoping meeting process will be considered during development of the Plan-EA.
- Property Owner/Stakeholder Meetings – If requested or if necessary, members of the project team may meet with selected property owners/stakeholders to update them on the project and receive feedback specific to their respective properties. The meetings will be conducted by the sponsors with assistance from NRCS, BC&A, and McMillen Jacobs as needed.
- Government Agency Meeting – A meeting will be conducted with participating government agencies and potential participating agencies coinciding with the public scoping meeting. If deemed necessary, a separate meeting with government agencies may be conducted.

Participants at the public meeting may make statements orally or submit comments in writing either at the meeting or subsequently by phone, mail, fax, or e-mail during the scoping comment period. Meeting announcements will be mailed to recipients included on the Plan-EA mailing list, posted at libraries and other community gathering places (when appropriate), announced through paid advertisements in newspapers, and posted on the NRCS website. Upon request by a prescribed date prior to the meetings, translators for non-English speakers and/or assistance to individuals with hearing or sight impairment will be provided at meetings. The government agency/public scoping meetings will take place in a convenient location for the affected community (Senior Center/Library) and the facilities will be fully accessible to those with disabilities. The number and location of property owner/stakeholder meetings will be dependent on the number and location of proposed measures and locality of owner/stakeholders.

2.2.2 Draft Plan-EA

The Draft Plan-EA public meeting will be held to solicit comments on the Draft Plan-EA. One meeting will be held with government agencies and the public, including property owners/stakeholders, will be invited to attend. The document will be available for review prior to the public meeting, and the public comment period will be open for a total of 30 days. The public meeting will be held in the middle of the comment period to ensure adequate time for the public and agencies to file comments. The comments received during the public meeting process will be addressed (if applicable) in the Final Plan-EA.

2.2.3 Stakeholders and Cooperating Agencies

Direct stakeholders and cooperating agencies for the project are anticipated to include the following:

- NRCS
- Wasatch County
- Daniel Irrigation Company
- Central Utah Water Conservancy District
- Utah Department of Agriculture and Food – Division of Water Quality

- United States Department of the Interior U.S. Fish and Wildlife Service
- United States Department of Defense U.S. Army Corps of Engineers

Meetings will be conducted with the direct stakeholders/cooperating agencies for the project on a regular basis so that questions, comments, and/or concerns are addressed in a timely manner. These meetings will be held in-person or via conference call at set intervals in the project schedule after submittal review periods have ended. The point of contact for each stakeholder/cooperating agency will bring project information back to their organization for internal review.

2.3 Materials

Various materials and methods will be used to distribute information regarding the NEPA review process to government agencies and the public. These materials and methods are summarized in Sections 2.3.1 to 2.3.4 below.

2.4 Newsletters and Meeting Announcements

Notification of project meetings and availability of Plan-EA documents for review will be announced to government agencies and the public through newsletters and flyers. The recipients on the mailing list will be mailed letter announcements of notification of the scoping items and Draft Plan-EA items listed below. In addition, flyers will be posted in public libraries and at other gathering places (when appropriate). Non-English language versions of the mailings and flyers will be made available if requested. All mailings and flyers will include notification of the open and close of the comment periods, contacts and methods to provide comment, time/day/location for the meetings, and resources/contacts to obtain additional information. An e-mail notification of the Final Plan-EA and Finding of No Significant Impact (FONSI) availability (if a FONSI is determined by the responsible federal official [RFO]) will be sent to interested agencies and public constituents who provide e-mail contact information for NEPA updates during the NEPA review process.

- Announcement of the scoping meeting and open comment period
- Announcement of the Draft Plan-EA availability, public meeting, and open comment period

2.4.1 Press Releases

Press releases will be issued in advance of public meetings to announce the availability of project materials. It is anticipated that there will be press releases to announce the scoping and Draft Plan-EA public meetings, along with the open comment periods, and the availability of the Draft Plan-EA for review. This will be accomplished by publishing the information in the local newspaper (The Wasatch Wave) two times during the open comment periods. The first release will run on the first day of the open comment period (approximately 14 days before the meeting) and the second release one week later (approximately 7 days before the public meeting).

2.4.2 Website

The items listed below will be posted on the NRCS website throughout the NEPA review process. Cooperating agencies may also have similar postings to their representative agency information websites,

but it will be the responsibility of the agencies to post these materials. Sponsors may also choose to post available materials to their websites for public availability and review.

- Announcement of the scoping meeting and open comment period.
- Announcement of the Draft Plan-EA availability, public meeting, open comment period, and Draft Plan-EA document for download.
- Announcement of the Final Plan-EA availability and Final Plan-EA document for download.
- Announcement of the FONSI availability and FONSI for download (if a FONSI is determined by the RFO).

2.4.3 Meeting Materials

NEPA phase-specific handouts will be available for attendees at all public meetings. Public meeting presentations will be available as handouts, as appropriate, and on the website for review by those unable to attend meetings. Visual graphics in the form of displays will also be located around the meeting venue for reference. A flyer will be distributed at each meeting containing a project description, aerial photo showing the limits of the project, and a written comment form on which the public can submit comments during the public comment period.

3.0 Plan Implementation Schedule

The anticipated schedule for the scoping, Draft Plan-EA, and Final Plan-EA phases of the project are provided below. Public participation will be solicited during integral milestones in the project schedule. The first public participation will occur during the scoping phase of the project. Note that the dates presented in the subsections below are subject to change pending the concept design process, stakeholder/cooperating agency involvement, and any unforeseen issues that may arise.

3.1 Scoping

Scoping consists of an open comment period, scoping meeting, and other agency/property owner/ stakeholder meetings. A notice will be posted to websites and mailed to government agencies and the public at the start of the scoping open comment period. Flyers of the notice may be posted in public libraries and other gathering places (when appropriate). A notice will also be posted in the local newspaper at the start of the scoping open comment period, and another posted one week later (prior to the scoping meeting). The scoping meeting will be held during the middle of the open comment period. The comment period will be open for 30 days. An approximate timeline for the scoping process is provided below; these dates are subject to change.

- January 24, 2020: Scoping meeting notice mailed, posted to websites, and posted in local newspaper; start of open comment period
- February 12, 2020: Hold scoping meeting, and hold property owner/stakeholder meetings and government agency meetings as necessary
- March 2, 2020: End of open comment period

3.2 Draft Plan-EA

The Draft Plan-EA period consists of availability of the Draft Plan-EA for public review, open comment period, and a Draft Plan-EA meeting. Once the Draft Plan-EA is filed with the NRCS, notices will be mailed, posted, and published in the newspaper the same as described in Section 3.1 Scoping. The Draft Plan-EA meeting will be held during the middle of the open comment period. The comment period will be open for 30 days. An approximate timeline for the Draft Plan-EA process is provided below; these dates are subject to change.

- August 2020: Draft Plan-EA meeting notice mailed, posted to websites, and posted in local newspaper; Draft Plan-EA made available for public and agency review; start of open comment period
- August 2020: Hold Draft Plan-EA meeting
- September 2020: End comment period

3.3 Final Plan-EA and FONSI

Once the Final Plan-EA is complete, NRCS will file the document and issue a Notice of Availability (NOA). If the NRCS RFO makes a FONSI determination for the project, NRCS will issue an NOA of the FONSI.

The Final Plan-EA and FONSI NOA will be posted to the NRCS project website and the documents will be made available for download. Agencies and public e-mail contacts provided during the NEPA review process for project update status will be sent an NOA of the Final Plan-EA and FONSI by e-mail. An approximate timeline for the Final Plan-EA and FONSI is provided below; these dates are subject to change.

- November 2020: NOA of the Final Plan-EA and document for download posted to NRCS project website
- December 2020: NOA of the FONSI and document for download posted to NRCS project website, and e-mail notices sent

3.4 Public Meeting Agenda

The public meetings during the scoping and Draft Plan-EA periods will follow a pre-determined agenda so that all representatives of government agencies and the public can voice their opinions. A general public meeting agenda is provided below.

- Introduction: Moderator welcome; project materials handed to attendees as they enter the venue.
- Project Presentation: Brief presentation (when deemed necessary), overview of the project and the NEPA status to date.
- Open Comment: Open floor for informal oral questions and answers.
- Open House or Meeting: An informal open house or meeting with an interactive discussion among interested parties will be held. Visual graphics describing the project will be displayed throughout the meeting room and attendees will be given the opportunity to submit written comments.

4.0 Public Participation Documentation

Detailed documentation of the NEPA review process will be performed for inclusion in the administrative record. This section summarizes the public participation documentation that will be provided for the NEPA review process.

4.1 Comment Tracking and Response Management

All government, public, and property owner meetings will be fully documented for inclusion into the NEPA documents and/or administrative record. Public comments will be received by phone, mail, e-mail, fax, comment card, and verbally at the meetings. All comments received for the project will be categorized and incorporated into each respective phase of the Plan-EA.

All comments will be sent to BC&A for tracking and will be delivered to NRCS at the beginning of each week during the respective comment period. A project e-mail address will be created by BC&A for responses submitted via e-mail, and a telephone number will be specified for verbal responses. BC&A will maintain a database for inclusion of all contacts received throughout the Plan-EA process.

4.2 Scoping Meeting

A meeting summary report from the scoping meetings will be prepared and posted to the project website for stakeholder and public input pertaining to the preparation of responses. The Scoping Report will include categorized comments from meeting comment cards, meeting attendance sheets, notification materials, and verbal/written input received during the scoping meeting and open comment period. This scoping meeting summary report will be incorporated into the formal Scoping Report for the project.

4.3 Draft Plan-EA Meeting

A meeting summary from the Draft Plan-EA meeting will be prepared and distributed to the stakeholders for input on the preparation of responses. The summary will include categorized comments from meeting comment cards, meeting attendance sheets, notification materials, and verbal/written input received during the Plan-EA meeting and open comment period. This meeting summary will be incorporated into the Final Plan-EA for the project.

4.4 Agency, Property Owner, and Stakeholder Meetings

Meetings conducted with agencies, property owners, and stakeholders will be documented through meeting minutes and provided in the administrative record. Agency consultation and associated meetings will be described and documented in the Final Plan-EA.

Technical Memorandum for the Tri-Valley Watershed Plan-EA

BOWEN COLLINS & ASSOCIATES

TECHNICAL MEMORANDUM (DRAFT)

TO:	Jason Roper, P.E. NRCS Civil Engineer
COPIES:	Brandon Cluff – County Planner, Wasatch County Roger Pearson – Engineer, Central Utah Water Conservancy District Hugh Barker – President, Daniel Irrigation Company
FROM:	Cody Moultrie, P.E. Bowen Collins & Associates
DATE:	November 14, 2022
SUBJECT:	Tri-Valley Watershed Plan EA – Daniel Irrigation and Center Creek Overflow Projects
JOB NO.:	627-19-01

Revision No.	Revision Date	Notes
0	07-31-2020	Draft Review.
1	06-08-2021	Added Center Creek Overflow Project
2	11-14-2022	Updated project components and cost estimates

SECTION 1 - INTRODUCTION

1.1 INTRODUCTION

Wasatch County, Utah contracted with Bowen Collins & Associates (BC&A) to prepare a new Watershed Plan and Environmental Assessment (Plan-EA) for the Tri-Valley Watershed in accordance with USDA Natural Resource Conservation Services (NRCS) guidelines and requirements. The funding for this project was provided by the NRCS through the Watershed and Flood Prevention Operations (WFPO) Program. The Sponsor for this Plan-EA is Wasatch County (Sponsor/County). The principal objective of this Plan-EA is to provide the Sponsor and NRCS with National Environmental Policy Act (NEPA) analysis and documents for various Sponsor-selected project watersheds within the larger Tri-Valley Watershed.

Multiple projects were studied as part of this Plan-EA; the focus of this Technical Memorandum (TM) is the Daniel Irrigation Project and overflow structure on Center Creek (see Section 6). The Daniel Irrigation project is located in the Town of Daniel, in the southern portion of Wasatch County, just south of Heber City. The Daniel Irrigation Company (DIC) delivers irrigation water to users in and around Daniel. The current system is a pressurized irrigation system, which was converted from open canals for flood irrigation as part of the Wasatch County Water Efficiency Project. Central Utah Water Conservancy District (CUWCD) is the wholesale water provider to the system and operates

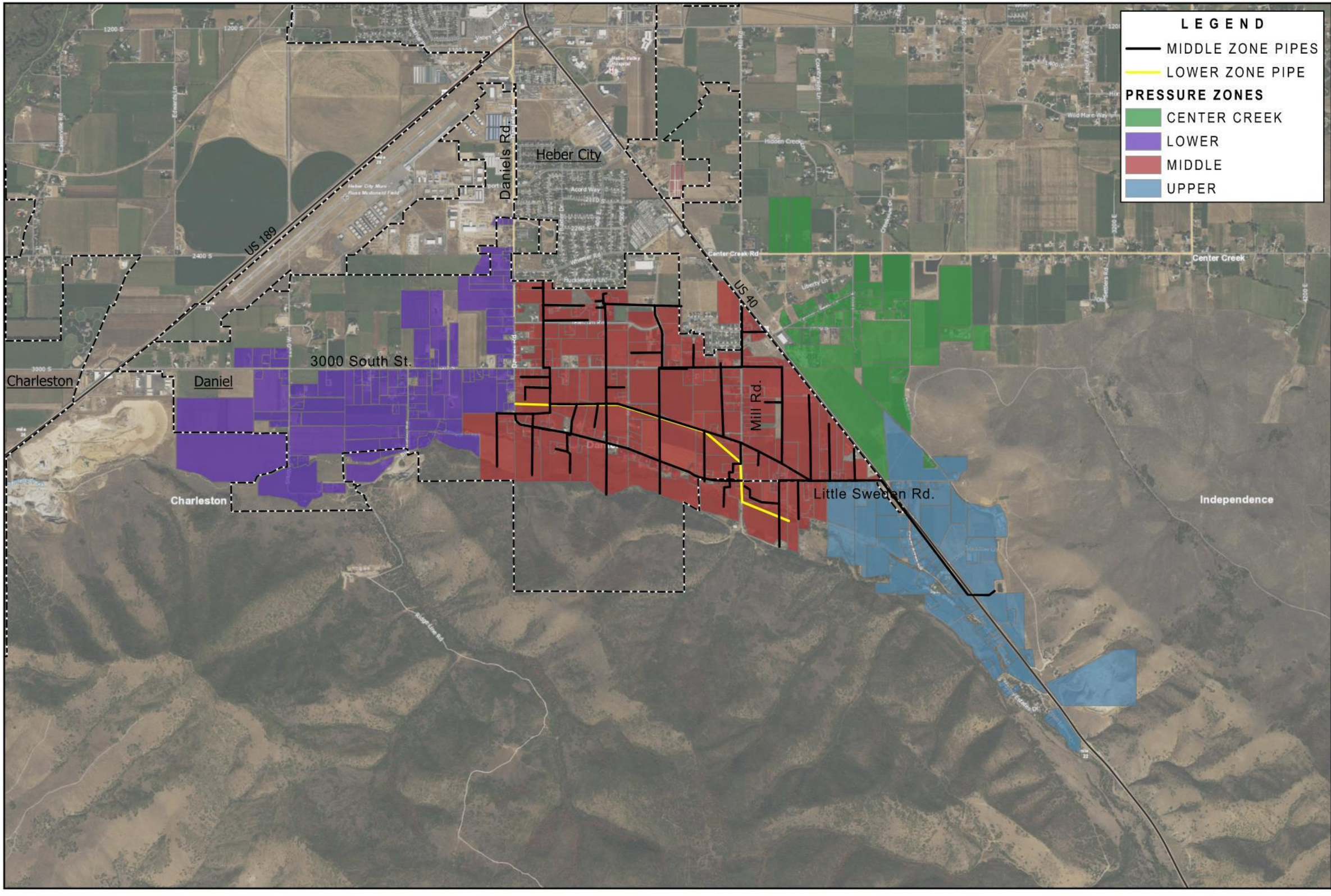
and maintains the main trunkline of the system, while DIC operates and maintains the distribution laterals.

This system utilizes four pressure zones: Upper, Middle, Lower, and Center Creek. These pressure zones are shown in Figure 1. The irrigation network located in the Middle pressure zone was analyzed as part of this TM and is also referred to as the service area in this analysis. The Middle Zone pipes and the Lower Zone main trunk line are also shown on Figure 1. As the Middle Zone is the focus of this TM, the Lower Zone trunk line is not shown on most other figures for clarity.

The Middle pressure zone consists of approximately 573 acres of irrigated area. This area is serviced by a pressurized irrigation system with pipe sizes and lengths as shown in Figure 2 and Table 1. The system is fed by the Middle Pond, located adjacent to Highway 40, approximately 4,000 feet southeast of the Middle pressure zone.

The existing main trunk line is 12- to 16-inches in diameter and is made of transite material. This pipe material, otherwise known as asbestos cement, was a popular pipe material in the mid-1900s due to its light weight and resistance to corrosion. However, since that time it has been discovered that asbestos is a carcinogen and health issues can arise from high levels of asbestos in the drinking water. Additionally, because of the health hazards and brittle nature of the pipe, it is known to be potentially dangerous and difficult to repair or maintain. For these reasons it is generally recommended to replace or abandon in place transite pipe whenever possible. Improvement alternatives proposed as part of this study include the replacement of transite pipe with polyvinyl chloride (PVC) pipe. The existing 12- to 16-inch trunk line is also located in the back of fields where it is hard for DIC to maintain the pipeline. DIC would also like to look at relocating the pipeline to Little Sweden Road to help improve access for maintenance.

In addition to the transite trunk line that feeds the Middle pressure zone, a second transite trunkline runs from the Lower Pond, through the Middle zone service area, to the Lower pressure zone. As part of the proposed improvement alternatives, this Lower zone trunkline would also be replaced by a new PVC pipeline. The new pipeline would also be located in Little Sweden Road, allowing for both the Middle and Lower pressure zone trunklines to be built concurrently and allowing easier access to the pipeline for operation and maintenance.



SCALE: 1 in = 2,000 ft

NORTH:

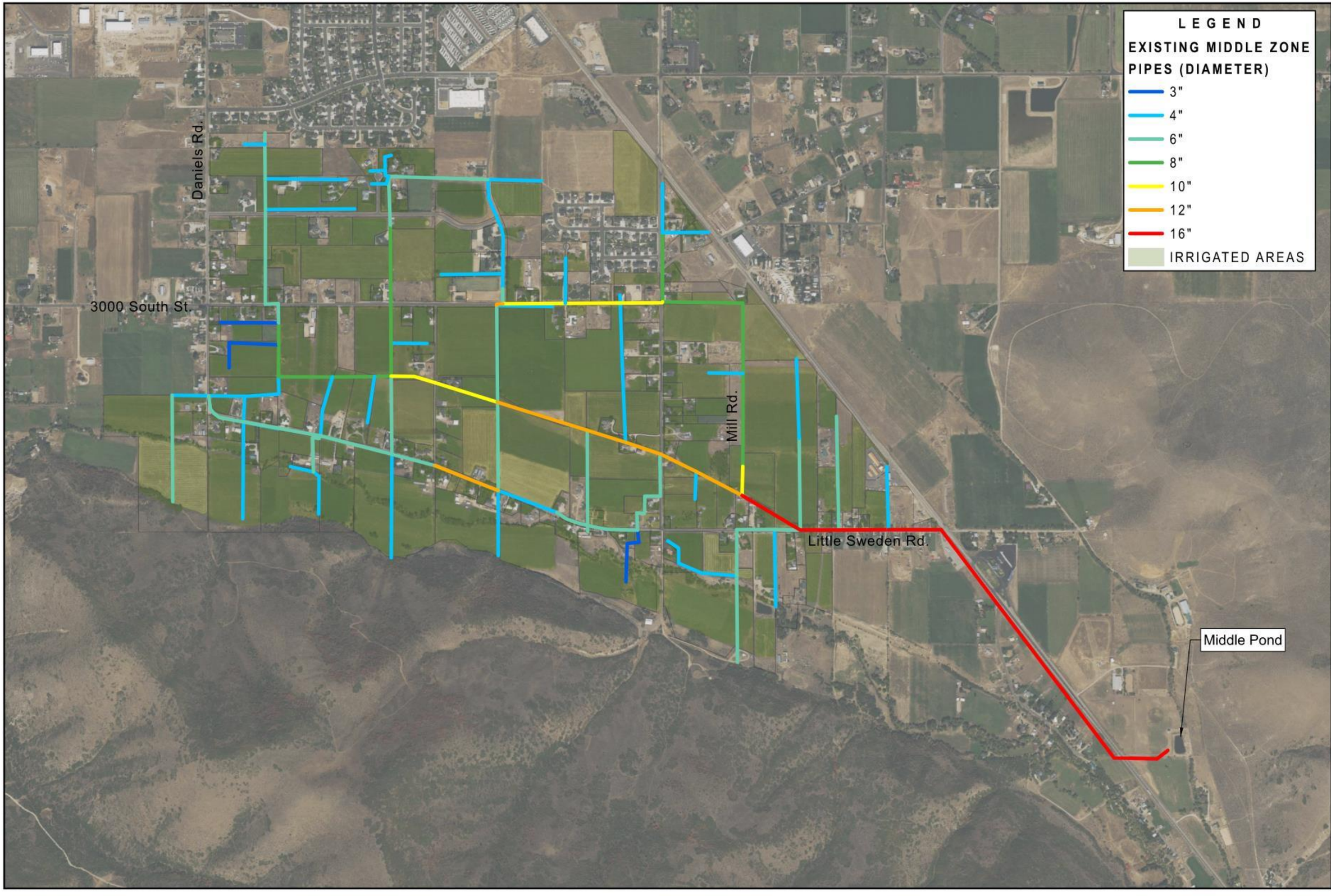
IRRIGATION SYSTEM PRESSURE ZONES

WASATCH COUNTY
DANIEL IRRIGATION PROJECT

BOWEN COLLINS & ASSOCIATES

FIGURE NO.
1

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SCALE: 1 in = 1,000 ft

NORTH:

IRRIGATION AREAS AND PIPELINE SIZES

WASATCH COUNTY
DANIEL IRRIGATION PROJECT

BOWEN COLLINS & ASSOCIATES

FIGURE NO.
2

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Table 1
Existing Middle Zone Pipeline Inventory

Size (in)	Length (ft)
3	2,294
4	29,048
6	16,732
8	14,379
10	1,638
12	3,085
16	6,753
Total	**73,930**

As mentioned previously, the main trunk line feeding the Middle pressure zone from the Middle Pond consists of 12-inch and 16-inch transite pipe. This pipeline is in poor condition and in need of repair or replacement. Additionally, some users within the pressure zone have experienced low pressure at delivery points, limiting their ability to adequately utilize their irrigation water right. An InfoWater model was developed to model the maximum velocity in existing pipes and minimum and maximum pressure at delivery junctions to determine what deficiencies exist within the system. The development of this hydraulic model, its results, and corresponding recommendations are discussed in this TM.

1.2 EXISTING DATA

The irrigation system hydraulic analysis for the project utilized the data sources presented in Table 2.

Table 2
Study Data Sources

Data	Source	Description
Existing Middle Zone Hydraulic Model	CUWCD	EPANet Input files used to create the InfoWater model of the Middle Zone Irrigation System
Existing Pipeline Geodatabase	CUWCD	GIS data listing properties of existing of irrigation pipelines
Turn-based and On-Demand Irrigation Demands	CUWCD	Demand information compiled and organized in spreadsheets used to define demands throughout the irrigation system
2018 LiDAR Elevation Data	AGRC	LiDAR elevation data used to verify elevations at various locations throughout the service area
Hexagon 30CM Imagery	AGRC	Imagery provided via online webmap for use as backgrounds for report figures

SECTION 2 - IRRIGATION SYSTEM ALTERNATIVES

In addition to a Do-Nothing alternative, two alternatives were considered in this analysis to replace the main transite turnklines (both Middle and Lower pressure zone trunklines) and address conveyance restrictions throughout the Middle system. In addition to the transite pipe replacement, pipelines throughout the distribution system that are found to experience high velocity leading to high head loss and reduced pressure are recommended to be replaced. The criteria for determining the threshold for pipe replacement are based on the NRCS Conservation Practice Standard for Irrigation Pipelines (Practice Code 430). As stated in Practice Code 430, the working pressure within each mainline pipe should not exceed 72% of the pipe rating and maximum velocities throughout the irrigation system are not to exceed 5 fps. Additionally, working pressure within the system should not be lower than 40 psi to allow adequate pressure for sprinkler irrigation.

The existing Lower Zone trunkline connects to the Lower Pond then runs west to 1200 East, then north along 1200 East before running through fields to a connection to the Lower system located approximately 1000 feet southwest of the intersection of 3000 South and Daniel Road. The proposed Lower Zone trunk line would replace the existing transite line from the Lower Pond to Little Sweden Road, at which point a new pipeline would be installed within Little Sweden Road before terminating at the existing Lower Zone connection point. This replacement trunkline is included in both alternatives.

The existing Middle Zone trunkline connects to the Middle Pond then runs parallel to Highway 40 before turning to run parallel to Little Sweden Road. Both alternatives would remove and replace the existing transite pipe along Little Sweden Road and the remaining transite trunkline through the service area. The two alternatives differ in the pipe alignment selected for the replacement trunkline between the Middle Pond and Little Sweden Road. Figure 3 shows the proposed pipelines associated with each alternative. A description of these two alternatives is as follows:

- Alternative No. 1 – Replace the existing 16-inch pipeline in place. This alternative would replace the 16-inch line from the Middle Pond to Little Sweden Road.
- Alternative No. 2 – Utilize an existing 30-inch pipe from the Middle Pond to the end of Little Sweden Road east of Highway 40. A new pipeline would then be installed between the end of the 30-inch pipe and the Highway 40/Little Sweden Road intersection.

A hydraulic model was developed using ArcMap and InfoWater modelling software to evaluate these two alternatives. These alternatives were also evaluated based on estimated construction costs to determine the least cost alternatives that addresses the system deficiencies.

The following sections summarize the development of the irrigation demands throughout the service area and the hydraulic modeling of the proposed alternative irrigation systems.



SCALE: 1 in = 800 ft

NORTH:

PROPOSED PIPELINES ALTERNATIVES COMPARISON

WASATCH COUNTY

DANIEL IRRIGATION PROJECT

BOWEN COLLINS & ASSOCIATES

FIGURE NO. 3

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SECTION 3 - DEMAND ANALYSIS

The following subsections detail the process used to develop the demand distribution for the InfoWater model.

3.1 EXISTING DEMANDS

Irrigation water is delivered from the Middle Pond to users throughout the service area through a pressurized irrigation pipe network. Demands for each user are defined on a per-turn basis or on-demand basis. Irrigation tickets for each field in the Middle Pressure zone are provided in Appendix B for reference.

3.1.1 Turn-Based Demands

The Daniel Middle Irrigation system operates on a 14-day, 12-hour turn basis. This results in 28 individual turns, labeled as "Sets" in the demand data provided by CUWCD. Each set is labeled as AM or PM. Each field in the service area is numbered and is associated with an irrigation ticket. Turn-based irrigation fields are categorized in the CUWCD database with the Ticket Type of "Daniel". Each Daniel Irrigation Ticket provides the following information:

1. Number of shares,
2. Irrigation schedule defined by number of sets on a defined rotation, and
3. Number of sprinkler heads and flow per sprinkler head.

The flow rate for a given set is calculated by multiplying the number of sprinklers by the defined flow rate per sprinkler head. Using this information, the irrigation flow pattern over a 14-day period for a given field can be determined. The overall system flow pattern can also be determined by summing the total flow for each of the 28 sets.

3.1.2 On-Demand Demands

In addition to turn-based tickets, DIC delivers water to certain fields on an on-demand basis. These fields are associated with an irrigation ticket categorized in the CUWCD database with a Ticket Type of "DIMeter" or "Meter". Flows associated with these tickets are not based on turns or sets and instead are used as needed. Each DIMeter Ticket lists the following information:

1. Number of shares,
2. Beginning meter reading (in gallons),
3. Allowed annual use (in gallons), and
4. Ending meter reading (in gallons).

To convert the listed annual use for a given field into an average daily demand in gallons per minute (gpm), the annual use value is divided by 525,600 (number of minutes in a year). The Peak Day Demand (PDD) is then determined by multiplying the average day demand by a PDD factor. The PDD factor can be estimated based on a system's actual usage when monthly or daily meter readings are available. For this project, daily/monthly usage was not available, so PDD factors were assumed based on engineering judgement and experience in developing water master plans for many entities throughout the State of Utah. The PDD Factors assumed for this project are 2.4 for AM sets, and 1.7 for PM sets. These factors were selected as higher irrigation usage is typically seen in the evening and morning.

These on-demand demands are not associated with any set schedule and can therefore occur at any time. Therefore, each on-demand PDD was applied to each set within the 14-day period to estimate the overall PDD on the system.

3.1.3 Demand Distribution

To simplify the demands in the hydraulic model, demands from multiple fields were assigned to single junctions. The assignment of field demands to individual junctions was based on visual inspection and is shown in Figure 4. In Figure 4, field demands that were assigned to a given nearby junction are symbolized with the same color. Demand and set patterns were assigned to each junction in the model based on the turn-based and on-demand demands associated with each field assigned to a given junction. The following section discusses the development and results of the InfoWater hydraulic model.

A summary of the turn-based and on-demand demands per set based on a 14-day irrigation period are listed in Table 3. The on-demand flows listed in Table 3 are the calculated PDDs that may need to be delivered. As mentioned previously, these flows are on-demand and can be used anytime regardless of irrigation schedule. Theoretically, these flows could all occur at the same time. For the purpose of determining minimum pressures and maximum pipe velocities, these demands were added to the turn-based demands for each set within the hydraulic model.

Table 3
Demand Distribution Summary

Day	Flow Per Set (gpm)					
	Turn-Based[1]		On-Demand[2]		Total	
	AM	PM	AM	PM	AM	PM
1	3,223	3,300	376	266	3,599	3,566
2	3,424	3,346	376	266	3,800	3,612
3	3,244	3,330	376	266	3,620	3,596
4	4,144	3,822	376	266	4,520	4,088
5	3,845	3,214	376	266	4,221	3,480
6	3,112	2,156	376	266	3,488	2,422
7	3,320	3,174	376	266	3,696	3,440
8	3,320	3,380	376	266	3,696	3,646
9	3,008	3,094	376	266	3,384	3,360
10	3,716	3,506	376	266	4,092	3,772
11	3,580	3,014	376	266	3,956	3,280
12	2,890	1,934	376	266	3,266	2,200
13	30	84	376	266	406	350
14	84	84	376	266	460	350

Notes:

1. *Turn-based demands are based on sprinkler head flow rates and number of sprinklers per set for each field. No additional peaking factor was applied to these values.*
2. *On-demand flows are based on average daily demand derived from annual usage listed on meter irrigation tickets, multiplied by a PDD factor (2.4 for AM sets, 1.7 for PM sets).*

Existing Pipelines (Typ)

Demand at Junction (Includes Demands from Nearby, Color-coded, Fields))

Fields (With Field Numbers)

3000 South St.

Daniels Rd.

Center Creek Rd

Little Sweden Rd.

Mill Rd.

SCALE: 1 in = 800 ft

NORTH:

IRRIGATION SYSTEM DEMAND DISTRIBUTION

WASATCH COUNTY

DANIEL IRRIGATION PROJECT

BOWEN COLLINS & ASSOCIATES

FIGURE NO. 4

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SECTION 4 - HYDRAULIC ANALYSIS

The following subsections detail the hydraulic analyses of the Daniel Irrigation system.

4.1 INTRODUCTION/BACKGROUND

A hydraulic model was developed to evaluate the hydraulic performance of the existing irrigation system and the proposed irrigation system alternatives. CUWCD personnel provided pipeline size and location data throughout the service area. Demands were distributed throughout the service area in the model as described in the previous section.

The hydraulic model was used to identify existing system deficiencies based on meeting the irrigation system demands, while complying with the requirements outlined in the NRCS Practice Code 430. The model was also used to size proposed pipelines for each improvement alternative considered.

4.2 DATA SOURCES AND MODEL DEVELOPMENT

GIS and model data were provided for this modelling effort by CUWCD. This information included pipeline diameters and lengths, and elevations for each junction.

4.2.1 Modeling Assumptions

Demands from multiple fields were assigned to nearby model junctions (see Figure 4). Each junction in the model was assigned up to two demands and associated patterns. Demand 1 refers to turn-based demand. The pattern associated with each turn-based demand was customized based on the water schedule defined by the contributing fields' irrigation tickets. Demand 2 refers to on-demand demands. The pattern associated with these demands applies a 2.4 PDD factor to AM sets, and a 1.7 PDD factor to PM sets.

The hydraulic model was set up to represent demands during a full 14-day irrigation rotation, computed at 12-hour increments. Modeling the system this way simulates a quasi-steady state scenario, where peak flow rates, velocities, and pressures are determined for each set, but draining of the Middle Pond is not modeled. It was assumed that the Middle Pond was always at elevation discussed below and did not have diurnal fluctuations. Figures showing velocity and pressure associated with each set within the 14-day irrigation rotation are provided in Appendix C. The Middle Pond is modeled as a fixed-head reservoir, with an elevation of 5,975 feet, corresponding with the lowest anticipated water surface elevation in the pond that can deliver the required demands to the system. It is assumed that irrigation diversions from Danial Creek and CUWCD can provide adequate flow to the Middle Pond when necessary to maintain this minimum water surface elevation.

For modelling purposes, irrigation pipes throughout the system were assumed to have a Hazen-Williams C-value of 110 for transite pipe and 120 for PVC, based on the pipe material and the age of the system. It was also assumed that existing 12-inch and 16-inch diameter lines are transite, while pipes 16-inch diameter and smaller are PVC. New PVC pipes were assigned a C-value of 130.

4.3 MODEL RESULTS

The purpose of the hydraulic evaluation is to identify deficiencies in the existing system based on meeting irrigation demands within the design criteria established. As stated in the NRCS Code 430, the working pressure within each pipe should not exceed 72% of the pipe rating and maximum velocities throughout the irrigation system are not to exceed 5 fps. Additionally, the recommended

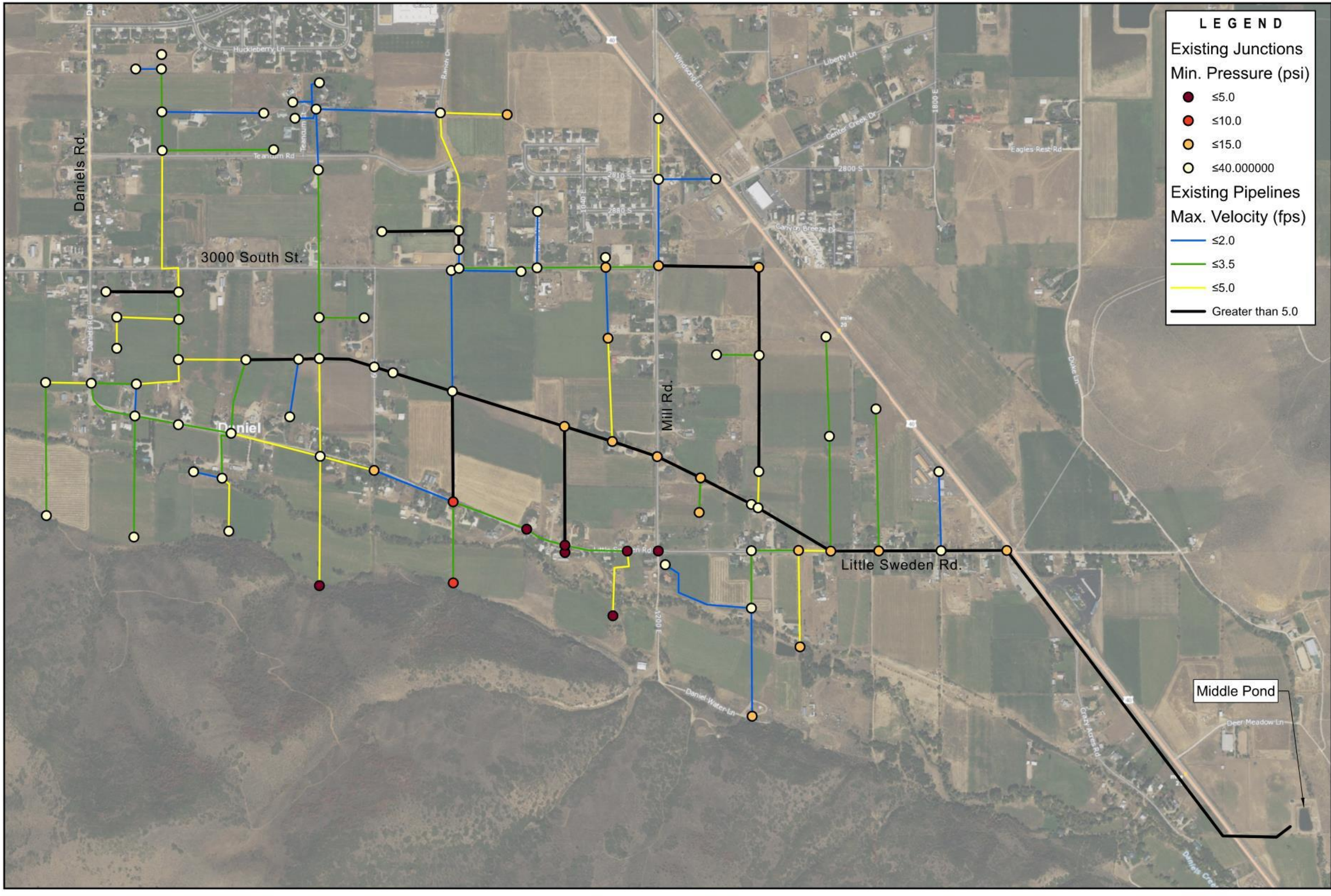
pressure to be delivered is 40 psi. The hydraulic model was used to identify areas where these requirements are not met.

Figure 5 shows maximum velocities and minimum pressures experienced throughout the system based on existing conditions and the modeling assumptions outlined above for the 14-day irrigation rotations. Deficient pipes and junctions are symbolized red, orange, and yellow. Figure 6 shows maximum pressures throughout the system for the 14-day irrigation rotations. Improvement alternatives to address these deficiencies were also modeled and are described below.

4.3.1 Description of Alternatives Modeled

Two irrigation system improvement alternatives were considered in this study to address existing system deficiencies. Each of these alternatives include the replacement of deficient pipes throughout the service area. These alternatives differ in the alignment for which the main trunkline into the service area is replaced:

- Alternative No. 1 – This alternative would replace the 16-inch line from the Middle Pond to Little Sweden Road with a new 20-inch pipeline following the existing pipeline alignment parallel to Highway 40 and Little Sweden Road until the approximate location of where the existing pipeline turns through the private properties to the northwest. From this location the new trunkline would be continue in Little Sweden Road to connect to the existing irrigation distribution system to allow better access to the pipeline for maintenance. Figure 7 shows the proposed pipe layout and model results for this alternative.
- Alternative No. 2 – Utilize an existing 30-inch pipe from the Middle Pond to the end of Little Sweden Road east of Highway 40. A valve vault would also be installed to allow CUWCD the option of pumping to fill the Middle Pond or pumping directly to the Daniel Irrigation System. Similar to Alternative 1, a new 20-inch pipeline would then be installed between the end of the 30-inch pipe and the Highway 40/Little Sweden Road intersection and continue within Little Sweden Road to connect to the existing irrigation distribution system to allow better access to the pipeline for maintenance. This Alternative would also provide an interconnection to the Center Creek pressure zone to provide CUWCD with additional operational flexibility. Figure 8 shows the proposed pipe layout and model results for this alternative.


LEGEND
Existing Junctions
Min. Pressure (psi)
≤5.0
≤10.0
≤15.0
≤40.000000
Existing Pipelines
Max. Velocity (fps)
≤2.0
≤3.5
≤5.0
Greater than 5.0
Daniels Rd.
3000 South St.
Daniel
Mill Rd.
Little Sweden Rd.
Middle Pond
Huckleberry Ln
Teanum Rd
Ranch Dr
Windsong Ln
Liberty Ln
Canyon Creek Dr
Eagles Rest Rd
2800 S
2810 S
2880 S
1800 E
1640 E
1200 E
Carry on Breeze Dr
Daniels Rd
Daniel Water Ln
Deer Meadow Ln
Dixie Ln
Grey Acres Rd
SCALE:
1 in = 800 ft
NORTH:
EXISTING DEFICIENCIES
WASATCH COUNTY
DANIEL IRRIGATION PROJECT
BOWEN COLLINS & ASSOCIATES
FIGURE NO.
5
P:\Wasatch County\627-19-01 Tri-Valley Watershed Plan EA\6.0 Reports\01 - Daniels Irrigation\GIS\DanielsIrrigation\DanielsIrrigation.aprx cmoutine 11/6/2020

LEGEND

Existing Junctions

Max. Pressure (psi)

- ≤60.0
- ≤80.0
- ≤100.0
- Greater than 100.0

Existing Pipelines

Max. Velocity (fps)

- ≤2.0
- ≤3.5
- ≤5.0
- Greater than 5.0

SCALE: 1 in = 800 ft

NORTH:

EXISTING SYSTEM MAXIMUM OPERATING PRESSURES

WASATCH COUNTY

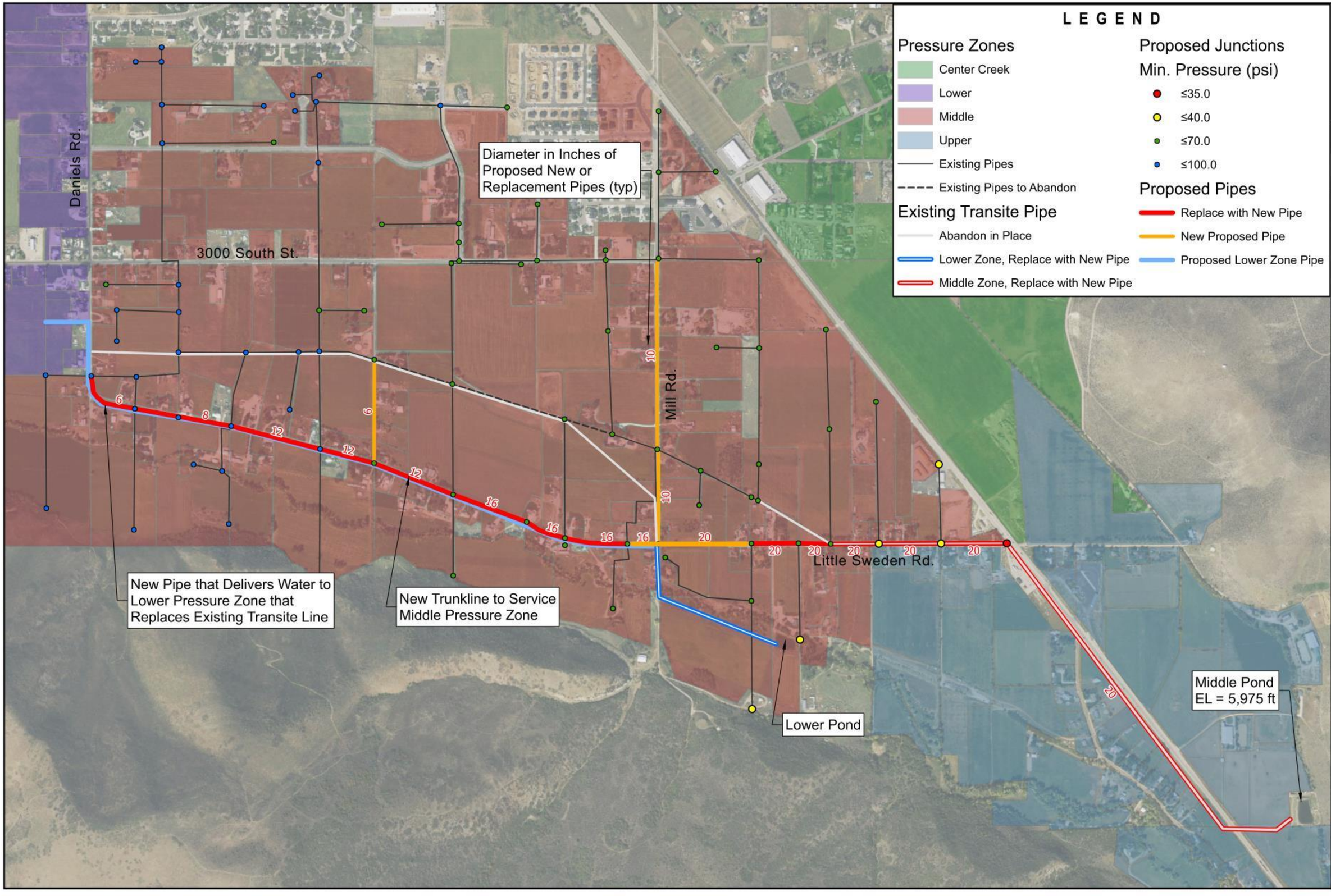
DANIEL IRRIGATION PROJECT

BOWEN COLLINS & ASSOCIATES

FIGURE NO.

6

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SCALE: 1 in = 800 ft

NORTH:

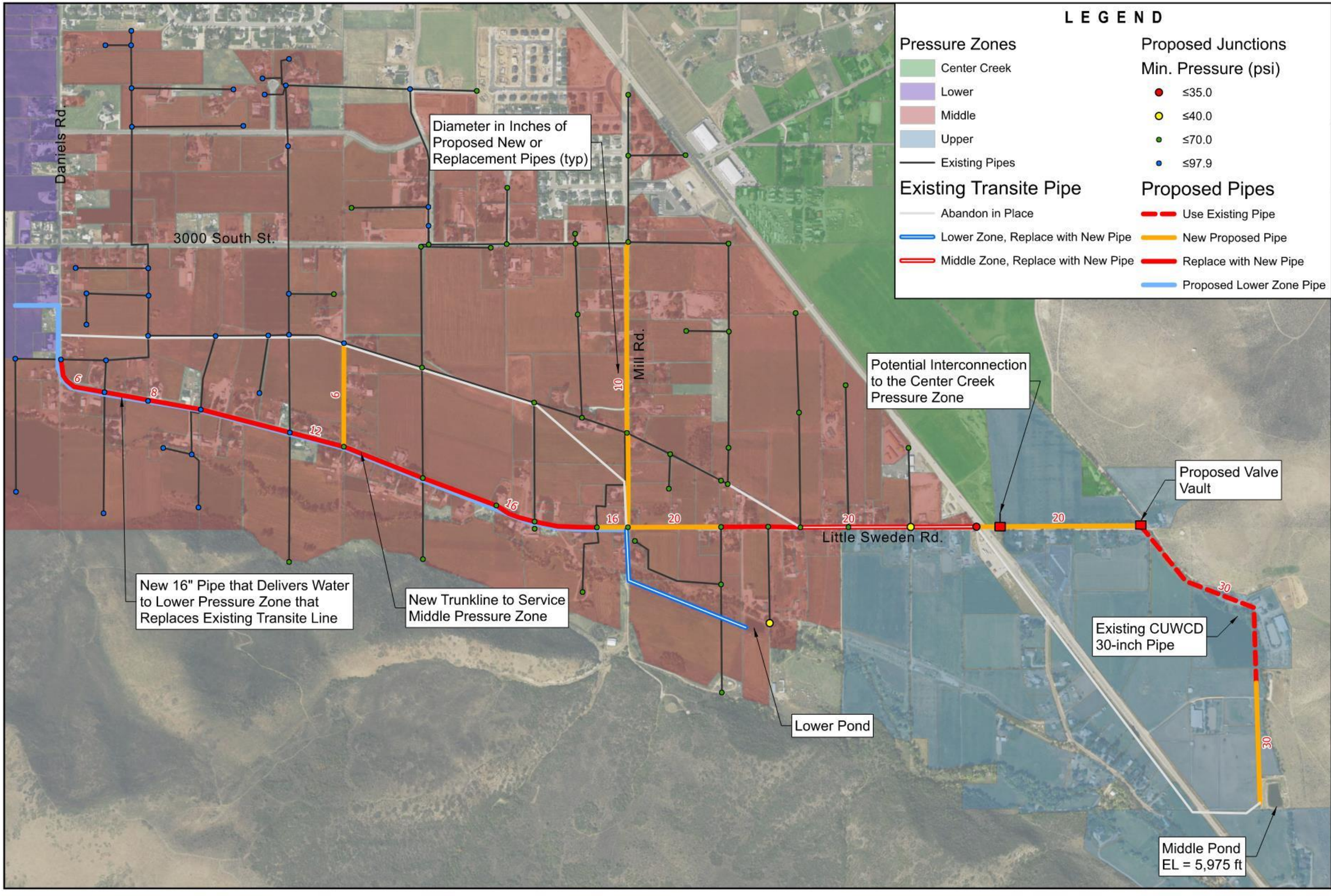
ALTERNATIVE 1
PROPOSED PIPES

WASATCH COUNTY
DANIEL IRRIGATION PROJECT

BOWEN COLLINS & ASSOCIATES

FIGURE NO.
7

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SCALE: 1 in = 800 ft

NORTH:

ALTERNATIVE 2
PROPOSED PIPES

WASATCH COUNTY
DANIEL IRRIGATION PROJECT

BOWEN COLLINS & ASSOCIATES

FIGURE NO.
8

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4.4 EVALUATIONS AND CONCLUSIONS

The existing Middle Zone irrigation system was modeled to identify existing deficiencies. As shown in Figure 5, nearly all of the existing service area experiences minimum pressures that are inadequate for sprinkler irrigation at some point within the 14-day irrigation set window. In many cases, the calculated velocities in the existing pipes exceed the recommended values provided in the NRCS Practice Code 430. It is anticipated that pipelines that exceed 5 fps will be replaced. Modeling indicated that by replacing these pipes, the low-pressure issues were also resolved. The proposed pipelines with associated minimum pressures are shown in Figure 7 and Figure 8.

Based on conversations with CUWCD personnel, the pressure class of the PVC pipelines in the system are Class 125. As shown in Figure 6, the hydraulic model indicated that the calculated max pressures in the system were below 125 psi. However, pressures in some of the existing pipelines were calculated to be greater than 72% of the pressure rating of the pipes. These conversations also indicated that neither the District nor the Daniel Irrigation Company have had significant maintenance issues caused by high pressures in the existing pipes. For these reasons, it is anticipated that measures to adequately protect the pipeline against transient pressures would be provided as part of the final design. Alternatively, a variance to the maximum pressure requirements outlined in the NRCS Practice Code 430 may be requested during final design for the existing pipelines. For any new pipelines, pipe pressure class would be specified such that the NRCS Practice Code 430 requirements are met.

Table 4 lists the sizes and lengths of the proposed pipelines for Alternatives 1 and 2 that remedy the deficiencies identified in the hydraulic model and that replace problematic transite pipe trunklines.

Table 4
Improvement Alternatives Proposed Pipeline Sizes and Lengths

Pipeline Size (in)	Alternative 1 Length (ft)	Alternative 2 Length (ft)
6	1,600	1,600
8	950	950
10	2,700	2,700
12	2,200	2,200
16	8,700[1]	8,700[1]
20	7,350	4,850
30	0	1,150
Total	23,500	22,150

Note:

1. *These lengths include approximately 6,650 feet of pipe for the new Lower Zone trunkline.*

The following sections describe the evaluation of cost and non-cost factors for the two proposed alternatives, as well as a "Do Nothing" alternative. A recommended alternative is selected based on comparing the costs and benefits of the various alternatives.

4.4.1 Do Nothing Alternative

The Do Nothing alternative would result in the existing irrigation system remaining as-is. The relative cost and benefits (or lack thereof) associated with this alternative are as follows:

- Zero capital cost.
- Continued decrease in pressure and reduced ability to make water deliveries.
- Significant maintenance required for older pipe sections, especially the transite pipe sections.
- Eventual replacement of pipes in poor condition will be required to maintain irrigation deliveries.

4.4.2 Alternative No. 1

This alternative consists of replacing the entire transite trunk line and replacing other distribution pipes that were shown to be undersized. The relative cost and benefits (or lack thereof) associated with this alternative are as follows:

- Requires additional length of pipeline to be installed but fewer valve vaults when compared to Alternative No. 2, resulting in the anticipated lowest capital cost.
- Improves operation and maintenance required for the system by eliminating transite pipe material.
- Replaces older pipes in poor condition that are currently restricting flow deliveries and increases system's ability to deliver flow to meet demands reliably.

4.4.3 Alternative No. 2

This alternative consists of replacing most of the transite trunkline and replacing other distribution pipes that were found to be undersized. Additionally, this alternative utilizes an existing 30-inch pipeline to act as the first reach of the trunkline from the Middle Pond to Little Sweden Road. A valve vault would be installed to control the delivery of water at the junction where the new trunkline would tie into the existing 30-inch line. The relative cost and benefits (or lack thereof) associated with this alternative are as follows:

- Approximately 3% higher anticipated capital cost when compared to Alternative No. 1.
- Less required new pipe due to the ability to utilize an existing 30-inch CUWCD pipe for the first reach of the trunk line.
- Improves operation and maintenance required for the system by eliminating transite pipe material.
- Replaces older pipes in poor condition that are currently restricting flow deliveries and increases system's ability to deliver flow to meet demands reliably.
- Provides operational flexibility by allowing the DIC system to receive water from the Middle Pond or from CUWCD directly. Also allows CUWCD operational flexibility with a potential connection to the Center Creek pressure zone.

- During typical operation of the existing system, the Middle Pond will eventually fill with Daniel Creek water. Often there is excess water in Daniel Creek that cannot be stored in the Middle Pond and there is not currently a reliable way for DIC or CUWCD to capture that excess water. The interconnections associated with Alternative 2 allow for the capture and delivery of excess water in Daniel's Creek to the Lower Zone Pond.

4.4.4 Evaluation and Recommendations

The Do Nothing Alternative has no capital cost. However, it does not result in the removal or abandonment of the problematic transite pipeline or address deficiencies in the existing irrigation system. Additionally, operation and maintenance costs would increase over time as pipes in poor condition continue to fail. Therefore, the Do Nothing Alternative is not recommended.

Alternatives Nos. 1 and 2 both address the issues in the existing system related to the aging transite pipeline, system operations and maintenance, existing velocity and pressure deficiencies, and pipe condition. The estimated costs for these two alternatives are within 5% of each other. Alternative No. 2 provides significantly more operational flexibility by its use of an existing CUWCD pipeline and the potential interconnectivity to the Center Creek pressure zone. For this reason, Alternative No. 2 appears to be the most viable alternative and is recommended as the preferred alternative, despite its slightly higher capital cost.

SECTION 5 - CENTER CREEK OVERFLOW PIPE

5.1 CENTER CREEK BACKGROUND

The existing Center Creek channel starts high up in Center Creek Canyon and traverses downstream and enters the Heber Valley where its slope flattens out similar to an alluvial fan. Based on an inventory and study done by Central Utah Water Conservancy District (CUWCD) in 2017 (see Figure 9), Center Creek is assumed to have a capacity of 100 cfs and the effective FEMA study shows that sections of the creek have a capacity of 50 cfs.

Magpie Canyon and Lake Creek South/Humbug Canal also discharge into Center Creek. Magpie Canyon does not have any channelized flow path and observed runoff is typically shallow overland sheet flow. Lake Creek South/Humbug Canal flows into a large detention basin near the Central Utah Water Conservancy District office before discharging into Center Creek. Over time, as the Heber Valley has developed, Center Creek flow paths have been altered by development activities. Instead of areas flooding and attenuating the runoff, the runoff in the creek now has a higher peak discharge and is concentrated in a single channel with few diversions to divert water for irrigation purposes. Due to these flow path changes, the existing downstream facilities (pipes and open channels) do not have the capacity to convey runoff from the 100-year design storm and smaller events.

5.2 DEFICIENCIES AND ICING CONCERNS

The Center Creek channel below the canyon mouth conveys very little water between June and October, as the creek water is diverted to reservoirs that supply a pressurized irrigation system. From November through April a small amount of spring discharge flows in the creek through the study area. The winter water in the channel also provides water to livestock in fields adjacent to the creek channel. The creek also conveys significant runoff in response to snowmelt and large precipitation events that generate runoff.

Shallow flooding has been observed near Center Creek Road and 2400 East in the past that originated in Magpie Canyon where at least one home had to be protected from flooding by the placement of sandbags. Also, in the coldest part of the winter months, water in the creek often freezes and creates ice jams that causes water to spill out onto Center Creek Road, creating icing and safety problems as shown in Figure 10.

5.3 RECOMMENDED IMPROVEMENTS

To mitigate the icing issues, about 400 linear feet of 18" channel overflow pipe with four catch basin inlets and a roadside drainage ditch should be installed adjacent to Center Creek Road near 2400 East. This will help prevent water that may overtop Center Creek in the winter from flowing onto Center Creek Road and causing safety issues due to ice. The overflow pipe would convey runoff back to Center Creek through connecting to the existing culvert under Center Creek Road (See Figure 11). Staging area for the construction would be next to the Central Utah Water Conservancy District irrigation pond just west of 2400 East on Center Creek Road.

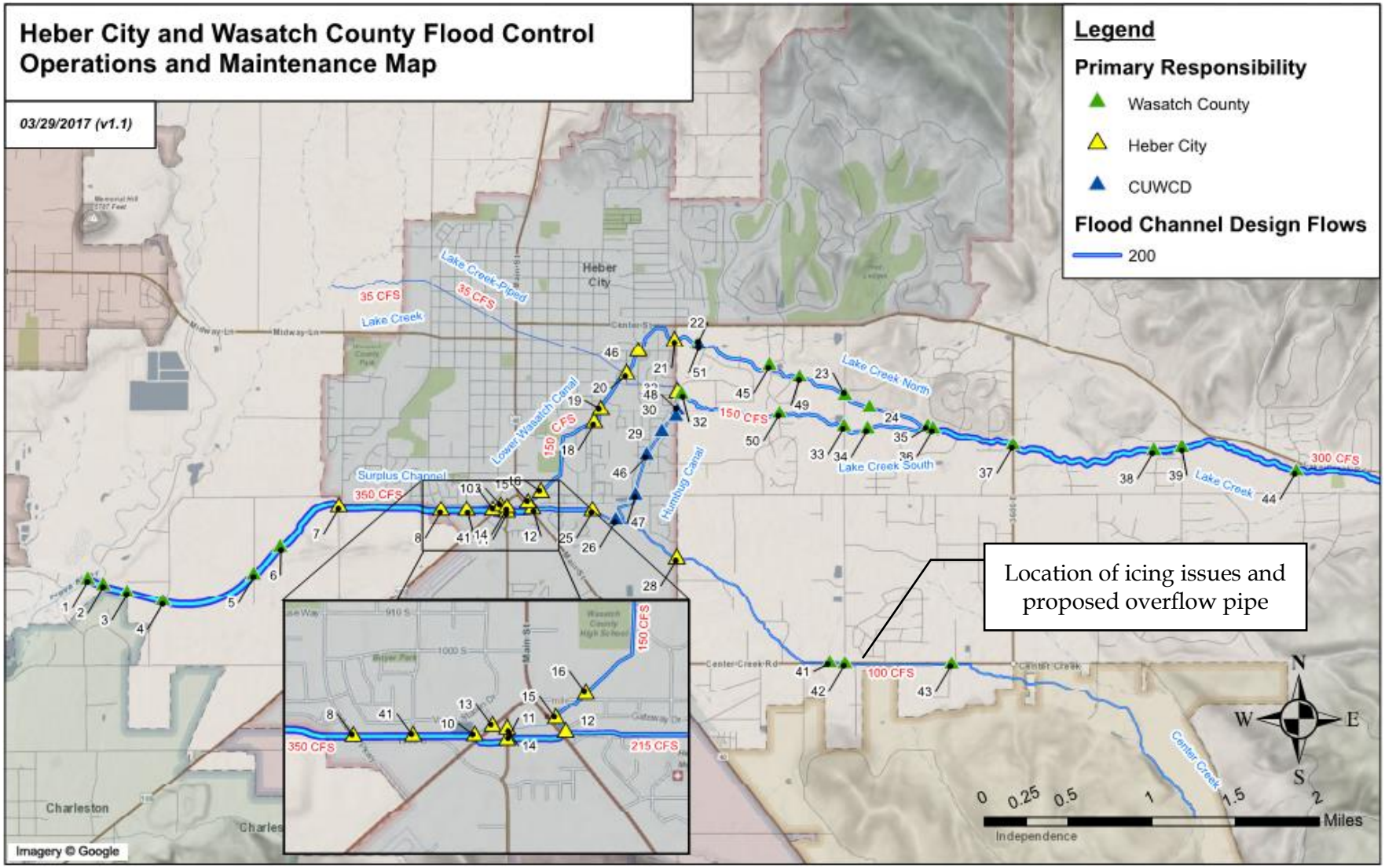
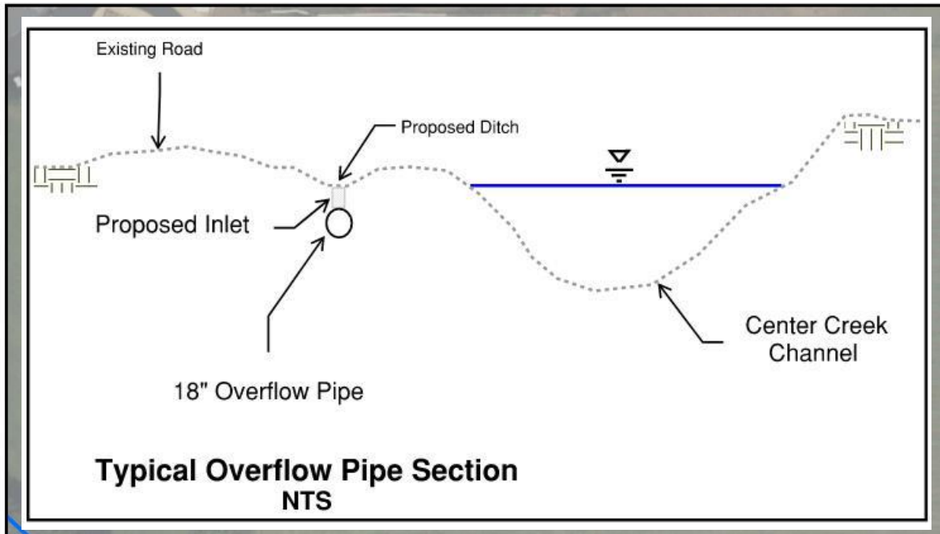


Figure 9. CUWCD Inventory of Existing Flood Control Facilities (Provided by CUWCD)



Figure 10: Icing Problem from Center Creek on Center Creek Road



Typical Overflow Pipe Section
NTS

LEGEND

CenterCreek
Overflow Pipe
Overflow Pipe Project Boundary
Channel Stationing
Minor (100 ft)
Major (1000 ft)

2400 E

Icing Issues

~400LF Overflow Pipe with Inlets (see inset)

Staging Area

160+00

150+00

2380

2534

Connect Overflow Pipe to Existing Culvert Under Center Creek Road

NORTH:

SCALE:

0 75 150
FEET

CENTER CREEK OVERFLOW PIPE

WASATCH COUNTY/NRCS
TRI-VALLEY WATERSHED PLAN-EA

Notes:
Projection: NAD 1983 State Plane Utah Central

NRCS

BOWEN COLLINS & ASSOCIATES

FIGURE NO.
11

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SECTION 6 - PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COSTS

A summary of the conceptual level construction costs for the two improvement alternatives considered for the Daniel Irrigation are provided in Table 5 and Table 6 and the Center Creek project in Table 7. These opinions of probable construction costs are based upon the preliminary design system layout, information from recent bids on similar projects, and estimating/master planning guidelines. Note that the cost estimates include a 20-percent contingency for budgeting to account for unknown factors that may be present at the time of bid including variability in material pricing and bidding climate. Note also that the difference in estimated costs between the two Daniel Irrigation options is approximately 3%.

Table 5
Preliminary Opinion of Probable Construction Cost (Alternative 1)

Preliminary Opinion of Probable Construction Cost (Alternative 1)

BOWEN COLLINS & ASSOCIATES

Project: Daniel Irrigation Project			*Date:*	10/4/2022	
Owner: Daniel Irrigation Company			*Prepared by:*	CM/TO	
Item No.	**Classification of Unit Price Work**	**Quantity**	**Unit**	**Unit Price**	**Amount**
1	Mobilization (5%)	1	LS	$ 151,388	$ 151,388
2	Survey	1	LS	$ 15,000	$ 15,000
3	Traffic Control	1	LS	$ 25,000	$ 25,000
4	6" C-900 PVC Pipe	1,600	LF	$ 60	$ 96,000
5	8" C-900 PVC Pipe	950	LF	$ 65	$ 61,750
6	10" C-900 PVC Pipe	2,700	LF	$ 70	$ 189,000
7	12" C-900 PVC Pipe	2,200	LF	$ 80	$ 176,000
8	16" C-900 PVC Pipe	8,700	LF	$ 100	$ 870,000
9	20" C-900 PVC Pipe	7,350	LF	$ 125	$ 918,750
10	30" C-900 PVC Pipe	0	LF	$ 220	$ -
11	Service Connection	75	EA	$ 1,300	$ 97,500
12	Asphalt Replacement (3" Asphalt over 6" Roadbase)	225,000	SF	$2.75	$ 618,750
13				**SUBTOTAL:**	**$ 3,219,138**
14			CONTINGENCY	20%	$ 643,827.50
15				**SUBTOTAL:**	**$ 3,862,965**
16			Engineering	10%	$ 321,914
17			Real Property Rights	0%	$ -
18			Natural Resource Rights	0%	$ -
19			Permitting	0.50%	$ 16,096
20			Relocation Payments	0%	$ -
21			Administration	5%	$ 160,957
			OTHER INSTALLATION COSTS SUBTOTAL:		**$ 498,966**
				TOTAL:	**$ 4,361,931**

This opinion of probable construction is based on experience with past projects of similar construction. It is understood that Bowen Collins & Associates has no control over economical factors or unknown conditions that may have a significant impact on actual project costs. Bowen Collins & Associates does not guarantee its cost estimates and accepts no liability for problems created by the difference in actual costs and this opinion of probable construction cost.

Table 6
Preliminary Opinion of Probable Construction Cost (Alternative 2)

Preliminary Opinion of Probable Construction Cost (Alternative 2)

BOWEN COLLINS & ASSOCIATES

Project: Daniel Irrigation Project			*Date:*	10/4/2022	
Owner: Daniel Irrigation Company			*Prepared by:*	CM/TO	
Item No.	**Classification of Unit Price Work**	**Quantity**	**Unit**	**Unit Price**	**Amount**
1	Mobilization (5%)	1	LS	$ 155,800	$ 155,800
2	Survey	1	LS	$ 15,000	$ 15,000
3	Traffic Control	1	LS	$ 20,000	$ 20,000
4	6" C-900 PVC Pipe	1,600	LF	$ 60	$ 96,000
5	8" C-900 PVC Pipe	950	LF	$ 65	$ 61,750
6	10" C-900 PVC Pipe	2,700	LF	$ 70	$ 189,000
7	12" C-900 PVC Pipe	2,200	LF	$ 80	$ 176,000
8	16" C-900 PVC Pipe	8,700	LF	$ 100	$ 870,000
9	20" C-900 PVC Pipe	4,850	LF	$ 125	$ 606,250
10	30" C-900 PVC Pipe	1,150	LF	$ 220	$ 253,000
11	Valve Vault	2	EA	$ 100,000	$ 200,000
12	Service Connection	75	EA	$ 1,300	$ 97,500
13	Asphalt Replacement (3" Asphalt over 6" Roadbase)	206,000	SF	$2.75	$ 566,500
14				**SUBTOTAL:**	**$ 3,306,800**
15			CONTINGENCY	20%	$ 661,360.00
16				**SUBTOTAL:**	**$ 3,968,160**
17			Engineering	10%	$ 330,680
18			Real Property Rights	2%	$ 60,000
19			Natural Resource Rights	0%	$ -
20			Permitting	0.50%	$ 16,534
21			Relocation Payments	0%	$ -
22			Administration	5%	$ 165,340
			OTHER INSTALLATION COSTS SUBTOTAL:		**$ 572,554**
				TOTAL:	**$ 4,540,714**

This opinion of probable construction is based on experience with past projects of similar construction. It is understood that Bowen Collins & Associates has no control over economical factors or unknown conditions that may have a significant impact on actual project costs. Bowen Collins & Associates does not guarantee its cost estimates and accepts no liability for problems created by the difference in actual costs and this opinion of probable construction cost.

Table 7
Preliminary Opinion of Probable Construction Cost
(Center Creek Overflow Pipe)

Preliminary Opinion of Probable Construction Cost (Center Creek)

BOWEN COLLINS & ASSOCIATES

Project:	*Center Creek - Overflow Pipe*		*Date:*	10/4/2022	
Desc:	*Overflow Pipe with Inlets*		*Prepared by:*	CM/TO	
Item No.	**Classification of Unit Price Work**	**Quantity**	**Unit**	**Unit Price**	**Amount**
1	Mobilization	1	LS	$ 10,000	$ 10,000
2	Survey	1	LS	$ 5,000	$ 5,000
	SWPPP	1	LS	$ 10,000	$ 10,000
3	Traffic Control	1	LS	$ 10,000	$ 10,000
4	Channel Overflow Pipe (18" Class III Pipe)	450	LF	$ 110	$ 49,500
5	Channel Overflow Inlets	4	EA	$ 5,000	$ 20,000
6	Cross Drain Gutter	450	LF	$ 25	$ 11,250
14				**SUBTOTAL:**	**$ 115,750**
15			CONTINGENCY	20%	$ 23,150.00
16				**SUBTOTAL:**	**$ 138,900**
17			Engineering	15%	$ 17,000
18			Real Property Rights	0%	$ -
19			Natural Resource Rights	0%	$ -
20			Permitting	8.64%	$ 10,000
21			Relocation Payments	0%	$ -
22			Administration	7%	$ 8,000
			OTHER INSTALLATION COSTS SUBTOTAL:		**$ 35,000**
				TOTAL:	**$ 173,900**

This opinion of probable construction is based on experience with past projects of similar construction. It is understood that Bowen Collins & Associates has no control over economical factors or unknown conditions that may have a significant impact on actual project costs. Bowen Collins & Associates does not guarantee its cost estimates and accepts no liability for problems created by the difference in actual costs and this opinion of probable construction cost.

SECTION 7 - STATEMENT OF LIMITATIONS

This document represents Bowen Collins & Associates professional judgement based on the information available at the time of its completion, and as appropriate for the project scope of work. Services performed in developing the content of this document have been conducted in a manner consistent with that level and skill ordinarily exercised by members of the engineering profession currently practicing under similar conditions. No warranty, express or implied, is made.

SECTION 8 - REFERENCES

Natural Resources Conservation Service, January 2020, Conservation Practice Standard, Irrigation Pipeline, Code 430.

APPENDIX A
NRCS IRRIGATION PIPELINE PRACTICE STANDARD

NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD
IRRIGATION PIPELINE
(Ft.)

CODE 430

DEFINITION

A pipeline and appurtenances installed to convey water for storage or application, as part of an irrigation water system.

PURPOSE

This practice may be applied as part of a resource management system to achieve one or more of the following purposes:

- Conveyance of water from a source of supply to an irrigation system or storage reservoir.
- Reduce energy use.
- Develop renewable energy systems (i.e., in-pipe hydropower).

CONDITIONS WHERE PRACTICE APPLIES

This standard applies to water conveyance and distribution pipelines installed above or below ground.

This standard does not apply to multiple outlet irrigation system components (e.g., surface gated pipes, sprinkler lines, or micro irrigation tubing).

CRITERIA

General Criteria Applicable to All Purposes

The water supply, quality, and rate of irrigation delivery for the area served by the pipeline shall be sufficient to make irrigation practical and feasible, for the crops to be grown and the irrigation water application methods to be used.

Pipelines shall be placed only in soils and environmental conditions suitable for the material type being selected.

Pipelines shall be designed to meet all service requirements such that internal pressure, including hydraulic transients or static pressure at any point is less than the pressure rating of the pipe.

Capacity. Capacity shall be sufficient to convey the design delivery flow rate for the planned conservation practices.

Design capacity of the pipeline conveyance or distribution system for irrigation systems shall be sufficient to meet the requirements for efficient application based on one of the following:

- Adequate to meet the moisture demands of all crops to be irrigated in the design area.
- Sufficient to meet the requirements of selected irrigation events during critical crop growth periods when less than full irrigation is planned.
- For special-purpose irrigation systems, sufficient to apply a specified amount of water to the design area in a specified operating period.

In computing the above capacity requirements, allowance must be made for reasonable water losses during application or use.

Friction and Other Losses. For design purposes, head loss for hydraulic grade line computations shall be computed using one of the following equations: Manning's, Hazen-Williams, or Darcy-Weisbach. Equation selection shall be based on the given flow conditions and the pipe materials used. Other head losses (also called minor losses) from change in velocity and direction of flow due to inlet type, valves, bends, enlargements or contractions can be significant and shall be evaluated as appropriate. For closed, pressurized systems, the hydraulic grade line for all pipelines shall be maintained above the top of the pipeline at all locations for all flows unless specifically designed for negative internal pressures.

Flexible Conduit Design. Flexible conduits such as plastic pipe, steel pipe, aluminum pipe, corrugated metal pipe, or ductile iron pipe, shall be designed using NRCS National Engineering Handbook (NEH) Part 636, Chapter 52, Structural Design of Flexible Conduits, and the following criteria:

Smooth Wall Plastic Pipe. When operating at design capacity, the full-pipe flow velocity should not exceed 5 feet per second in pipelines with valves or some other flow control appurtenances placed within the pipeline or at the downstream end. As a safety factor against surge, the working pressure at any point should not exceed 72 percent of the pressure rating of the pipe. If either of these limits is exceeded, special design consideration must be given to the flow conditions, and measures must be taken to adequately protect the pipeline against transient pressures.

Corrugated or Profile Wall Plastic Pipe. When operating at design capacity, the full-pipe flow velocity should not exceed 5 feet per second in pipelines with valves or some other flow control appurtenance placed within the pipeline or at the downstream end. As a safety factor against surge, the working pressure at any point should not exceed 72 percent of the pressure rating of the pipe. If the pipe is not pressure rated, the maximum allowable pressure shall be 25 feet of head, or the maximum pressure as specified by the manufacturer for the pipe and connecting joints used.

Smooth Wall Steel Pipe. The specified maximum allowable pressure shall be determined using the hoop stress formula, limiting the allowable tensile stress to 50 percent of the yield-point stress for the material selected. Design stresses for commonly used steel and steel pipe are shown in the NEH Part 636, Chapter 52.

Corrugated Metal Pipe. Maximum allowable pressure for the pipe shall be:

- 20 feet of head for annular and helical pipe with sealed seams and watertight coupling bands.
- 30 feet of head for helical pipe with welded seams, annular ends, and watertight couplings.

Smooth Wall Aluminum Pipe. The maximum allowable pressure of the pipe shall be determined using the hoop stress formula limiting the allowed tensile stress to 7,500 psi.

Rigid Conduit Design. Rigid conduits such as concrete pipe or plastic mortar pipe shall be designed using the following criteria:

Non-reinforced Concrete Pipe with Mortar Joints. The maximum allowable pressure for pipe with mortar joints shall not exceed one-fourth of the certified hydrostatic test pressure as determined by the test procedure described in ASTM C118. Nor shall they exceed the following:

Diameter (inches)	Maximum Allowable Pressure (feet)
6 through 8	40
10 and greater	35

Non-reinforced Concrete Pipe with Rubber Gasket Joints. The maximum allowable pressure for non-reinforced concrete pipe with rubber gasket joints shall not exceed one-third the certified hydrostatic test pressure as determined by the test procedure described in ASTM C505. Nor shall they exceed the following:

Diameter (inches)	Maximum Allowable Pressure (feet)
6 through 12	50
15 through 18	40
21 and greater	30

Cast-in-Place Concrete Pipe. Maximum working pressure for cast-in-place concrete pipe shall be 15 feet above the centerline of pipe. Cast–in-place concrete pipe shall be used only in stable soils that are capable of being used as the outside form for approximately the bottom half of the conduit.

Reinforced Concrete Pipe with Gasket Joints. The maximum allowable pressure for reinforced concrete pipe with rubber gasket joints shall be not exceed the rated hydrostatic pressure for the specified pipe according to appropriate ASTM or AWWA standards.

Reinforced Plastic Mortar Pipe. The pipeline shall be designed to meet all service requirements without a static or working

pressure at any point greater than the maximum allowable working pressure of the pipe used. The static or working pressure of pipelines open to the atmosphere shall include free board. The minimum acceptable pipe pressure rating shall be 50 psi.

Support of Pipe. Irrigation pipelines both below and above ground shall be supported, where needed, to provide stability against external and internal forces. Pipe support shall be designed using NEH Part 636, Chapter 52.

Joints and Connections. All connections shall be designed and constructed to withstand the pipeline working pressure without leakage and leave the inside of the pipeline free of any obstruction that would reduce capacity.

Permissible joint deflection shall be obtained from the manufacturer for the joint type and pipe material used.

For sloping steel pipe, expansion joints shall be placed adjacent to and downhill from anchors or thrust blocks.

For welded pipe joints, expansion joints shall be installed, as needed, to limit pipeline stresses to the allowable values.

For suspended pipelines, joints shall be designed for pipe loading including the water in the pipe, wind, ice, and the effects of thermal expansion and contraction.

Joints and connections for metal pipes should be of similar materials whenever possible. If dissimilar materials are used, the joints or connections shall be protected against galvanic corrosion.

Depth of Cover. Buried pipe shall be installed at sufficient depth below the ground surface to provide protection from hazards imposed by traffic loads, farming operations, freezing temperatures, or soil cracking, as applicable.

Pipelines shall have sufficient strength to withstand all external loads on the pipe for the given installation conditions. Appropriate live loads shall be used for the anticipated traffic conditions.

Where it is not possible to achieve sufficient cover or sufficient strength, a carrier (encasement) pipe or other mechanical measures shall be used.

Pressure Reduction. Pressure reduction shall be incorporated in circumstances such as head gain exceeding pressure loss by a significant amount, excessive line pressured for the type of irrigation system, or excessive static pressures.

Inlets. Inlets shall be of adequate size for the type of entrance condition to ensure design flow capacity without excessive head losses.

Provision shall be made to prevent the inflow of trash or other materials into the pipeline if these materials would be detrimental to the pipe capacity or performance of the irrigation application system.

For gravity flow inlets with square-edged or gated orifices, the nappe created by inflow at the orifice entrance shall be vented.

Water control structures, stands, Z-pipes and dog-legs are all acceptable inlet devices. Water control structures are commonly used for gravity flow pipelines, but do not account for removal of entrained air. Therefore, pipelines using these inlets must also meet the requirements listed under Vents.

Check Valves and Backflow Prevention. A check valve shall be installed between the pump discharge and the pipeline if detrimental backflow may occur. Check valves can cause extreme internal pressures, due to water hammer; if they close too fast as flow reversal occurs. “Non slam” type check valves or solenoid operated valves may be required.

Approved backflow prevention devices (chemigation valves) shall be used on all pipelines in which fertilizer, liquid manure, waste water, pesticides, acids, or other chemicals are added to the water supply and where back flow may contaminate the source water supply or groundwater.

Valves and Other Appurtenances. Pressure ratings of valves and other appurtenances shall equal or exceed the pipeline working pressure. When lever operated valves are used, an analysis shall be performed to evaluate potential surge/water hammer assuming an instantaneous valve closure.

Stands Open to the Atmosphere. Stands shall be used when water enters the pipeline to avoid entrapment of air; to prevent surge pressures and collapse because of vacuum failure; and to prevent pressure from exceeding the design working stress of the pipe. The stand shall be designed to:

- Allow a minimum of 1 foot of freeboard. The maximum height of the stand above the centerline of the mainline pipeline must not exceed the maximum working head of the pipe.
- Have the top of each stand at least 4 feet above the ground surface except for surface gravity inlets or where visibility is not a factor. Gravity inlets and stands shall be equipped with trash racks and covers.
- Have a downward water velocity in stands not in excess of 2 feet per second. The inside diameter of the stand shall not be less than the inside diameter of the pipeline.

The cross sectional area of stands may be reduced above a point 1 foot above the top of the upper inlet, but the reduced cross section shall not be such that it would produce an average velocity of more than 10 feet per second if the entire flow were discharging through it.

If the water velocity of an inlet pipe exceeds three times the velocity of the outlet, the centerline of the inlet shall have a minimum vertical offset from the centerline of the outlet at least equal to the sum of the diameters of the inlet and outlet pipes.

Stands shall be constructed of steel pipe or other approved material and be supported on a base adequate to support the stand and prevent movement or undue stress on the pipeline.

Sand traps, when combined with a stand, shall have a minimum inside dimension of 30 inches and shall be constructed so the bottom is at least 24 inches below the invert of the outlet pipeline. The downward velocity of flow of the water in a sand trap shall not exceed 0.25 feet per second. Suitable provisions shall be made for cleaning sand traps.

The dimensions of gate stands shall be adequate to accommodate the gate or gates required, and shall be large enough to make the gates accessible for repair.

The size of float valve stands shall be adequate to provide accessibility for maintenance.

Stands must be constructed in a manner to insure vibration from the pump discharge pipe is not carried to the stand.

Pressure-relief valves can be used as an alternative to stands open to the atmosphere. A pressure-relief valve shall serve the pressure-relief function of the open stand or vent for which it is an alternative.

Stands Closed to the Atmosphere. If pressure-relief valves and air-and-vacuum valves are used instead of open stands, all requirements detailed in “Stands Open to the Atmosphere” shall apply except as modified below.

The inside diameter of the closed stand shall be equal to or greater than that of the pipeline for at least 1 foot above the top of the uppermost inlet of outlet pipe. To facilitate attaching the pressure-relief valve and the air-and-vacuum valve, the stand may be capped at this point, or if additional height is required, the stand may be extended to the desired elevation by using the same inside diameter or a reduced cross section. If a reduced section is used, the cross-sectional area shall be such that it would produce an average velocity of no more than 10 feet per second if the entire flow were discharged though it. If no vertical offset is required between the pump discharge pipe and the outlet pipeline and the discharge pipe is “dog-legged” below ground, the stand shall extend at least 1 foot above the highest part of the pump discharge pipe.

An acceptable alternative design for stands requiring no vertical inlet offset (when inlet velocity is less than three times that of the outletting pipeline) shall be:

- Construct the dog-leg section of the pump discharge pipe with the same nominal pipe diameter as that of the pipeline.
- Install the pressure-relief valve and the air-and-vacuum valve on top of the upper horizontal section of the dog-leg.

Pressure-relief and air-and-vacuum valves shall be installed on stands with the nominal size pipe required to fit the valves’ threaded inlets.

Surge Tanks and Air Chambers. If surge tanks and/or air chambers are required for control of hydraulic transients or water column separation, they shall have adequate size to ensure the water volume needs of the pipeline are met without the tank/chamber being emptied, and that the required flow into the pipeline for the calculated pressure drop is met.

Pressure Relief Valves. A pressure relief (PR) valve shall be installed between the pump discharge and the pipeline if excessive pressure can build up when all valves are closed. If needed to protect the pipeline against pressure reducing valve malfunction or failure, PR valves shall be installed downstream of pressure reducing valves.

Manufacturers of PR valves marketed for use under this standard shall provide capacity tables that give the discharge capacities of the valves at the maximum permissible pressure and differential pressure settings. These tables shall be based on performance tests, and shall be the basis for acceptance of these valves and selection of the design pressure setting.

PR valves shall be set to open at a pressure as low as practical, but no greater than 5 psi above the pressure rating or maximum allowable pressure of the pipe. The valves shall have sufficient flow capacity to reduce the excessive pressures in the pipeline. In lieu, of a detailed surge/pressure analysis, the minimum size of PR valve shall be ¼ inch nominal valve size per inch of the nominal pipeline diameter.

The pressure at which the valves start to open shall be marked on each PR valve. Adjustable PR valves shall be sealed or otherwise altered to prevent changing the adjustment from that marked on the valve.

Air Release Valves. Five types of air vents/valves commonly used on irrigation pipelines are continuous acting air release valves (CAV), vacuum-relief valves (VR), air release and vacuum relief valves (AVR), combination air valves (COMB), and open vents. Open vents are described in the “Vents” section of this standard.

If accumulation of air during operation may occur CAV shall be used to release air from the filled pipeline while under pressure. Normal orifice venting diameter is 1/16 to 3/8 inch.

VR valves shall be used for relief of vacuum pressures (i.e., negative pressures) due to sudden gate or valve closure, pump shutoff, or drainage of the pipeline.

AVR valves may be used for the same requirements described for VR valves. These valves shall also be used to release air from the pipeline on filling prior to the pipe being pressurized. They shall be used to alleviate flow restrictions, air locks, and water surging due to the presence of air within pipelines.

COMB valves have the combined function of all three valves (CAV, VR, and AVR) in one body. COMB valves may be used for any of the conditions in which a CAV, VR, or AVR is required.

If needed to provide positive means for air escape during filling and air entry while emptying, an AVR, VR, or COMB valve shall be installed at all summits, upstream and downstream of all in line valves as needed, at the entrance, and at the end(s) of the pipelines. Such valves are needed at these locations if the pipeline is closed to the atmosphere. However, they may not be needed if other features of the pipe system, such as permanently located sprinkler nozzles or other unclosed service outlets, adequately vent the particular location during filling and emptying operations. The use of these system features must be analyzed for air flow rate and the proper use of such features described in the Operation and Maintenance plan. High points in the pipeline require a CAV unless an outlet is located at that point.

In addition to the locations described above, an AVR or COMB valve shall be located at changes of grade in downward direction of flow in excess of 10 degrees, to ensure adequate air release during filling. On long pipelines, additional AVR or COMB valves may be required to adequately vent the pipe during filling.

For air release, the AVR or COMB valve shall be sized to exhaust air from the pipeline at the rate needed to prevent operational problems with the pipeline, while maintaining the proper operation of the valve. For design purposes, the exhaust pressure differential shall be limited to 2 psi.

For vacuum relief, the AVR, VR, or COMB valves shall be sized for air entry into the pipeline, ensuring the pipeline does not collapse due to vacuum created during drainage of the pipeline. For design purposes, the vacuum pressure differential shall be limited to 5 psi.

If the required vacuum relief orifice diameter is significantly larger than the required air release orifice diameter, separate valves may be required to help eliminate excessive water hammer caused when the air is released too fast from the pipeline.

CAV or COMB valves shall be used as needed to permit air to escape while the line is at

working pressure. Small orifices of these valve types shall be sized according to the design working pressure and venting requirements recommended by the valve manufacturer.

The location of the CAV or COMB valves shall be sufficient distance downstream from the introduction of air into the system (under pressure conditions) to allow the air to be collected at the top of the pipe. Under some circumstances (e.g., pumped system with low pressure or velocity) consideration should be given to installing vent chambers for CAV or COMB valves. The vent chamber should be constructed according to the requirements under the second criteria in the "Vents" section of this standard.

In lieu of a detailed design, for the corresponding pipe material below, the following size air valves shall be used:

- For Plastic ≤ 50 psi - 0.22 x pipe diameter
- For Plastic > 50 psi - 0.10 x pipe diameter
- For Metal - 0.125 x pipe diameter
- For Concrete - 0.125 x pipe diameter

Manufacturers of air valves marketed for use under this standard shall provide dimensional data or a capacity table based on performance tests, which shall be the basis for selection and acceptance of these valves.

Vents. Venting must be designed into systems open to the atmosphere to provide for the removal and entry of air and protection from surge. The following criteria shall apply:

Vents shall have a minimum freeboard of 1 foot above the hydraulic gradeline at design capacity. The maximum height of the vent above the centerline of the pipeline must not exceed the maximum allowable working pressure of the pipe.

A vent chamber shall be constructed to intercept and/or capture air within the pipeline. The chamber shall intercept the circumference arc of 75 degrees at the top of the pipe (i.e., a vent chamber diameter of 2/3 the diameter of the pipeline). The chamber shall extend vertically at least one pipeline diameter up from the centerline of the pipeline. Above this elevation, the vent chamber may be reduced to minimum diameter of 2 inches.

When an AVR or COMB valve is used instead of a vent, the above requirements shall apply except that the reduced section shall be sized to meet the nominal pipe size required to fit the valve's threaded inlet. An acceptable alternative is to install the valve(s) in the side of a service outlet, provided that the service outlet riser is properly located and adequately sized. If both AVR and PR valves are required at the location, the 10 feet per second velocity criteria given under the "Stands Open to the Atmosphere" section of this standard, shall apply to the reduced section.

Vent chambers shall be installed on all open vents and closed vents with air valves, when the normal operating pressure of the pipe is 10 psi or less.

A vent shall be located at the downstream end of laterals, at summits in the line, and at points where the grade changes more than 10 degrees in a downward direction of flow.

Outlets. Appurtenances to deliver water from the pipe system to the field, ditch, reservoir, or surface pipe system, are known as outlets. Outlets shall have adequate capacity to deliver the required flow to:

- The hydraulic gradeline of a pipe or ditch,
- A point at least 6 inches above the field surface,
- The design surface elevation in a reservoir, or
- An individual sprinkler, lateral line, hydrant, or other device at the required operating pressure.

Outlets shall be designed to minimize erosion, physical damage, or deterioration due to exposure.

Filling. The pipe system shall have a means of controlling the filling of the pipeline to prevent entrapped air and excessive transient pressures.

Filling velocities greater than 1 foot per second in a closed to the atmosphere pipe system (i.e., all outlets closed) requires special evaluation and provisions to remove entrapped air and prevent transient pressures.

If filling at a low flow rate is not possible, the system shall be open to the atmosphere (outlets open) prior to pressurizing. The valves to the irrigation system components (gated pipe, wheel line, pivot, etc.) should be opened to release entrapped air and minimize transient pressures

in the system. The system shall be designed for air removal and excessive transient pressures that may develop at higher filling rate.

Flushing. If the sediment load in the water is significant, the pipeline shall have adequate velocity to ensure that sediment is moved through and flushed out of the pipeline.

If provisions are needed for flushing sediment or other foreign material, a suitable valve shall be installed at the distant end or low point of the pipeline.

Draining. Provisions shall be made for the complete removal of water from the pipeline by gravity or other means when:

- Freezing temperatures are a hazard.
- Draining is required by the pipe manufacturer.
- Draining of the pipeline is otherwise specified.

The water drained from pipelines shall not cause water quality, soil erosion, or safety problems upon release.

Safe Discharge of Water. Provisions shall be made for water being discharged from valves, especially air valves and pressure relief valves. Such valves shall be located such that flows are directed away from system operators, livestock, electrical equipment, and other control valves or hook-ups.

Thrust Control. Abrupt changes in pipeline grade, horizontal alignment, tees, or reduction in pipe size, normally require an anchor or thrust blocks to absorb pipeline axial thrust. Thrust control is typically needed at the end of the pipeline, and at in-line control valves.

The pipe manufacturer's recommendations for thrust control shall be followed. In absence of manufacturer's data, thrust blocks shall be designed using NEH Part 636, Chapter 52.

Longitudinal Bending. For plastic pipe, the allowable longitudinal bending for the pipeline shall be based on material type and the pressure rating, and shall be in accordance with industry standards, or as described in NEH Part 636 Chapter 52.

Thermal Effects. For plastic pipe, thermal effects must be properly factored into system design. Pressure ratings for pipes are normally based on a pipe temperature of 73.4ºF. When operating temperature is higher the effective pressure rating of the pipe shall be reduced accordingly.

Values and procedures for pressure rating reduction shall follow information described in the NEH Part 636, Chapter 52.

Physical Protection. Steel pipe installed above ground shall be galvanized or shall be protected with a suitable protective paint coating, including a primer coat and a minimum of two final coats.

Plastic pipe installed above ground shall be resistant to ultraviolet light throughout the intended life of the pipe or measures taken to protect the pipe from damage due to ultraviolet light.

All pipes shall be protected from hazards presented by traffic loads, farm operations, freezing temperatures, fire, thermal expansion and contraction. Reasonable measures shall be taken to protect the pipe from potential vandalism.

Corrosion Protection. All metal to metal fittings, such as risers, bends, tees, and reducers, should be of similar metals. If dissimilar metals are used, the fittings shall be protected against galvanic corrosion (e.g., separate dissimilar metals with rubber or plastic insulator).

Bolts used to join galvanized steel shall be galvanized; plastic coated, stainless steel, or otherwise protected to prevent galvanic corrosion. Bolts used to join aluminum, other than aluminum alloy bolts, must be plastic coated or otherwise protected to prevent galvanic corrosion.

Interior protective coatings shall be provided when the pH of the water falls outside the ranges shown in the following table.

Material	Water pH
Aluminized Steel	Less than 5 or greater than 9
Galvanized Steel	Less than 6 or greater than 10
Aluminum Alloy	Less than 4 or greater than 10

Unlined steel pipelines can experience corrosion from very pure water (e.g., snow melt). If the Langelier Saturation Index (LSI) is a greater negative number than -1, corrosion protection shall be provided.

To calculate the LSI, it is necessary to know the alkalinity (mg/l as CaCO3), the calcium hardness (mg/l Ca+2 as CaCO3), the total dissolved solids (mg/l TDS), the actual pH, and the temperature of the water (°C). These values are used in the following equations:

$LSI = pH - pH_s$

$pH_s = (9.3 + A + B) - (C + D)$

Where:

$A = (\text{Log10 [TDS]} - 1) / 10$

$B = -13.12 \times \text{Log10 (°C} + 273) + 34.55$

$C = \text{Log10 } [Ca^{+2} \text{ as } CaCO_3] - 0.4$

$D = \text{Log10 [alkalinity as } CaCO_3]$

Galvanized steel pipe may be used when the soil resistivity is greater than 4000 ohm-cm.

Hot-dipped asphalt or polymeric-coated, galvanized steel pipe shall be provided if the soil resistivity along any part of the pipeline is between 3000 and 4000 ohm-cm. In addition to the above coatings, cathodic protection shall be provided for galvanized steel pipe if the soil resistivity is less than 3000 ohm-cm.

Aluminized steel pipe may be used when the soil resistivity is greater than 1500 ohm-cm and the soil pH is between 5 and 9.

Aluminum alloy pipe may be used when the soil resistivity is greater than 500 ohm-cm and the soil pH is between 4 and 10.

When cathodic protection is required, joints and connecting bands shall be electrically bridged to ensure continuous flow of current. A dielectric connection shall be placed between the pump and the pipeline and between pipes with different coatings.

The total current required, kind and number of anodes needed, and life expectancy for the cathodic protection shall be designed in accordance with NRCS Design Note 12, Control of Underground Corrosion.

Resistivity Measurement Requirements for Metal Pipe. If risk of corrosion is “high” based on the Cooperative Soil Survey’s Soil Features Report, soil-resistivity measurements shall be conducted to determine corrosion protection requirements. .For this purpose, field resistivity measurements shall be made or samples for laboratory analysis shall be taken at least every 400 feet along the proposed pipeline and at points where a visible change in soil characteristics occurs. If adjacent readings differ markedly, additional measurements shall be taken to locate the point of change. Resistivity determinations shall be made at two or more depths in the soil profile at each sampling station; with the lowest depth at the stratum in which the pipe will be laid. The lowest value of soil resistivity found at each sampling station shall be used as the design value for that station.

After the pipe trench is excavated, a detailed soil resistivity survey shall be made as a verification of the final required cathodic protection. At this time, resistivity measurements shall be made in each exposed soil horizon at intervals not exceeding 200 feet. The lowest value of soil resistivity found at each sampling station shall be used as the design value for that station. If design values for adjacent stations differ significantly, additional intermediate measurements shall be made.

Electric Fields. An electric field can develop where a metal pipeline is installed adjacent to an existing metal pipeline. This situation can adversely affect the new pipeline. The new pipeline shall be adequately protected from this condition.

Environmental Constraints for Aluminum Pipe. Water quality shall be considered for aluminum pipeline installations. A copper content in excess of 0.02 ppm produces nodular pitting and rapid deterioration of the pipe if water is allowed to become stagnant. When the copper content exceeds this limit, the pipeline shall be designed to allow draining after each use.

Protection from corrosion shall be provided for aluminum pipe installed in contact with concrete.

Environmental Constraints for Concrete Pipe. Concrete pipelines shall not be installed on sites where the sulfate-salt concentration in the soil or soil water exceeds 1.0 percent. On sites where the sulfate concentration is more than 0.1 percent but not more than 1.0 percent, concrete pipe may be used only if the pipe is made with Type V or Type II cement, with tricalcium aluminate content not exceeding 5.5 percent.

Additional Criteria Applicable to Reduce Energy Use

Provide analysis to demonstrate reduction of energy use from practice implementation.

Reduction of energy use is calculated as average annual or seasonal energy reduction compared to previous operating conditions.

Additional Criteria Applicable to Develop Renewable Energy Systems

Renewable energy systems shall meet applicable design criteria in NRCS and/or industry standards, and shall be in accordance with manufacturer's recommendations. Hydropower systems shall be designed, operated, and maintained in accordance with the Microhydropower Handbook, Sections 4 and 5, as appropriate.

CONSIDERATIONS

Safety. Pipelines may present a threat to the safety of people, during both installation and operation. Consider safety as follows:

- Address trench safety in design and during construction.
- Provide protection for people from inlets of pipelines and open stands.
- Provide protection for people from water blowing from pressure-relief, air-release, and other valves.
- Determine the existence or non-existence of underground utilities prior to construction.

Economic. Economics can be a major factor in pipeline design, as follows:

- Select pipe based on lifetime energy requirements, as well as initial costs of materials.
- Select pipe material based upon expected life of practice.
- Consider hydropower applications as alternatives to use of pressure reduction valves or reduced pipe diameter to induce friction loss.

Water Quality and Quantity. The effects of an irrigation pipeline on water quality and quantity should be considered when designing an irrigation pipeline. Consider the effects:

- On the water budget, especially on infiltration and evaporation,
- On downstream flows or aquifers that would affect other water uses or users,
- On potential use for irrigation management,
- Of installing a pipeline in vegetation that may have been located next to the original conveyance,
- Of installing the pipeline (replacing other types of conveyance) on channel erosion or the movement of sediment and soluble and sediment-attached substances carried by water,
- On the movement of dissolved substances into the soil and on percolation below the root zone or to ground water recharge,
- Of controlled water delivery on the temperatures of water resources that could cause undesirable effects on aquatic and wildlife communities,
- On wetlands or water-related wildlife habitats, and
- On the visual quality of water resources.

Environment. Base pipe material selection on exposure considerations (such as soil resistivity, pH, sunlight, and traffic). Soil texture, resistivity, pH, moisture content, redox potential and depth are important soil properties to be aware of for pipelines and in reducing soil limitations related to corrosivity, or packing of soil material. Refer to soil survey information of the area and on-site soil investigations should be considered during planning.

The Langelier Saturation Index and related indices may be a factor in determining type of material to use for a pipeline.

Pipelines installed below the ground surface should have a soil plan describing soil

reconstruction of disturbed soil during and after pipeline installation so original soil productivity is restored after pipeline installation. Appropriate vegetation should be established to stabilize disturbed areas that will not be cropped.

PLANS AND SPECIFICATIONS

Prepare plans and specifications for irrigation pipelines that describe the requirements for applying the practice according to this standard. As a minimum the plans and specifications shall include:

- A plan view of the layout of the pipeline.
- Profile of the irrigation pipeline.
- Pipe material and sizes.
- Pipe joint requirements.
- Site specific construction specifications that describe in writing the installation of the irrigation pipeline. Include the specification for pressure testing of the irrigation pipeline.
- Depth of cover and backfill requirements.
- Disposal requirements for excess soil material.
- Vegetative establishment requirements.

OPERATION AND MAINTENANCE

An Operation and Maintenance (O&M) Plan shall be developed for each pipeline system installed. The plan should document needed actions to ensure that practices perform adequately throughout their expected life.

O&M requirements shall be included as an identifiable part of the design. Depending on the scope of the project, this may be accomplished by brief statements in the plans and specifications, the conservation plan narrative, or as a separate O&M Plan.

Other aspects of O&M, such as draining procedures, marking crossing locations, valve operation to prevent pipe or appurtenant damage, appurtenance or pipe maintenance, and recommended operating procedures, should be described as needed within the O&M Plan.

Monitoring of any cathodic protection systems shall be performed as specified in the O&M Plan.

A filling procedure shall be developed, which details allowable flow rates and appurtenance operation at the various phases of the filling process, required to assure safe filling of the pipeline. Flow measuring appurtenances such as flow meters or weirs, or other means (e.g., number of turns of a gate valve) should be used to determine the rate of flow into the pipeline system. This information shall be provided to the operator, and shall be incorporated into the Operation and Management Plan as appropriate.

CERTIFICATION

Certification documentation upon completion requires:

- Type and Diameter of Pipe, Pressure Rating
- Length of Pipe
- Backfill class and Material class (if applicable)
- Minimum cover depth
- ASTM Spec and SDR of installed pipe
- Conservation measures implemented

REFERENCES

ASTM C118, Standard Specification for Irrigation Pipe for Irrigation or Drainage.

ASTM C505, Standard Specification for Nonreinforced Concrete Irrigation Pipe with Rubber Gasket Joints.

McKinney, J.D., et al. Microhydropower Handbook, IDO-10107, Volumes 1 & 2. U.S. Department of Energy, Idaho Operations Office.

USDA-NRCS, National Engineering Handbook, Part 636, Chapter 52, Structural Design of Flexible Conduits.

USDA-NRCS, Engineering Design Note 12, Control of Underground Corrosion.

United States Department of Agriculture

Natural Resources Conservation Service

CONSERVATION PRACTICE STANDARD

IRRIGATION PIPELINE

CODE 430

(ft)

DEFINITION

A pipeline and appurtenances installed to convey water for storage or application, as part of an irrigation water system.

PURPOSE

This practice is used to accomplish one or more of the following purposes:

- Convey water from a supply source to an irrigation system, storage pond, or reservoir.
- Reduce irrigation conveyance water losses by converting from open channel to pipeline.
- Reduce energy use.

CONDITIONS WHERE PRACTICE APPLIES

This standard applies to water conveyance and distribution pipelines installed above or below ground.

This standard does not apply to multiple-outlet irrigation system components (e.g., surface gated pipes, sprinkler lines, or microirrigation tubing). Use NRCS Conservation Practice Standards (CPSs) Irrigation System, Surface and Subsurface (Code 443), Sprinkler System (Code 442), and Irrigation System, Microirrigation (Code 441) for these components.

This practice does not apply to pipelines in systems for animal watering or waste transfer. Use NRCS CPS Livestock Pipeline (Code 516) to supply animal watering facilities. Use NRCS CPS Waste Transfer (Code 634) to transfer waste material.

CRITERIA

General Criteria Applicable to All Purposes

Ensure that the quantity and quality of the water supply is sufficient for the planned conservation practice(s) and the system(s) supplied by the pipeline.

Select pipeline materials suitable for the specific soils, topography, and environmental conditions.

Design the pipeline to meet all service requirements so that internal pressure at any point, including hydraulic transients or static pressure, is less than the pressure rating of the pipe.

Notify landowner and/or contractor of their responsibility to locate all buried utilities in the project area, including drainage tile and other structural measures. The landowner is also required to obtain all necessary permits for project installation prior to construction.

NRCS reviews and periodically updates conservation practice standards. To obtain the current version of this standard, contact your Natural Resources Conservation Service State office or visit the Field Office Technical Guide online by going to the NRCS website at https://www.nrcs.usda.gov/ and type FOTG in the search field.
USDA is an equal opportunity provider, employer, and lender.

Capacity
Design sufficient pipeline capacity to convey the design flow rate for the planned conservation practices. Include reasonable water losses during the application or use of the water in the design capacity.

Friction and other losses
For design purposes, compute head loss for hydraulic grade line computations using one of the following equations: Manning's, Hazen-Williams, or Darcy-Weisbach. Base the equation selection on the given flow conditions and the pipe materials used. Evaluate and include other head losses (called minor or local losses) from a change in velocity and direction of flow due to inlet type, valves, bends, enlargements, or contractions as appropriate. For pressurized systems, maintain the hydraulic grade line for all pipelines above the top of the pipeline at all locations for all flows unless specifically designed for negative internal pressures.

Flexible conduit design
Design flexible conduits, such as plastic pipe, steel pipe, aluminum pipe, corrugated metal pipe, or ductile iron pipe, using NRCS National Engineering Handbook (NEH) (Title 210), Part 636, Chapter 52, "Structural Design of Flexible Conduits," and the criteria below.

Plastic pipe (smooth, currugated, or profile wall)
When operating at design capacity, do not exceed 5-feet-per-second velocity in the full-pipe flow in pipelines with valves or some other flow control appurtenance placed within the pipeline or at the downstream end. As a safety factor against surge, keep the working pressure at any point at or below 72 percent of the pressure rating of the pipe. If either of these limits is exceeded, provide measures to adequately protect the pipeline against transient pressures.

Smooth wall steel pipe
Determine the specified maximum allowable pressure using the hoop stress formula, limiting the allowable tensile stress to 50 percent of the yield-point stress for the material selected. Design stresses for commonly used steel pipe are shown in 210-NEH-636-52.

Corrugated metal pipe
Keep maximum allowable pressure for the pipe at—

- Twenty feet of head for annular and helical pipe with sealed seams and watertight coupling bands.
- Thirty feet of head for helical pipe with welded seams, annular ends, and watertight couplings.

Smooth wall aluminum pipe
Determine the maximum allowable pressure of the pipe using the hoop stress formula, limiting the allowed tensile stress to 7,500psi.

Rigid conduit design
Design rigid conduits, such as concrete pipe or plastic mortar pipe, using the criteria below.

Nonreinforced concrete pipe with mortar joints
Keep the maximum allowable pressure at or below one-fourth of the certified hydrostatic test pressure as determined by the test procedure described in ASTM C118-15, "Standard Specification for Concrete Pipe for Irrigation or Drainage." Also, keep the maximum allowable pressure at or below the amounts indicated in table 1.

Table 1: Maximum allowable pressure for Nonreinforced concrete pipe with mortar joints

Diameter (inches)	Maximum Allowable Pressure (feet)
6 through 8	40
10 and greater	35

Nonreinforced concrete pipe with rubber gasket joints
Keep the maximum allowable pressure at or below one-third the certified hydrostatic test pressure as determined by the test procedure described in ASTM C505, “Standard Specification for Nonreinforced Concrete Irrigation Pipe with Rubber Gasket Joints.” Also, keep the maximum allowable pressure at or below the amounts indicated in table 2.

Table 2: Maximum allowable pressure for Nonreinforced concrete pipe with rubber gasket joints

Diameter (inches)	Maximum Allowable Pressure (feet)
6 through 12	50
15 through 18	40
21 and greater	30

Cast-in-place concrete pipe
Limit the maximum working pressure to 15 feet above the centerline of the pipe. Use cast-in-place concrete pipe only in stable soils that are capable of being used as the outside form for approximately the bottom half of the conduit.

Reinforced concrete pipe with gasket joints
Limit the maximum allowable pressure at or belowthe rated hydrostatic pressure for the specified pipe according to appropriate ASTM or American Water Works Association (AWWA) standards.

Reinforced plastic mortar pipe
Design the pipeline to meet all service requirements without a static or working pressure at any point greater than the maximum allowable working pressure of the pipe used. Include free board in the static or working pressure of pipelines open to the atmosphere. Use 50 psi as the minimum acceptable pipe pressure rating.

Support of pipe
Provide support against external and internal forces for both above and below ground pipelines where needed. Design the pipe support using 210-NEH-636-52.

Joints and connections
Design and construct all connections to withstand the pipeline working pressure without leakage and leave the inside of the pipeline free of any obstruction that would reduce capacity.

Obtain the permissible joint deflection from the manufacturer for the joint type and pipe material used.

For sloping steel pipe, place expansion joints adjacent to and downhill from anchors or thrust blocks.

For welded pipe joints, install expansion joints, as needed, to limit pipeline stresses to the allowable values.

For suspended pipelines, design pipe loading using 210-NEH-636-52. Include the effects of water in the pipe, wind, ice, thermal expansion and contraction, and the joints and fittings in the suspended pipeline design.

Use similar materials, whenever possible, for joints and connections for metal pipes. If dissimilar materials are used, protect the joints or connections against galvanic corrosion.

Depth of cover
Install buried pipe at sufficient depth below the ground surface to provide protection from hazards imposed by traffic loads, farming operations, freezing temperatures, or soil cracking, as applicable.

Ensure pipelines have sufficient strength to withstand all external loads on the pipe for the given installation conditions. Use appropriate live loads for the anticipated traffic conditions. Refer to 210-NEH-636-52, for procedures to analyze external loads on buried pipe.

Where it is not possible to achieve sufficient cover or sufficient strength, use a carrier (encasement) pipe or other mechanical measures.

Pressure reduction
Incorporate pressure reduction in circumstances such as head gain exceeding pressure loss by a significant amount, excessive line pressures for the type of irrigation system, or excessive static pressures.

Inlets
Design inlets with adequate size for the type of entrance condition to ensure design flow capacity without excessive head losses.

Provide measures to prevent the inflow of trash or other materials into the pipeline if these materials would be detrimental to the pipe capacity or performance of the system supplied by the pipeline.

For gravity flow inlets with square-edged or gated orifices, vent the nappe created by the inflow at the orifice entrance.

Water control structures, stands, Z-pipes, and doglegs are all acceptable inlet devices. When using these inlets, ensure the removal of entrained air.

Check valves and backflow prevention
Install a check valve between the pump discharge and the pipeline if detrimental backflow may occur. Check valves can cause extreme internal pressures due to water hammer if they close too fast as flow reversal occurs. “Non-slam” type check valves or solenoid-operated valves may be required.

Use approved backflow prevention devices (such as a chemigation check valve) on all pipelines in which fertilizer, pesticides, acids, or other chemicals are added to the water supply.

Valves and other appurtenances
Ensure the pressure ratings of valves and other appurtenances equal or exceed the pipeline working pressure. When lever-operated valves are used, perform an analysis to evaluate potential surge/water hammer assuming an instantaneous valve closure.

Stands open to the atmosphere
Stands open to the atmosphere are used when water enters the pipeline to avoid entrapment of air, to prevent surgepressures and collapse because of vacuum failure, and to prevent pressure from exceeding the design working stress of the pipe. Design the stand to—

- Allow a minimum of 1 foot of freeboard. The maximum height of the stand above the centerline of the mainline pipeline must not exceed the maximum working head of the pipe.
- Have the top of each stand at least 4 feet above the ground surface except for surface gravity inlets or where visibility is not a factor. Equip gravity inlets and stands with trash racks and covers.
- Limit the downward water velocity in the stand to no more than 2 feet per second. Ensure that the inside diameter of the stand is not less than the inside diameter of the pipeline

The cross sectional area of a stand open to the atmosphere may be reduced no less than 1 foot above the top of the upper inlet. If a reduced section is used, design it to allow discharge of the design flow at no more than 10 feet per second.

If the water velocity of an inlet pipe exceeds three times the velocity of the outlet, ensure that the centerline of the inlet has a minimum vertical offset from the centerline of the outlet at least equal to the sum of the diameters of the inlet and outlet pipes.

Construct stands of steel pipe or other approved material. Design the stand base to bear the weight of the stand when full and to prevent movement or undue stress on the pipeline.

Ensure that sand traps, when combined with a stand, have a minimum inside dimension of 30 inches and are constructed so the bottom is at least 24 inches below the invert of the outlet pipeline. Ensure that the downward velocity of flow of the water in a sand trap does not exceed 0.25 feet per second. Make suitable provisions for cleaning sand traps.

Design gate stands so that their dimensions are adequate to accommodate the required gates. Ensure that gate stands allow adequate access for gate repair.

Design float stands so that they are large enough to provide accessibility for maintenance.

Construct stands so that vibration from the pump discharge pipe does not transfer to the stand.

Pressure-relief valves are used as an alternative to stands open to the atmosphere. Ensure that all pressure-relief valves serve the pressure-relief function of the open stand or vent for which it is an alternative.

Stands closed to the atmosphere
If pressure-relief valves and air-and-vacuum valves are used instead of open stands, all requirements detailed in the section above, “Stands open to the atmosphere” apply except as modified below.

Ensure that the inside diameter of the closed stand is equal to or greater than that of the pipeline for at least 1 foot above the top of the uppermost inlet of outlet pipe. To facilitate attaching the pressure-relief valve and the air-and-vacuum valve, the stand can be capped at this point. If additional height is required, the stand can be extended to the desired elevation by using the same inside diameter or a reduced cross section. If a reduced section is used, ensure that the cross-sectional area is such that it would produce an average velocity of no more than 10 feet per second if the entire flow were discharged through it. If no vertical offset is required between the pump discharge pipe and the outlet pipeline and the discharge pipe is “dog-legged” below ground, extend the stand at least 1 foot above the highest part of the pump discharge pipe.

Use either of the following two alternative designs for stands requiring no vertical inlet offset (when inlet velocity is less than three times that of the discharge pipeline):

- Construct the dogleg section of the pump discharge pipe with the same nominal pipe diameter as that of the pipeline.
- Install the pressure-relief valve and the air-and-vacuum valve on top of the upper horizontal section of the dogleg.

Install pressure-relief and air-and-vacuum valves on stands with the nominal size pipe required to fit the valves’ threaded inlets.

Surge tanks and air chambers
If surge tanks and/or air chambers are required for control of hydraulic transients or water column separation, ensure that their size meets the water volume needs of the pipeline without the tank/chamber being emptied, and that the required flow into the pipeline for the calculated pressure drop is met.

Pressure relief valves
Install a pressure relief (PR) valve between the pump discharge and the pipeline if excessive pressure can build up when all valves are closed. If needed to protect the pipeline against pressure reducing valve malfunction or failure, install PR valves downstream of pressure reducing valves.

Manufacturers of PR valves marketed for use under this standard must provide capacity tables that give the discharge capacities of the valves at the maximum permissible pressure and differential pressure settings. These tables must be based on performance tests, and must be the basis for acceptance of these valves and selection of the design pressure setting.

Set PR valves to open at a pressure as low as practical, but no greater than 5 psi below the pressure rating or maximum allowable pressure of the pipe. Ensure that the valves have sufficient flow capacity to reduce the excessive pressures in the pipeline.

Indicate or mark the pressure at which the valves start to open on each PR valve. Seal or otherwise alter adjustable PR valves to prevent changing the adjustment from that marked on the valve.

Air release valves
Five types of air vents/valves commonly used on irrigation pipelines are continuous acting air release valves (CAV), vacuum-relief valves (VR), air release and vacuum relief valves (AVR), combination air valves (COMB), and open vents. Open vents are described in the section “Vents” below.

Where the accumulation of air occurs during operation, use a CAV at the appropriate location to release air from the filled pipeline while under pressure. Normal orifice venting diameter is 1/16 to 3/8 inch.

Use VR valves for relief of vacuum pressures (i.e., negative pressures) due to sudden gate or valve closure, pump shutoff, or drainage of the pipeline.

AVR valves can be used for the same requirements described for VR valves. Use AVR valves to release air from the pipeline on filling prior to the pipe being pressurized. Use AVR valves to alleviate flow restrictions, air locks, and water surging due to the presence of air within pipelines. Include air valves at all high points along the pipeline. Install an air valve at least every 2,500 feet on horizontal runs.

COMB valves have the combined function of all three valves (CAV, VR, and AVR) in one body. COMB valves can be used for any of the conditions in which a CAV, VR, or AVR is required.

If needed to provide positive means for air escape during filling and air entry while emptying, install an AVR, VR, or COMB valve at all summits, upstream and downstream of all in-line valves as needed, at the entrance, and at the end(s) of the pipelines. Such valves are needed at these locations if the pipeline is closed to the atmosphere. However, they are not be needed if other features of the pipe system, such as permanently located sprinkler nozzles or other unclosed service outlets, adequately vent the particular location during filling and emptying operations. Analyze the use of these system features for airflow rate and the proper use of such features described in the operation and maintenance plan. High points in the pipeline require a CAV unless an outlet is located at that point.

In addition to the locations described above, place an AVR or COMB valve at changes of grade in downward direction of flow in excess of 10 degrees to ensure adequate air release during filling. On long pipelines (i.e., over 2,500 feet), additional AVR or COMB valves may be required to vent the pipe during filling.

For air release, size the AVR or COMB valve to exhaust air from the pipeline at the rate needed to prevent operational problems with the pipeline, while maintaining the proper operation of the valve. For design purposes, limit the exhaust pressure differential to 2 psi.

For vacuum relief, size the AVR, VR, or COMB valves for air entry into the pipeline, ensuring the pipeline does not collapse due to vacuum created during drainage of the pipeline. For design purposes, limit the vacuum pressure differential to 5 psi.

If the required vacuum relief orifice diameter is significantly larger than the required air release orifice diameter, separate valves may be required to help eliminate excessive water hammer caused when the air is released too fast from the pipeline.

Use CAV or COMB valves as needed to permit air to escape while the line is at working pressure. Size small orifices of these valve types according to the design working pressure and venting requirements recommended by the valve manufacturer.

Ensure that the location of the CAV or COMB valves is a sufficient distance downstream from the introduction of air into the system (under pressure conditions) to allow the air to be collected at the top of the pipe. Under some circumstances (e.g., pumped system with low pressure or velocity) consideration should be given to installing vent chambers for CAV or COMB valves. Construct the vent chamber according to the requirements under the second criteria in the section “Vents” below.

In lieu of a detailed design, for the corresponding pipe material below, use the following air valve sizes:

- For plastic ≤ 50 psi - 0.22 x pipe diameter
- For plastic > 50 psi - 0.10 x pipe diameter
- For metal - 0.125 x pipe diameter
- For concrete - 0.125 x pipe diameter

Document that the manufacturers of air valves marketed for use under this standard provide dimensional data or a capacity table based on performance tests, and use these data for the selection and acceptance of these valves.

Vents
Vents that are open to the atmosphere provide for the removal and entry of air and protection from surge. Use the following design criteria:

- Ensure that vents have a minimum freeboard of 1 foot above the hydraulic grade line at design capacity. The maximum height of the vent above the centerline of the pipeline must not exceed the maximum allowable working pressure of the pipe.
- Construct a vent chamber to intercept and/or capture air within the pipeline. Ensure that the chamber intercepts the circumference arc of 75 degrees at the top of the pipe (i.e., a vent chamber diameter of 2/3 the diameter of the pipeline). Extend the chamber vertically at least one pipeline diameter up from the centerline of the pipeline. Above this elevation, the vent chamber can be reduced to minimum diameter of 2 inches.
- When an AVR or COMB valve is used instead of a vent, use the above requirements. In addition, size the reduced section to meet the nominal pipe size required to fit the valve’s threaded inlet. An acceptable alternative is to install the valve(s) in the side of a service outlet, provided that the service outlet riser is properly located and adequately sized. If both AVR and PR valves are required at the location, apply the 10 feet per second velocity criterion given under the section above, “Stands open to the atmosphere,” to the reduced section.
- Install vent chambers on all open vents and closed vents with air valves, when the normal operating pressure of the pipe is 10 psi or less.

  Place a vent at the downstream end of laterals, at summits in the line, and at points where the grade changes more than 10 degrees in a downward direction of flow.

Outlets
Appurtenances that deliver water from the pipe system to the field, ditch, reservoir, or surface pipe system are known as outlets. Ensure that the outlets have adequate capacity to deliver the required flow to—

- The hydraulic grade line of a pipe or ditch,
- A point at least 6 inches above the field surface,
- The design surface elevation in a reservoir, or
- An individual sprinkler, lateral line, hydrant, or other device at the required operating pressure.

Design outlets to minimize erosion, physical damage, or deterioration due to exposure.

Filling
Ensure that the pipe system has a means of controlling the filling of the pipeline to prevent entrapped air and excessive transient pressures.

Filling velocities greater than 1 foot per second in a closed to the atmosphere pipe system (i.e., all outlets closed) requires special evaluation and provisions to remove entrapped air and prevent transient pressures.

If filling the pipeline at a low flow rate is not possible, design the system for air removal and mitigate transient pressures at the higher filling rates.

Flushing
If the sediment load in the water is significant, design the pipeline to provide adequate velocity to move sediment through and be flushed out of the pipeline.

If provisions are needed for flushing sediment or other foreign material, install a suitable valve at the distant end or low point of the pipeline.

Draining
Make provisions for the complete removal of water from the pipeline by gravity or other means when—

- Freezing temperatures are a hazard.
- The pipe manufacturer requires draining.
- Draining of the pipeline is recommended.

Ensure that the water drained from pipelines does not cause water quality, soil erosion, or safety problems upon release.

Safe discharge of water
Make provisions for water discharged from valves, especially air valves and pressure relief valves. Place these valves so that flows from the valves are directed away from system operators, livestock, electrical equipment, and other control valves or hook-ups.

Thrust control
Abrupt changes in pipeline grade, horizontal alignment, tees, or reduction in pipe size, normally require an anchor or thrust blocks to absorb pipeline axial thrust. Thrust control is typically needed at the end of the pipeline, and at in-line control valves.

Follow the pipe manufacturer’s recommendations for thrust control. In absence of manufacturer’s data, design thrust blocks using 210-NEH-636-52.

Longitudinal bending
For plastic pipe, base the allowable longitudinal bending for the pipeline on the material type and the pressure rating. Ensure that the longitudinal bending is in accordance with industry standards, or as described in 210-NEH-636-52.

Thermal effects
For plastic pipe, thermal effects must be properly factored into system design. Pressure ratings for pipes are normally based on a pipe temperature of 73.4 ºF. Reduce the effective pressure rating by an appropriate amount when the operating temperature is higher than 73.4 ºF.

Ensure that values and procedures for pressure rating reduction follow information described in the 210-NEH-636-52.

Physical protection
Ensure that steel pipe installed above ground is either galvanized or protected with a suitable protective paint coating, including a primer coat and a minimum of two final coats.

Ensure that plastic pipe installed above ground is resistant to ultraviolet light throughout the intended life of the pipe or measures taken to protect the pipe from damage due to ultraviolet light.

Protect all pipes from hazards presented by traffic loads, farm operations, freezing temperatures, fire, thermal expansion and contraction. Take reasonable measures to protect the pipe from potential vandalism.

Corrosion protection
Ensure that all metal to metal fittings, such as risers, bends, tees, and reducers, are of similar metals. If dissimilar metals are used, protect the fittings against galvanic corrosion (e.g., separate dissimilar metals with rubber or plastic insulator).

Galvanize bolts used to join galvanized steel, plastic coated, stainless steel, or otherwise protected to prevent galvanic corrosion. Bolts used to join aluminum, other than aluminum alloy bolts, must be plastic coated or otherwise protected to prevent galvanic corrosion.

Provide interior protective coatings when the pH of the water falls outside the ranges shown in table 3.

Table 3: Ranges in water ph values used to determine the need for interior protective coatings

Material	Water pH
Aluminized steel	Less than 5 or greater than 9
Galvanized steel	Less than 6 or greater than 10
Aluminum alloy	Less than 4 or greater than 10

Unlined steel pipelines can experience corrosion from very pure water (e.g., snowmelt). Provide corrosion protection if the Langelier Saturation Index (LSI) is less than -1.

Galvanized steel pipe can be used when the soil resistivity is greater than 4000 ohm-cm.

Use hot-dipped asphalt or polymeric-coated, galvanized steel pipe if the soil resistivity along any part of the pipeline is between 3000 and 4000 ohm-cm. In addition to the above coatings, provide cathodic protection for galvanized steel pipe if the soil resistivity is less than 3000 ohm-cm.

Aluminized steel pipe can be used when the soil resistivity is greater than 1500 ohm-cm and the soil pH is between five and nine.

Aluminum alloy pipe can be used when the soil resistivity is greater than 500 ohm-cm and the soil pH is between four and ten.

When cathodic protection is required, electrically bridge joints and connecting bands to ensure continuous flow of current. Place a dielectric connection between the pump and the pipeline and between pipes with different coatings.

Design the total current required, kind and number of anodes needed, and life expectancy for the cathodic protection in accordance with NRCS Technical Note (Title 210), Design Engineering, Design Note 12, “Control of Underground Corrosion.”

Resistivity measurement requirements for metal pipe
If risk of corrosion is “high” based on the Cooperative Soil Survey’s Soil Features Report, conduct soil-resistivity measurements to determine corrosion protection requirements. For this purpose, make field resistivity measurements or take samples for laboratory analysis at least every 400 feet along the proposed pipeline route and at points where a visible change in soil characteristics occurs. If adjacent readings differ markedly, take additional measurements to locate the point of change. Make resistivity determinations at two or more depths in the soil profile at each sampling station, with the lowest depth at the stratum in which the pipe will be laid. Use the lowest value of soil resistivity found at each sampling station as the design value for that station.

After excavation of the pipe trench, make a detailed soil resistivity survey as a verification of the final required cathodic protection. At this time, make resistivity measurements in each exposed soil horizon at intervals not exceeding 200 feet. Use the lowest value of soil resistivity found at each sampling station as the design value for that station. If design values for adjacent stations differ significantly, make additional intermediate measurements.

Electric fields
An electric field can develop where a metal pipeline is installed adjacent to an existing metal pipeline. This situation can adversely affect the new pipeline. Protect the new pipeline from this condition.

Environmental constraints for aluminum
Evaluate water quality for aluminum pipeline installations. A copper content in excess of 0.02 ppm produces nodular pitting and rapid deterioration of the pipe if water is allowed to become stagnant. When the copper content exceeds this limit, design the pipeline to allow draining after each use, or avoid the use of aluminum pipe.

Provide protection from corrosion for aluminum pipe installed in contact with concrete.

Environmental constraints for concrete
Do not install concrete pipelines on sites where the sulfate-salt concentration in the soil or soil water exceeds 1.0 percent. On sites where the sulfate concentration is more than 0.1 percent but not more than 1.0 percent, concrete pipe can be used only if the pipe is made with Type V or Type II cement, with tricalcium aluminate content not exceeding 5.5 percent.

Additional Criteria for Reducing Energy Use

Provide analysis to demonstrate reduction of energy use from practice implementation.

Calculate the reduction of energy use by comparing the planned average annual or seasonal energy use to previous operating conditions.

CONSIDERATIONS

Additional Considerations for Safety

Pipelines may present a threat to the safety of people, during both installation and operation. Consider safety as follows:

- Address trench safety in design and during construction.
- Provide protection for people from inlets of pipelines and open stands.
- Provide protection for people from water blowing from pressure-relief, air-release, and other valves.
- Determine the existence or nonexistence of underground utilities prior to construction.
- Install a locate wire or safety tape above a buried pipe for future reference. Survey with GPS to mark grade and alignment changes.

Additional Considerations for Economics

Economics can be a major factor in pipeline design, as follows:

- Select pipe based on lifetime energy requirements, as well as initial costs of materials.
- Select pipe material based upon expected life of practice.
- Consider hydropower applications as alternatives to use of pressure reduction valves or reduced pipe diameter to induce friction loss.

Additional Considerations for Water Quality and Quantity

Consider the effects of an irrigation pipeline on water quality and quantity when designing an irrigation pipeline. Consider the effects:

- On the water budget, especially on infiltration and evaporation.
- On downstream flows or aquifers that would affect other water uses or users,
- On potential use for irrigation management.
- Of installing a pipeline on vegetation that may have been located next to the original conveyance.
- Of installing the pipeline (replacing other types of conveyance) on channel erosion or the movement of sediment and soluble and sediment-attached substances carried by water.
- On the movement of dissolved substances into the soil and on percolation below the root zone or to ground water recharge.
- Of controlled water delivery on the temperatures of water resources that could cause undesirable effects on aquatic and wildlife communities.
- On wetlands or water-related wildlife habitats.
- On the visual quality of water resources.

Additional Considerations for the Environment

Base pipe material selection on exposure considerations (such as soil resistivity, pH, sunlight, and traffic). Soil texture, resistivity, pH, moisture content, redox potential and depth are important soil properties to be aware of for pipelines and in reducing soil limitations related to corrosivity, or packing of soil material. Refer to soil survey information of the area and on-site soil investigations should be considered during planning.

The Langelier Saturation Index and related indices may be a factor in determining type of material to use for a pipeline.

Pipelines installed below the ground surface should have a soil plan describing soil reconstruction of disturbed soil during and after pipeline installation so original soil productivity is restored after pipeline installation. Appropriate vegetation should be established to stabilize disturbed areas that will not be cropped.

PLANS AND SPECIFICATIONS

Prepare plans and specifications for irrigation pipelines that describe the requirements for applying the practice according to this standard. Include, at a minimum, the following items in the plans and specifications:

- A plan view of the layout of the pipeline.
- Profile of the irrigation pipeline if not parallel to the ground surface with a uniform minimum depth of cover.
- Pipe material and sizes.
- Pipe joint requirements.
- Site-specific construction specifications that describe in writing the installation of the irrigation pipeline. Include the specification for leak testing of the irrigation pipeline.
- Depth of bedding, embedment, and backfill requirements.
- Thrust block design.
- Location and sizing of—
    - Pressure relief valves.
    - Continuous acting air release valves.
    - Vacuum relief valves.
    - Air release/vacuum relief valves.
    - Combination air valves.
    - Open vents.

- Disposal requirements for excess soil material.
- Vegetative establishment requirements.
- Location of utilities and notification requirements.

OPERATION AND MAINTENANCE

Develop an operation and maintenance (O&M) plan for each pipeline system installed. Ensure that the plan describes the required actions so that the pipeline system performs adequately throughout its expected life.

Include procedures for—

- Draining the pipeline.
- Marking crossing locations.
- Valve operation to prevent pipe or appurtenant damag.
- Appurtenance or pipe maintenance.
- Recommended operating procedures, as needed within the O&M plan.

Include the procedure to monitor any cathodic protection systems.

Describe the filling procedure, which details allowable flow rates and appurtenance operation at the various phases of the filling process, to ensure safe filling of the pipeline. Use flow measuring appurtenances such as flow meters or weirs, or other means (e.g., number of turns of a gate valve) to determine the rate of flow into the pipeline system. Provide this information to the operator, and incorporate it in the O&M plan as appropriate.

REFERENCES

ASTM C118-15. 2015. Standard Specification for Irrigation Pipe for Irrigation or Drainage. ASTM International. West Conshohocken, PA.

ASTM C505-15. 2015. Standard Specification for Nonreinforced Concrete Irrigation Pipe with Rubber Gasket Joints. ASTM International. West Conshohocken, PA.

ASTM F1668-16. 2016. Standard Guide for Construction Procedures for Buried Plastic Pipe. ASTM International. West Conshohocken, PA.

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APPENDIX B
DEMAND DATA AND SUMMARY

Demand Patterns per Junction

JUNC_ID	J10	J100	J1002	J1004	J102	J104	J106	J108	J110	J112	J114	J116	J118	J12	J120	J122	J124	J126	J128	J130	J132	J134	J136	J138	J140	
Set1		0.00		0.00	0.13		0.00	0.00	0.00	1.00	0.00			0.00	0.00	1.00	1.00				0.68	0.46	0.00	0.18	0.00	
Set2		0.39		0.00	0.33		0.00	0.00	1.00	0.00	0.00			0.67	0.00	1.00	0.74				0.68	0.46	0.00	0.54	0.00	
Set3		1.00		0.38	0.21		0.00	0.00	0.65	0.00	0.00			0.67	0.00	1.00	0.74				0.26	0.46	1.00	0.54	1.00	
Set4		1.00		0.38	0.21		0.00	0.00	0.65	0.00	0.00			0.67	0.00	1.00	0.74				0.00	0.46	1.00	0.54	1.00	
Set5		0.39		0.38	0.67		1.00	0.00	0.65	0.00	0.00			0.67	0.00	0.00	0.74				0.00	0.46	1.00	0.54	1.00	
Set6		0.76		0.25	0.92		1.00	0.00	0.85	0.00	0.00			0.67	0.50	0.00	0.74				0.00	0.46	1.00	0.54	1.00	
Set7		0.76		1.00	0.92		0.65	1.00	0.35	1.00	0.00			0.67	0.25	1.00	0.74				0.00	0.46	1.00	0.46	0.80	
Set8		0.76		0.89	0.92		0.00	0.75	0.00	0.00	0.00			0.67	0.42	1.00	0.58				0.00	0.46	0.90	0.82	0.72	
Set9		0.76		0.83	0.92		0.00	0.39	0.00	1.00	0.00			0.67	0.42	1.00	0.26				0.32	0.00	0.90	1.00	0.52	
Set10		0.00		0.42	0.96		0.00	0.00	0.00	0.00	1.00			0.67	0.42	1.00	0.00				0.32	0.77	0.00	1.00	0.48	
Set11		0.00		0.34	1.00		0.00	0.00	0.00	0.83	1.00			1.00	0.42	1.00	0.00				0.32	1.00	0.00	0.57	0.28	
Set12		0.00		0.00	0.83		0.00	0.00	0.00	0.00	0.62			0.00	1.00	0.00	0.00				0.32	0.31	0.00	0.54	0.00	
Set13		0.00		0.00	0.13		0.00	0.00	0.00	1.00	0.00			0.00	0.00	1.00	0.74				1.00	0.46	0.00	0.18	0.00	
Set14		0.39		0.00	0.33		0.00	0.00	1.00	0.00	0.00			0.67	0.00	1.00	0.74				0.68	0.46	0.00	0.54	0.00	
Set15		1.00		0.00	0.21		0.00	0.00	0.65	0.00	0.00			0.67	0.00	1.00	0.74				0.26	0.46	1.00	0.54	1.00	
Set16		1.00		0.00	0.21		0.00	0.00	0.65	0.00	0.00			0.67	0.00	1.00	0.74				0.00	0.46	1.00	0.54	1.00	
Set17		0.39		0.00	0.67		1.00	0.00	0.65	0.00	0.00			0.67	0.00	0.00	0.74				0.00	0.46	1.00	0.54	1.00	
Set18		0.76		0.00	0.92		1.00	0.00	0.85	0.00	0.00			0.67	0.50	0.00	0.74				0.00	0.46	1.00	0.57	1.00	
Set19		0.76		0.75	0.92		1.00	0.00	0.35	1.00	0.00			0.67	0.25	1.00	0.74				0.00	0.46	1.00	0.46	0.80	
Set20		0.76		0.75	0.92		0.65	0.00	0.00	0.00	0.00			0.67	0.42	1.00	0.58				0.32	0.46	0.90	0.82	0.72	
Set21		0.76		0.75	0.92		0.00	1.00	0.00	1.00	0.00			0.67	0.42	1.00	0.00				0.32	0.00	0.90	1.00	0.52	
Set22		0.00		0.34	0.96		0.00	0.75	0.00	0.00	1.00			0.67	0.42	1.00	0.00				0.32	0.77	0.00	1.00	0.48	
Set23		0.00		0.34	1.00		0.00	0.39	0.00	0.83	1.00			1.00	0.42	1.00	0.00				0.32	1.00	0.00	0.57	0.28	
Set24		0.00		0.00	0.83		0.00	0.00	0.00	0.00	0.62			0.00	1.00	0.00	0.00				0.32	0.31	0.00	0.54	0.00	
Set25		0.00		0.00	0.00		0.00	0.00	0.00	0.00	0.00			0.00	0.00	0.00	0.00				0.00	0.00	0.00	0.00	0.00	
Set26		0.00		0.00	0.00		0.00	0.00	0.00	0.00	0.00			0.00	0.00	0.00	0.00				0.00	0.00	0.00	0.00	0.00	
Set27		0.00		0.00	0.00		0.00	0.00	0.00	0.00	0.00			0.00	0.00	0.00	0.00				0.00	0.00	0.00	0.00	0.00	
Set28		0.00		0.00	0.00		0.00	0.00	0.00	0.00	0.00			0.00	0.00	0.00	0.00				0.00	0.00	0.00	0.00	0.00	
Max (gpm)		198	0	0	318	144	0	120	144	156	36	78	0	0	18	72	120	155	0	0	0	204	130	60	168	150	
Avg. On Demand (gpm)		0.0	0.0	0.0	2.3	6.8	0.0	9.8	1.8	3.2	5.0	2.3	0.0	3.4	0.0	6.6	2.7	7.3	0.0	0.0	3.7	1.4	1.4	1.4	10.6	0.0	

- Apply peak day demand factor to on-demand demands with demand pattern in InfoWater model

Demand Patterns per Junct

JUNC_ID	J142	J144	J146	J148	J150	J152	J154	J156	J158	J160	J162	J164	J166	J168	J170	J172	J174	J176	J178	J180	J182	J184	J186	J188	J190
Set1	0.71	1.00	1.00	1.00		1.00	1.00	0.00	1.00	0.75	0.00	1.00		0.00		1.00	0.00	0.00		1.00	0.00			0.68	
Set2	0.36	1.00	0.27	1.00		1.00	0.60	0.00	1.00	0.75	0.00	1.00		0.00		1.00	0.00	1.00		1.00	0.00			0.00	
Set3	0.29	1.00	1.00	1.00		1.00	0.00	0.00	1.00	0.38	0.00	1.00		0.00		1.00	0.00	1.00		1.00	0.00			0.05	
Set4	0.29	1.00	0.20	1.00		0.50	1.00	0.00	1.00	0.38	0.00	0.93		0.00		1.00	0.00	1.00		1.00	0.00			0.05	
Set5	0.64	1.00	1.00	1.00		0.50	1.00	0.00	1.00	0.38	0.00	0.76		0.00		1.00	0.00	1.00		1.00	0.67			0.05	
Set6	0.64	1.00	0.20	1.00		0.50	1.00	0.28	1.00	0.38	1.00	0.76		0.00		1.00	0.00	1.00		1.00	0.67			0.00	
Set7	0.64	1.00	1.00	1.00		0.50	1.00	1.00	1.00	0.38	0.25	0.76		0.00		1.00	0.00	1.00		1.00	0.67			1.00	
Set8	0.21	1.00	0.20	1.00		0.50	1.00	1.00	1.00	1.00	0.00	0.76		0.00		1.00	1.00	1.00		1.00	0.67			1.00	
Set9	0.00	1.00	0.87	1.00		0.50	1.00	1.00	1.00	1.00	0.25	0.74		0.33		1.00	1.00	1.00		0.00	1.00			1.00	
Set10	0.00	0.25	0.20	1.00		0.50	1.00	1.00	1.00	0.63	0.00	0.74		1.00		1.00	1.00	0.83		0.00	1.00			0.68	
Set11	0.00	0.00	1.00	1.00		0.00	1.00	1.00	0.96	0.63	0.25	0.20		1.00		1.00	1.00	0.67		0.00	1.00			0.68	
Set12	0.64	0.00	0.40	1.00		0.00	1.00	1.00	0.00	0.63	0.00	0.20		1.00		0.13	1.00	0.00		0.00	1.00			0.68	
Set13	1.00	1.00	1.00	1.00		1.00	1.00	0.00	1.00	0.75	0.00	1.00		0.00		1.00	0.00	0.00		1.00	0.00			0.68	
Set14	0.64	1.00	0.27	1.00		1.00	0.60	0.00	1.00	0.75	0.00	1.00		0.00		1.00	0.00	1.00		1.00	0.00			0.00	
Set15	0.64	1.00	1.00	1.00		1.00	0.00	0.00	1.00	0.38	0.00	1.00		0.00		1.00	0.00	1.00		1.00	0.00			0.05	
Set16	0.64	1.00	0.20	1.00		0.50	1.00	0.00	1.00	0.38	0.00	0.93		0.00		1.00	0.00	1.00		1.00	0.00			0.05	
Set17	0.64	1.00	1.00	1.00		0.50	1.00	0.00	1.00	0.38	0.00	0.76		0.00		1.00	0.00	1.00		1.00	0.67			0.05	
Set18	0.64	1.00	0.20	1.00		0.50	1.00	0.28	1.00	0.38	1.00	0.76		0.00		1.00	0.00	1.00		1.00	0.67			0.00	
Set19	0.64	1.00	1.00	1.00		0.50	1.00	1.00	1.00	0.38	0.25	0.76		0.00		1.00	0.00	1.00		1.00	0.67			1.00	
Set20	0.21	1.00	0.00	1.00		0.50	1.00	1.00	1.00	1.00	0.00	0.76		0.00		1.00	1.00	1.00		1.00	0.67			1.00	
Set21	0.00	1.00	0.87	1.00		0.50	1.00	1.00	1.00	1.00	0.25	0.74		0.33		1.00	1.00	1.00		0.00	1.00			1.00	
Set22	0.00	0.25	0.20	1.00		0.50	1.00	1.00	1.00	0.63	0.00	0.74		1.00		1.00	1.00	0.83		0.00	1.00			0.68	
Set23	0.00	0.00	1.00	1.00		0.00	1.00	1.00	0.96	0.63	0.25	0.20		1.00		1.00	1.00	0.67		0.00	1.00			0.68	
Set24	0.00	0.00	0.20	1.00		0.00	1.00	1.00	0.00	0.63	0.00	0.20		1.00		0.13	1.00	0.00		0.00	1.00			0.68	
Set25	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00		0.00	0.00	0.00		0.00	0.00			0.00	
Set26	0.64	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00		0.00	0.00	0.00		0.00	0.00			0.00	
Set27	0.64	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00		0.00	0.00	0.00		0.00	0.00			0.00	
Set28	0.64	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00		0.00	0.00	0.00		0.00	0.00			0.00	
Max (gpm)	84	96	90	102	0	12	150	108	162	48	24	178	0	18	0	90	12	180	0	24	18	0	0	76	0
Avg. On Demand (gpm)	0.5	0.9	4.1	0.0	0.0	9.5	0.5	0.0	0.0	0.0	1.4	0.0	0.0	1.8	0.0	0.9	0.0	0.9	0.0	0.0	0.9	0.0	0.0	0.9	2.3

- Apply peak day demand factor to on-

Demand Patterns per Junct

JUNC_ID	J192	J194	J196	J198	J200	J202	J204	J206	J208	J210	J212	J214	J216	J218	J22	J220	J222	J224	J226	J228	J230	J232	J234	J236	J238
Set1		0.00	0.78	0.78			1.00				0.00	0.00	0.97		1.00		0.00			1.00				0.00	0.25
Set2		1.00	0.96	0.00			0.94				0.00	0.00	0.68		1.00		0.51			0.00				0.00	0.25
Set3		0.00	0.96	0.78			0.94				0.00	0.22	0.38		1.00		0.58			0.00				0.00	0.25
Set4		0.00	0.65	0.00			0.94				0.00	1.00	0.59		1.00		0.93			0.00				0.00	0.33
Set5		0.38	0.00	0.78			0.56				0.00	1.00	0.35		0.00		0.93			0.00				1.00	0.00
Set6		0.08	0.83	0.00			0.00				0.52	1.00	0.35		0.00		1.00			0.00				1.00	0.00
Set7		0.08	1.00	1.00			0.00				0.52	1.00	0.76		0.00		0.72			0.00				1.00	0.00
Set8		0.04	0.78	0.00			0.00				1.00	1.00	0.76		0.00		0.65			0.00				1.00	1.00
Set9		0.00	0.00	0.00			0.00				0.96	1.00	1.00		0.00		0.79			1.00				1.00	1.00
Set10		0.00	0.00	0.00			0.00				0.91	1.00	0.76		0.00		0.65			0.00				1.00	1.00
Set11		0.00	0.00	0.00			0.00				0.52	1.00	0.76		0.00		0.65			0.91				0.00	1.00
Set12		0.00	0.48	0.00			0.00				0.52	1.00	0.35		0.00		0.14			0.00				0.00	1.00
Set13		0.00	0.78	0.78			1.00				0.52	0.00	0.97		1.00		0.00			1.00				0.00	0.25
Set14		0.00	0.96	0.00			0.94				0.35	0.00	0.68		1.00		0.00			0.00				0.00	0.25
Set15		0.00	0.96	0.78			0.94				0.00	0.22	0.38		1.00		0.07			0.00				0.00	0.25
Set16		1.00	0.65	0.00			0.94				0.00	1.00	0.59		1.00		0.42			0.00				0.00	0.33
Set17		0.38	0.00	0.78			0.56				0.00	1.00	0.00		0.00		0.42			0.00				1.00	0.00
Set18		0.08	0.83	0.00			0.00				0.00	1.00	0.00		0.00		0.49			0.00				1.00	0.00
Set19		0.08	1.00	1.00			0.00				0.00	1.00	0.00		0.00		0.21			0.00				1.00	0.00
Set20		0.04	0.78	0.00			0.00				0.00	1.00	0.00		0.00		0.14			0.00				1.00	1.00
Set21		0.00	0.00	0.00			0.00				0.00	1.00	0.24		0.00		0.28			1.00				1.00	1.00
Set22		0.00	0.00	0.00			0.00				0.00	1.00	0.00		0.00		0.14			0.00				1.00	1.00
Set23		0.00	0.00	0.00			0.00				0.00	1.00	0.00		0.00		0.14			0.91				0.00	1.00
Set24		0.00	0.48	0.00			0.00				0.00	1.00	0.00		0.00		0.14			0.00				0.00	1.00
Set25		0.00	0.00	0.00			0.00				0.00	0.00	0.00		0.00		0.00			0.00				0.00	0.00
Set26		0.00	0.00	0.00			0.00				0.00	0.00	0.00		0.00		0.00			0.00				0.00	0.00
Set27		0.00	0.00	0.00			0.00				0.00	0.00	0.00		0.00		0.00			0.00				0.00	0.00
Set28		0.00	0.00	0.00			0.00				0.00	0.00	0.00		0.00		0.00			0.00				0.00	0.00
Max (gpm)		144	138	108	0	0	192	0	0	0	92	192	204	0	78	0	86	0	0	66	0	0	0	42	72	0
Avg. On Demand (gpm)		4.1	9.9	0.0	1.4	1.4	0.0	4.6	0.0	0.0	0.0	0.0	8.4	1.4	2.3	0.0	4.6	0.5	0.0	1.4	0.0	0.0	0.0	0.0	2.3	0.0

- Apply peak day demand factor to on-

Demand Patterns per Junct

JUNC_ID	J24	J28	J30	J32	J34	J38	J42	J44	J48	J50	J52	J54	J56	J58	J60	J62	J90	J92	J94	J96	J98	
Set1			0.85	0.96		1.00		0.00		0.00			1.00		0.00						1.00	1.00
Set2			0.00	0.98		1.00		0.26		0.00			0.80		1.00						1.00	0.41
Set3			0.85	0.98		1.00		0.00		0.00			0.00		0.00						1.00	0.41
Set4			0.00	0.98		1.00		0.57		0.00			0.00		0.00						0.00	0.12
Set5			0.85	0.98		1.00		0.30		0.00			0.00		0.00						0.00	0.02
Set6			0.00	0.98		1.00		1.00		0.00			0.60		0.00						0.00	0.00
Set7			0.85	0.98		1.00		0.91		0.00			0.60		0.00						0.00	0.00
Set8			0.00	0.98		1.00		1.00		1.00			0.60		0.00						0.00	0.00
Set9			1.00	0.98		0.27		0.74		1.00			0.60		0.00						0.00	0.22
Set10			0.00	1.00		0.00		1.00		1.00			0.60		0.00						0.00	0.37
Set11			1.00	1.00		0.00		0.74		1.00			1.00		0.00						0.00	0.37
Set12			0.00	0.98		0.00		1.00		0.00			1.00		0.00						0.00	0.53
Set13			0.85	0.96		1.00		0.00		0.00			1.00		0.00						1.00	1.00
Set14			0.00	0.98		1.00		0.26		0.00			1.00		1.00						1.00	0.41
Set15			0.85	0.98		1.00		0.00		0.00			1.00		0.00						1.00	0.41
Set16			0.00	0.98		1.00		0.57		0.00			0.80		0.00						0.00	0.12
Set17			0.85	0.98		1.00		0.30		0.00			0.00		0.00						0.00	0.02
Set18			0.00	0.98		1.00		1.00		0.00			0.60		0.00						0.00	0.00
Set19			0.85	0.98		1.00		0.91		0.00			0.60		0.00						0.00	0.00
Set20			0.00	0.98		1.00		1.00		1.00			0.60		0.00						0.00	0.00
Set21			1.00	0.98		0.27		0.74		1.00			0.60		0.00						0.00	0.22
Set22			0.00	1.00		0.00		1.00		1.00			0.60		0.00						0.00	0.37
Set23			1.00	1.00		0.00		0.74		1.00			0.00		0.00						0.00	0.37
Set24			0.00	0.98		0.00		1.00		0.00			0.00		0.00						0.00	0.53
Set25			0.00	0.00		0.00		0.00		0.00			1.00		0.00						0.00	0.00
Set26			0.00	0.00		0.00		0.00		0.00			1.00		0.00						0.00	0.00
Set27			0.00	0.00		0.00		0.00		0.00			1.00		0.00						0.00	0.00
Set28			0.00	0.00		0.00		0.00		0.00			1.00		0.00						0.00	0.00
Max (gpm)		0	78	312	0	66	0	138	0	48	0	0	30	0	60	0	0	0	0	0	114	294
Avg. On Demand (gpm)		0.0	0.9	0.0	0.0	0.0	0.0	6.8	0.0	0.0	0.0	0.0	2.3	0.0	1.8	0.0	0.0	0.0	0.0	0.0	0.0	2.7

- Apply peak day demand factor to on-

DI Meter Demand Analysis
Updated: July 10, 2020

		Meter Readings					Annual Usage (Gallons)								
Field	MeterType	Oct 19	Oct 18	Oct 17	Oct 16	Oct 15	2019	2018	2017	2016	Average (gal/yr)	ST Dev.	Average Day Demand (gpm)	Allowed Annual Use (gal/yr)	Allowed Avg. Day Demand (gpm)
4202	DIMeter		275,020	9,390,070	8,332,110	7,822,420			1,057,960	509,690	783,825	35%	1.5	960,000	1.8
4203	DIMeter	9,024,400	8,699,000	8,206,000	7,781,350	7,190,490	325,400	493,000	424,650	590,860	458,478	21%	0.9	240,000	0.5
4204	DIMeter	1,174,650	872,350	574,100	432,610	635,170	302,300	298,250	141,490		247,347	30%	0.5	480,000	0.9
4205	DIMeter	2,599,350	2,407,160	2,299,740	2,141,980	1,898,400	192,190	107,420	157,760	243,580	175,238	28%	0.3	720,000	1.4
4206	DIMeter	6,441,050	6,094,220	5,664,950	5,228,320	4,871,420	346,830	429,270	436,630	356,900	392,408	10%	0.7	480,000	0.9
4208	DIMeter		1,597,990	1,539,450	1,470,550	1,407,150		58,540	68,900	63,400	63,613	7%	0.1	480000	0.9
4210	DIMeter		5,116,010	5,116,010	5,116,011	5,116,010		0		1	1	100%	0.0	480000	0.9
4211	DIMeter	3,152,370	3,004,600	2,773,590	2,646,420	2,380,740	147,770	231,010	127,170	265,680	192,908	30%	0.4	1440000	2.7
4212	DIMeter	2,493,635	1,760,097	1,517,262	1,077,288	687,653	733,538	242,835	439,974	389,635	451,496	39%	0.9	1200000	2.3
4213	DIMeter		559,407	543,770		4,890,840		15,637			15,637	0%	0.0	1200000	2.3
4214	DIMeter	8,114,730	7,285,130	6,458,950	5,669,710	4,966,560	829,600	826,180	789,240	703,150	787,043	6%	1.5	840000	1.6
4215	DIMeter	2,964,520	2,620,060	2,272,140	1,939,560	1,616,260	344,460	347,920	332,580	323,300	337,065	3%	0.6	480000	0.9
4217	DIMeter	4,262,620	4,092,990	4,019,550	3,953,290	3,647,280	169,630	73,440	66,260	306,010	153,835	63%	0.3	240000	0.5
4218	DIMeter	32,422,000	30,820,400	28,869,800	26,575,000	24,693,800	1,601,600	1,950,600	2,294,800	1,881,200	1,932,050	13%	3.7	2640000	5.0
4219	DIMeter						0	0	0	0	0		0.0		0.0
4220	DIMeter	4,363,500	4,287,000	4,930,300	4,020,600	3,920,200	76,500		909,700	100,400	362,200	107%	0.7	720000	1.4
4222	DIMeter		325,780	294,670		236,480		31,110			31,110	0%	0.1	360000	0.7
4223	DIMeter		3,103,730	2,779,360	2,568,450	2,274,160		324,370	210,910	294,290	276,523	17%	0.5	240000	0.5
4224	DIMeter	1,392,693	697,520	3,104,050	3,019,400	205,516	695,173				695,173	0%	1.3	720000	1.4
4225	DIMeter		7,185,190	6,920,890		6,517,110		264,300			264,300	0%	0.5	240000	0.5
4229	DIMeter	8,500,780	8,014,170	7,561,730	7,060,560	6,598,520	486,610	452,440	501,170	462,040	475,565	4%	0.9	1752000	3.3
4231	DIMeter	5,435,050	5,156,330	4,832,800	4,550,450	4,276,240		323,530	282,350	274,210	293,363	7%	0.6	480000	0.9
4232	DIMeter	6,004	5,498		3,369,400	2,216,020				1,153,380	1,153,380	0%	2.2	240000	0.5
4233	DIMeter	4,620,800	4,209,800	3,834,300	3,605,100	2,701,300	411,000	375,500	229,200	903,800	479,875	53%	0.9	240000	0.5
4234	DIMeter	1,292,800	1,219,286	1,219,286	1,219,280	1,213,470	73,514	0	6	5,810	19,833	157%	0.0	840000	1.6
4235	DIMeter	359,009				358,902	1	0	0		0	141%	0.0	2640000	5.0
4236	DIMeter		9,234,680			7,368,170				622,170	622,170	0%	1.2	1920000	3.7
4237	DIMeter		3,672,800	3,672,700	3,287,650	2,895,870		100	385,050	391,780	258,977	71%	0.5	720000	1.4
4238	DIMeter	2,927,890	2,868,850	2,732,230	2,571,940	2,271,110	59,040	136,620	160,290	300,830	164,195	53%	0.3	480,000	0.9
4240	DIMeter						0	0	0	0	0	#DIV/0!	0.0	480000	0.9
4241	DIMeter	5,184,920	4,935,130	4,506,000	4,249,990	3,947,700	249,790	429,130	256,010	302,290	309,305	23%	0.6	480000	0.9
4243	DIMeter	5,099,660	4,423,640	3,569,890	2,719,310	1,941,920	676,020	853,750	850,580	777,390	789,435	9%	1.5	960000	1.8
4246	DIMeter						0	0	0	0	0	#DIV/0!	0.0	720000	1.4
4248	DIMeter	2,328,780	1,977,340	1,814,980	1,683,600	1,515,070	351,440	162,360	131,380	168,530	203,428	43%	0.4	480000	0.9
4250	DIMeter	293,715	205,244	524,730	9,567,190	8,812,680				754,510	754,510	0%	1.4	1128000	2.1
4252	DIMeter	845,340	823,130	794,320		7,639,200	22,210	28,810			25,510	13%	0.0	720000	1.4
4254	DIMeter						0	0	0	0	0	#DIV/0!	0.0	0	0.0
4256	DIMeter	1,607,920	1,577,560	1,549,730		1,530,270	30,360	27,830			29,095	4%	0.1	480000	0.9
4258	DIMeter	5,809,300	5,809,300	5,809,300	5,809,300	5,809,300	0	0	0	0	0	#DIV/0!	0.0	720000	1.4
4259	DIMeter	3,202,240	3,202,260	3,171,850	2,971,810	2,766,240		30,410	200,040	205,570	145,340	56%	0.3	528000	1.0
4261	DIMeter	1,605,492	671,657	4,324,420	3,248,590	2,812,068	933,835		1,075,830	436,522	815,396	34%	1.6	1,680,000	3.2
4263	DIMeter	3,522,780	3,328,920	3,073,310	2,843,530	2,626,990	193,860	255,610	229,780	216,540	223,948	10%	0.4	480000	0.9
4264	DIMeter	547,170	489,960	324,810			57,210	165,150		0	74,120	92%	0.1	480,000	0.9
4265	DIMeter	983,144	929,228	868,840	814,096	763,352	53,916	60,388	54,744	50,744	54,948	6%	0.1	240000	0.5
4267	DIMeter		1,943,150	1,773,190	1,684,500	1,577,300		169,960	88,690	107,200	121,950	29%	0.2	480000	0.9
4269	DIMeter	3,979,790	3,951,530	3,943,970	3,898,230	3,839,310	28,260	7,560	45,740	58,920	35,120	55%	0.1	120000	0.2
4271	DIMeter		6,075,049	5,871,550	5,592,690	5,308,990		203,499	278,860	283,700	255,353	14%	0.5	960000	1.8
4272	DIMeter	5,558,970	5,781,900	5,495,570	5,175,440	4,854,290		286,330	320,130	321,150	309,203	5%	0.6	360000	0.7
4274	DIMeter		383,543	5,312,910	4,747,480	4,000,680			565,430	746,800	656,115	14%	1.2	1920000	3.7
4279	DIMeter	4,215,980	3,896,120	3,520,220	3,104,610	2,742,450	319,860	375,900	415,610	362,160	368,383	9%	0.7	480000	0.9

4281	DIMeter	88,038	0	2,965,180	2,756,520	2,553,300	88,038		208,660	203,220	166,639	33%	0.3	480000	0.9
4283	DIMeter	35,711	16,561	0	146,050	138,010	19,150	16,561		8,040	14,584	33%	0.0	720000	1.4
4285	DIMeter					2,378,600	0	0	0		0	#DIV/0!	0.0	0	0.0
4286	DIMeter	3,077,110	3,077,110	2,561,530	2,034,170	1,482,770		515,580	527,360	551,400	531,447	3%	1.0	480000	0.9
4289	DIMeter	5,218,920	4,976,490	4,673,570	4,406,220	4,169,430	242,430	302,920	267,350	236,790	262,373	10%	0.5	480000	0.9
4293	DIMeter	401,682	275,295	115,505	4,064,250	3,969,190	126,387	159,790		95,060	127,079	21%	0.2	240000	0.5
4295	DIMeter	3,697,488	3,148,796	2,588,540	2,000,000	1,817,650	548,692	560,256	588,540	182,350	469,960	35%	0.9	1200000	2.3
4299	DIMeter		2,430,100	2,339,500		2,174,960		90,600			90,600	0%	0.2	480000	0.9
4302	DIMeter	4,071,540	3,866,800	3,682,860	2,037,160	1,761,130	204,740	183,940	1,645,700	276,030	577,603	107%	1.1	720000	1.4
4310	DIMeter	2,092,270	1,955,560	1,802,990	1,693,280	1,576,000	136,710	152,570	109,710	117,280	129,068	13%	0.2	480000	0.9
4312	DIMeter	9,798,030	9,252,880	8,624,490	8,037,130	7,423,660	545,150	628,390	587,360	613,470	593,593	5%	1.1	480000	0.9
4313	DIMeter		13,358,900	11,934,400	10,580,500	9,382,400		1,424,500	1,353,900	1,198,100	1,325,500	7%	2.5	1200000	2.3
4315	DIMeter		2,678,396	2,097,219	1,549,495	1,041,400		581,177	547,724	508,095	545,665	5%	1.0	600000	1.1
4316	DIMeter		5,943,230	5,267,630	4,644,820	3,948,940		675,600	622,810	695,880	664,763	5%	1.3	840000	1.6
4317	DIMeter	2,363,890	2,361,400	2,339,670	2,320,260	2,300,780	2,490	21,730	19,410	19,480	15,778	49%	0.0	480000	0.9
4320	DIMeter	1,838,030	1,734,710	1,596,160	1,447,451	1,363,010	103,320	138,550	148,709	84,441	118,755	22%	0.2	240,000	0.5
4323	DIMeter		529,600	53,500	9,534,770	9,109,370		476,100		425,400	450,750	6%	0.9	480000	0.9
4325	DIMeter		129,373		451,350	451,330		129,373		20	64,697	100%	0.1	720000	1.4
4326	DIMeter						0	0	0	0	0	#DIV/0!	0.0	720000	1.4
4328	DIMeter		2,265,570	1,804,750	1,181,100	798,840		460,820	623,650	382,260	488,910	21%	0.9	960000	1.8
4329	DIMeter		1,366,100	1,029,970	801,360	722,840		336,130	228,610	78,520	214,420	49%	0.4	720000	1.4
4330	DIMeter		13,527,727	10	1,721,980	1,706,400		13,527,717	-1,721,970	15,580	3,940,442	173%	7.5	1440000	2.7
4331	DIMeter	4,006,130	3,888,100	3,738,690	3,573,680	3,457,150	118,030	149,410	165,010	116,530	137,245	15%	0.3	720000	1.4
4332	DIMeter		2,931,020		2,931,020	2,931,020				0	0	#DIV/0!	0.0	960,000	1.8
4333	DIMeter	43,870						0	0	0	0	#DIV/0!	0.0	240000	0.5
4335	DIMeter	8,213,440	8,000,780	7,618,720	7,217,170	6,864,410	212,660	382,060	401,550	352,760	337,258	22%	0.6	480000	0.9
4340	DIMeter	727,210	667,150	594,480	525,480	458,740	60,060	72,670	69,000	66,740	67,118	7%	0.1	480000	0.9
4345	DIMeter		5,264,550	4,995,110	4,909,720	4,691,460		269,440	85,390	218,260	191,030	41%	0.4	480000	0.9
4348	DIMeter	3,615,000		3,598,570	3,346,110	3,009,340			252,460	336,770	294,615	14%	0.6	720000	1.4
4350	DIMeter		1,858,880	1,684,820	1,369,390	976,540		174,060	315,430	392,850	294,113	31%	0.6	480000	0.9
4352	DIMeter		529,870						0	0	0	#DIV/0!	0.0	1536000	2.9
4353	DIMeter		3,013,420	3,200,010		3,200,010					#DIV/0!	#DIV/0!	#DIV/0!	360000	0.7
4355	DIMeter		411,868			9,834,810			0		0	#DIV/0!	0.0	1920000	3.7
4359	DIMeter		2,033,281	960,634	1,730,258	1,729,875		1,072,647		383	536,515	100%	1.0	600000	1.1
4360	DIMeter		1,994,777	943,364	1,562,243	1,582,007		1,051,413			1,051,413	0%	2.0	5160000	9.8
4361	DIMeter		7,283,340	6,748,430	6,330,810	5,903,390		534,910	417,620	427,420	459,983	12%	0.9	1,200,000	2.3
4362	DIMeter						0	0	0	0	0	#DIV/0!	0.0		0.0
4363	DIMeter	2,468,430	2,333,720	2,106,870	1,913,640	1,798,020	134,710	226,850	193,230	115,620	167,603	27%	0.3	240000	0.5
4366	DIMeter	71,684,327	386,680	381,200	367,810	199,250		5,480	13,390	168,560	62,477	120%	0.1	240000	0.5
4372	DIMeter	7,247,600	7,128,850	7,011,820	589,900	545,200	118,750	117,030		44,700	93,493	37%	0.2	240000	0.5
4375	DIMeter		7,509,280			5,659,700			0		0	#DIV/0!	0.0	1440000	2.7
4381	DIMeter				2,297,430	2,217,680	0	0		79,750	26,583	141%	0.1	480000	0.9
4383	DIMeter	5,856,670	5,560,010	5,155,250	4,677,600	4,203,930	296,660	404,760	477,650	473,670	413,185	18%	0.8	2400000	4.6
4384	DIMeter		12,380,200	11,091,900	8,964,700	6,840,800		1,288,300	2,127,200	2,123,900	1,846,467	21%	3.5	2160000	4.1
4386	DIMeter		5,485,540	5,274,030	4,757,400	4,090,230		211,510	516,630	667,170	465,103	41%	0.9	480000	0.9
4388	DIMeter						0	0	0	0	0	#DIV/0!	0.0	480000	0.9
4390	DIMeter	19,478,900	18,405,300	10,160,300	9,243,200	8,770,800	1,073,600	8,245,000	917,100	472,400	2,677,025	120%	5.1	720000	1.4
4391	DIMeter	12,489,100	1,091,590	1,723,500	1,763,700	1,763,700				0	0	#DIV/0!	0.0	720000	1.4
4392	DIMeter	1,763,700	1,763,700	1,763,700	1,611,270	1,522,010			152,430	89,260	120,845	26%	0.2	240000	0.5
4393	DIMeter		8,772,620	8,156,030	7,610,730	7,082,850		616,590	545,300	527,880	563,257	7%	1.1	1440000	2.7
4396	DIMeter		157,530	153,331	383,466	353,750		4,199		29,716	16,958	75%	0.0	240000	0.5
4397	DIMeter	7,585,640	7,182,620	6,934,890	6,646,230	6,363,400	403,020	247,730	288,660	282,830	305,560	19%	0.6	240000	0.5
4398	DIMeter	3,451,510	3,063,920	2,752,520	2,440,560	2,169,920	387,590	311,400	311,960	270,640	320,398	13%	0.6	1440000	2.7
4399	DIMeter	1,703,600	1,665,980	1,622,270	1,563,500	1,515,550	37,620	43,710	58,770	47,950	47,013	16%	0.1	840000	1.6
4400	DIMeter	2,240,470	2,159,270	1,988,080	1,799,047	1,696,620	81,200	171,190	189,033	102,427	135,963	33%	0.3	240000	0.5
4401	DIMeter					5,166,110	0	0	0		0	#DIV/0!	0.0	720000	1.4
4407	DIMeter	1,722,080	1,665,200				56,880				56,880	0%	0.1	0	0.0
4408	DIMeter	25,681,831	0	0	0	0					#DIV/0!	#DIV/0!	#DIV/0!	240000	0.5

4409	DIMeter	33,174,559	0	0	0	0	#DIV/0!	#DIV/0!	#DIV/0!	240000	0.5

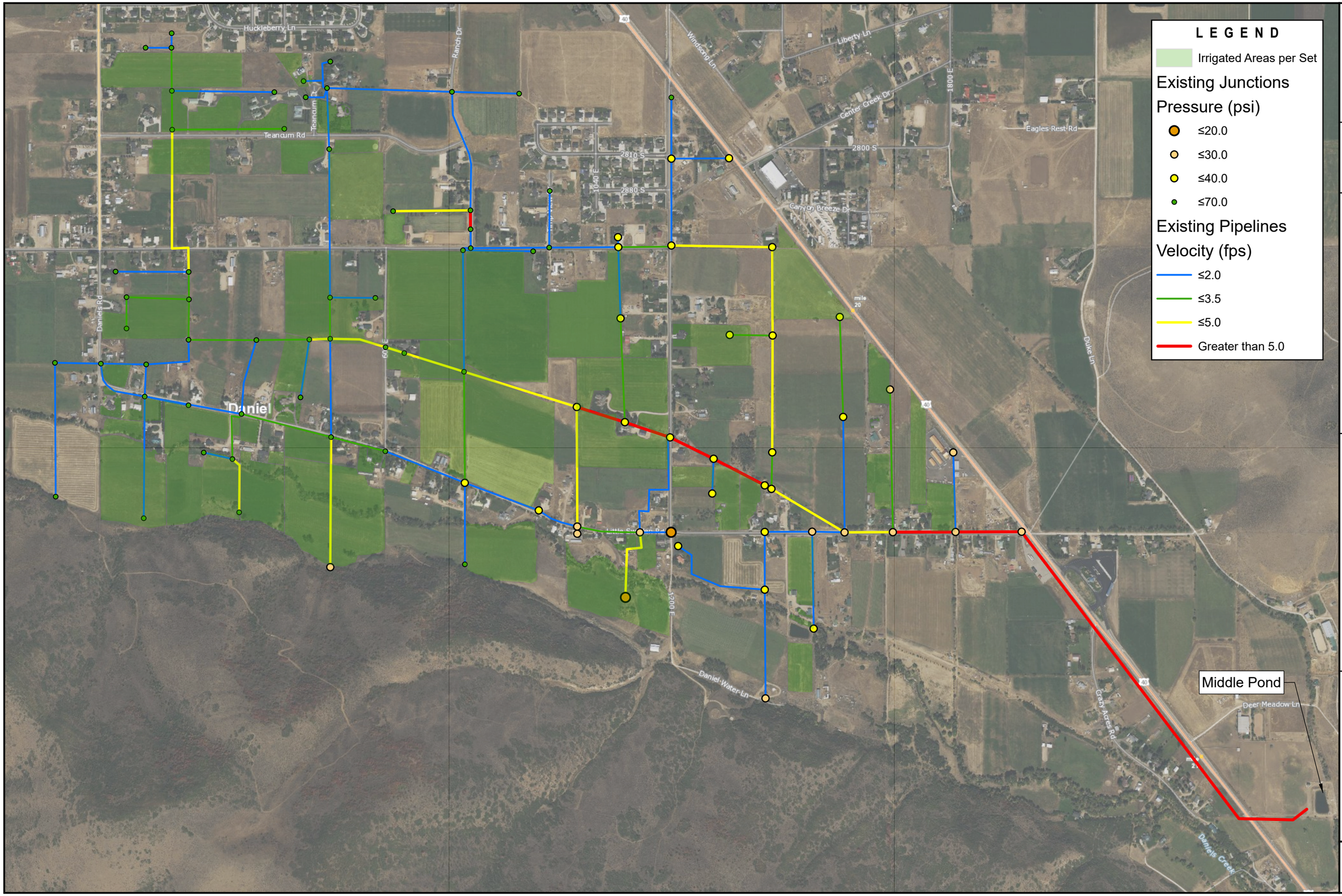
Flow Rate per Set per Field

FIELD	Demand Junction	Ticket Type	Set1	Set2	Set3	Set4	Set5	Set6	Set7	Set8	Set9	Set10	Set11	Set12	Set13	Set14	Set15	Set16	Set17	Set18	Set19	Set20	Set21	Set22	Set23	Set24	Set25	Set26	Set27	Set28	
4201	J220	Daniel	0	0	0	0	0	0	0	0	12	12	12	12	0	0	0	0	0	0	0	0	12	12	12	12	0	0	0	0	96
4202	J152	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4203	J154	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4204	J136	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4205	J1004	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4206	J168	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4207	J42	Daniel	0	36	0	36	0	36	24	36	0	36	0	36	0	36	0	36	0	36	24	36	0	36	0	36	0	0	0	0	480
4208	J42	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4209	J172	Daniel	90	90	90	90	90	90	90	90	90	90	90	12	90	90	90	90	90	90	90	90	90	90	90	12	0	0	0	0	2004
4210	J58	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4211	J124	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4212	J146	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4213	J236	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4214	J1012	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4215	J188	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4216	J1004	Daniel	0	0	120	120	120	78	78	42	24	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	606
4217	J162	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4218	J214	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4219	J220	Daniel	0	0	0	24	24	24	0	0	0	0	0	0	0	0	0	24	24	24	0	0	0	0	0	0	0	0	0	0	144
4220	J130	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4221	J138	Daniel	30	90	90	90	90	90	0	0	0	0	0	0	30	90	90	90	90	90	0	0	0	0	0	0	0	0	0	0	960
4222	J218	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4223	J42	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4224	J132	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4225	J138	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4226	J160	Daniel	0	0	18	18	18	18	18	18	18	0	0	0	0	0	18	18	18	18	18	18	18	0	0	0	0	0	0	0	252
4227	J142	Daniel	30	30	0	0	0	0	0	0	0	0	0	54	54	54	30	30	0	0	0	0	0	0	0	0	0	54	54	54	444
4228	J142	Daniel	0	0	0	0	54	54	54	18	0	0	0	0	0	0	0	0	54	54	54	18	0	0	0	0	0	0	0	0	360
4229	J138	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4230	J12	Daniel	0	12	12	12	12	12	12	12	12	12	18	0	0	12	12	12	12	12	12	12	12	12	18	0	0	0	0	0	252
4231	J172	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4232	J192	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4233	J134	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4234	J42	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4235	J138	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4236	J152	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4237	J1012	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4238	J146	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4239	J146	Daniel	72	6	72	0	72	0	72	0	72	0	72	0	72	6	72	0	72	0	72	0	72	0	72	0	0	0	0	0	876
4240	J130	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4241	J162	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4242	J164	Daniel	40	40	40	40	40	40	40	40	36	36	36	36	40	40	40	40	40	40	40	40	36	36	36	36	0	0	0	0	928
4243	J194	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4244	J194	Daniel	30	0	0	0	0	0	30	0	0	0	0	0	30	0	0	0	0	0	30	0	0	0	0	0	0	0	0	0	120
4245	J236	Daniel	0	0	0	0	0	0	0	72	72	72	72	72	0	0	0	0	0	0	0	72	72	72	72	72	0	0	0	0	720
4246	J194	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4247	J194	Daniel	0	54	54	12	0	0	0	0	0	0	0	0	0	54	54	12	0	0	0	0	0	0	0	0	0	0	0	0	240
4248	J194	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4249	J194	Daniel	0	0	0	0	0	114	108	108	0	0	0	0	0	0	0	0	0	114	108	108	0	0	0	0	0	0	0	0	660
4250	J152	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4251	J156	Daniel	0	0	0	0	0	30	108	108	108	108	108	108	0	0	0	0	0	30	108	108	108	108	108	108	0	0	0	0	1356
4252	J194	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4253	J220	Daniel	0	0	6	12	12	18	18	12	12	0	0	0	0	0	6	12	12	18	18	12	12	0	0	0	0	0	0	0	180
4254	J138	None	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4255	J138	Daniel	0	0	0	0	0	0	0	60	90	90	90	90	0	0	0	0	0	0	0	60	90	90	90	90	0	0	0	0	840
4256	J144	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4257	J148	Daniel	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	0	0	0	0	2448
4258	J192	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4259	J194	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4260	J194	Daniel	78	78	78	78	0	0	0	0	0	0	0	0	78	78	78	78	0	0	0	0	0	0	0	0	0	0	0	0	624
4261	J110	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4262	J110	Daniel	0	156	48	48	48	78	0	0	0	0	0	0	0	156	48	48	48	78	0	0	0	0	0	0	0	0	0	0	756
4263	J146	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4264	J194	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4265	J214	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4266	J214	Daniel	120	60	0	0	0	0	0	0	0	0	0	0	120	60	0	0	0	0	0	0	0	0	0	0	0	0	0	0	360
4267	J168	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4268	J168	Daniel	0	0	0	0	0	0	0	0	6	18	18	18	0	0	0	0	0	0	0	0	6	18	18	18	0	0	0	0	120
4269	J214	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4270	J214	Daniel	0	0	0	48	0	0	0	0	48	0	0	0	0	0	0	48	0	0	0	0	48	0	0	0	0	0	0	0	192
4271	J138	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4272	J194	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4273	J194	Daniel	0	0	0	0	0	0	0	0	0	0	0	66	0	0	0	0	0	0	0	0	0	0	0	66	0	0	0	0	132
4274	J220	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4275	J226	None	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4276	J158	Daniel	162	162	162	162	162	162	162	162	162	162	156	0	162	162	162	162	162	162	162	162	162	162	156	0	0	0	0	0	3552

FIELD	Demand Junction	Ticket Type	Set1	Set2	Set3	Set4	Set5	Set6	Set7	Set8	Set9	Set10	Set11	Set12	Set13	Set14	Set15	Set16	Set17	Set18	Set19	Set20	Set21	Set22	Set23	Set24	Set25	Set26	Set27	Set28	
4277	J234	Daniel	0	0	0	0	42	42	42	42	42	42	0	0	0	0	0	0	42	42	42	42	42	42	0	0	0	0	0	0	504
4278	J214	Daniel	72	72	72	72	72	72	0	0	0	0	0	72	72	72	72	72	0	0	0	0	0	0	0	0	0	0	0	0	792
4279	J28	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4280	J28	Daniel	66	0	66	0	66	0	66	0	78	0	78	0	66	0	66	0	66	0	66	0	78	0	78	0	0	0	0	0	840
4281	J220	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4282	J220	Daniel	0	44	44	44	44	44	44	44	44	44	44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	440
4283	J54	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4284	J210	Daniel	0	0	0	0	0	48	48	92	88	84	48	48	48	32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	536
4285	J102	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4286	J124	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4287	J124	Daniel	41	0	0	0	0	0	0	0	41	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	82
4288	J134	Daniel	0	0	0	0	0	0	0	0	0	40	40	40	0	0	0	0	0	0	0	0	0	0	40	40	40	0	0	0	240
4289	J58	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4290	J58	Daniel	0	60	0	0	0	0	0	0	0	0	0	0	0	60	0	0	0	0	0	0	0	0	0	0	0	0	0	0	120
4291	J160	Daniel	36	36	0	0	0	0	0	30	30	30	30	30	36	36	0	0	0	0	0	30	30	30	30	30	0	0	0	0	444
4292	J192	Daniel	0	0	0	0	54	0	0	0	0	0	0	0	0	0	0	0	54	0	0	0	0	0	0	0	0	0	0	0	108
4293	J192	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4294	J192	Daniel	0	144	0	0	0	0	0	0	0	0	0	0	0	0	0	144	0	0	0	0	0	0	0	0	0	0	0	0	288
4295	J118	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4296	J136	Daniel	0	0	60	60	60	60	60	54	54	0	0	0	0	0	60	60	60	60	60	54	54	0	0	0	0	0	0	0	816
4297	J42	Daniel	0	0	0	0	0	60	60	60	60	60	60	60	0	0	0	0	0	60	60	60	60	60	60	60	0	0	0	0	840
4298	J236	Daniel	18	18	18	24	0	0	0	0	0	0	0	0	18	18	18	24	0	0	0	0	0	0	0	0	0	0	0	0	156
4299	J218	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4300	J188	Daniel	52	0	4	4	4	0	76	76	76	52	52	52	52	0	4	4	4	0	76	76	76	52	52	52	0	0	0	0	896
4301	J164	Daniel	138	138	138	126	96	96	96	96	96	96	0	0	138	138	138	126	96	96	96	96	96	96	0	0	0	0	0	0	2232
4302	J152	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4303	J124	Daniel	114	114	114	114	114	114	114	90	0	0	0	114	114	114	114	114	114	114	114	90	0	0	0	0	0	0	0	0	1776
4304	J102	Daniel	0	0	0	0	66	102	102	102	102	102	102	102	0	0	0	0	66	102	102	102	102	102	102	102	0	0	0	0	1560
4305	J42	Daniel	0	0	0	42	42	42	42	42	42	42	42	42	0	0	0	42	42	42	42	42	42	42	42	42	0	0	0	0	756
4306	J132	Daniel	138	138	54	0	0	0	0	0	0	0	0	0	138	138	54	0	0	0	0	0	0	0	0	0	0	0	0	0	660
4307	J132	Daniel	0	0	0	0	0	0	0	0	66	66	66	66	66	0	0	0	0	0	0	66	66	66	66	66	0	0	0	0	660
4308	J134	Daniel	60	60	60	60	60	60	60	60	0	0	0	0	60	60	60	60	60	60	60	60	0	0	0	0	0	0	0	0	960
4309	J138	DIMeter	0	0	0	0	0	0	78	78	78	78	6	0	0	0	0	0	0	0	6	78	78	78	78	6	0	0	0	0	642
4310	J54	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4311	J54	Daniel	30	24	0	0	0	0	0	0	0	0	30	30	30	30	30	24	0	0	0	0	0	0	0	0	30	30	30	30	348
4312	J192	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4313	J190	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4314	J10	Daniel	0	78	78	78	78	150	150	150	150	0	0	0	0	78	78	78	78	150	150	150	150	0	0	0	0	0	0	0	1824
4315	J1012	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4316	J1012	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4317	J134	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4318	J134	Daniel	0	0	0	0	0	0	0	0	0	60	90	0	0	0	0	0	0	0	0	0	0	60	90	0	0	0	0	0	300
4319	J10	Daniel	0	0	120	120	0	0	0	0	0	0	0	0	0	0	120	120	0	0	0	0	0	0	0	0	0	0	0	0	480
4320	J98	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4322	J214	Daniel	6	6	6	0	0	0	0	0	0	0	0	6	6	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	36
4323	J114	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4324	J114	Daniel	0	0	0	0	0	0	0	0	0	78	78	48	0	0	0	0	0	0	0	0	0	78	78	48	0	0	0	0	408
4325	J114	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4326	J122	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4327	J122	Daniel	120	120	120	120	0	0	120	120	120	120	120	0	120	120	120	120	0	0	120	120	120	120	120	0	0	0	0	0	2160
4328	J194	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4329	J102	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4330	J120	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4331	J226	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4332	J108	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4333	J98	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4334	J142	Daniel	0	0	24	24	0	0	0	0	0	0	0	0	0	0	24	24	0	0	0	0	0	0	0	0	0	0	0	0	96
4335	J98	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4336	J98	Daniel	36	36	36	36	6	0	0	0	0	0	0	0	36	36	36	36	6	0	0	0	0	0	0	0	0	0	0	0	300
4337	J226	Daniel	66	0	0	0	0	0	0	0	66	0	60	0	66	0	0	0	0	0	0	0	66	0	60	0	0	0	0	0	384
4338	J226	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4339	J48	Daniel	0	0	0	0	0	0	0	48	48	48	48	0	0	0	0	0	0	0	0	48	48	48	48	0	0	0	0	0	384
4340	J176	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4341	J176	Daniel	0	180	180	180	180	180	180	180	180	150	120	0	0	180	180	180	180	180	180	180	180	150	120	0	0	0	0	0	3420
4342	J174	Daniel	0	0	0	0	0	0	0	12	12	12	12	12	0	0	0	0	0	0	0	12	12	12	12	12	0	0	0	0	120
4343	J54	Daniel	0	0	0	0	0	18	18	18	18	18	0	0	0	0	0	0	0	18	18	18	18	18	0	0	0	0	0	0	180
4344	J212	Daniel	0	0	42	192	192	192	192	192	192	192	192	192	0	0	42	192	192	192	192	192	192	192	192	192	0	0	0	0	3540
4345	J192	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4346	J34	Daniel	66	66	66	66	66	66	66	66	18	0	0	0	66	66	66	66	66	66	66	66	18	0	0	0	0	0	0	0	1092
4347	J30	Daniel	180	186	186	186	186	186	186	186	186	186	186	180	180	186	186	186	186	186	186	186	186	186	186	180	0	0	0	0	4440
4348	J130	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4349	J30	Daniel	120	120	120	120	120	120	120	120	120	126	126	126	120	120	120	120	120	120	120	120	120	126	126	126	0	0	0	0	2916
4350	J120	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4351	J120	Daniel	0	0	0	0	0	0	18	30	30	30	30	30	0	0	0	0	0	0	18	30	30	30	30	30	0	0	0	0	336
4352	J120	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4353	J218	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4354	J120	Daniel	0	0	0	0	0	36	0	0	0	0	0	42	0	0	0	0	0	36	0	0	0	0	0	42	0	0	0	0	156

FIELD	Demand Junction	Ticket Type	Set1	Set2	Set3	Set4	Set5	Set6	Set7	Set8	Set9	Set10	Set11	Set12	Set13	Set14	Set15	Set16	Set17	Set18	Set19	Set20	Set21	Set22	Set23	Set24	Set25	Set26	Set27	Set28	
4355	J124	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4356	J192	Daniel	0	0	0	0	0	12	12	6	0	0	0	0	0	0	0	0	0	12	12	6	0	0	0	0	0	0	0	0	60
4357	J218	Daniel	78	78	78	78	0	0	0	0	0	0	0	0	78	78	78	78	0	0	0	0	0	0	0	0	0	0	0	0	624
4359	J118	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4360	J106	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4361	J42	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4362	J146	Daniel	0	0	0	0	0	0	0	0	6	18	18	18	0	0	0	0	0	0	0	0	6	18	18	18	0	0	0	0	120
4363	J142	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4364	J140	Daniel	0	0	150	150	150	150	120	108	78	72	42	0	0	0	150	150	150	150	120	108	78	72	42	0	0	0	0	0	2040
4365	J98	Daniel	168	0	0	0	0	0	0	0	0	0	0	0	168	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	336
4366	J98	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4369	J154	Daniel	150	90	0	150	150	150	150	150	150	150	150	150	150	90	0	150	150	150	150	150	150	150	150	150	0	0	0	0	3180
4370	J144	Daniel	96	96	96	96	96	96	96	96	96	24	0	0	96	96	96	96	96	96	96	96	96	24	0	0	0	0	0	0	1776
4371	J152	Daniel	6	6	6	6	6	6	6	6	6	6	0	0	6	6	6	6	6	6	6	6	6	6	0	0	0	0	0	0	120
4372	J152	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4373	J152	Daniel	6	6	6	0	0	0	0	0	0	0	0	0	6	6	6	0	0	0	0	0	0	0	0	0	0	0	0	0	36
4374	J110	Daniel	0	0	54	54	54	54	54	0	0	0	0	0	0	0	54	54	54	54	54	0	0	0	0	0	0	0	0	0	540
4375	J102	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4376	J142	Daniel	30	0	0	0	0	0	0	0	0	0	0	0	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	60
4377	J96	Daniel	114	114	114	0	0	0	0	0	0	0	0	0	114	114	114	0	0	0	0	0	0	0	0	0	0	0	0	0	684
4378	J98	Daniel	0	0	0	0	0	0	0	0	66	108	108	156	0	0	0	0	0	0	0	0	66	108	108	156	0	0	0	0	876
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4380	J102	Daniel	18	18	0	0	0	0	0	0	0	6	18	18	18	18	0	0	0	0	0	0	0	6	18	18	0	0	0	0	156
4381	J198	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4382	J202	Daniel	192	180	180	180	108	0	0	0	0	0	0	0	192	180	180	180	108	0	0	0	0	0	0	0	0	0	0	0	1680
4383	J204	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4384	J112	DIMeter	36	0	0	0	0	0	36	0	36	0	30	0	36	0	0	0	0	0	36	0	36	0	30	0	0	0	0	0	276
4385	J180	Daniel	24	24	24	24	24	24	24	24	0	0	0	0	24	24	24	24	24	24	24	24	0	0	0	0	0	0	0	0	384
4386	J112	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4388	J182	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4389	J182	Daniel	0	0	0	0	12	12	12	12	18	18	18	18	0	0	0	0	12	12	12	12	18	18	18	18	0	0	0	0	240
4390	J216	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4391	J200	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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4394	J98	Daniel	90	84	84	0	0	0	0	0	0	0	0	0	90	84	84	0	0	0	0	0	0	0	0	0	0	0	0	0	516
4395	J106	Daniel	0	0	0	0	120	120	78	0	0	0	0	0	0	0	0	0	120	120	120	78	0	0	0	0	0	0	0	0	756
4396	J136	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4397	J222	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4398	J214	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4399	J42	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4400	J98	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4401	J122	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4402	J162	Daniel	0	0	0	0	0	24	6	0	6	0	6	0	0	0	0	0	0	24	6	0	6	0	6	0	0	0	0	0	84
4403	J196	Daniel	84	0	84	0	84	0	108	0	0	0	0	0	84	0	84	0	84	0	108	0	0	0	0	0	0	0	0	0	720
4404	J214	Daniel	0	0	0	0	0	0	156	156	156	156	156	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	780
4405	J146	Daniel	18	18	18	18	18	18	18	18	0	0	0	18	18	18	18	18	18	18	18	0	0	0	0	0	0	0	0	0	288
4406	J108	Daniel	0	0	0	0	0	0	144	108	56	0	0	0	0	0	0	0	0	0	0	0	0	144	108	56	0	0	0	0	616
4407	J132	DIMeter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4408	J1004	DIMeter	0	0	0	0	0	0	120	120	120	54	54	0	0	0	0	0	0	0	120	120	120	54	54	0	0	0	0	0	936
4409	J1004	DIMeter	0	0	0	0	0	0	120	120	120	54	54	0	0	0	0	0	0	0	120	120	120	54	54	0	0	0	0	0	936

APPENDIX C
HYDRAULIC MODEL RESULTS



SCALE: 1 in = 800 ft

NORTH:

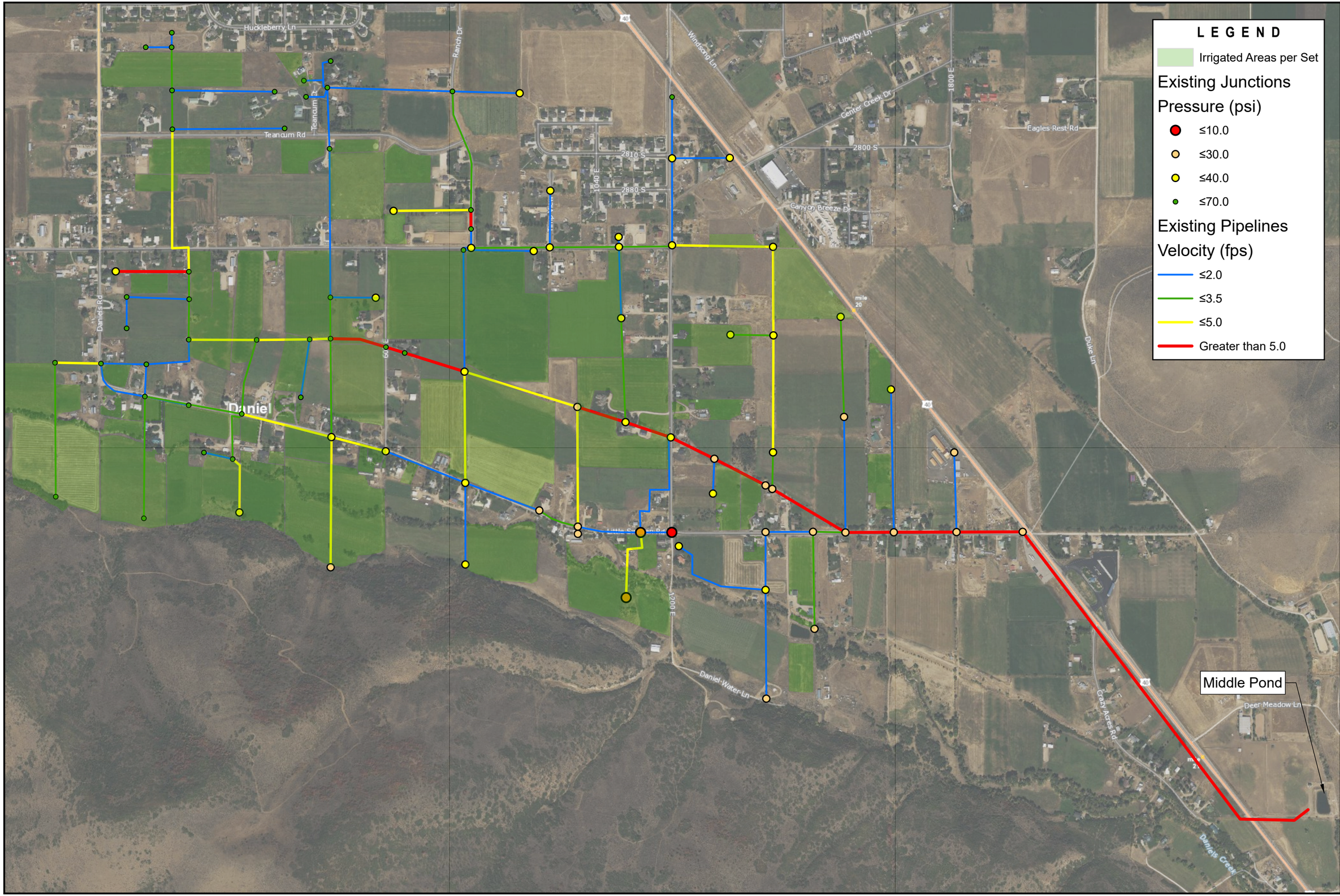
EXISTING DEFICIENCIES
SET 1 (DAY 1, AM)

WASATCH COUNTY
DANIEL IRRIGATION PROJECT

BOWEN COLLINS & ASSOCIATES

FIGURE NO.
A1

P:\Wasatch County\627-19-01 Tri-Valley Watershed Plan EA\6.0 Reports\01 - Daniels Irrigation\GIS\DanielsIrrigation\DanielsIrrigation.aprx cmoutrie 11/6/2020



SCALE: 1 in = 800 ft

NORTH:

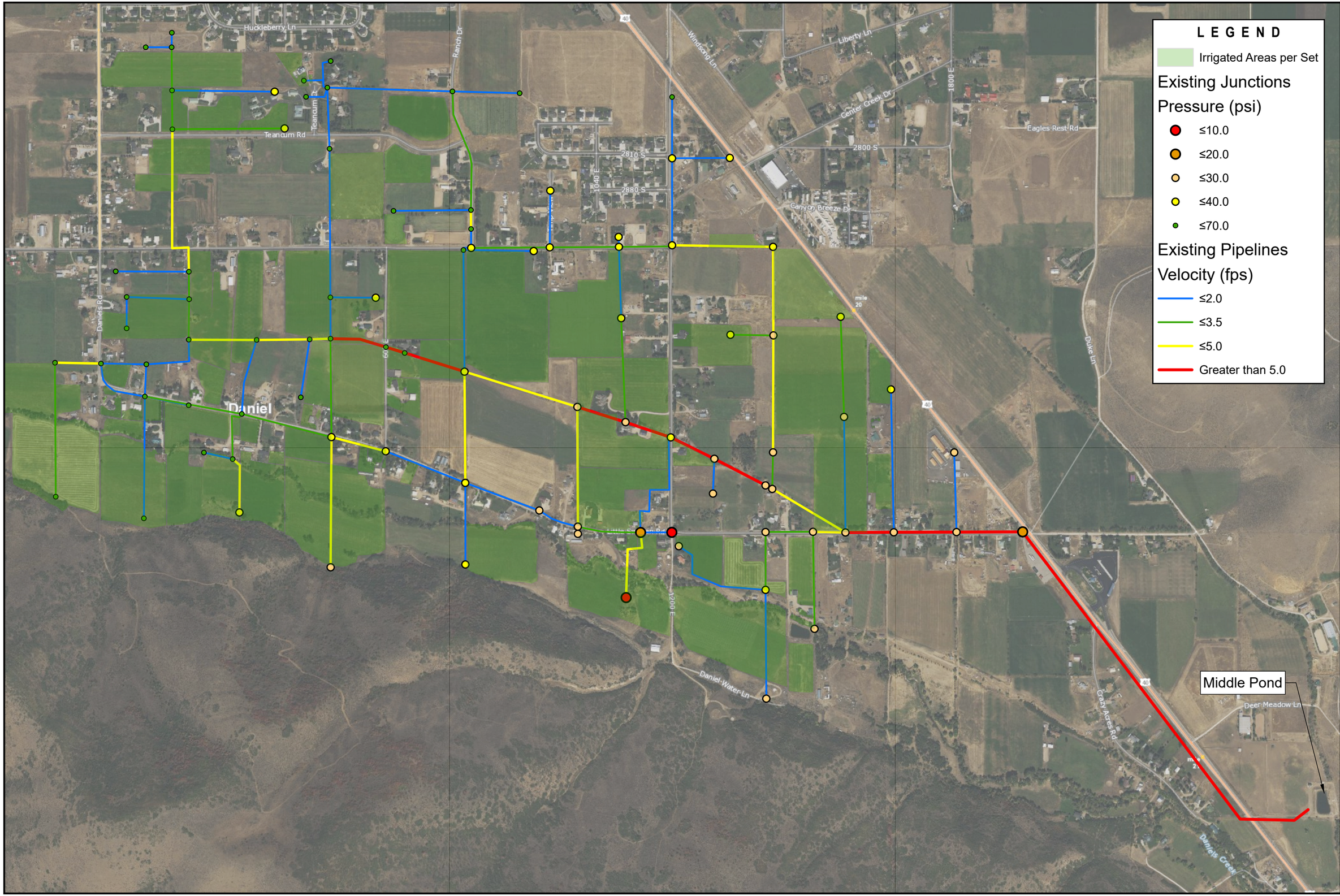
EXISTING DEFICIENCIES
SET 2 (DAY 1, PM)

WASATCH COUNTY
DANIEL IRRIGATION PROJECT

BOWEN COLLINS & ASSOCIATES

FIGURE NO.
A2

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SCALE: 1 in = 800 ft

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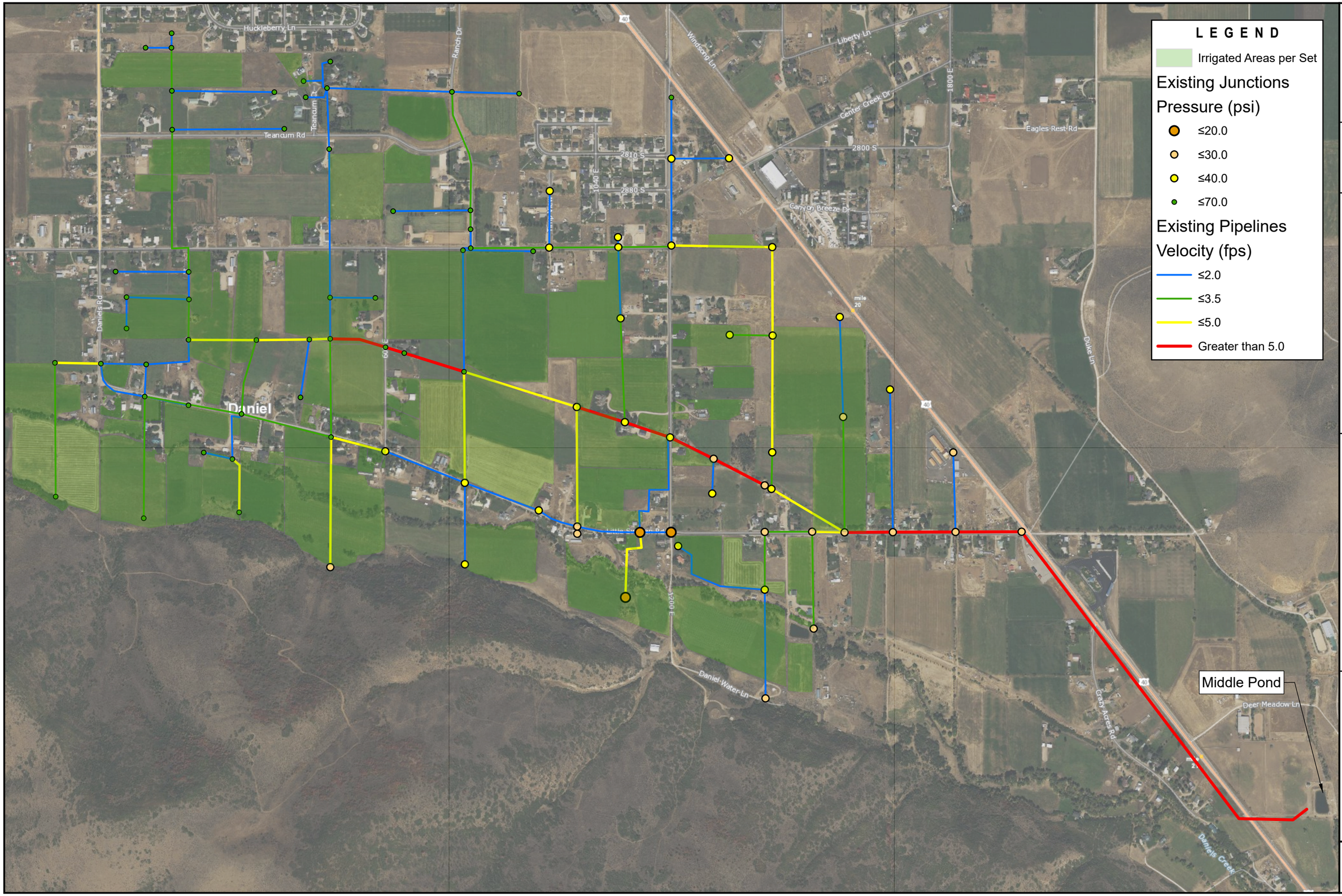
EXISTING DEFICIENCIES
SET 3 (DAY 2, AM)

WASATCH COUNTY
DANIEL IRRIGATION PROJECT

BOWEN COLLINS & ASSOCIATES

FIGURE NO.
A3

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SCALE: 1 in = 800 ft

NORTH:

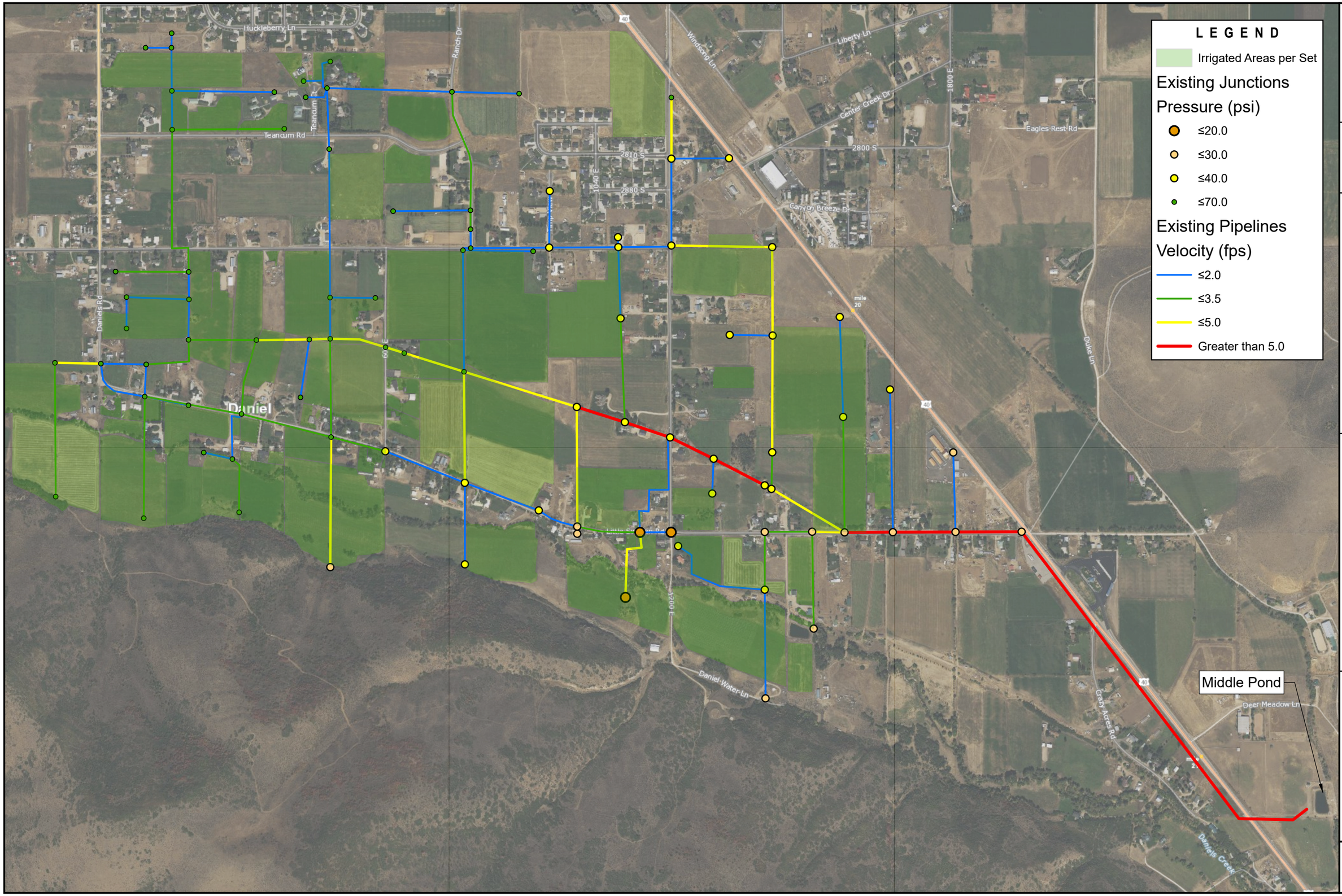
EXISTING DEFICIENCIES
SET 4 (DAY 2, PM)

WASATCH COUNTY
DANIEL IRRIGATION PROJECT

BOWEN COLLINS & ASSOCIATES

FIGURE NO.
A4

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SCALE: 1 in = 800 ft

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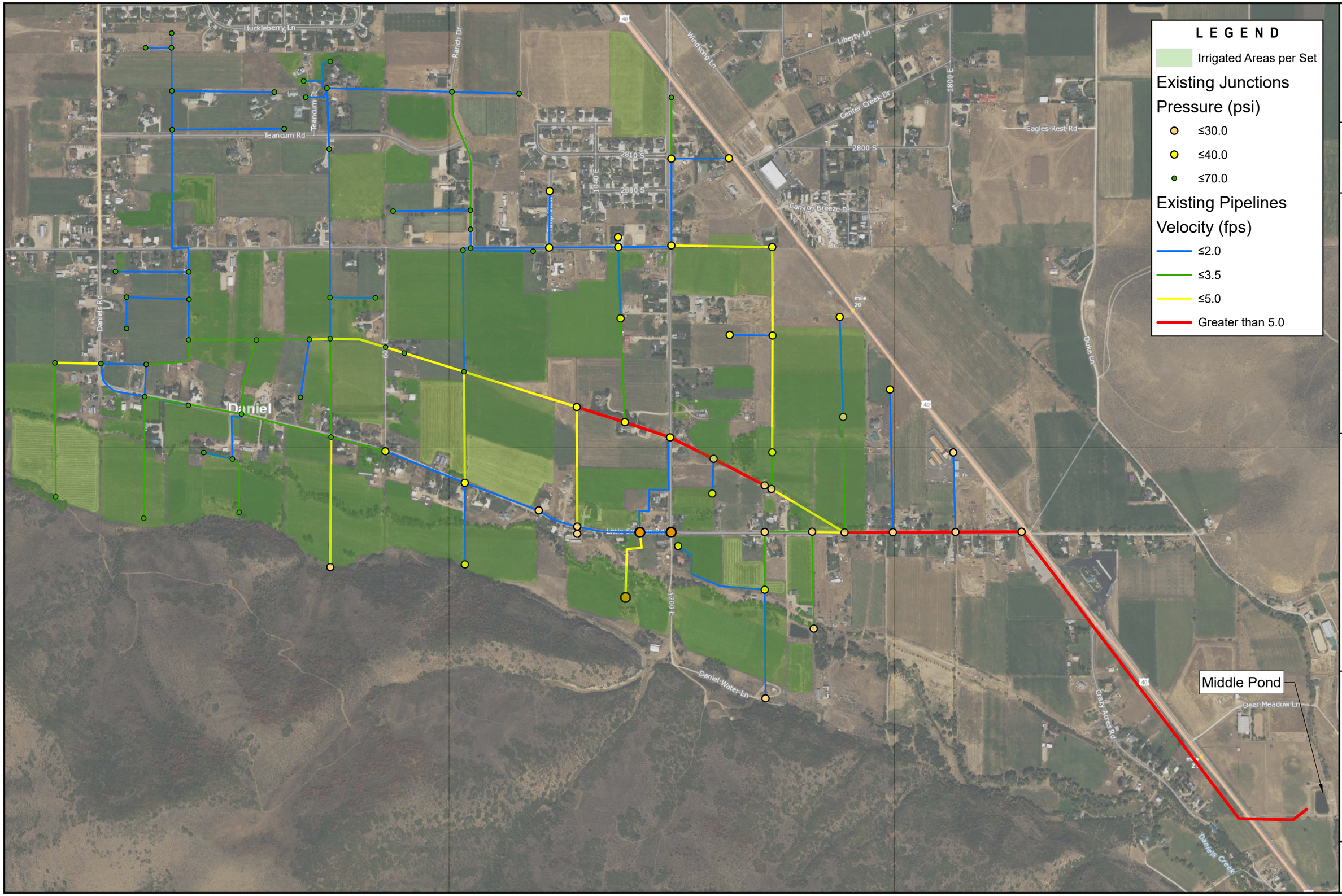
EXISTING DEFICIENCIES
SET 5 (DAY 3, AM)

WASATCH COUNTY
DANIEL IRRIGATION PROJECT

BOWEN COLLINS & ASSOCIATES

FIGURE NO.
A5

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SCALE: 1 in = 800 ft

NORTH:

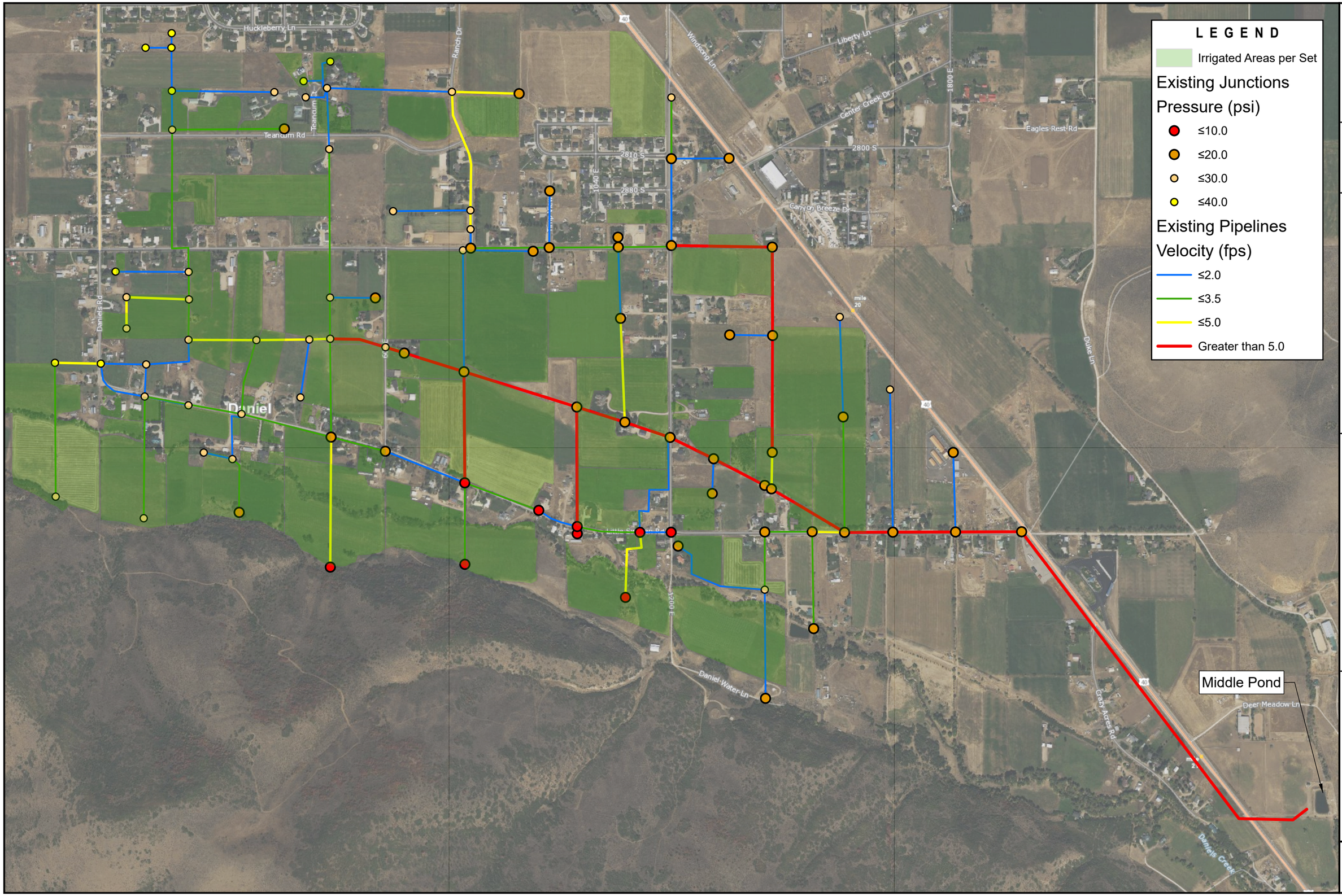
EXISTING DEFICIENCIES
SET 6 (DAY 3, PM)

WASATCH COUNTY
DANIEL IRRIGATION PROJECT

BOWEN COLLINS & ASSOCIATES

FIGURE NO.
A6

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SCALE: 1 in = 800 ft

NORTH:

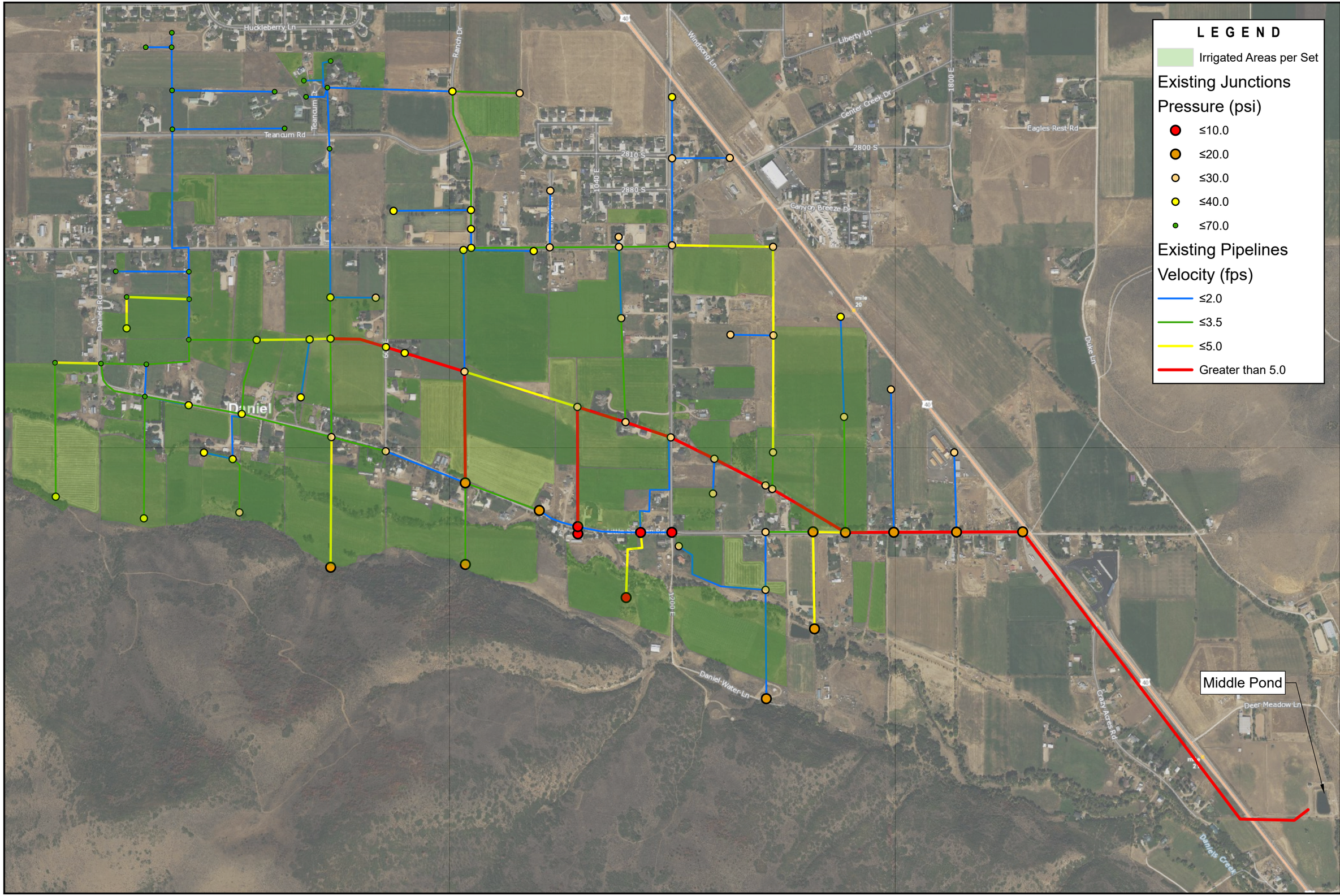
EXISTING DEFICIENCIES
SET 7 (DAY 4, AM)

WASATCH COUNTY
DANIEL IRRIGATION PROJECT

BOWEN COLLINS & ASSOCIATES

FIGURE NO.
A7

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SCALE: 1 in = 800 ft

NORTH:

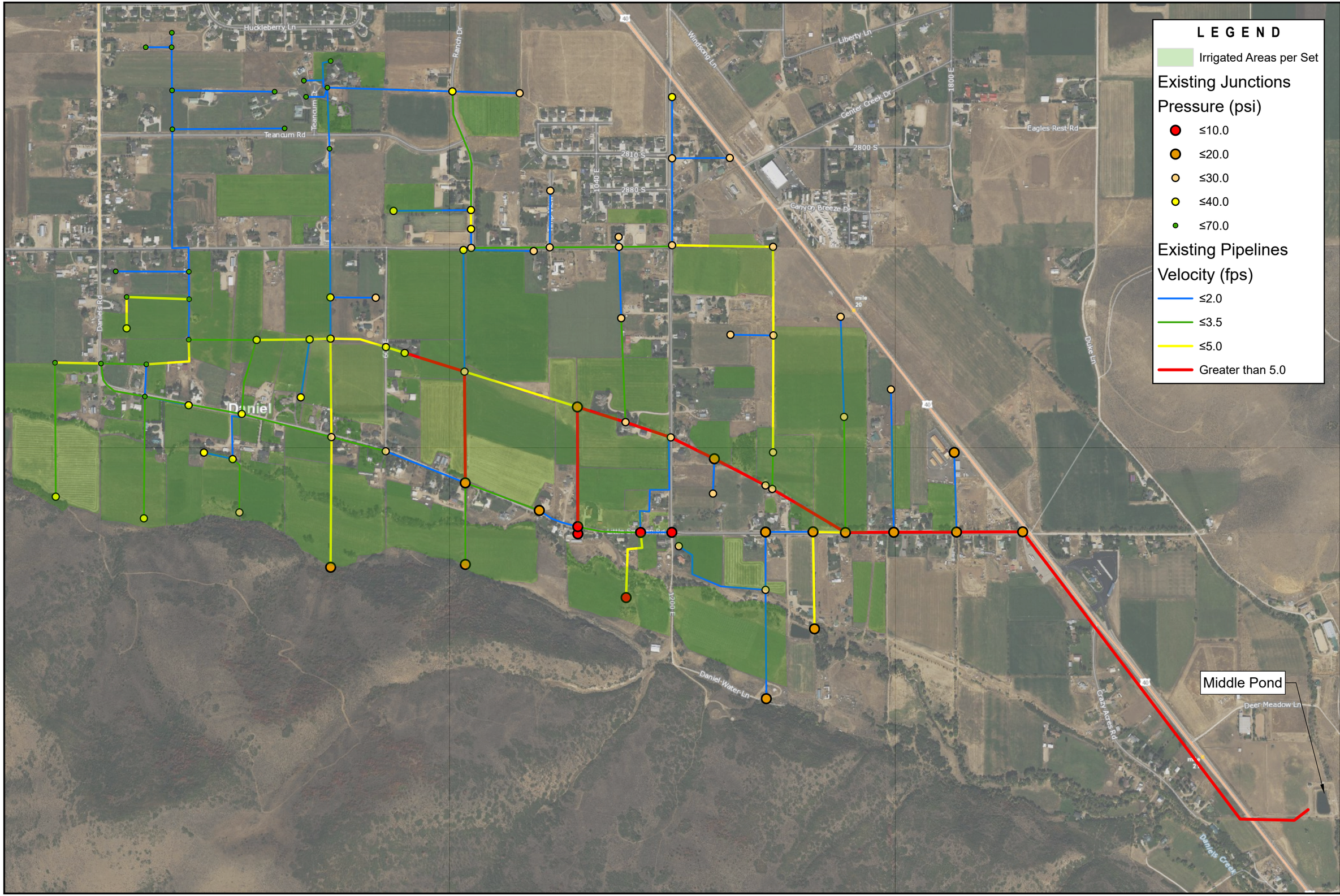
EXISTING DEFICIENCIES
SET 8 (DAY 4, PM)

WASATCH COUNTY
DANIEL IRRIGATION PROJECT

BOWEN COLLINS & ASSOCIATES

FIGURE NO.
A8

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SCALE: 1 in = 800 ft

NORTH:

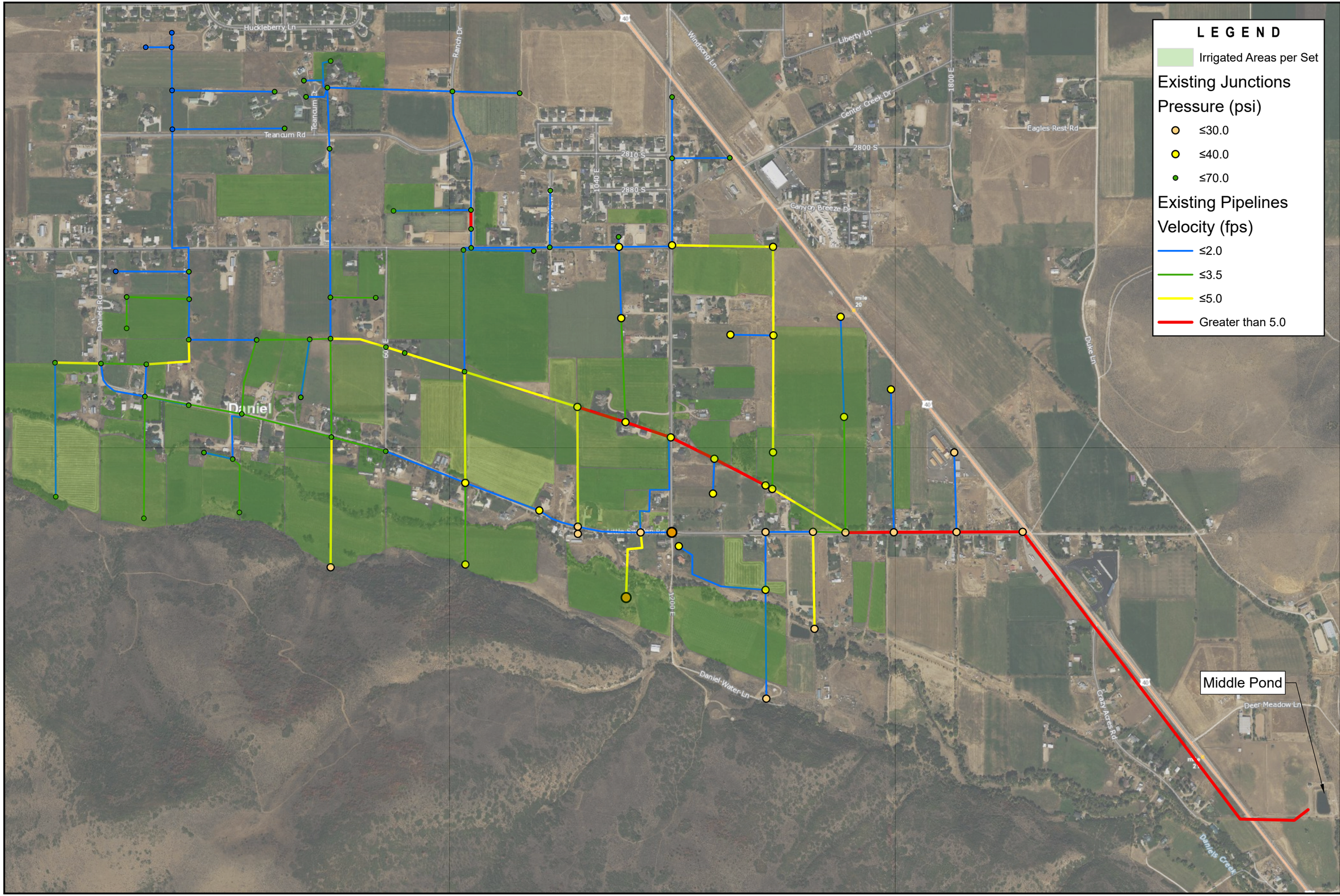
EXISTING DEFICIENCIES
SET 9 (DAY 5, AM)

WASATCH COUNTY
DANIEL IRRIGATION PROJECT

BOWEN COLLINS & ASSOCIATES

FIGURE NO.
A9

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SCALE: 1 in = 800 ft

NORTH:

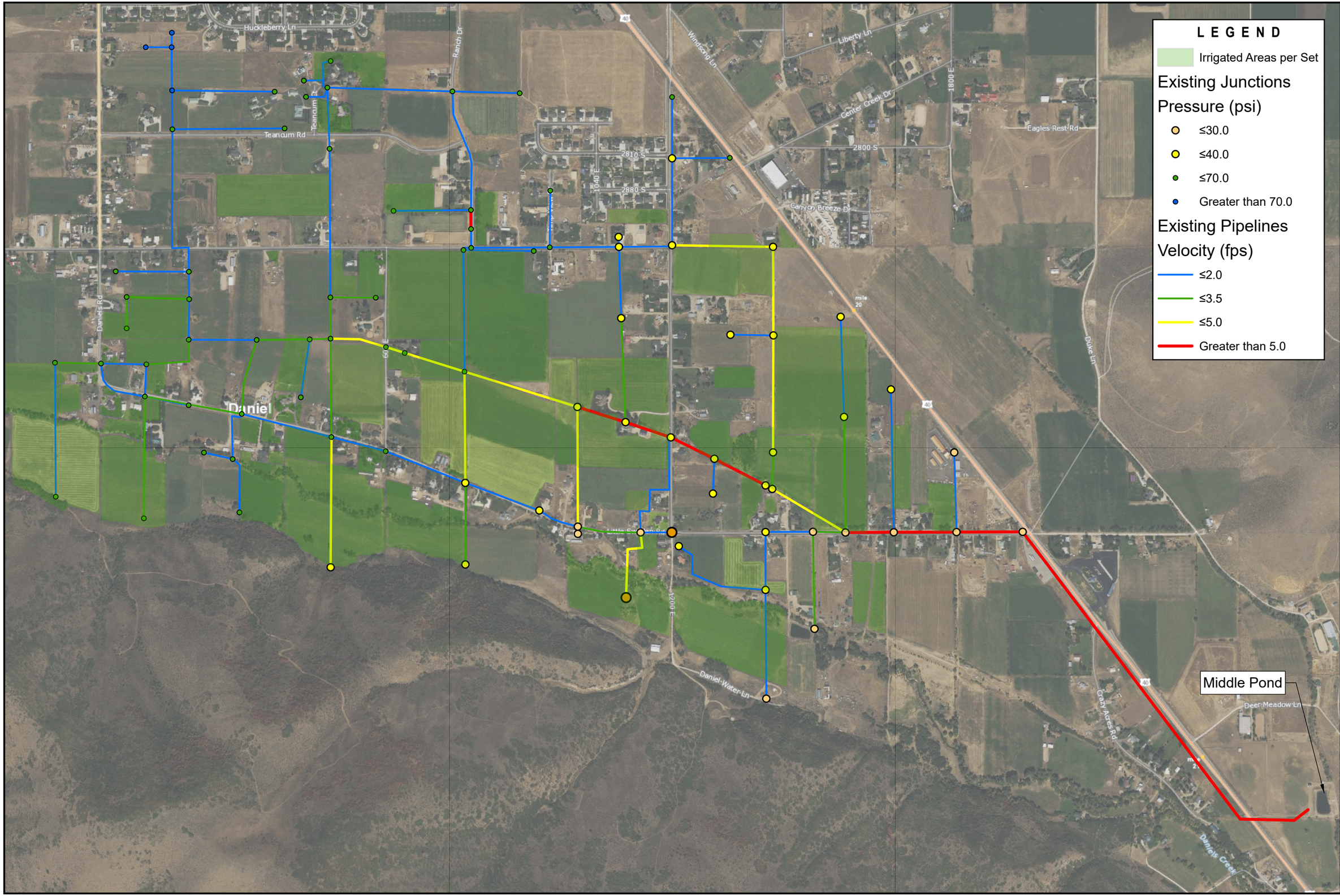
EXISTING DEFICIENCIES
SET 10 (DAY 5, PM)

WASATCH COUNTY
DANIEL IRRIGATION PROJECT

BOWEN COLLINS & ASSOCIATES

FIGURE NO.
A10

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SCALE: 1 in = 800 ft

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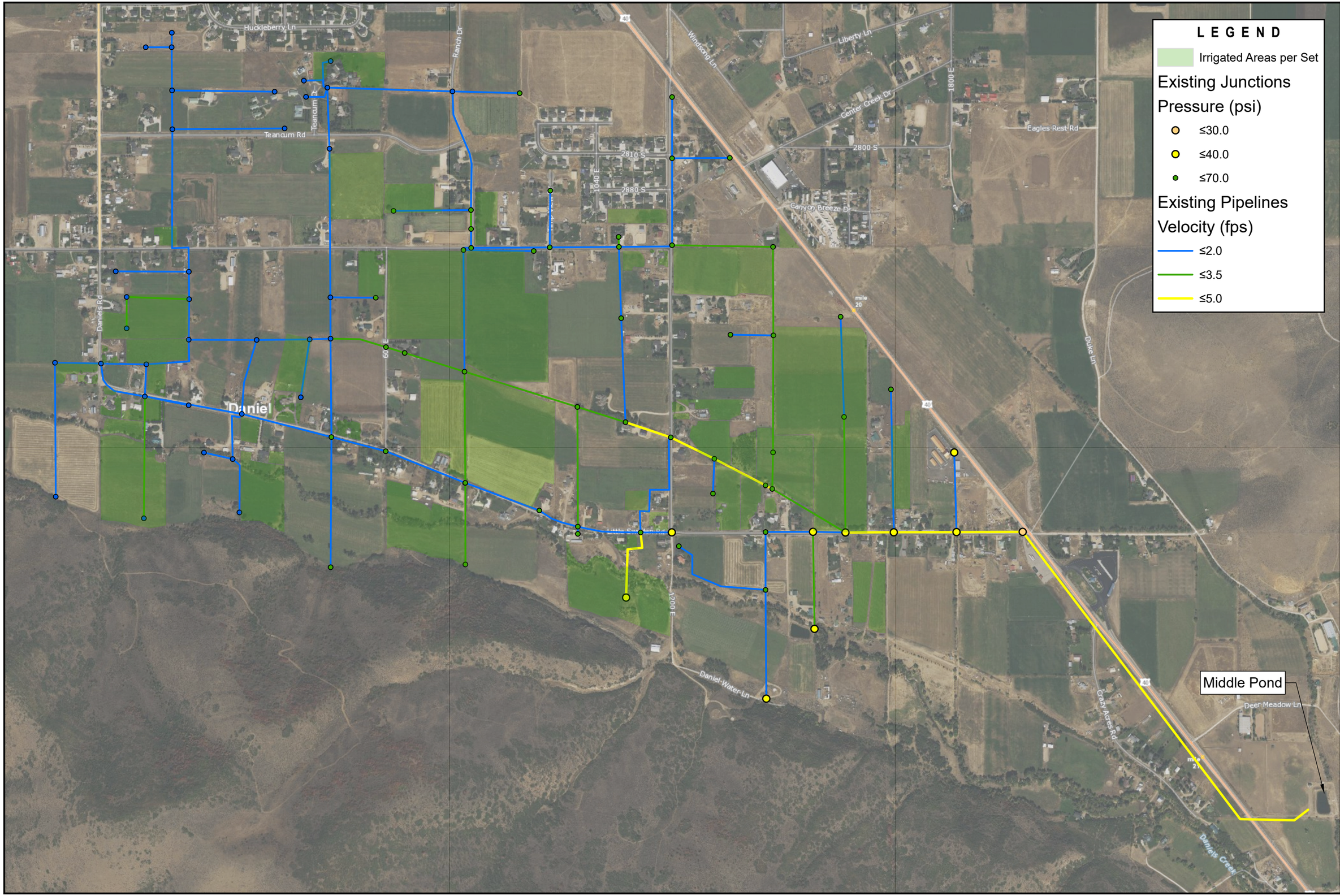
EXISTING DEFICIENCIES
SET 11 (DAY 6, AM)

WASATCH COUNTY
DANIEL IRRIGATION PROJECT

BOWEN COLLINS & ASSOCIATES

FIGURE NO.
A11

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SCALE: 1 in = 800 ft

NORTH:

EXISTING DEFICIENCIES
SET 12 (DAY 6, PM)

WASATCH COUNTY
DANIEL IRRIGATION PROJECT

BOWEN COLLINS & ASSOCIATES

FIGURE NO.
A12

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LEGEND

Irrigated Areas per Set

Existing Junctions

Pressure (psi)

- ≤10.0
- ≤30.0
- ≤40.0
- ≤70.0

Existing Pipelines

Velocity (fps)

- ≤2.0
- ≤3.5
- ≤5.0
- Greater than 5.0

Middle Pond

SCALE: 1 in = 800 ft

NORTH:

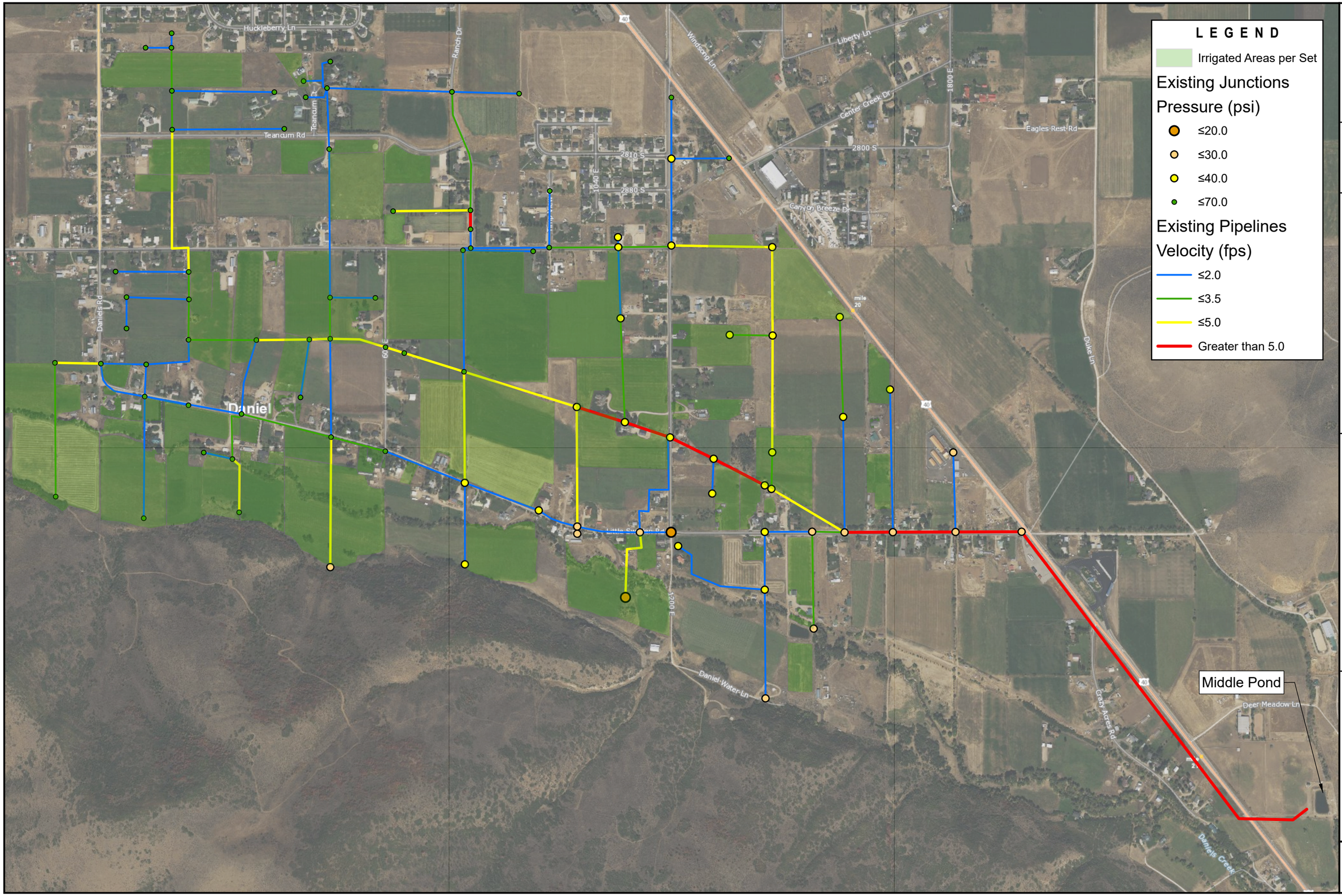
EXISTING DEFICIENCIES
SET 13 (DAY 7, AM)

WASATCH COUNTY
DANIEL IRRIGATION PROJECT

BOWEN COLLINS & ASSOCIATES

FIGURE NO.
A13

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SCALE: 1 in = 800 ft

NORTH:

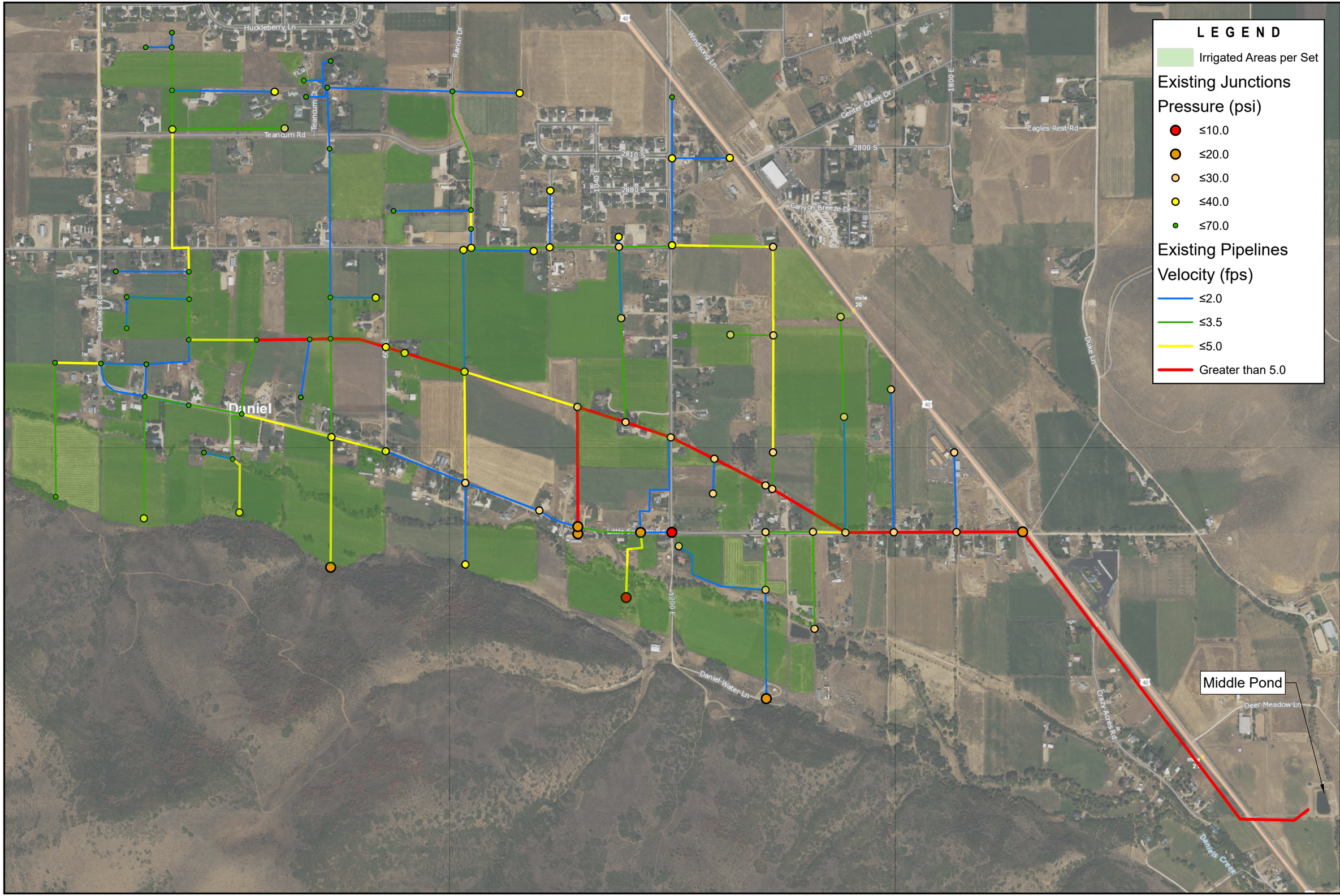
EXISTING DEFICIENCIES
SET 14 (DAY 7, PM)

WASATCH COUNTY
DANIEL IRRIGATION PROJECT

BOWEN COLLINS & ASSOCIATES

FIGURE NO.
A14

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SCALE: 1 in = 800 ft

NORTH:

EXISTING DEFICIENCIES
SET 15 (DAY 8, AM)

WASATCH COUNTY
DANIEL IRRIGATION PROJECT

BOWEN COLLINS & ASSOCIATES

FIGURE NO.
A15

P:\Wasatch County\627-19-01 Tri-Valley Watershed Plan EA\6.0 Reports\01 - Daniels Irrigation\GIS\DanielsIrrigation\DanielsIrrigation.aprx cmoutrie 11/6/2020

LEGEND

Irrigated Areas per Set

Existing Junctions Pressure (psi)

- ≤20.0
- ≤30.0
- ≤40.0
- ≤70.0

Existing Pipelines Velocity (fps)

- ≤2.0
- ≤3.5
- ≤5.0
- Greater than 5.0

Middle Pond

SCALE: 1 in = 800 ft

NORTH:

EXISTING DEFICIENCIES
SET 16 (DAY 8, PM)

WASATCH COUNTY
DANIEL IRRIGATION PROJECT

BOWEN COLLINS & ASSOCIATES

FIGURE NO.
A16

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LEGEND

Irrigated Areas per Set

Existing Junctions
Pressure (psi)

- ≤30.0
- ≤40.0
- ≤70.0
- Greater than 70.0

Existing Pipelines
Velocity (fps)

- ≤2.0
- ≤3.5
- ≤5.0
- Greater than 5.0

Middle Pond

SCALE: 1 in = 800 ft

NORTH:

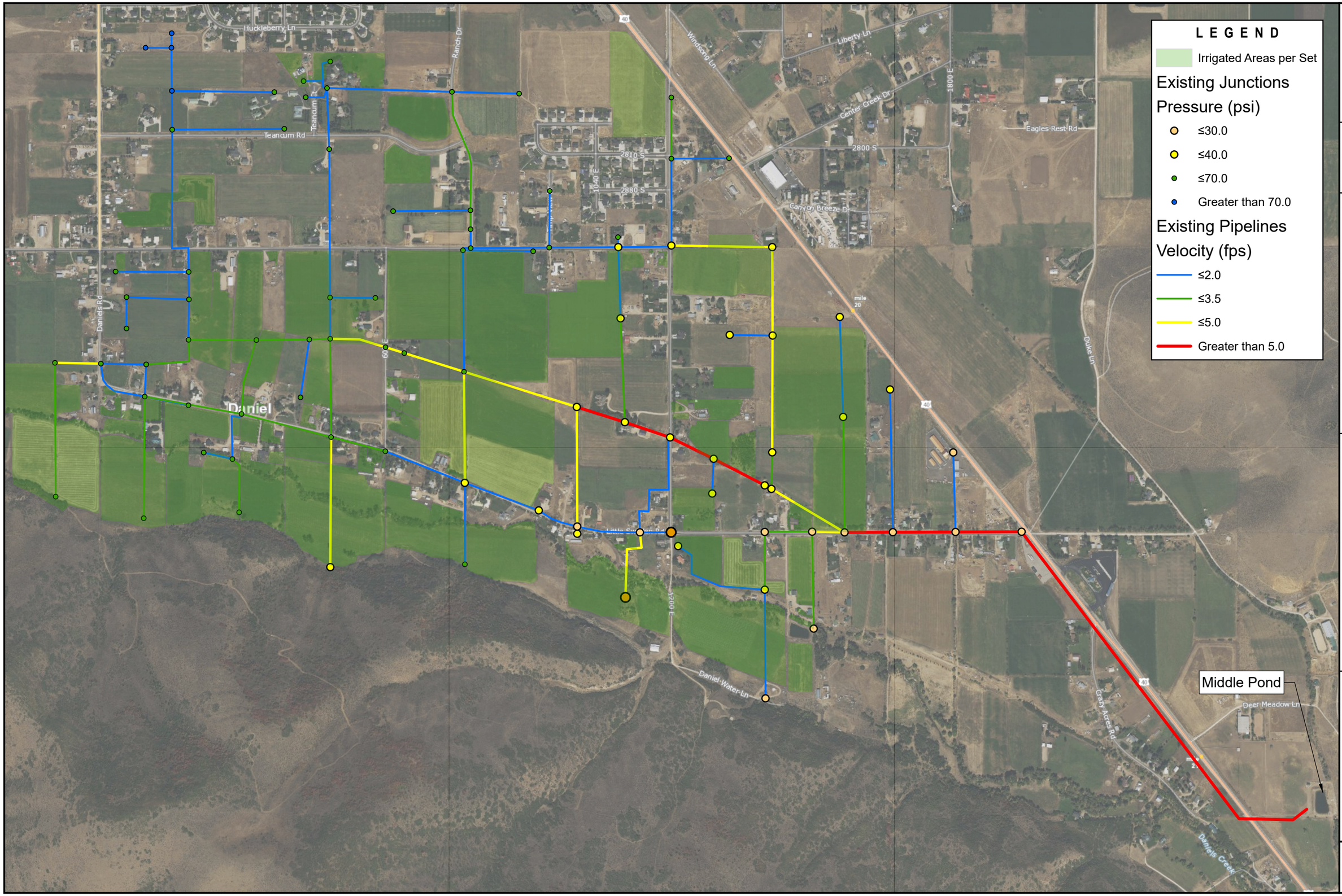
EXISTING DEFICIENCIES
SET 17 (DAY 9, AM)

WASATCH COUNTY
DANIEL IRRIGATION PROJECT

BOWEN COLLINS & ASSOCIATES

FIGURE NO.
A17

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SCALE: 1 in = 800 ft

NORTH:

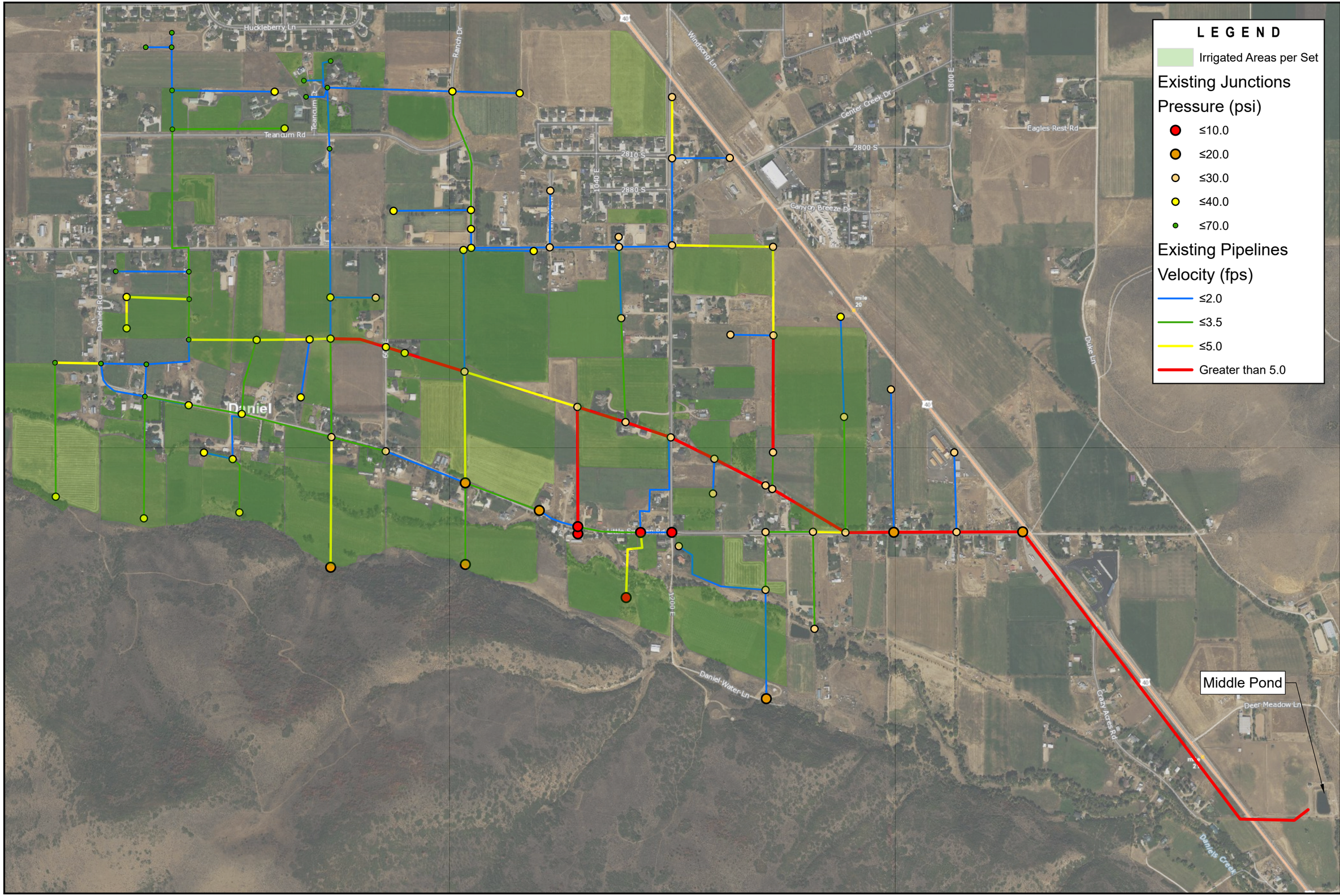
EXISTING DEFICIENCIES
SET 18 (DAY 9, PM)

WASATCH COUNTY
DANIEL IRRIGATION PROJECT

BOWEN COLLINS & ASSOCIATES

FIGURE NO.
A18

P:\Wasatch County\627-19-01 Tri-Valley Watershed Plan EA\6.0 Reports\01 - Daniels Irrigation\GIS\DanielsIrrigation\DanielsIrrigation.aprx cmoutrie 11/6/2020



SCALE: 1 in = 800 ft

NORTH:

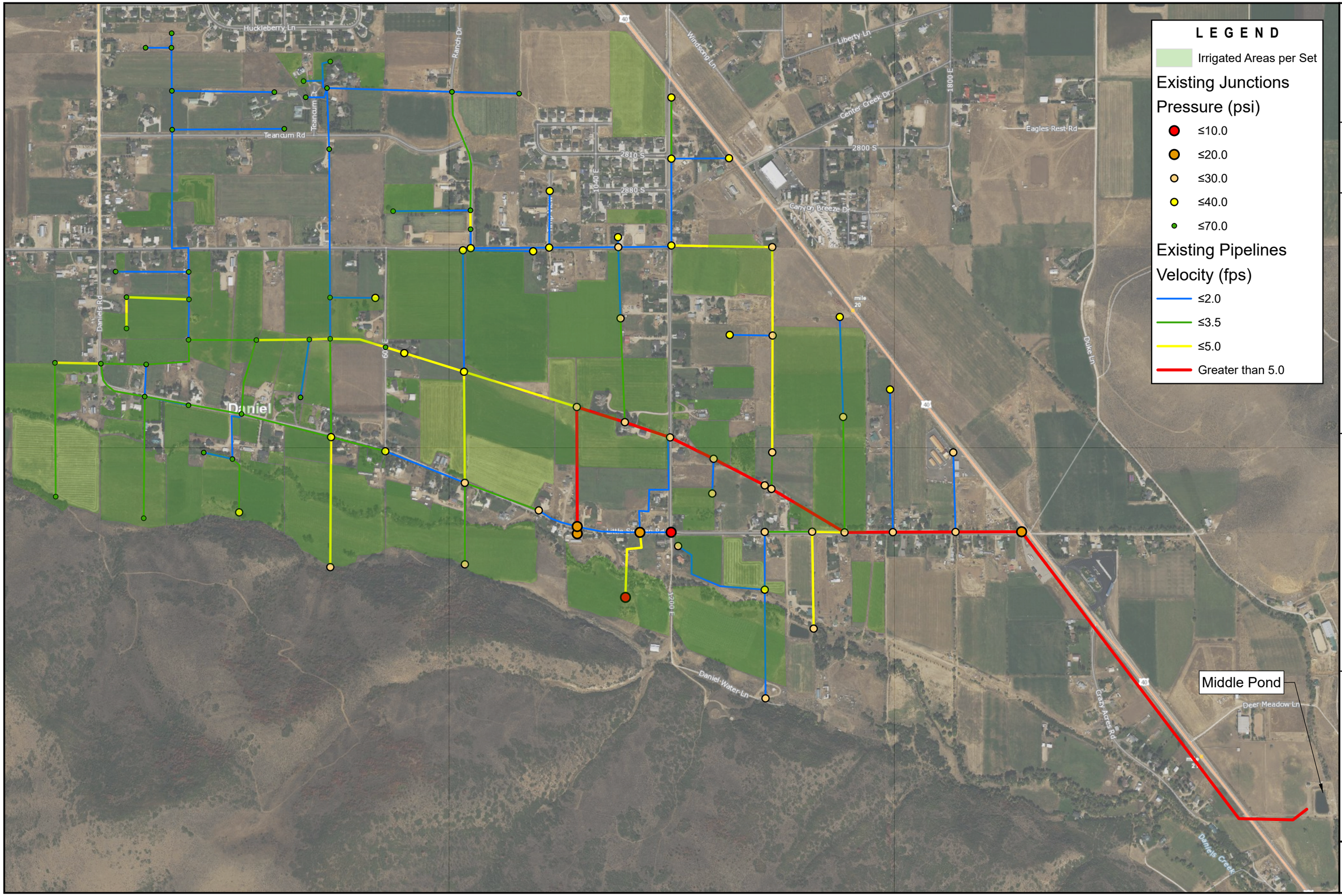
EXISTING DEFICIENCIES
SET 19 (DAY 10, AM)

WASATCH COUNTY
DANIEL IRRIGATION PROJECT

BOWEN COLLINS & ASSOCIATES

FIGURE NO.
A19

P:\Wasatch County\627-19-01 Tri-Valley Watershed Plan EA\6.0 Reports\01 - Daniels Irrigation\GIS\DanielsIrrigation\DanielsIrrigation.aprx cmoutre 11/6/2020



SCALE: 1 in = 800 ft

NORTH:

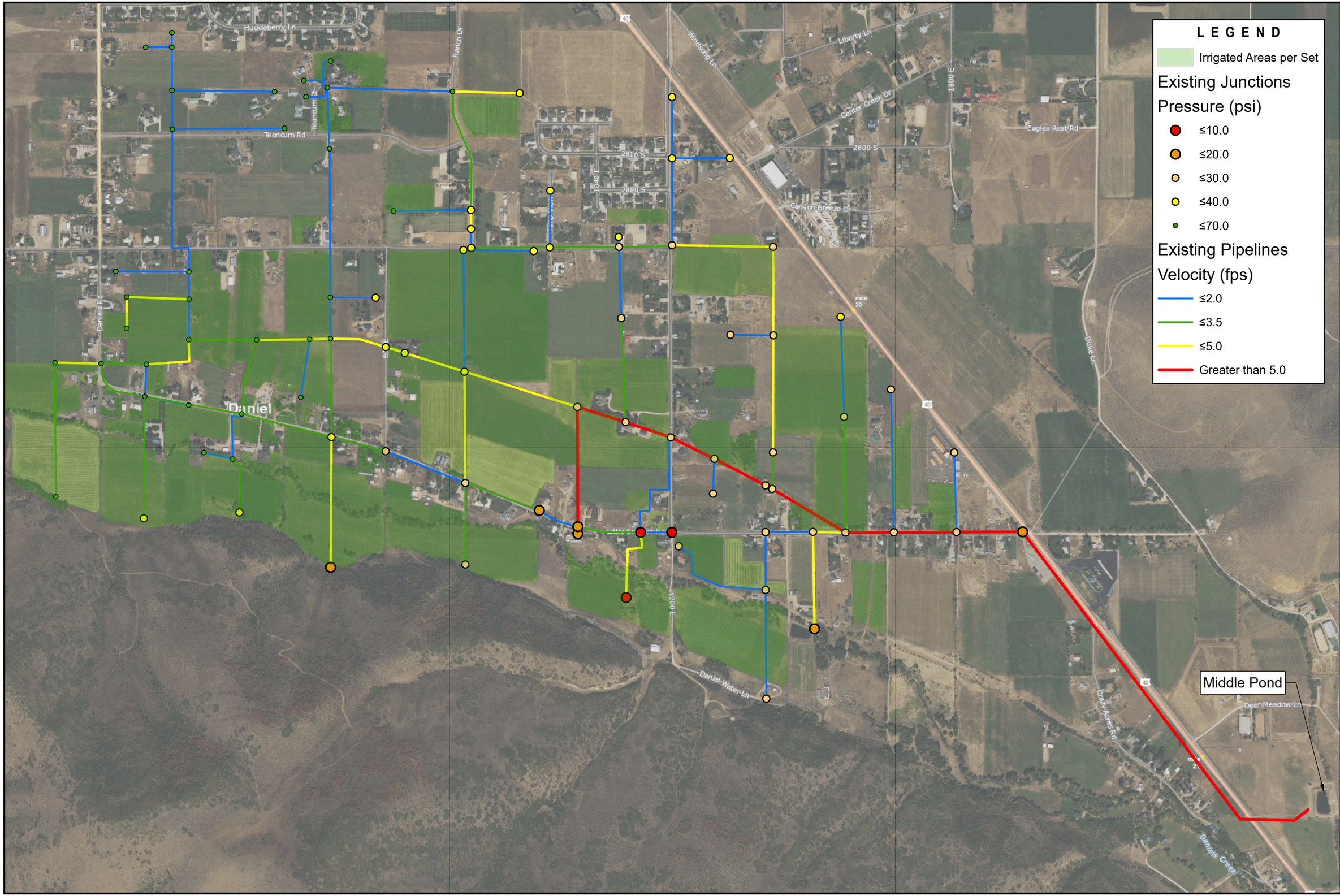
EXISTING DEFICIENCIES
SET 20 (DAY 10, PM)

WASATCH COUNTY
DANIEL IRRIGATION PROJECT

BOWEN COLLINS & ASSOCIATES

FIGURE NO.
A20

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SCALE: 1 in = 800 ft

NORTH:

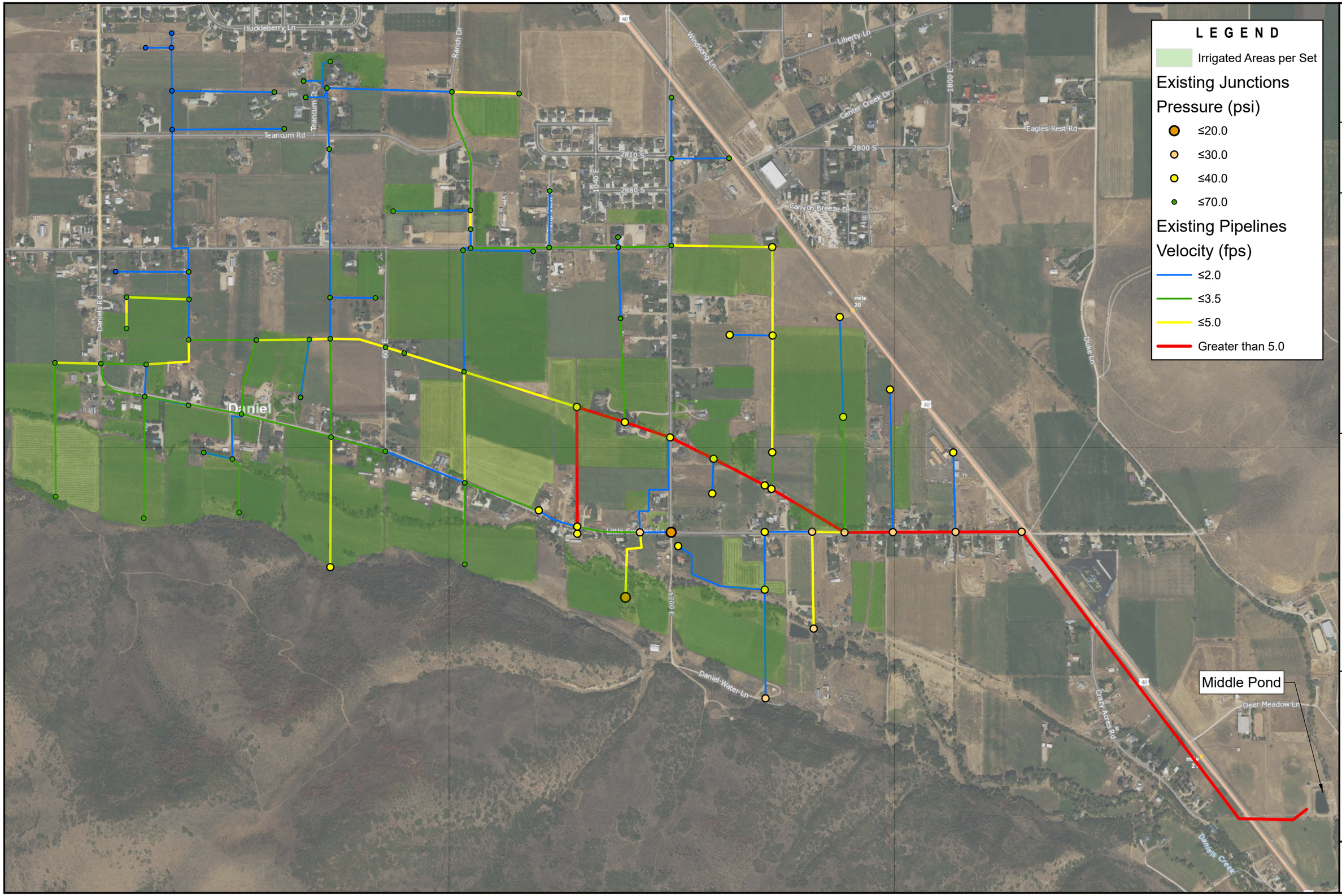
EXISTING DEFICIENCIES
SET 21 (DAY 11, AM)

WASATCH COUNTY
DANIEL IRRIGATION PROJECT

BOWEN COLLINS & ASSOCIATES

FIGURE NO.
A21

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SCALE: 1 in = 800 ft

NORTH:

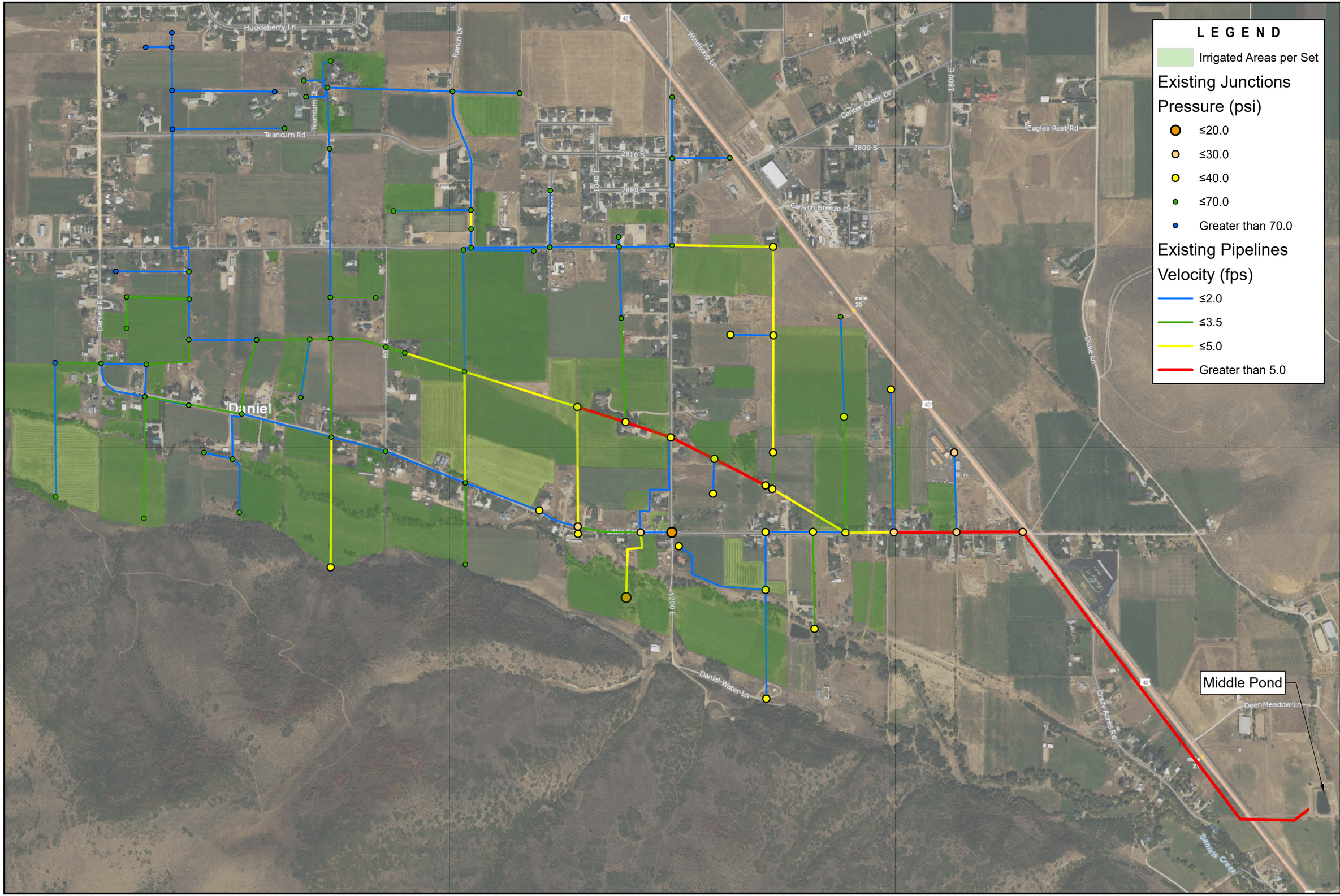
EXISTING DEFICIENCIES
SET 22 (DAY 11, PM)

WASATCH COUNTY
DANIEL IRRIGATION PROJECT

BOWEN COLLINS & ASSOCIATES

FIGURE NO.
A22

P:\Wasatch County\627-19-01 Tri-Valley Watershed Plan EA\6.0 Reports\01 - Daniels Irrigation\GIS\DanielsIrrigation\DanielsIrrigation.aprx cmoutre 11/6/2020



SCALE: 1 in = 800 ft

NORTH:

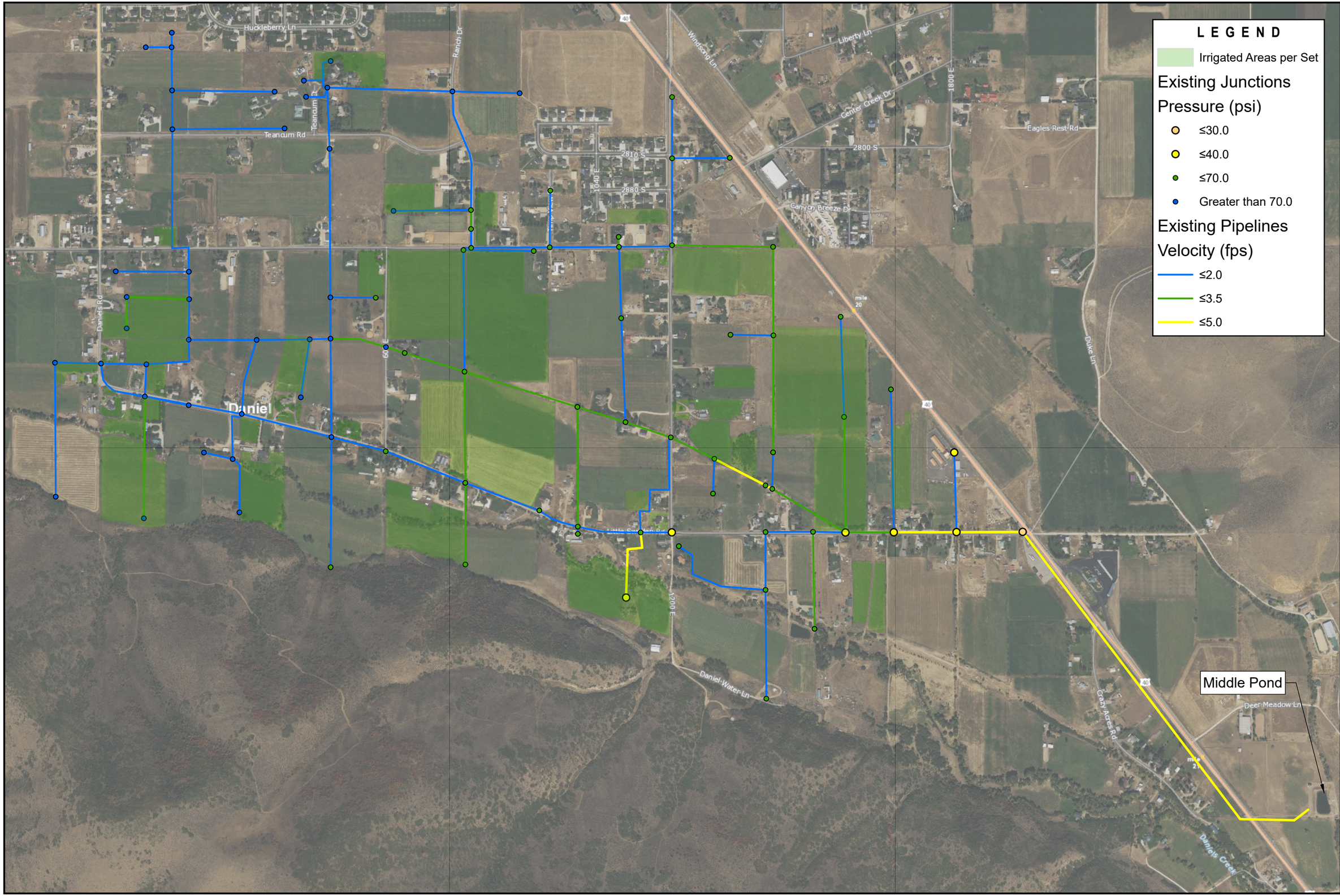
EXISTING DEFICIENCIES
SET 23 (DAY 12, AM)

WASATCH COUNTY
DANIEL IRRIGATION PROJECT

BOWEN COLLINS & ASSOCIATES

FIGURE NO.
A23

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SCALE: 1 in = 800 ft

NORTH:

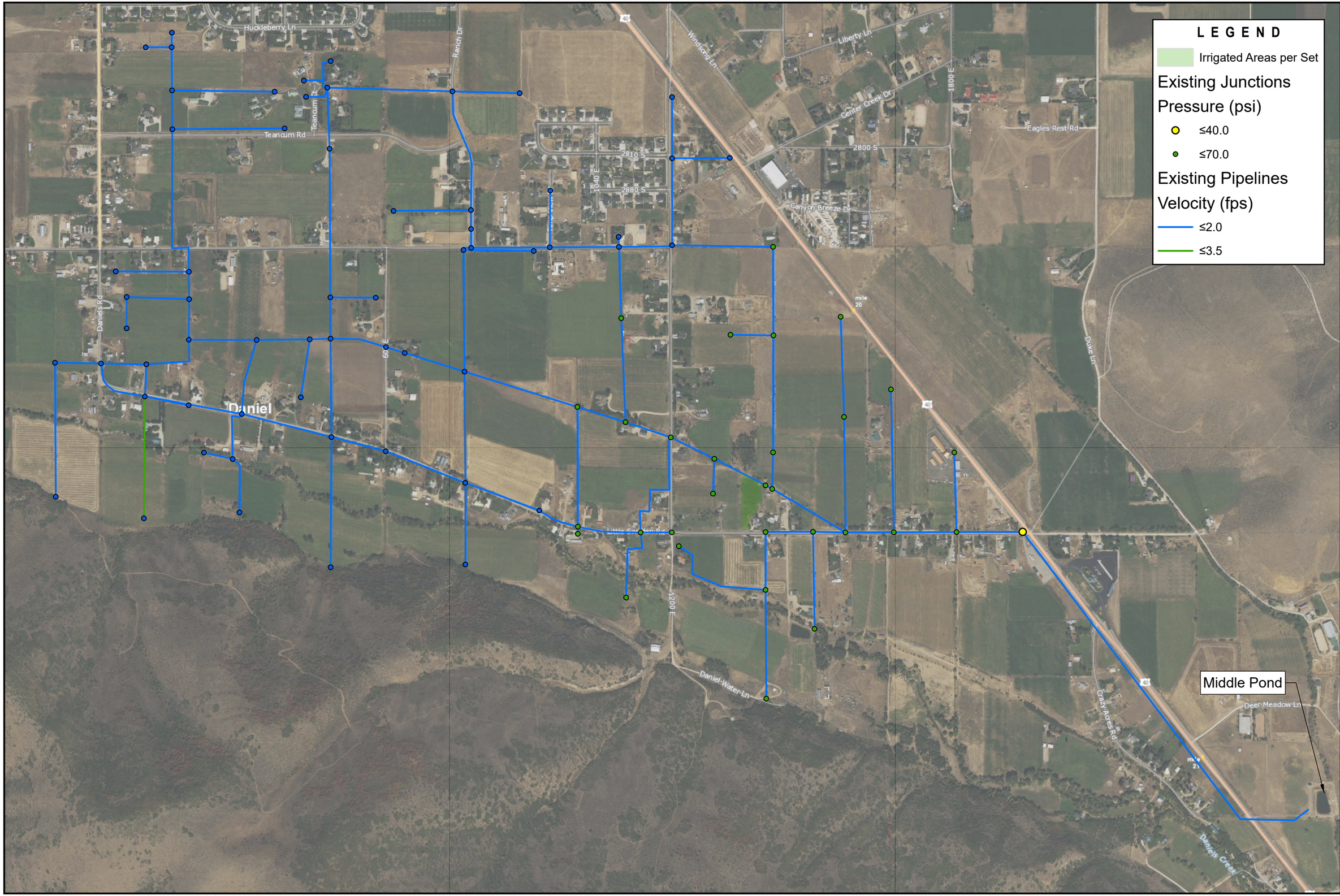
EXISTING DEFICIENCIES
SET 24 (DAY 12, PM)

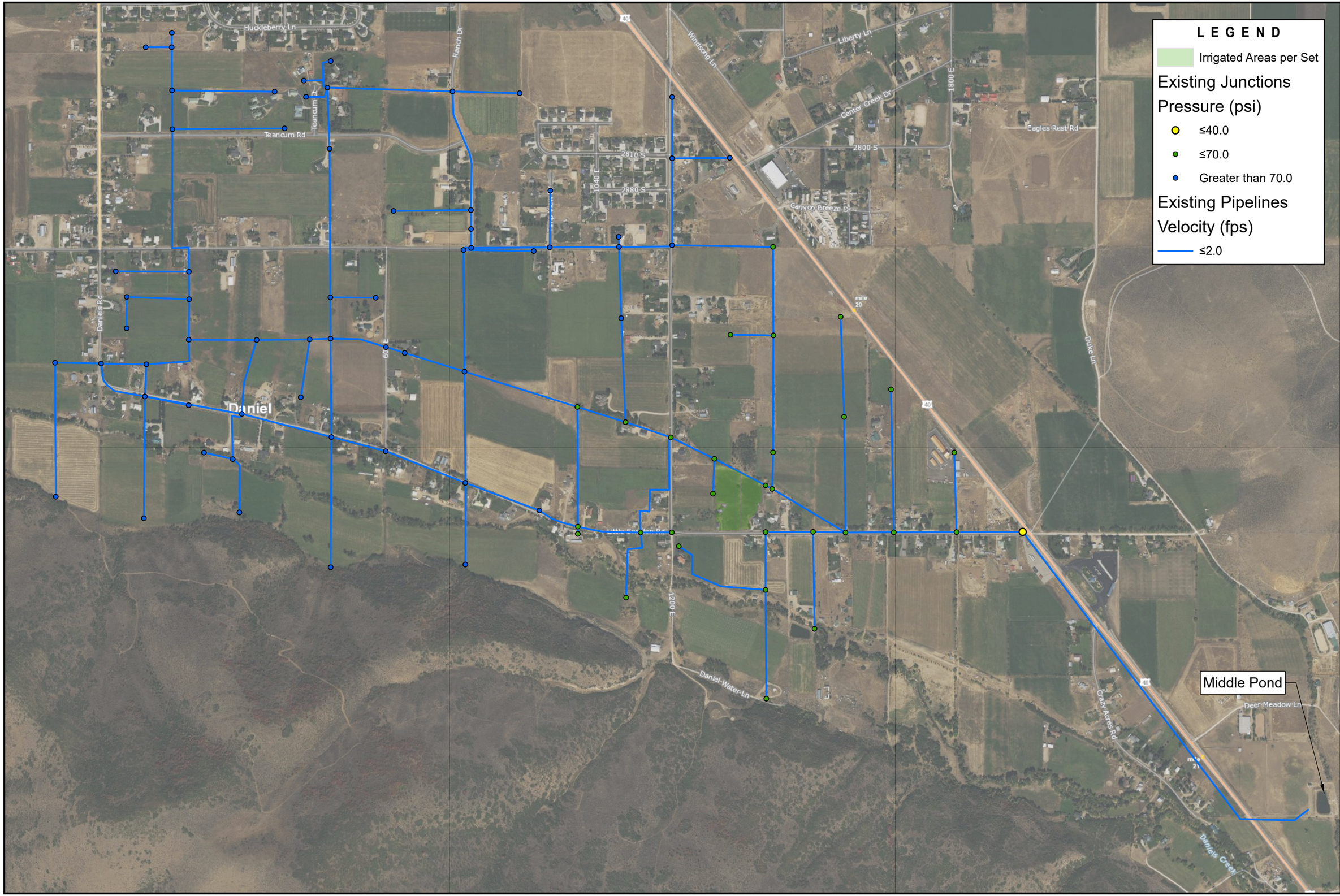
WASATCH COUNTY
DANIEL IRRIGATION PROJECT

BOWEN COLLINS & ASSOCIATES

FIGURE NO.
A24

P:\Wasatch County\627-19-01 Tri-Valley Watershed Plan EA\6.0 Reports\01 - Daniels Irrigation\GIS\DanielsIrrigation\DanielsIrrigation.aprx cmoutrie 11/6/2020


Huckleberry Ln
Ranch Dr
Teancum Pt
Teancum Rd
Windsong Ln
Liberty Ln
Center Creek Dr
1800 E
Eagles Rest Rd
2800 S
2810 S
1040 E
2880 S
Canyon Breeze Dr
mile 20
Duke Ln
Daniels Rd
600 E
Daniel
Little Sat Jen Rd
1200 E
Daniel Water Ln
Crazy Acres Rd
mile 21
Deer Meadow Ln
Daniels Creek
Middle Pond
LEGEND
Irrigated Areas per Set
Existing Junctions
Pressure (psi)
≤40.0
≤70.0
Existing Pipelines
Velocity (fps)
≤2.0
≤3.5
SCALE:
1 in = 800 ft
NORTH:
NORTH
EXISTING DEFICIENCIES
SET 25 (DAY 13, AM)
WASATCH COUNTY
DANIEL IRRIGATION
PROJECT
BOWEN COLLINS
& ASSOCIATES
FIGURE NO.
A25
P:\Wasatch County\627-19-01 Tri-Valley Watershed Plan EA\6.0 Reports\01 - Daniels Irrigation\GIS\DanielsIrrigation\DanielsIrrigation.aprx cmoutre 11/6/2020



SCALE: 1 in = 800 ft

NORTH:

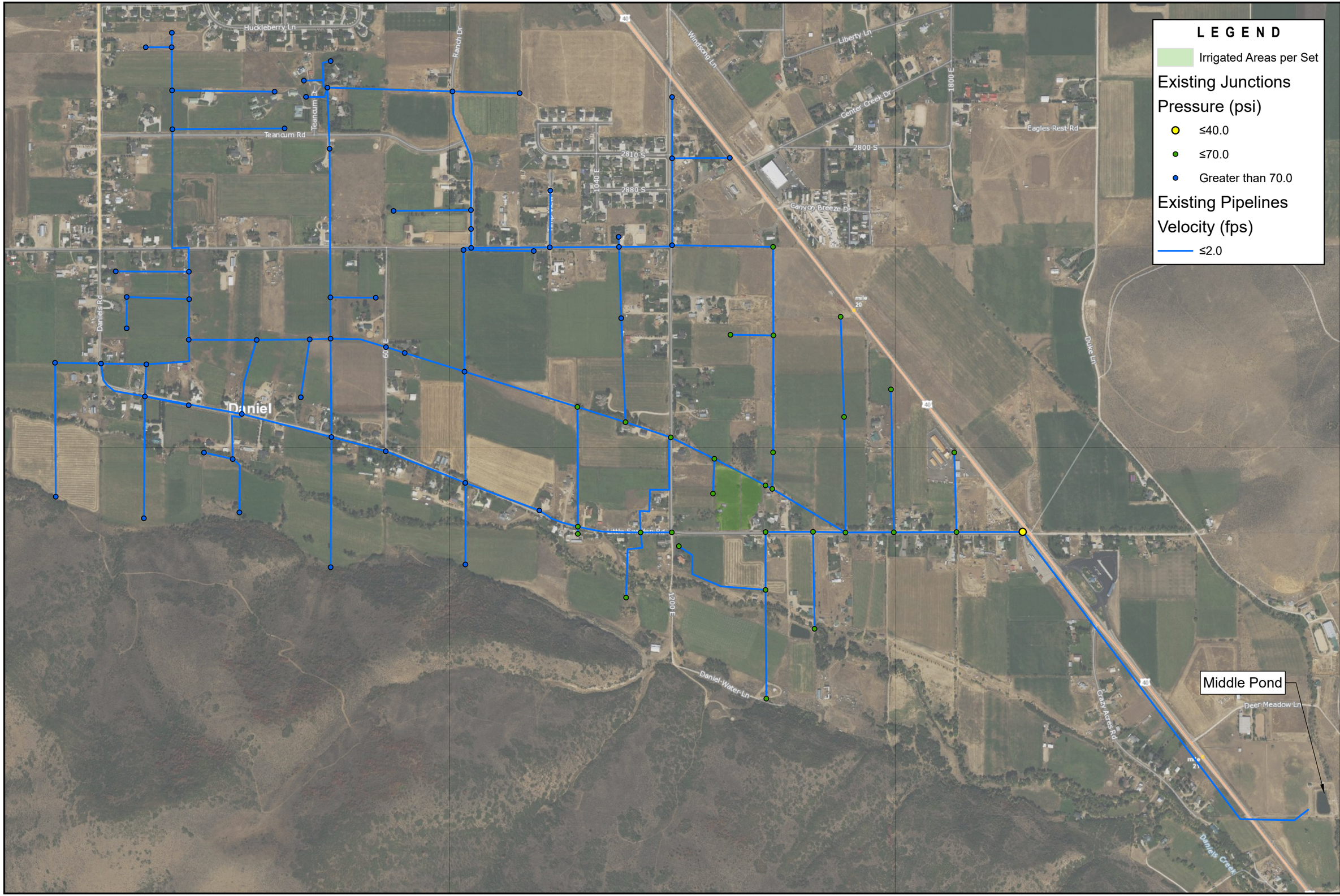
EXISTING DEFICIENCIES
SET 26 (DAY 13, PM)

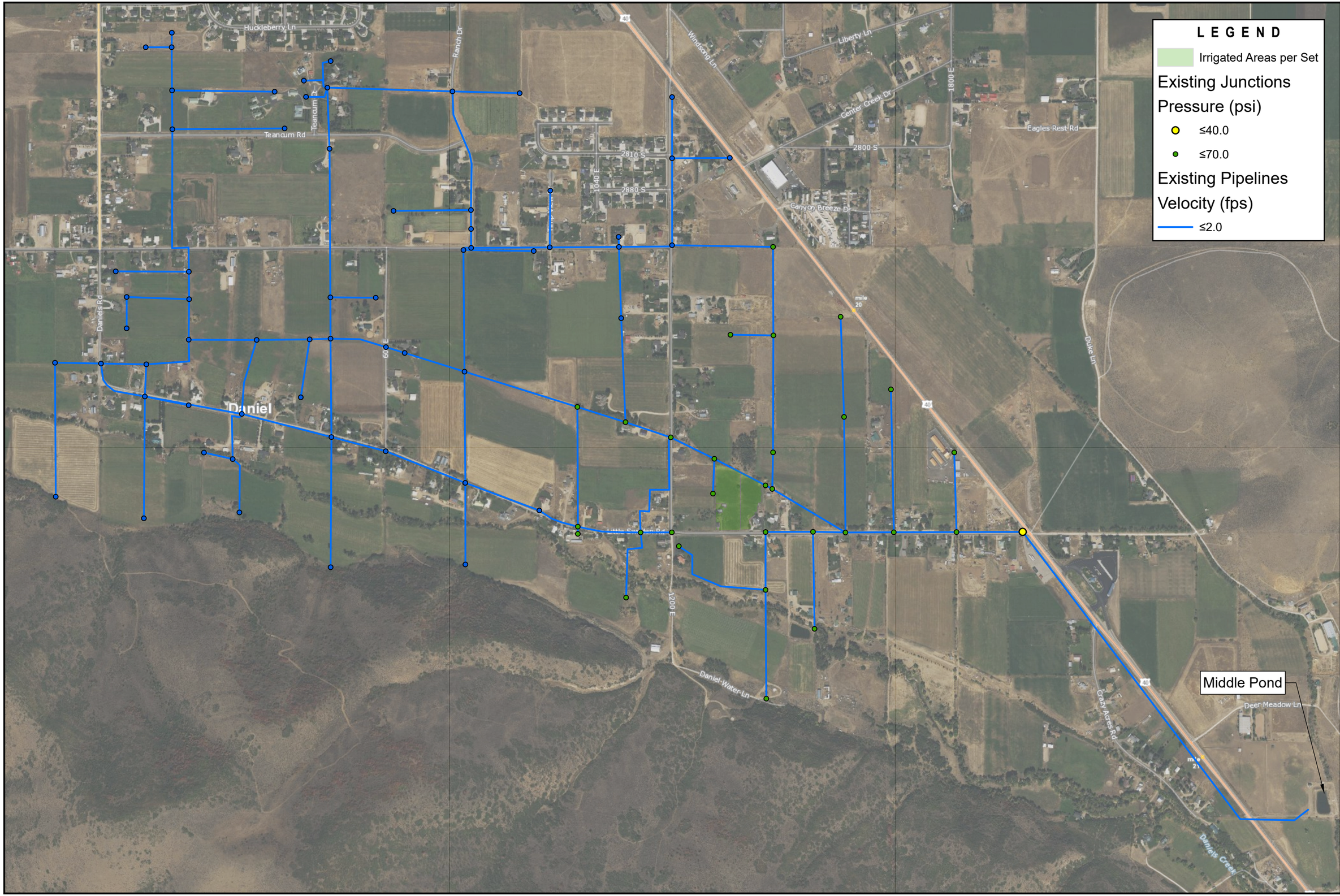
WASATCH COUNTY
DANIEL IRRIGATION PROJECT

BOWEN COLLINS & ASSOCIATES

FIGURE NO.
A26

P:\Wasatch County\627-19-01 Tri-Valley Watershed Plan EA\6.0 Reports\01 - Daniels Irrigation\GIS\DanielsIrrigation\DanielsIrrigation.aprx cmoutre 11/6/2020


Huckleberry Ln
Ranch Dr
Teancum Pt
Teancum Rd
Windsong Ln
Liberty Ln
Center Creek Dr
1800 E
Eagles Rest Rd
2800 S
2810 S
1040 E
2880 S
Canyon Breeze Dr
mile 20
Duke Ln
Daniels Rd
600 E
Daniel
Little Sat Jen Rd
1200 E
Daniel Water Ln
Crazy Acres Rd
mile 21
Deer Meadow Ln
Middle Pond
Daniels Creek
LEGEND
Irrigated Areas per Set
Existing Junctions
Pressure (psi)
≤40.0
≤70.0
Greater than 70.0
Existing Pipelines
Velocity (fps)
≤2.0
SCALE:
1 in = 800 ft
NORTH:
NORTH
EXISTING DEFICIENCIES
SET 27 (DAY 14, AM)
WASATCH COUNTY
DANIEL IRRIGATION
PROJECT
BOWEN COLLINS
& ASSOCIATES
FIGURE NO.
A27
P:\Wasatch County\627-19-01 Tri-Valley Watershed Plan EA\6.0 Reports\01 - Daniels Irrigation\GIS\DanielsIrrigation\DanielsIrrigation.aprx cmoutre 11/6/2020



SCALE: 1 in = 800 ft

NORTH:

EXISTING DEFICIENCIES
SET 28 (DAY 14, PM)

WASATCH COUNTY
DANIEL IRRIGATION PROJECT

BOWEN COLLINS & ASSOCIATES

FIGURE NO.
A28

P:\Wasatch County\627-19-01 Tri-Valley Watershed Plan EA\6.0 Reports\01 - Daniels Irrigation\GIS\DanielsIrrigation\DanielsIrrigation.aprx cmoutre 11/6/2020

Existing Pipe Set Data

Cum. Time (hrs)	0:00:00	12:00:00	24:00:00	36:00:00	48:00:00	60:00:00	72:00:00	84:00:00	96:00:00	108:00:00	120:00:00	132:00:00	144:00:00	156:00:00	168:00:00	180:00:00	192:00:00	204:00:00
Day	1		2		3		4		5		6		7		8		9	
Set (AM/PM)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Pipe ID	Velocity (ft/s)	Velocity (ft/s)	Velocity (ft/s)	Velocity (ft/s)	Velocity (ft/s)	Velocity (ft/s)	Velocity (ft/s)	Velocity (ft/s)	Velocity (ft/s)	Velocity (ft/s)	Velocity (ft/s)	Velocity (ft/s)	Velocity (ft/s)	Velocity (ft/s)	Velocity (ft/s)	Velocity (ft/s)	Velocity (ft/s)	Velocity (ft/s)
P100	3.06	4.01	3.71	3.65	3.42	3.02	2.71	2.64	2.33	2.28	1.81	0.47	2.88	3.2	3.67	3.67	3.41	2.91
P1006	0.23	0.16	0.23	0.16	0.23	0.16	0.23	0.16	0.23	0.16	0.23	0.16	0.23	0.16	0.23	0.23	0.23	0.16
P1008	1.27	1.43	0.98	0.71	0.66	0.62	0.96	0.78	1.05	1.15	1.19	0.62	1.57	1.36	1.01	1.01	0.57	0.55
P101	3.44	4.69	4.83	4.45	3.77	3.43	4.69	4.12	3.66	2.45	2.14	1.71	3.58	3.67	5.14	5.14	3.7	3.38
P1012	1.11	1.11	1.11	1.11	1.11	1.11	1.11	1.11	1.11	0.29	0.02	0.02	1.11	1.11	1.11	1.11	1.11	1.11
P1014	0.81	2.08	0.13	0.9	0.05	1.37	0.38	0.69	0.45	1.42	1.17	1.28	1.29	1.7	1.61	1.61	0.52	1.68
P1016	2.29	1.51	2.29	1.44	2.29	1.44	2.29	1.44	2.16	1.44	2.29	1.65	2.29	1.51	2.29	2.29	2.29	1.44
P1018	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
P1020	1.27	1.43	0.98	0.71	0.66	0.62	0.96	0.78	1.05	1.15	1.19	0.62	1.57	1.36	1.01	1.01	0.57	0.55
P1022	0.4	0.29	0.4	0.29	0.4	1.21	0.86	1.06	1.18	1.06	1.18	2.12	0.4	0.29	0.4	0.4	0.4	1.21
P1026	1.87	2.26	2.12	2.04	1.49	1.33	2.28	2.19	2.27	1.86	1.84	1.1	2.13	2	2.2	2.2	1.29	1.17
P1028	2.21	2.38	2.32	2.21	1.65	1.58	2.45	2.34	2.3	1.79	1.8	1.23	2.32	2.16	2.39	2.39	1.47	1.44
P103	3.67	4.92	4.95	4.57	3.88	3.55	4.81	4.43	3.97	2.64	2.34	1.91	3.81	3.9	5.26	5.26	3.82	3.49
P1034	0.77	1	0.93	0.91	0.86	0.76	0.68	0.66	0.58	0.57	0.45	0.12	0.72	0.8	0.92	0.92	0.85	0.73
P1038	1.93	2.3	2.18	2.08	1.54	1.37	2.34	2.23	2.33	1.9	1.89	1.14	2.18	2.04	2.26	2.26	1.34	1.21
P1040	0.35	0.25	0.35	0.25	0.35	0.25	0.35	0.25	0.35	0.25	0.35	0.25	0.35	0.25	0.35	0.35	0.35	0.25
P1042	0.67	0.85	0.98	1.06	0.7	0.61	1.11	1.13	1.05	0.71	0.68	0.45	0.69	0.71	1.02	1.02	0.61	0.54
P105	1.42	2.76	2.97	2.78	2.97	2.78	2.62	3.98	4.94	4.75	3.09	2.78	1.42	2.78	2.97	2.97	2.97	2.9
P107	0	0	1.7	1.7	1.7	1.7	1.36	1.23	0.89	0.82	0.48	0	0	0	1.7	1.7	1.7	1.7
P108	0.32	1.63	1.75	1.67	1.45	1.4	1.48	2.09	2.07	1.76	1.61	0.65	0.22	1.64	1.66	1.66	1.46	1.41
P109	0.09	0.06	1.62	1.59	1.62	1.59	1.62	1.44	1.46	0.06	0.09	0.06	0.09	0.06	1.62	1.62	1.62	1.59
P11	3.04	4.05	4.27	3.77	3.05	2.68	3.95	3.24	2.72	1.53	1.43	1.39	3.16	3.11	4.5	4.5	3.02	2.66
P111	3.41	1.41	1.44	0.45	0.14	0.05	0.07	0.05	0.81	1.29	1.31	1.82	3.41	1.42	1.44	1.44	0.14	0.05
P113	1.29	1.29	1.77	2.18	2.18	2.18	2.18	2.18	2.18	2.18	2.18	2.18	1.29	1.29	1.77	1.77	2.18	2.18
P115	2.91	2.91	2.91	0	0	0	0	0	0	0	0	0	2.91	2.91	2.91	2.91	0	0
P117	4.41	4.76	4.65	4.39	4.31	4.33	5.51	4.74	4.79	3.91	4.07	2.92	4.58	4.41	4.76	4.76	4.02	4.1
P119	3.88	4.24	4.12	3.87	4.27	4.3	5.47	4.72	4.75	3.89	4.03	2.89	4.05	3.89	4.23	4.23	3.99	4.08
P121	3.88	4.24	4.12	3.87	4.27	4.3	5.47	4.72	4.75	3.89	4.03	2.89	4.05	3.89	4.23	4.23	3.99	4.08
P123	0.2	0.14	0.2	0.14	0.97	0.91	0.7	0.14	0.2	0.14	0.2	0.14	0.2	0.14	0.2	0.2	0.97	0.91
P125	0.21	0.15	0.21	0.15	0.21	0.15	0.21	0.15	0.21	0.15	0.21	0.15	0.21	0.15	0.21	0.21	0.21	0.15
P127	0.6	0.43	0.6	0.43	3.66	3.49	2.59	0.43	0.6	0.43	0.6	0.43	0.6	0.43	0.6	0.6	3.66	3.49
P133	0.11	0.08	0.11	0.08	0.11	0.08	3.79	2.84	1.54	0.08	0.11	0.08	0.11	0.08	0.11	0.11	0.11	0.08
P135	1.95	2.77	2.84	3.04	2.72	2.65	4.07	3.34	2.85	1.36	1.46	0.26	1.62	2.41	2.95	2.95	2.35	2.3
P137	5.7	6.45	4.42	3.2	2.95	2.81	4.3	3.5	4.75	5.18	5.35	2.8	7.06	6.11	4.53	4.53	2.57	2.46
P139	3.61	3.58	1.44	0.06	0.09	0.06	0.09	0.06	1.75	1.73	1.75	1.73	5.29	3.6	1.44	1.44	0.09	0.06
P141	0.73	0.64	0.02	0.11	0.08	0.42	0.58	0.16	0.49	0.51	0.51	0.21	0.58	0.8	0.02	0.02	0.24	0.58
P143	0.61	0.61	0.61	0.61	0.61	0.61	0.61	0.61	0	0	0	0	0.61	0.61	0.61	0.61	0.61	0.61
P145	0.06	0.04	0.06	0.04	0.36	0.35	0.36	0.35	0.51	0.5	0.51	0.5	0.06	0.04	0.06	0.06	0.36	0.35
P147	1.48	1.56	0.9	1.03	0.97	1.1	2.02	1.3	1.61	0.99	1.25	0.86	1.56	1.66	0.88	0.88	0.61	0.73
P149	0.15	1.05	0.5	0.31	0.68	0.97	1.6	0.39	0.32	0.16	0.23	0.56	0.3	1.21	0.45	0.45	0.85	1.13
P151	0.09	0.06	0.09	0.06	0.09	0.06	0.09	0.06	0.09	0.06	0.09	0.06	0.09	0.06	0.09	0.09	0.09	0.06
P153	1.62	1.59	1.61	1.59	1.61	1.59	1.61	1.59	0.09	2.62	3.4	1.09	1.61	1.59	1.61	1.61	1.61	1.59
P155	1.56	0.79	0.65	0.64	1.4	1.39	1.4	0.47	0.03	0.02	0.03	1.39	2.18	1.39	1.4	1.4	1.4	1.39
P163	3.07	3	2.92	2.68	3.09	3.13	3.57	2.96	2.8	2.08	2.23	1.88	2.93	2.82	2.97	2.97	2.99	3.04
P165	1.33	0.25	0.45	0.56	0.29	0.12	0.19	0.35	1.32	1.76	1.79	1.56	0.45	0.42	0.41	0.41	0.39	0.2
P167	4.28	4.74	4.97	4.87	4.79	4.86	7.46	6.49	6.78	4.71	4.77	2.98	4.76	4.36	5.08	5.08	3.98	4.27
P17	1.07	2.7	2.29	2.58	2.19	2.03	2.36	2.7	2.64	2.34	2.43	1.63	1.37	1.87	2.89	2.89	2.24	2.07
P173	4.63	4.63	4.63	4.63	4.63	4.63	4.63	4.63	4.63	4.63	4.63	4.63	4.63	4.63	4.63	4.63	4.63	4.63
P175	3.32	3.96	3.99	4.03	3.81	3.96	5.6	5.13	5.15	4.05	3.84	2.31	3.69	3.53	4.17	4.17	3.24	3.54
P177	0.29	0.83	0.27	0.29	0.13	0.77	3.01	2.3	2.85	0.66	1.23	0.98	0.95	0.02	0.24	0.24	1.13	0.08
P179	0	0	0	0	0	0.77	2.76	2.76	2.76	2.76	2.76	2.76	0	0	0	0	0	0.77
P181	2.13	2.09	2.13	2.09	0.14	0.1	0.14	0.1	0.14	0.1	0.14	0.1	2.13	2.09	2.13	2.13	0.14	0.1
P183	1.61	2.18	2.31	2.6	2.56	2.75	3.2	3.34	3.56	3.13	2.56	1.26	1.82	1.8	2.32	2.32	2.19	2.47
P185	4.14	4.14	4.14	4.14	4.14	4.14	4.14	4.14	4.14	4.14	3.97	0	4.14	4.14	4.14	4.14	4.14	4.14
P187	0.92	0.92	0.47	0.47	0.47	0.47	0.47	1.23	1.23	0.77	0.77	0.77	0.92	0.92	0.47	0.47	0.47	0.47

Existing Pipe Set Data

Cum. Time (hrs)	0:00:00	12:00:00	24:00:00	36:00:00	48:00:00	60:00:00	72:00:00	84:00:00	96:00:00	108:00:00	120:00:00	132:00:00	144:00:00	156:00:00	168:00:00	180:00:00	192:00:00	204:00:00
Day	1		2		3		4		5		6		7		8		9	
Set (AM/PM)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Pipe ID	Velocity (ft/s)	Velocity (ft/s)	Velocity (ft/s)	Velocity (ft/s)	Velocity (ft/s)	Velocity (ft/s)	Velocity (ft/s)	Velocity (ft/s)	Velocity (ft/s)	Velocity (ft/s)	Velocity (ft/s)	Velocity (ft/s)	Velocity (ft/s)	Velocity (ft/s)	Velocity (ft/s)	Velocity (ft/s)	Velocity (ft/s)	Velocity (ft/s)
P189	1.59	2.24	1.94	2.42	2.56	2.7	2.64	3.22	3.44	3.38	2.41	1.29	1.66	1.95	2.25	2.25	2.42	2.58
P19	2.71	3.76	3.5	3.42	3.11	2.87	3.25	3.41	3.16	2.84	1.84	1.5	2.73	3.06	3.96	3.96	3.23	2.97
P191	4.54	4.54	4.54	4.23	3.45	3.45	3.45	3.45	3.36	3.36	0.91	0.91	4.54	4.54	4.54	4.54	3.45	3.45
P193	0.03	0.02	0.03	0.02	0.03	0.02	0.03	0.02	0.03	0.02	0.03	0.02	0.03	0.02	0.03	0.03	0.03	0.02
P195	0.47	1.53	0.27	1.96	2.33	2.59	1.95	3.22	3.61	3.72	2.88	1.48	0.03	1.4	1.21	1.21	2.22	2.49
P197	0.06	4.63	4.65	4.63	4.65	4.63	4.65	4.94	4.96	4.16	3.44	0.35	0.06	4.63	4.65	4.65	4.65	4.63
P199	0.4	0.01	1.05	0.37	0.8	1.01	0.5	1.05	1.33	1.57	1.09	0.65	0.14	0.11	0.3	0.3	0.71	0.94
P201	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
P203	1.18	2.34	0.06	2.34	2.35	2.34	2.35	2.34	2.35	2.34	2.35	2.34	2.35	0.35	2.35	2.35	2.35	2.34
P205	0.02	2.06	2.07	2.06	2.07	2.06	2.07	2.06	2.07	1.71	1.39	0.02	0.02	2.06	2.07	2.07	2.07	2.06
P207	3.16	3.18	2.94	2.02	1.97	1.07	2.51	1.48	0.86	0.6	0.71	1.02	3.16	2.26	2.94	2.94	1.97	1.07
P209	2.46	0.07	0.27	0.24	0.27	0.07	3.55	3.52	3.55	2.42	2.44	2.42	2.44	0.07	0.27	0.27	0.27	0.07
P21	4.4	5.46	5.1	5.04	4.56	4.49	6.05	5.39	4.94	3.87	3.76	2.4	4.62	4.73	5.29	5.29	4.15	4.11
P211	2.46	0.07	0.27	0.24	0.27	0.07	3.55	3.52	3.55	2.42	2.44	2.42	2.44	0.07	0.27	0.27	0.27	0.07
P213	2.81	3.17	2.9	1.98	1.94	1.06	2.01	0.98	0.36	0.26	0.36	0.68	2.81	2.25	2.9	2.9	1.94	1.06
P215	0.45	6.85	0.45	0.32	2.93	0.84	0.97	0.58	0.45	0.32	0.45	0.32	0.45	0.32	0.45	0.45	2.93	0.84
P217	4.83	3.87	4.98	3.4	2.65	1.63	3.26	1.56	0.47	0.33	0.47	1.09	4.83	3.88	4.98	4.98	2.65	1.63
P219	2.14	0	2.15	0	2.15	0	2.76	0	0	0	0	0	2.15	0	2.15	2.15	2.15	0
P221	2.38	2.19	2.25	2.19	1.42	0.14	0.2	0.14	0.2	0.14	0.2	0.14	2.38	2.19	2.25	2.25	1.42	0.14
P223	0.09	0.06	0.09	0.06	0.09	0.06	0.09	0.06	0.09	0.06	0.09	0.06	0.09	0.06	0.09	0.09	0.09	0.06
P225	2.3	2.13	2.17	2.14	1.35	0.09	0.13	0.09	0.13	0.09	0.13	0.09	2.3	2.14	2.17	2.17	1.35	0.09
P227	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
P229	0.28	0.2	0.28	0.2	0.28	0.2	0.28	0.2	0.28	0.2	0.28	0.2	0.28	0.2	0.28	0.28	0.28	0.2
P23	4.68	5.46	5.38	5.05	4.84	4.49	6.33	5.4	5.27	3.87	4.09	2.4	4.9	4.73	5.57	5.57	4.43	4.12
P231	5.45	5.78	5.92	5.67	5.53	5.7	7.2	6.53	6.62	5.55	5.46	3.98	5.79	5.46	6.13	6.13	5.15	5.32
P233	1.77	0.06	0.09	0.06	0.09	0.06	0.09	0.06	1.77	0.06	1.62	0.06	1.77	0.06	0.09	0.09	0.09	0.06
P249	2.34	2.06	2.07	1.92	1.59	1.57	1.59	1.67	1.57	1.53	0.48	0.44	2.1	2.06	2.07	2.07	1.59	1.57
P251	0.06	1.52	1.32	1.59	1.53	1.58	1.45	2.17	2.27	2.14	1.79	0.83	0.16	1.51	1.51	1.51	1.51	1.56
P27	5.36	6	5.89	5.56	5.7	5.6	7.44	6.55	6.62	5.2	5.35	3.43	5.7	5.43	6.05	6.05	5.16	5.16
P281	6.06	6.69	6.57	6.21	6.06	5.96	8.2	7.23	7.29	5.79	5.96	3.65	6.38	6.1	6.74	6.74	5.52	5.51
P283	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
P29	0.83	0.14	0.36	0.7	0.75	1.09	0.86	0.97	0.63	0.75	0.92	1.74	0.73	0.69	0.53	0.53	1.14	1.38
P33	2.3	2.38	1.73	1.85	1.79	1.91	2.84	2.12	1.74	1.64	2.1	1.13	2.38	2.47	1.7	1.7	1.43	1.54
P41	6.06	6.69	6.57	6.21	6.06	5.96	8.2	7.23	7.29	5.79	5.96	3.65	6.38	6.1	6.74	6.74	5.52	5.51
P43	6.28	6.91	6.69	6.54	6.38	6.54	8.76	7.71	7.63	6.21	6.3	4.23	6.67	6.39	6.94	6.94	5.83	6.09
P49	4.4	5.46	5.1	5.04	4.56	4.49	6.05	5.39	4.94	3.87	3.76	2.4	4.62	4.73	5.29	5.29	4.15	4.11
P53	6.28	6.91	6.69	6.54	6.38	6.54	8.76	7.71	7.63	6.21	6.3	4.23	6.67	6.39	6.94	6.94	5.83	6.09
P55	2.82	3.05	2.98	2.81	2.76	2.96	3.72	3.41	3.42	2.85	2.8	2.06	3.13	2.96	3.05	3.05	2.57	2.62
P57	0.09	0.74	2.47	2.44	2.47	2.44	2.13	1.9	1.58	0.88	0.56	0.06	0.09	0.74	2.47	2.47	2.47	2.44
P59	4.29	4.82	4.65	4.34	4.5	4.38	5.58	4.79	4.79	3.89	4.03	2.68	4.51	4.34	4.78	4.78	4.17	4.09
P61	1.12	2.28	3.85	3.72	3.85	3.93	3.56	3.92	4.05	3.24	2.34	1.68	1.12	2.36	4.19	4.19	3.85	3.98
P63	4.63	5.08	4.93	4.77	4.66	4.84	6.38	5.67	5.63	4.61	4.64	3.19	4.97	4.75	5.09	5.09	4.29	4.45
P65	4.97	5.58	5.72	5.6	5.51	5.69	7.19	6.52	6.5	5.37	5.27	3.73	5.31	5.26	5.93	5.93	5.14	5.32
P67	5.56	5.79	5.92	5.67	5.54	5.71	7.2	6.54	6.73	5.55	5.56	3.99	5.9	5.47	6.14	6.14	5.16	5.33
P93	0.49	1.06	2.53	2.49	2.53	2.69	2.4	2.15	1.85	1.13	0.97	0.45	0.49	1.13	2.87	2.87	2.53	2.69
P97	5.56	5.79	5.92	5.67	5.54	5.71	7.2	6.54	6.73	5.55	5.56	3.99	5.9	5.47	6.14	6.14	5.16	5.33

Existing Pipe Set Da

Cum. Time (hrs)	216:00:00	228:00:00	240:00:00	252:00:00	264:00:00	276:00:00	288:00:00	300:00:00	312:00:00	324:00:00
Day	10		11		12		13		14	
Set (AM/PM)	19	20	21	22	23	24	25	26	27	28
Pipe ID	Velocity (ft/s)	Velocity (ft/s)	Velocity (ft/s)	Velocity (ft/s)	Velocity (ft/s)	Velocity (ft/s)	Velocity (ft/s)	Velocity (ft/s)	Velocity (ft/s)	Velocity (ft/s)
P100	2.21	2.2	2.06	2.06	1.43	0.39	0.15	0.18	0.23	0.16
P1006	0.23	0.16	0.23	0.23	0.23	0.16	0.23	0.16	0.23	0.16
P1008	0.69	0.87	1.02	1.02	1.11	0.54	0.16	0.1	0.1	0.07
P101	4.69	4.11	3.63	3.63	2.12	1.72	0.72	0.37	0.36	0.26
P1012	1.11	1.11	1.11	1.11	0.02	0.02	0.02	0.02	0.02	0.02
P1014	0.49	0.78	0.45	0.45	1.03	1.31	1.21	1.15	0.14	0.1
P1016	2.29	1.24	2.16	2.16	2.29	1.44	0.11	0.08	0.11	0.08
P1018	0	0	0	0	0	0	0	0	0	0
P1020	0.69	0.87	1.02	1.02	1.11	0.54	0.16	0.1	0.1	0.07
P1022	0.86	1.06	1.18	1.18	1.18	2.12	0.4	0.29	0.4	0.29
P1026	1.77	1.74	2.21	2.21	1.71	1.02	0.2	0.14	0.01	0.01
P1028	1.97	1.89	2.15	2.15	1.68	1.15	0.31	0.22	0.14	0.1
P103	4.81	4.42	3.93	3.93	2.32	1.92	0.72	0.37	0.36	0.26
P1034	0.55	0.55	0.52	0.52	0.36	0.1	0.04	0.05	0.06	0.04
P1038	1.82	1.78	2.27	2.27	1.77	1.06	0.26	0.18	0.07	0.05
P1040	0.35	0.25	0.35	0.35	0.35	0.25	0.35	0.25	0.35	0.25
P1042	0.88	0.77	1.02	1.02	0.63	0.44	0.06	0.04	0.04	0.03
P105	2.62	3.98	4.94	4.94	3.09	2.78	0.65	0.46	0.65	0.46
P107	1.36	1.23	0.89	0.89	0.48	0	0	0	0	0
P108	1.48	2.1	2.08	2.08	1.62	0.64	0.06	0.02	0.09	0.07
P109	1.62	1.44	1.46	1.46	0.09	0.06	0.09	0.06	0.09	0.06
P11	3.95	3.24	2.71	2.71	1.42	1.39	0.57	0.31	0.35	0.25
P111	0.07	0.05	0.81	0.81	1.31	1.82	0.07	0.05	0.07	0.05
P113	2.18	2.18	2.18	2.18	2.18	2.18	0	0	0	0
P115	0	0	0	0	0	0	0	0	0	0
P117	5.03	4.54	4.55	4.55	3.89	2.8	0.83	0.58	0.56	0.4
P119	4.99	4.52	4.51	4.51	3.85	2.78	0.79	0.56	0.52	0.37
P121	4.99	4.52	4.51	4.51	3.85	2.78	0.79	0.56	0.52	0.37
P123	0.97	0.64	0.2	0.2	0.2	0.14	0.2	0.14	0.2	0.14
P125	0.21	0.15	0.21	0.21	0.21	0.15	0.21	0.15	0.21	0.15
P127	3.66	2.42	0.6	0.6	0.6	0.43	0.6	0.43	0.6	0.43
P133	0.11	0.08	3.79	3.79	1.54	0.08	0.11	0.08	0.11	0.08
P135	2.87	2.07	2.71	2.71	1.09	0.64	0.47	0.29	0.24	0.18
P137	3.1	3.89	4.6	4.6	4.98	2.42	0.7	0.45	0.47	0.34
P139	0.09	1.73	1.75	1.75	1.75	1.73	0.09	0.06	0.09	0.06
P141	0.52	0.82	0.57	0.57	0.29	0.38	0.07	0.03	0.03	0.02
P143	0.61	0.61	0	0	0	0	0	0	0	0
P145	0.36	0.35	0.51	0.51	0.51	0.5	0.06	0.04	0.06	0.04
P147	0.41	0.06	1.22	1.22	0.71	0.5	0.2	0.15	0.26	0.18
P149	0.5	0.27	1.38	1.38	1.03	0.73	0.12	0.11	0.23	0.16
P151	0.09	0.06	0.09	0.09	0.09	0.06	0.09	0.06	0.09	0.06
P153	1.61	1.59	0.09	0.09	3.4	1.09	0.09	0.06	0.09	0.06
P155	1.4	0.47	0.03	0.03	0.03	0.02	0.03	1.39	1.4	1.39
P163	3.32	2.96	2.34	2.34	2.16	1.85	0.53	0.33	0.42	0.29
P165	0.05	0.35	1.89	1.89	1.71	1.53	0.08	0.02	0.03	0.03
P167	6.66	5.87	6.49	6.49	4.63	2.81	1.41	1.29	0.34	0.24
P17	2.36	2.71	2.67	2.67	2.44	1.63	0.84	0.17	0.21	0.15
P173	4.63	4.63	4.63	4.63	4.63	4.63	0	0	0	0
P175	4.99	4.61	4.88	4.88	3.61	2.21	0.91	0.56	0.36	0.25
P177	2.75	2.1	2.85	2.85	1.55	0.91	1.14	1.27	0.29	0.21
P179	2.76	2.76	2.76	2.76	2.76	2.76	0	0	0	0
P181	0.14	0.1	0.14	0.14	0.14	0.1	0.14	0.1	0.14	0.1
P183	3.2	3.3	3.39	3.39	2.47	1.31	0.62	0.37	0.13	0.09
P185	4.14	4.14	4.14	4.14	3.97	0	0	0	0	0
P187	0.47	1.23	1.23	1.23	0.77	0.77	0	0	0	0

Existing Pipe Set Da

Cum. Time (hrs)	216:00:00	228:00:00	240:00:00	252:00:00	264:00:00	276:00:00	288:00:00	300:00:00	312:00:00	324:00:00
Day	10		11		12		13		14	
Set (AM/PM)	19	20	21	22	23	24	25	26	27	28
Pipe ID	Velocity (ft/s)	Velocity (ft/s)	Velocity (ft/s)	Velocity (ft/s)	Velocity (ft/s)	Velocity (ft/s)	Velocity (ft/s)	Velocity (ft/s)	Velocity (ft/s)	Velocity (ft/s)
P189	2.64	3.2	3.37	3.37	2.36	1.32	0.63	0.24	0.06	0.05
P19	3.25	3.43	3.22	3.22	1.87	1.48	0.64	0.1	0.24	0.17
P191	3.45	3.45	3.36	3.36	0.91	0.91	0	0	0	0
P193	0.03	0.02	0.03	0.03	0.03	0.02	0.03	0.02	0.03	0.02
P195	1.95	3.2	3.54	3.54	2.84	1.5	0.76	0.18	0.12	0.09
P197	4.65	4.94	4.96	4.96	3.44	0.35	0.06	0.04	0.06	0.04
P199	0.5	1.04	1.29	1.29	1.06	0.66	0.42	0.1	0.11	0.08
P201	0	0	0	0	0	0	0	0	0	0
P203	2.35	2.34	2.35	2.35	2.35	2.34	2.35	0.35	0.06	0.04
P205	2.07	2.06	2.07	2.07	1.39	0.02	0.02	0.02	0.02	0.02
P207	2.51	1.48	0.86	0.86	0.71	1.02	0.38	0.27	0.38	0.27
P209	3.55	3.52	3.55	3.55	2.44	2.42	0.1	0.07	0.1	0.07
P21	5.02	4.5	4.6	4.6	3.37	2.19	0.83	0.48	0.46	0.32
P211	3.55	3.52	3.55	3.55	2.44	2.42	0.1	0.07	0.1	0.07
P213	2.01	0.98	0.36	0.36	0.36	0.68	0.36	0.26	0.36	0.26
P215	0.97	0.58	0.45	0.45	0.45	0.32	0.45	0.32	0.45	0.32
P217	3.26	1.56	0.47	0.47	0.47	1.09	0.47	0.33	0.47	0.33
P219	2.76	0	0	0	0	0	0	0	0	0
P221	0.2	0.14	0.2	0.2	0.2	0.14	0.2	0.14	0.2	0.14
P223	0.09	0.06	0.09	0.09	0.09	0.06	0.09	0.06	0.09	0.06
P225	0.13	0.09	0.13	0.13	0.13	0.09	0.13	0.09	0.13	0.09
P227	0	0	0	0	0	0	0	0	0	0
P229	0.28	0.2	0.28	0.28	0.28	0.2	0.28	0.2	0.28	0.2
P23	5.3	4.51	4.93	4.93	3.7	2.2	0.84	0.49	0.47	0.33
P231	6.51	6.02	6.19	6.19	5.1	3.63	1.03	0.81	0.73	0.56
P233	0.09	0.06	1.77	1.77	1.62	0.06	0.09	0.06	0.09	0.06
P249	1.59	1.67	1.57	1.57	0.48	0.44	0.08	0.04	0.05	0.04
P251	1.45	2.16	2.26	2.26	1.78	0.83	0.34	0.08	0.01	0.01
P27	6.6	6	6.27	6.27	5.04	3.23	1.12	0.77	0.57	0.4
P281	7.33	6.68	6.89	6.89	5.64	3.45	1.2	0.82	0.63	0.45
P283	0	0	0	0	0	0	0	0	0	0
P29	0.04	0.44	0.52	0.52	1.1	1.79	0.15	0.11	0.28	0.19
P33	1.23	0.76	1.35	1.35	1.56	0.77	0.22	0.17	0.28	0.2
P41	7.33	6.68	6.89	6.89	5.64	3.45	1.2	0.82	0.63	0.45
P43	7.89	7.16	7.23	7.23	5.98	3.88	1.25	1.01	0.84	0.63
P49	5.02	4.5	4.6	4.6	3.37	2.19	0.83	0.48	0.46	0.32
P53	7.89	7.16	7.23	7.23	5.98	3.88	1.25	1.01	0.84	0.63
P55	3.22	2.91	2.91	2.91	2.49	1.79	0.53	0.37	0.36	0.25
P57	2.13	1.9	1.58	1.58	0.56	0.06	0.09	0.06	0.09	0.06
P59	4.94	4.39	4.51	4.51	3.74	2.53	0.77	0.45	0.48	0.34
P61	3.56	3.92	4.05	4.05	2	1.34	0.78	0.65	0.78	0.65
P63	5.7	5.16	5.2	5.2	4.33	2.88	0.91	0.71	0.61	0.46
P65	6.5	6.02	6.08	6.08	4.92	3.38	1.02	0.81	0.72	0.55
P67	6.52	6.03	6.3	6.3	5.21	3.64	1.03	0.82	0.73	0.56
P93	2.4	2.15	1.85	1.85	0.63	0.11	0.49	0.45	0.49	0.45
P97	6.52	6.03	6.3	6.3	5.21	3.64	1.03	0.82	0.73	0.56

Existing Junction Set Data

Cum. Time (hrs)	0:00:00		12:00:00		24:00:00		36:00:00		48:00:00		60:00:00		72:00:00		84:00:00		96:0
Day	1				2				3				4				
Set/Time	1	AM	2	PM	3	AM	4	PM	5	AM	6	PM	7	AM	8	PM	9
Junction ID	Demand (gpm)	Pressure (psi)	Demand (gpm)	Pressure (psi)	Demand (gpm)	Pressure (psi)	Demand (gpm)	Pressure (psi)	Demand (gpm)	Pressure (psi)	Demand (gpm)	Pressure (psi)	Demand (gpm)	Pressure (psi)	Demand (gpm)	Pressure (psi)	Demand (gpm)
J10	0	58.76	77.22	49.09	198	49.09	198	53.85	77.22	57.3	150.48	57.22	150.48	27.58	150.48	42.27	150.48
J100	0	35.23	0	31.56	0	31.16	0	34.04	0	34.66	0	33.15	0	14.54	0	24.26	0
J1002	0	44.14	0	39.43	0	39.4	0	42.82	0	43.38	0	41.95	0	19.89	0	31.33	0
J1004	5.52	27.45	3.91	21.71	126.36	20.59	124.75	23.77	126.36	25.32	83.41	23.78	323.52	-7.89	286.93	6.55	269.46
J1006	0	36.55	0	32.19	0	32.04	0	35.38	0	35.49	0	33.94	0	12.7	0	24.02	0
J1008	0	13.81	0	8.68	0	6.94	0	10.78	0	11.68	0	10.79	0	-21.54	0	-6.44	0
J1010	0	41.76	0	35.15	0	34.98	0	38.13	0	39.79	0	38.27	0	10.34	0	23.24	0
J1012	13.68	40.85	9.69	36.35	13.68	36.23	9.69	39.64	13.68	39.94	9.69	38.46	13.68	16.81	9.69	28.21	13.68
J1014	0	40.63	0	36.11	0	36.01	0	39.39	0	39.71	0	38.22	0	16.59	0	27.97	0
J102	35.04	37.43	59.08	33.13	46.56	32.95	41.8	36.25	112.8	36.18	144.04	34.62	148.8	13.66	144.04	24.94	148.8
J104	0	39.58	0	35.29	0	35.1	0	38.41	0	38.12	0	36.58	0	15.7	0	27.1	0
J106	23.52	47.23	16.66	43.01	23.52	42.75	16.66	46.13	143.52	41.7	136.66	40.53	101.52	21.28	16.66	34.82	23.52
J108	4.32	46.9	3.06	39	4.32	40.66	3.06	44.23	4.32	46.05	3.06	44.94	148.32	11.35	111.06	28.53	60.48
J110	7.68	51.24	161.44	43.34	109.08	45	106.84	48.57	109.08	50.39	138.04	49.28	62.28	20.61	5.44	35.74	7.68
J112	48	58.77	8.5	51.34	12	52.8	8.5	56.36	12	58.2	8.5	57.18	48	28.58	8.5	43.53	48
J114	5.52	47.35	3.91	41.84	5.52	43.75	3.91	48.03	5.52	48.74	3.91	47.38	5.52	24.34	3.91	36.34	5.52
J118	8.16	39.99	5.78	35.71	8.16	35.52	5.78	38.84	8.16	38.54	5.78	37	8.16	16.12	5.78	27.52	8.16
J12	0	54.17	12	45.54	12.06	45.79	12.06	49.98	12.06	52.71	12.06	52.33	12.06	23.91	12.06	37.86	12.06
J120	15.84	39.58	11.22	35.23	15.84	35.07	11.22	38.41	15.84	38.52	47.22	36.89	33.84	15.69	41.46	26.99	46.08
J122	126.48	34.04	124.59	30.18	126.48	29.73	124.59	32.33	6.48	33.73	4.59	32.35	126.48	12.61	124.59	21.98	126.48
J124	172.52	35.37	127.11	31.74	132.22	31.51	127.11	34.8	132.22	35.02	127.11	33.51	132.22	12.29	102.31	23.66	57.82
J130	8.88	43.86	6.29	39.16	8.88	39.11	6.29	42.55	8.88	43.11	6.29	41.68	8.88	19.6	6.29	31.04	8.88
J132	141.36	44.33	140.38	38.89	56.4	44.97	2.38	50.2	3.36	50.91	2.38	49.55	3.36	26.5	2.38	38.51	68.64
J134	63.36	44.64	62.38	37.58	63.16	38.22	62.18	41.86	63.16	43.72	62.18	42.93	63.16	15.67	62.18	29.27	3.36
J136	3.36	37.49	2.38	34.92	63.36	29.38	62.38	31.34	63.36	32.08	62.38	30.76	63.36	19.5	56.38	25.53	57.36
J138	55.44	32.07	108.02	26.98	116.16	24.45	108.74	26.83	116.16	27.14	108.74	26.4	102.72	15.1	155.78	16.28	193.44
J140	0	28.83	0	26.26	150	21.28	150	23.19	150	23.98	150	22.61	120	11.79	108	17.62	78
J142	61.2	32.58	30.85	30.02	25.56	29.42	25.21	31.49	54.96	32.37	54.61	30.85	54.96	14.74	18.49	22.77	1.2
J144	98.16	28.24	97.53	22.5	98.16	21.37	97.53	24.56	98.16	26.11	97.53	24.57	98.16	-7.11	97.53	7.33	98.16
J146	99.84	21.93	30.97	16.8	99.84	15.07	24.97	18.91	99.84	19.8	24.97	18.92	99.84	-13.41	24.97	1.68	88.14
J148	102	15.29	102	10.16	102	8.42	102	12.26	102	13.16	102	12.27	102	-20.06	102	-4.96	102
J152	34.8	37.21	28.15	30.64	34.8	30.46	22.15	33.6	28.8	35.25	22.15	33.71	28.8	5.76	22.15	18.67	28.8
J154	60.2	33.79	150.85	27.53	1.2	27.03	90.85	30.09	1.2	31.77	150.85	29.94	151.2	-1.47	150.85	12.91	151.2
J156	0	40.24	0	33.68	0	33.49	0	36.64	0	38.29	30.24	36.43	108	5.48	108	18.38	108
J158	162	29.38	162	21.65	162	21.86	162	25.09	162	27.01	162	25.93	162	-1.7	162	11.28	162
J160	36	50.54	36	43.03	18.24	43.64	18.24	47.46	18.24	49.57	18.24	48.91	18.24	21.63	48	34.58	48
J162	27.36	53.76	2.38	44.35	3.36	45.08	2.38	48.57	3.36	51.26	2.38	50.59	3.36	22.3	10.85	34.93	5.48
J164	178	46.21	178	36.81	178	37.53	165.54	41.76	135.28	46.03	135.28	45.36	135.28	17.07	135.28	29.7	131.72
J166	0	61.89	0	51.23	0	52.09	0	55.48	0	58.37	0	57.88	0	29.21	0	41.75	0
J168	4.32	61.49	3.06	50.79	4.32	51.87	3.06	55.01	4.32	57.81	3.06	57.25	4.32	28.72	3.06	41.1	10.26
J170	0	57.59	0	46.89	0	47.97	0	51.11	0	53.91	0	53.35	0	24.82	0	37.2	0
J172	46.16	56.57	91.53	43.24	2.16	47.97	91.53	47.46	92.16	50.21	91.53	49.7	92.16	21.13	91.53	33.55	92.16
J174	0	69.26	0	53.09	0	54.06	0	57.29	0	60.2	0	59.7	0	31.09	12	42.43	12
J176	2.16	64.06	181.53	45.91	182.16	46.87	181.53	50.11	182.16	53.01	181.53	52.52	182.16	23.9	181.53	35.25	182.16
J178	0	48.14	0	43.4	0	43.43	0	46.88	0	47.45	0	46.02	0	23.93	0	35.38	0
J180	24	61.73	24	54.3	24	55.76	24	59.32	24	61.16	24	60.14	24	31.54	24	46.49	0
J182	2.16	60.94	1.53	53.51	2.16	54.96	1.53	58.52	14.22	60.33	13.59	59.31	14.22	30.72	13.59	45.66	20.16
J184	0	58.69	0	49.01	0	49.13	0	54.31	0	57.77	0	57.96	0	27.83	0	42.9	0
J186	0	60.14	0	53.33	0	53.42	0	58.6	0	62.05	0	62.29	0	26.49	0	41.64	0

Existing Junction Set Data

Cum. Time (hrs)	0:00:00		12:00:00		24:00:00		36:00:00		48:00:00		60:00:00		72:00:00		84:00:00		96:0
Day	1				2				3				4				
Set/Time	1	AM	2	PM	3	AM	4	PM	5	AM	6	PM	7	AM	8	PM	9
Junction ID	Demand (gpm)	Pressure (psi)	Demand (gpm)	Pressure (psi)	Demand (gpm)	Pressure (psi)	Demand (gpm)	Pressure (psi)	Demand (gpm)	Pressure (psi)	Demand (gpm)	Pressure (psi)	Demand (gpm)	Pressure (psi)	Demand (gpm)	Pressure (psi)	Demand (gpm)
J188	54.16	58.7	1.53	53.33	5.96	53.39	5.33	58.58	5.96	62.03	1.53	62.29	78.16	23.64	77.53	38.84	78.16
J190	5.52	58.17	3.91	48.36	5.52	48.59	3.91	54.04	5.52	57.51	3.91	57.88	5.52	27.56	3.91	42.83	5.52
J192	9.84	64.52	150.97	32.4	9.84	54.94	6.97	60.46	64.56	59.35	18.49	63.92	21.36	33.46	12.73	49.1	9.84
J194	131.76	53.07	148.83	47.15	156.24	42.81	106.53	54.49	23.76	60.2	131.37	62.82	161.76	28.45	124.47	47.91	23.76
J196	84	43.7	0	40.65	84.24	33.43	0	47.99	84.24	50.82	0	56.32	108	17.39	0	41.41	0
J198	3.36	55.78	2.38	49.97	3.36	45.6	2.38	57.31	3.36	63.38	2.38	66.28	3.36	31.91	2.38	51.37	3.36
J200	3.36	47.98	2.38	42.17	3.36	37.79	2.38	49.51	3.36	55.57	2.38	58.48	3.36	24.1	2.38	43.57	3.36
J202	192	55.87	180	50.16	180.48	45.76	180.48	57.5	107.52	63.96	0	67.15	0	32.77	0	52.24	0
J204	11.04	58.02	7.82	52.32	11.04	47.91	7.82	59.65	11.04	66.11	7.82	69.31	11.04	34.92	7.82	54.39	11.04
J206	0	57.17	0	51.46	0	47.06	0	58.8	0	65.26	0	68.45	0	34.07	0	53.54	0
J208	0	28.88	0	26.59	0	24.63	0	26.49	0	27.33	0	26.06	0	14.37	0	19.72	0
J210	0	32.89	0	30.55	0	29.7	0	31.66	0	32.71	47.84	31.28	47.84	17.48	92	23.98	88.32
J212	0	31.78	0	29.92	42.24	28.33	192	29.5	192	30.43	192	29.22	192	17.26	192	22.87	192
J214	218.16	57.48	152.28	50.3	97.68	51.56	134.64	55.08	91.56	57.01	85.68	56.1	175.2	27.85	169.32	42.27	224.16
J216	3.36	59.64	2.38	52.21	3.36	53.66	2.38	57.22	3.36	59.06	2.38	58.04	3.36	29.45	2.38	44.39	3.36
J218	83.52	34.55	81.91	31.47	83.52	30.84	81.91	33.4	5.52	35.66	3.91	34.2	5.52	17.64	3.91	25.99	5.52
J22	0	42.06	0	37.02	0	36.9	0	40.15	0	41.25	0	40.09	0	17.1	0	28.44	0
J220	11.04	47.1	51.82	39.37	60.92	39.58	87.8	42.81	91.02	44.73	93.82	43.65	72.96	16.02	63.72	29	78.98
J222	1.2	55.92	0.85	46.52	1.2	47.24	0.85	50.74	1.2	53.42	0.85	52.76	1.2	24.47	0.85	37.09	1.2
J224	0	26.01	0	24.71	0	23.87	0	25.38	0	26.16	0	25.18	0	15.4	0	19.99	0
J226	69.36	26.75	2.38	26.87	3.36	26.03	2.38	27.55	3.36	28.33	2.38	27.35	3.36	17.56	2.38	22.16	69.36
J234	0	54.36	0	44.73	0	45.47	0	48.85	42	51.33	42	50.65	42	22.38	42	35.05	42
J236	23.52	64.5	21.91	53.21	23.52	54.21	27.67	57.41	5.52	60.35	3.91	59.82	5.52	31.25	75.91	43.17	77.52
J238	0	34.19	0	30.8	0	30.25	0	32.59	0	33.88	0	32.43	0	14.49	0	23.02	0
J24	0	47.74	0	41.61	0	41.68	0	45.29	0	46.74	0	45.92	0	20.52	0	33.12	0
J28	68.16	46.23	1.53	40.41	68.46	40.38	1.53	43.97	68.46	45.27	1.53	44.43	68.46	19.53	1.53	31.91	80.16
J30	300	46.06	306	41.34	305.76	41.3	305.76	44.73	305.76	45.3	305.76	43.87	305.76	21.79	305.76	33.22	305.76
J34	66	49.66	66	42.58	66	43.24	66	46.85	66	48.74	66	47.92	66	20.69	66	34.27	17.82
J42	16.32	31.34	47.56	28.43	16.32	27.79	90.22	29.85	57.72	31.04	149.56	29.52	141.9	13.41	149.56	21.09	118.44
J44	0	30.87	0	28.53	0	27.68	0	29.6	0	30.65	0	29.27	0	15.48	0	21.99	0
J48	0	34.25	0	29.94	0	29.57	0	32.41	0	33.72	0	32.4	0	11.19	48	21.32	48
J50	0	31.26	0	29	0	28.13	0	30.02	0	31.05	0	29.69	0	16.21	0	22.57	0
J52	0	33.47	0	30.35	0	29.76	0	32.28	0	33.5	0	32.03	0	15.48	0	23.82	0
J54	35.52	31	27.91	28.55	5.52	25.77	3.91	27.66	5.52	28.47	21.91	27.08	23.52	15.61	21.91	21.13	23.52
J56	0	27.74	0	25.87	0	24.86	0	26.62	0	27.55	0	26.35	0	14.39	0	20	0
J58	4.32	37.5	63.06	34.92	4.32	31.07	3.06	32.99	4.32	33.77	3.06	32.41	4.32	21.2	3.06	26.9	4.32
J60	0	26.07	0	24.53	0	23.59	0	25.29	0	26.17	0	25.07	0	14.06	0	19.22	0
J62	0	21.81	0	20.68	0	19.96	0	21.27	0	21.95	0	21.1	0	12.61	0	16.59	0
J92	0	50.85	0	43.34	0	43.73	0	47.55	0	49.66	0	49	0	21.72	0	35.12	0
J94	0	50.2	0	43.15	0	43.55	0	47.21	0	49.07	0	48.3	0	21.48	0	34.73	0
J96	114	34.65	114	32.78	114	31.19	0	36.86	0	37.79	0	36.59	0	24.63	0	30.24	0
J98	300.48	29.37	124.59	32.15	127.02	31.17	39.87	33.83	12.36	34.83	4.59	33.73	6.48	22.72	4.59	27.89	71.16

Existing Junction Se

Cum. Time (hrs)	0:00	108:00:00		120:00:00		132:00:00		144:00:00		156:00:00		168:00:00		180:00:00		192:00:00	
Day	5			6				7				8				9	
Set/Time	AM	10	PM	11	AM	12	PM	13	AM	14	PM	15	AM	16	PM	17	AM
Junction ID	Pressure (psi)	Demand (gpm)	Pressure (psi)	Demand (gpm)	Pressure (psi)	Demand (gpm)	Pressure (psi)	Demand (gpm)	Pressure (psi)	Demand (gpm)	Pressure (psi)	Demand (gpm)	Pressure (psi)	Demand (gpm)	Pressure (psi)	Demand (gpm)	Pressure (psi)
J10	42.62	0	62.89	0	62.58	0	82.74	0	53.96	77.22	58.06	198	45.32	198	51.22	77.22	63.14
J100	22.79	0	36.01	0	35.59	0	49.94	0	31.77	0	35.46	0	28.94	0	33.64	0	38.61
J1002	29.72	0	45.06	0	44.41	0	61.14	0	40.11	0	44.26	0	36.88	0	42.41	0	48.01
J1004	3.97	137.47	26.49	113.64	25.92	3.91	47.01	5.52	22.15	3.91	27.3	5.52	17.82	3.91	25.41	5.52	32.28
J1006	22.51	0	37.45	0	36.79	0	52.99	0	32.76	0	36.78	0	29.6	0	34.97	0	39.98
J1008	-9.56	0	13.5	0	12.28	0	33.89	0	8.51	0	14.26	0	4.17	0	12.42	0	18.64
J1010	21.85	0	40.91	0	40.94	0	61.77	0	36.81	0	41.33	0	31.9	0	38.46	0	46.07
J1012	26.63	9.69	41.79	13.68	41.11	9.69	57.58	13.68	36.95	9.69	41.06	13.68	33.75	9.69	39.22	13.68	44.49
J1014	26.41	0	41.54	0	40.89	0	57.34	0	36.73	0	40.81	0	33.53	0	38.98	0	44.27
J102	23.41	149.8	38.18	160.32	37.53	131.08	53.58	35.04	33.67	59.08	37.64	46.56	30.54	41.8	35.84	112.8	40.62
J104	25.57	0	40.34	0	39.68	0	55.74	0	35.83	0	39.8	0	32.69	0	38	0	42.56
J106	33.22	16.66	48.06	23.52	47.33	16.66	63.46	23.52	43.48	16.66	47.52	23.52	40.34	16.66	45.72	143.52	46.15
J108	29.74	3.06	49.57	4.32	48.58	3.06	68.8	4.32	42.14	3.06	45.33	4.32	37.68	3.06	43.37	4.32	52.05
J110	35.01	5.44	53.91	7.68	52.92	5.44	73.14	7.68	46.48	161.44	49.67	109.08	42.02	106.84	47.71	109.08	56.39
J112	42.68	8.5	61.57	41.88	60.58	8.5	80.97	48	54.1	8.5	57.79	12	49.82	8.5	55.49	12	64.22
J114	33.8	81.91	48.76	83.52	47.96	52.27	66.58	5.52	41.83	3.91	47.04	5.52	41.14	3.91	47.55	5.52	53.57
J118	25.98	5.78	40.77	8.16	40.1	5.78	56.16	8.16	36.24	5.78	40.22	8.16	33.1	5.78	38.43	8.16	42.98
J12	37.75	12.06	57.23	18	56.88	0	77.02	0	49.48	12.06	53.53	12.06	42.3	12.06	48.17	12.06	58.54
J120	25.46	41.46	40.42	46.08	39.75	83.22	55.78	15.84	35.79	11.22	39.82	15.84	32.63	11.22	38	15.84	43.01
J122	20.68	124.59	34.29	126.48	34.03	4.59	49.16	126.48	30.46	124.59	34.18	126.48	27.44	124.59	32.01	6.48	37.88
J124	22.83	12.41	38.29	17.52	37.67	12.41	53.58	132.22	32.23	127.11	36.27	132.22	29.09	127.11	34.4	132.22	39.48
J130	29.43	6.29	44.79	8.88	44.13	6.29	60.88	8.88	39.83	6.29	44	8.88	36.59	6.29	42.13	8.88	47.73
J132	34.61	67.66	49.6	68.64	48.76	67.66	67.42	207.36	33.46	141.1	44.04	56.4	42.36	2.38	49.72	3.36	55.73
J134	29.4	102.48	45.99	133.36	44.19	42.68	66.73	63.16	40.07	62.18	44.21	63.16	35.21	62.18	40.96	63.16	49.58
J136	24.44	2.38	35.97	3.36	36.72	2.38	46.8	3.36	35.07	2.38	37.13	63.36	27.23	62.38	30.56	63.36	34.65
J138	11	186.02	21.24	121.2	27.76	108.74	38.51	55.68	29.63	108.74	29.16	116.16	22.57	108.74	26.25	116.16	29.71
J140	16.85	72	27.02	42	27.95	0	38.14	0	26.41	0	28.47	150	19.13	150	22.41	150	26.55
J142	21.62	0.85	32.95	1.2	32.93	54.61	44.96	85.2	29.05	54.61	32.88	54.96	27.08	54.61	30.77	54.96	35.77
J144	4.75	25.53	27.3	2.16	26.74	1.53	47.83	98.16	22.93	97.53	28.08	98.16	18.6	97.53	26.19	98.16	33.07
J146	-1.43	24.97	21.62	99.84	20.4	42.97	42.02	99.84	16.63	31.27	22.39	99.84	12.3	24.97	20.55	99.84	26.77
J148	-8.08	102	14.98	102	13.75	102	35.37	102	9.98	102	15.74	102	5.65	102	13.9	102	20.12
J152	17.26	22.15	36.32	22.8	36.34	16.15	57.14	34.8	32.25	28.15	36.78	34.8	27.37	22.15	33.96	28.8	41.53
J154	10.38	150.85	32.63	151.2	32.15	150.85	53.21	151.2	28.34	150.85	33.31	151.2	23.87	90.85	31.44	1.2	38.69
J156	16.98	108	36.03	108	36.05	108	56.86	0	35.28	0	39.81	0	30.41	0	37	0	44.57
J158	10.16	162	29.26	155.52	30.45	0	62.29	162	24.62	162	28.8	162	18.83	162	24.84	162	33.31
J160	34.08	30.24	53.01	30.24	52.49	30.24	72.42	36	45.96	36	50.08	18.24	40.49	18.24	46.29	18.24	55.34
J162	34.33	2.38	53.99	5.48	56.16	2.38	77.95	5.48	49.16	2.38	52.82	3.36	41.09	2.38	47.28	3.36	57.35
J164	29.27	131.72	48.93	35.6	54.13	35.6	75.92	178	41.61	178	45.28	178	33.55	165.54	40.47	135.28	52.12
J166	41.27	0	61.29	0	62.74	0	84.93	0	56.99	0	60.33	0	47.77	0	53.77	0	64.4
J168	40.5	21.06	60.39	22.32	62.07	21.06	84.41	4.32	56.56	3.06	59.9	4.32	47.36	3.06	53.38	4.32	63.86
J170	36.6	0	56.49	0	58.17	0	80.51	0	52.66	0	56	0	43.46	0	49.48	0	59.96
J172	32.9	91.53	52.84	92.16	54.47	91.53	76.86	92.16	48.97	13.53	55.9	92.16	39.77	91.53	45.83	92.16	56.26
J174	41.81	12	63.49	12	66.46	12	92.06	0	64.35	0	62.2	0	49.61	0	55.63	0	66.24
J176	34.62	150.93	56.89	122.76	60.3	1.53	86.86	2.16	59.15	181.53	55.02	182.16	42.42	181.53	48.46	182.16	59.05
J178	33.74	0	49.07	0	48.42	0	65.2	0	44.06	0	48.25	0	40.91	0	46.47	0	52.08
J180	45.71	0	64.61	0	63.61	0	84	24	57.06	24	60.75	24	52.78	24	58.45	24	67.18
J182	44.78	19.53	63.68	20.16	62.68	19.53	83.07	2.16	56.26	1.53	59.95	2.16	51.98	1.53	57.66	14.22	66.36
J184	43.4	0	63.71	0	63.39	0	83.49	0	53.88	0	58.42	0	45.36	0	51.27	0	63.62
J186	42.05	0	65.26	0	64.88	0	85.04	0	55.37	0	62.75	0	49.65	0	55.56	0	67.9

Existing Junction Se

Cum. Time (hrs)	0:00		108:00:00		120:00:00		132:00:00		144:00:00		156:00:00		168:00:00		180:00:00		192:00:00	
Day		5				6				7				8				9
Set/Time	AM		10	PM	11	AM	12	PM	13	AM	14	PM	15	AM	16	PM	17	AM
Junction ID	Pressure (psi)	Demand (gpm)	Pressure (psi)	Demand (gpm)	Pressure (psi)	Demand (gpm)	Pressure (psi)	Demand (gpm)	Pressure (psi)	Demand (gpm)	Pressure (psi)	Demand (gpm)	Pressure (psi)	Demand (gpm)	Pressure (psi)	Demand (gpm)	Pressure (psi)	Demand (gpm)	Pressure (psi)
J188	39.21	53.21	63.86	53.84	63.45	53.21	83.64	53.84	53.94	1.53	62.75	5.96	49.62	5.33	55.54	5.96	67.88		
J190	43.39	3.91	63.71	5.52	63.38	3.91	83.45	5.52	53.37	3.91	58.07	5.52	44.81	3.91	50.72	5.52	63.36		
J192	49.74	6.97	70.13	9.84	69.74	6.97	89.87	9.84	59.72	6.97	64.5	9.84	51.17	150.97	34.76	64.56	65.2		
J194	49.73	16.83	70.12	23.76	69.72	83.07	89.22	131.4	48.27	149.31	56.82	156.24	39.04	106.53	51.17	23.76	66.05		
J196	43.23	0	63.62	0	63.22	0	82.72	84.24	38.89	0	50.32	84.24	29.66	0	44.67	84.24	56.67		
J198	53.19	2.38	73.59	3.36	73.18	2.38	92.68	3.36	50.99	2.38	59.65	3.36	41.83	2.38	53.99	3.36	69.23		
J200	45.38	2.38	65.78	3.36	65.38	2.38	84.88	3.36	43.18	2.38	51.84	3.36	34.02	2.38	46.19	3.36	61.42		
J202	54.05	0	74.45	0	74.05	0	93.55	192	51.07	180.48	59.83	180.48	41.99	180.48	54.17	107.52	69.81		
J204	56.2	7.82	76.61	11.04	76.2	7.82	95.71	11.04	53.22	7.82	61.99	11.04	44.14	7.82	56.33	11.04	71.96		
J206	55.35	0	75.75	0	75.35	0	94.85	0	52.37	0	61.13	0	43.29	0	55.47	0	71.11		
J208	18.28	0	27.71	0	28.31	0	38.18	0	26.46	0	28.83	0	22.75	0	25.91	0	29.9		
J210	22.67	83.72	32.69	47.84	32.78	47.84	43.65	47.84	30.06	32.2	33.16	0	27.91	0	31.27	0	35.64		
J212	21.53	192	30.39	192	30.49	192	40.08	0	29.36	0	32.19	42.24	26.71	192	29.12	192	32.99		
J214	41.41	169.32	60.26	175.2	59.29	85.68	79.75	218.04	52.82	153	56.82	97.68	48.57	134.64	54.21	20.16	63.1		
J216	43.54	2.38	62.44	3.36	61.44	2.38	81.83	3.36	54.96	2.38	58.65	3.36	50.68	2.38	56.36	3.36	65.09		
J218	24.58	3.91	36.43	5.52	36.22	3.91	49.09	83.52	31.35	81.91	34.85	83.52	28.79	81.91	33	5.52	39.18		
J22	27.09	0	42.92	0	42.4	0	60.04	0	37.96	0	42.08	0	34.3	0	39.75	0	46.19		
J220	27.88	63.72	46.98	66.94	47.36	19.86	68.79	11.04	42.34	7.82	46.52	17.06	36.55	43.94	42.56	47.16	51.03		
J222	36.5	0.85	56.16	1.2	58.33	0.85	80.11	1.2	51.33	0.85	54.99	1.2	43.26	0.85	49.45	1.2	59.51		
J224	18.71	0	26.07	0	26.04	0	33.98	0	24.01	0	26.57	0	22.54	0	25.08	0	28.27		
J226	19.45	2.38	28.23	63.42	27	2.38	36.15	69.36	24.75	2.38	28.73	3.36	24.71	2.38	27.24	3.36	30.43		
J234	34.39	42	54.03	0	55.78	0	77.56	0	49.57	0	53.2	0	41.49	0	47.57	42	57.42		
J236	42.58	75.91	62.73	77.52	64.51	75.91	87.33	23.52	59.58	21.91	62.33	23.52	49.77	27.67	55.76	5.52	66.4		
J238	21.77	0	34.25	0	34.11	0	47.9	0	30.84	0	34.36	0	28.09	0	32.22	0	37.66		
J24	32.04	0	49.43	0	48.76	0	67.82	0	43.38	0	47.63	0	38.84	0	44.6	0	52.17		
J28	30.69	1.53	47.78	80.16	47.08	1.53	65.86	68.46	41.92	1.53	46.2	68.46	37.59	1.53	43.34	68.46	50.59		
J30	31.62	312	46.97	312	46.33	305.76	63.06	299.52	42.03	305.76	46.18	305.76	38.78	305.76	44.31	305.76	49.93		
J34	33.73	0	52	0	51.24	0	71.4	66	45.09	66	49.21	66	40.23	66	45.96	66	54.6		
J42	19.89	149.56	31.22	118.44	31.2	149.56	43.62	16.32	28.23	47.44	31.54	16.32	25.75	90.22	29.44	57.72	34.44		
J44	20.7	0	30.68	0	30.74	0	41.6	0	28.1	0	31.16	0	25.88	0	29.21	0	33.58		
J48	19.96	48	34.61	48	34.25	0	50.48	0	30.44	0	34.35	0	27.17	0	32.13	0	38.23		
J50	21.27	0	31.07	0	31.14	0	41.78	0	28.54	0	31.57	0	26.36	0	29.64	0	33.93		
J52	22.42	0	34.27	0	34.06	0	46.93	0	30.27	0	33.73	0	27.71	0	31.88	0	37.02		
J54	19.88	21.91	29.65	35.52	30.3	33.91	40.3	35.52	28.58	33.91	30.77	35.52	23.62	27.91	26.87	5.52	31.03		
J56	18.66	0	27.52	0	27.62	0	37.21	0	25.31	0	28.15	0	23.24	0	26.25	0	30.12		
J58	25.85	3.06	35.97	4.32	36.73	3.06	46.8	4.32	35.07	63.06	37.14	4.32	28.93	3.06	32.2	4.32	36.34		
J60	17.87	0	26.06	0	26.11	0	34.97	0	23.82	0	26.63	0	22.1	0	24.95	0	28.54		
J62	15.48	0	21.86	0	21.84	0	28.73	0	20.08	0	22.3	0	18.81	0	21	0	23.77		
J92	34.61	0	53.24	0	52.72	0	72.65	0	46.27	0	50.4	0	40.58	0	46.38	0	55.43		
J94	34.05	0	52.29	0	51.69	0	71.54	0	45.66	0	49.82	0	40.53	0	46.31	0	54.82		
J96	28.9	0	37.76	0	37.86	0	47.45	114	32.22	114	35.05	114	29.57	0	36.49	0	40.36		
J98	26.16	113.37	33.85	115.26	33.86	160.41	41.96	300.48	27.12	125.13	34.24	127.02	29.67	39.87	33.49	12.36	37.19		

Existing Junction Se

Cum. Time (hrs)	204:00:00		216:00:00		228:00:00		240:00:00		252:00:00		264:00:00		276:00:00		288:00:00		300:(
Day			10				11				12				13		
Set/Time	18	PM	19	AM	20	PM	21	AM	22	PM	23	AM	24	PM	25	AM	26
Junction ID	Demand (gpm)	Pressure (psi)	Demand (gpm)	Pressure (psi)	Demand (gpm)	Pressure (psi)	Demand (gpm)	Pressure (psi)	Demand (gpm)	Pressure (psi)	Demand (gpm)	Pressure (psi)	Demand (gpm)	Pressure (psi)	Demand (gpm)	Pressure (psi)	Demand (gpm)
J10	150.48	62.74	150.48	40.86	150.48	51.14	150.48	48.95	0	66.88	0	67.22	0	85.58	0	101.06	0
J100	0	37.05	0	23.31	0	29.69	0	27.72	0	39.02	0	38.95	0	52.28	0	65.28	0
J1002	0	46.38	0	30.34	0	37.71	0	35.22	0	48.38	0	48.21	0	63.68	0	78.74	0
J1004	3.91	29.99	244.02	5.51	242.41	15.47	244.02	10.38	112.03	30.62	113.64	30	3.91	49.87	5.52	64.78	3.91
J1006	0	38.28	0	22.66	0	30	0	27.95	0	40.69	0	40.49	0	55.49	0	70.28	0
J1008	0	17	0	-8.14	0	2.6	0	-3.14	0	17.63	0	16.36	0	36.88	0	52.27	0
J1010	0	44.05	0	23.18	0	31.82	0	28.26	0	45.03	0	45.47	0	64.56	0	79.72	0
J1012	9.69	42.85	13.68	27	9.69	34.38	13.68	32.1	9.69	45.06	13.68	44.85	9.69	60.1	13.68	75	9.69
J1014	0	42.6	0	26.78	0	34.14	0	31.88	0	44.82	0	44.63	0	59.86	0	74.77	0
J102	144.04	38.91	148.8	23.45	144.04	30.77	148.8	28.8	149.8	41.4	160.32	41.19	131.08	56.06	16.32	70.73	11.56
J104	0	40.88	0	25.39	0	32.83	0	30.95	0	43.56	0	43.34	0	58.22	0	72.88	0
J106	136.66	44.82	143.52	28.97	94.66	38.67	23.52	38.6	16.66	51.28	23.52	50.99	16.66	65.94	23.52	80.53	16.66
J108	3.06	50.62	4.32	32.42	3.06	41.71	148.32	31.85	111.06	50.21	60.48	52.43	3.06	71.82	4.32	86.9	3.06
J110	138.04	54.95	62.28	36.76	5.44	46.05	7.68	41.11	5.44	57.42	7.68	57.7	5.44	76.15	7.68	91.24	5.44
J112	8.5	62.93	48	44.41	8.5	53.51	48	49.08	8.5	65.5	41.88	65.55	8.5	84.04	12	99.04	8.5
J114	3.91	52	5.52	35.61	3.91	42.46	5.52	39.42	81.91	52.14	83.52	52.09	52.27	69.32	5.52	84.93	3.91
J118	5.78	41.3	8.16	25.8	5.78	33.25	8.16	31.37	5.78	43.98	8.16	43.75	5.78	58.64	8.16	73.3	5.78
J12	12.06	57.82	12.06	37.2	12.06	46.73	12.06	44.07	12.06	61.21	18	61.51	0	79.86	0	95.06	0
J120	47.22	41.23	33.84	25.65	41.46	32.97	46.08	30.9	41.46	43.66	46.08	43.44	83.22	58.28	15.84	73.31	11.22
J122	4.59	36.4	126.48	21.71	124.59	27.96	126.48	25.59	124.59	37.37	126.48	37.45	4.59	51.56	6.48	63.55	4.59
J124	127.11	37.83	132.22	22.23	102.31	29.64	17.52	28.97	12.41	41.47	17.52	41.26	12.41	56.04	17.52	69.85	12.41
J130	6.29	46.12	8.88	30.05	6.29	37.44	8.88	34.93	6.29	48.11	8.88	47.93	6.29	63.42	8.88	78.47	6.29
J132	2.38	54.16	3.36	37.77	67.66	43.3	68.64	40.23	67.66	52.98	68.64	52.9	67.66	70.16	3.36	87.1	2.38
J134	62.18	48.49	63.16	29.57	62.18	38.52	3.36	35.8	102.48	50.03	133.36	48.99	42.68	69.65	3.36	84.76	2.38
J136	62.38	33.37	63.36	25.26	56.38	29.5	57.36	27.84	2.38	38.16	3.36	39.37	2.38	48.74	3.36	57.42	2.38
J138	113.78	28.66	102.72	20.86	155.78	20.25	193.44	14.4	186.02	23.43	121.2	30.31	108.74	40.42	25.44	52.88	18.02
J140	150	25.22	120	17.54	108	21.59	78	20.25	72	29.21	42	30.6	0	40.08	0	48.76	0
J142	54.61	34.28	54.96	22.32	18.49	27.86	1.2	25.88	0.85	35.66	1.2	35.9	0.85	47.57	1.2	58.15	54.61
J144	97.53	30.77	98.16	6.29	97.53	16.26	98.16	11.17	25.53	31.43	2.16	30.82	1.53	50.69	2.16	65.6	1.53
J146	24.97	25.13	99.84	-0.01	6.97	10.73	88.14	4.98	24.97	25.75	99.84	24.49	24.97	45.01	9.84	60.4	6.97
J148	102	18.48	102	-6.66	102	4.08	102	-1.66	102	19.11	102	17.84	102	38.36	0	65.6	0
J152	22.15	39.48	28.8	18.59	22.15	27.23	28.8	23.67	22.15	40.43	22.8	40.86	16.15	59.93	22.8	75.09	16.15
J154	150.85	36.01	151.2	11.92	150.85	21.82	151.2	16.8	150.85	36.75	151.2	36.28	150.85	56.05	151.2	71	150.85
J156	30.24	42.2	108	18.3	108	26.94	108	23.38	108	40.14	108	40.57	108	59.64	0	78.12	0
J158	162	31.83	162	11.58	162	20.23	162	16.78	162	33.56	155.52	35.21	0	65.09	0	80.28	0
J160	18.24	54.37	18.24	34.91	48	43.45	48	40.37	30.24	56.97	30.24	57.11	30.24	75.27	0	90.37	0
J162	2.38	56.33	3.36	35.58	10.85	43.85	5.48	40.84	2.38	58.18	5.48	60.87	2.38	80.76	5.48	96.59	2.38
J164	135.28	51.1	135.28	30.35	135.28	38.62	131.72	35.78	131.72	53.12	35.6	58.85	35.6	78.73	0	94.86	0
J166	0	63.56	0	42.49	0	50.66	0	47.74	0	65.43	0	67.43	0	87.75	0	103.85	0
J168	3.06	62.95	4.32	42	3.06	50.02	10.26	46.99	21.06	64.56	22.32	66.77	21.06	87.23	4.32	103.37	3.06
J170	0	59.05	0	38.1	0	46.12	0	43.09	0	60.66	0	62.87	0	83.33	0	99.47	0
J172	91.53	55.4	92.16	34.41	91.53	42.47	92.16	39.39	91.53	57.01	92.16	59.18	91.53	79.68	92.16	95.78	13.53
J174	0	65.4	0	44.37	12	51.34	12	48.29	12	67.65	12	71.16	12	94.88	0	111.17	0
J176	181.53	58.22	182.16	37.18	181.53	44.17	182.16	41.1	150.93	61.05	122.76	65	1.53	89.68	2.16	105.97	1.53
J178	0	50.45	0	34.4	0	41.76	0	39.25	0	52.39	0	52.23	0	67.76	0	82.83	0
J180	24	65.89	24	47.37	24	56.47	0	52.11	0	68.54	0	68.58	0	87.07	0	102.07	0
J182	13.59	65.06	14.22	46.54	13.59	55.64	20.16	51.18	19.53	67.61	20.16	67.65	19.53	86.14	2.16	101.2	1.53
J184	0	63.48	0	41.11	0	51.78	0	49.73	0	67.7	0	68.02	0	86.33	0	101.91	0
J186	0	67.81	0	39.77	0	50.52	0	48.38	0	69.25	0	69.51	0	87.87	0	106.23	0

Existing Junction Se

Cum. Time (hrs)	204:00:00		216:00:00		228:00:00		240:00:00		252:00:00		264:00:00		276:00:00		288:00:00		300:(
Day	9		10				11				12				13		
Set/Time	18	PM	19	AM	20	PM	21	AM	22	PM	23	AM	24	PM	25	AM	26
Junction ID	Demand (gpm)	Pressure (psi)	Demand (gpm)	Pressure (psi)	Demand (gpm)	Pressure (psi)	Demand (gpm)	Pressure (psi)	Demand (gpm)	Pressure (psi)	Demand (gpm)	Pressure (psi)	Demand (gpm)	Pressure (psi)	Demand (gpm)	Pressure (psi)	Demand (gpm)
J188	1.53	67.81	78.16	36.92	77.53	47.71	78.16	45.54	53.21	67.85	53.84	68.08	53.21	86.48	2.16	106.23	1.53
J190	3.91	63.4	5.52	40.84	3.91	51.71	5.52	49.72	3.91	67.69	5.52	68.01	3.91	86.29	5.52	101.9	3.91
J192	18.49	69.44	21.36	46.74	12.73	57.98	9.84	56.07	6.97	74.12	9.84	74.37	6.97	92.71	9.84	108.25	6.97
J194	131.37	68.34	161.76	41.73	124.47	56.79	23.76	56.06	16.83	74.11	23.76	74.36	83.07	92.06	23.76	108.24	16.83
J196	0	61.84	108	30.67	0	50.29	0	49.56	0	67.61	0	67.86	0	85.56	0	101.74	0
J198	2.38	71.8	3.36	45.19	2.38	60.25	3.36	59.52	2.38	77.57	3.36	77.82	2.38	95.52	3.36	111.7	2.38
J200	2.38	64	3.36	37.38	2.38	52.45	3.36	51.71	2.38	69.77	3.36	70.01	2.38	87.72	3.36	103.89	2.38
J202	0	72.67	0	46.05	0	61.11	0	60.38	0	78.44	0	78.68	0	96.39	0	112.56	0
J204	7.82	74.83	11.04	48.2	7.82	63.27	11.04	62.53	7.82	80.6	11.04	80.83	7.82	98.55	11.04	114.71	7.82
J206	0	73.97	0	47.35	0	62.41	0	61.68	0	79.74	0	79.98	0	97.69	0	113.86	0
J208	0	28.67	0	20.12	0	23.69	0	21.68	0	29.9	0	30.86	0	40.08	0	48.81	0
J210	0	34.38	0	24.17	0	28.63	0	26.67	0	35.28	0	35.53	0	45.69	0	55.26	0
J212	192	31.87	192	23.02	192	26.84	192	24.93	192	32.58	192	32.89	192	41.87	0	52.36	0
J214	14.28	61.93	20.16	43.18	14.28	52.19	69.12	48.21	14.28	64.48	20.16	64.5	14.28	82.87	20.16	97.74	14.28
J216	2.38	63.79	3.36	45.28	2.38	54.38	3.36	49.94	2.38	66.37	3.36	66.41	2.38	84.9	3.36	99.9	2.38
J218	3.91	37.75	5.52	25.52	3.91	31.09	5.52	29.11	3.91	39.26	5.52	39.32	3.91	51.31	5.52	62.83	3.91
J22	0	44.82	0	27.91	0	35.39	0	32.65	0	46.41	0	46.36	0	62.66	0	76.32	0
J220	49.96	49.55	29.1	29.3	19.86	37.95	35.12	34.5	19.86	51.28	23.08	52.11	19.86	71.59	11.04	86.78	7.82
J222	0.85	58.49	1.2	37.75	0.85	46.02	1.2	43.01	0.85	60.35	1.2	63.04	0.85	82.93	1.2	98.76	0.85
J224	0	27.35	0	20.11	0	23.24	0	21.5	0	27.86	0	28.02	0	35.46	0	42.56	0
J226	2.38	29.52	3.36	22.27	2.38	25.4	69.36	22.24	2.38	30.02	63.42	28.97	2.38	37.62	3.36	44.72	2.38
J234	42	56.39	42	35.65	42	43.97	42	40.9	42	58.22	0	60.5	0	80.38	0	96.16	0
J236	3.91	65.52	5.52	44.52	75.91	52.08	77.52	49.07	75.91	66.89	77.52	69.21	75.91	90.15	5.52	106.41	3.91
J238	0	36.18	0	22.84	0	28.56	0	26.36	0	37.15	0	37.31	0	50.21	0	61.5	0
J24	0	51.07	0	32.82	0	41.21	0	38.04	0	53.19	0	53.12	0	70.57	0	84.86	0
J28	1.53	49.48	68.46	31.48	1.53	39.72	80.16	36.58	1.53	51.47	80.16	51.35	1.53	68.58	2.16	82.72	1.53
J30	305.76	48.3	305.76	32.25	305.76	39.62	305.76	37.12	312	50.29	312	50.13	305.76	65.6	0	80.66	0
J34	66	53.49	66	34.59	66	43.52	17.82	40.13	0	56.03	0	56.05	0	74.32	0	89.1	0
J42	149.56	32.95	141.9	20.99	149.56	26.18	118.44	24.15	149.56	33.93	118.44	34.17	149.56	45.84	16.32	56.42	11.56
J44	0	32.3	0	22.09	0	26.52	0	24.56	0	33.16	0	33.43	0	43.6	0	53.1	0
J48	0	36.75	0	21.01	48	27.72	48	25.14	48	37.86	48	37.88	0	52.96	0	65.61	0
J50	0	32.67	0	22.69	0	27.02	0	25.07	0	33.51	0	33.79	0	43.76	0	53.12	0
J52	0	35.59	0	23.36	0	28.92	0	26.95	0	37.1	0	37.16	0	49.14	0	60.67	0
J54	21.91	29.69	23.52	21.36	21.91	25.1	23.52	23.28	21.91	31.84	5.52	32.95	3.91	42.25	35.52	50.93	33.91
J56	0	29	0	20.15	0	23.97	0	22.06	0	29.71	0	30.02	0	39	0	47.59	0
J58	3.06	35.02	4.32	26.96	3.06	30.87	4.32	29.25	3.06	38.16	4.32	39.37	3.06	48.74	4.32	57.43	3.06
J60	0	27.51	0	19.36	0	22.88	0	21.01	0	28.08	0	28.32	0	36.63	0	44.63	0
J62	0	22.98	0	16.7	0	19.41	0	17.9	0	23.42	0	23.55	0	30	0	36.16	0
J92	0	54.46	0	35	0	43.98	0	40.9	0	57.2	0	57.34	0	75.49	0	90.37	0
J94	0	53.74	0	34.76	0	43.59	0	40.33	0	56.24	0	56.31	0	74.39	0	89.11	0
J96	0	39.24	0	30.38	0	34.21	0	32.3	0	39.95	0	40.26	0	49.24	0	59.73	0
J98	4.59	36.17	6.48	28.02	4.59	31.54	71.16	29.3	113.37	35.86	115.26	36.08	160.41	43.62	6.48	53.29	4.59

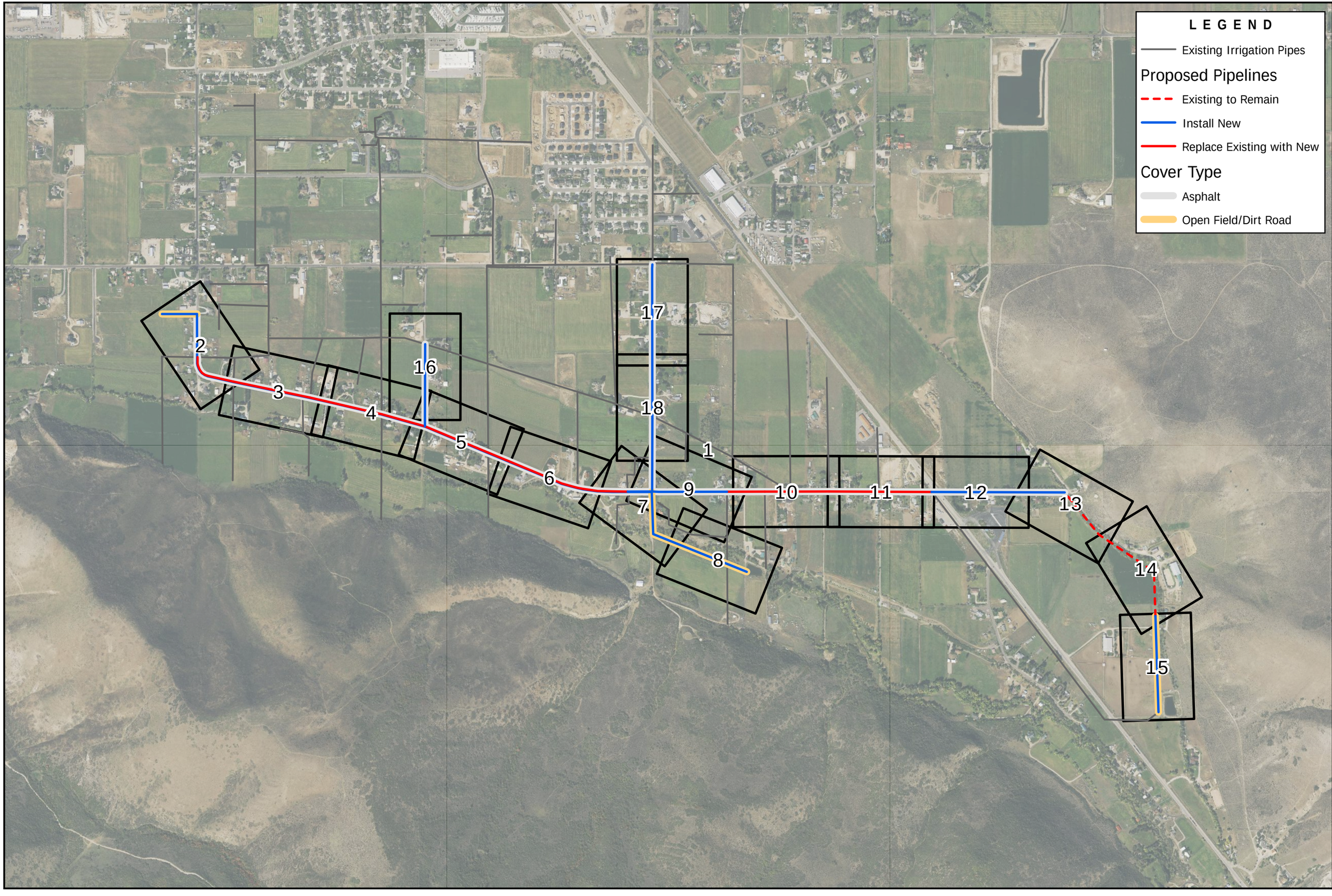
Existing Junction Se

Cum. Time (hrs)	00:00	312:00:00		324:00:00	
Day		14			
Set/Time	PM	27	AM	28	PM
Junction ID	Pressure (psi)	Demand (gpm)	Pressure (psi)	Demand (gpm)	Pressure (psi)
J10	101.99	0	102.22	0	102.6
J100	65.84	0	65.99	0	66.3
J1002	79.4	0	79.57	0	79.92
J1004	65.51	5.52	66.42	3.91	66.75
J1006	70.93	0	71.1	0	71.44
J1008	53	0	53.91	0	54.24
J1010	80.61	0	80.91	0	81.27
J1012	75.68	13.68	75.83	9.69	76.19
J1014	75.44	0	75.6	0	75.95
J102	71.38	16.32	71.54	11.56	71.88
J104	73.54	0	73.69	0	74.04
J106	81.26	23.52	81.35	16.66	81.76
J108	87.72	4.32	87.91	3.06	88.3
J110	92.06	7.68	92.25	5.44	92.63
J112	99.86	12	100.05	8.5	100.43
J114	85.64	5.52	85.81	3.91	86.16
J118	73.96	8.16	74.11	5.78	74.47
J12	95.95	0	96.18	0	96.55
J120	73.97	15.84	74.13	11.22	74.48
J122	64.09	6.48	64.3	4.59	64.58
J124	70.51	17.52	70.67	12.41	71.01
J130	79.15	8.88	79.31	6.29	79.67
J132	87.8	3.36	87.97	2.38	88.33
J134	85.57	3.36	85.8	2.38	86.16
J136	57.79	3.36	57.86	2.38	58.09
J138	53.36	25.44	53.32	18.02	53.66
J140	49.12	0	49.2	0	49.43
J142	58.17	54.96	58.33	54.61	58.58
J144	66.33	2.16	67.24	1.53	67.56
J146	61.13	9.84	62.03	6.97	62.36
J148	66.33	0	67.23	0	67.56
J152	75.98	22.8	76.28	16.15	76.64
J154	71.75	1.2	72.87	0.85	73.2
J156	79.01	0	79.32	0	79.67
J158	81.18	0	81.47	0	81.83
J160	91.2	0	91.43	0	91.79
J162	97.64	3.36	97.91	2.38	98.28
J164	95.91	0	96.17	0	96.55
J166	105.01	0	105.26	0	105.64
J168	104.57	4.32	104.83	3.06	105.21
J170	100.67	0	100.93	0	101.31
J172	100.56	2.16	100.92	1.53	101.3
J174	112.37	0	112.62	0	113
J176	107.17	2.16	107.42	1.53	107.8
J178	83.5	0	83.67	0	84.01
J180	102.89	0	103.08	0	103.47
J182	102.02	2.16	102.21	1.53	102.6
J184	102.85	0	103.06	0	103.46
J186	107.18	0	107.39	0	107.79

Existing Junction Se

Cum. Time (hrs)	00:00	312:00:00		324:00:00	
Day		14			
Set/Time	PM	27	AM	28	PM
Junction ID	Pressure (psi)	Demand (gpm)	Pressure (psi)	Demand (gpm)	Pressure (psi)
J188	107.17	2.16	107.39	1.53	107.78
J190	102.84	5.52	103.05	3.91	103.45
J192	109.27	9.84	109.41	6.97	109.87
J194	109.26	23.76	109.4	16.83	109.87
J196	102.76	0	102.9	0	103.37
J198	112.72	3.36	112.86	2.38	113.33
J200	104.92	3.36	105.05	2.38	105.53
J202	113.59	0	113.72	0	114.2
J204	115.74	11.04	115.87	7.82	116.35
J206	114.89	0	115.02	0	115.5
J208	49.17	0	49.25	0	49.47
J210	55.64	0	55.77	0	55.99
J212	52.69	0	52.8	0	53
J214	98.56	20.16	98.76	14.28	99.14
J216	100.72	3.36	100.91	2.38	101.3
J218	63.32	5.52	63.46	3.91	63.73
J22	76.99	0	77.21	0	77.54
J220	87.68	11.04	87.97	7.82	88.33
J222	99.81	1.2	100.07	0.85	100.45
J224	42.83	0	42.92	0	43.08
J226	45	3.36	45.08	2.38	45.25
J234	97.21	0	97.47	0	97.85
J236	107.6	5.52	107.86	3.91	108.24
J238	61.98	0	62.17	0	62.43
J24	85.61	0	85.84	0	86.18
J28	83.45	2.16	83.68	1.53	84.02
J30	81.33	0	81.5	0	81.85
J34	89.91	0	90.13	0	90.49
J42	56.84	16.32	57	11.56	57.25
J44	53.48	0	53.61	0	53.83
J48	66.2	0	66.43	0	66.73
J50	53.49	0	53.62	0	53.83
J52	61.16	0	61.3	0	61.57
J54	51.29	35.52	51.37	33.91	51.6
J56	47.92	0	48.03	0	48.23
J58	57.79	4.32	57.87	3.06	58.1
J60	44.94	0	45.04	0	45.22
J62	36.4	0	36.48	0	36.62
J92	91.2	0	91.43	0	91.79
J94	89.91	0	90.14	0	90.5
J96	60.06	0	60.17	0	60.36
J98	53.6	6.48	53.7	4.59	53.88

APPENDIX D
PRELIMINARY PROJECT FIGURES
(FORTHCOMING)



SCALE: 1 in = 1,000 ft

NORTH:

30% DESIGN - PROPOSED PIPELINE ALIGNMENTS

WASATCH COUNTY
DANIEL IRRIGATION PROJECT

BOWEN COLLINS & ASSOCIATES

FIGURE NO.
1

P:\Wasatch County\627-19-01 Tri-Valley Watershed Plan EA\6.0 Reports\01 - Daniels Irrigation\GIS\DanielsIrrigation\DanielsIrrigation.aprx cmoutine 11/13/2022



SCALE: 1 in = 80 ft

NORTH:

30% DESIGN - PROPOSED PIPELINE ALIGNMENTS

WASATCH COUNTY

DANIEL IRRIGATION PROJECT

BOWEN COLLINS & ASSOCIATES

FIGURE NO.

2

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SCALE: 1 in = 80 ft

NORTH:

30% DESIGN - PROPOSED PIPELINE ALIGNMENTS

WASATCH COUNTY

DANIEL IRRIGATION PROJECT

BOWEN COLLINS & ASSOCIATES

FIGURE NO.

3

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SCALE: 1 in = 80 ft

NORTH:

30% DESIGN - PROPOSED PIPELINE ALIGNMENTS

WASATCH COUNTY

DANIEL IRRIGATION PROJECT

BOWEN COLLINS & ASSOCIATES

FIGURE NO.

4

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SCALE: 1 in = 80 ft

NORTH:

30% DESIGN - PROPOSED PIPELINE ALIGNMENTS

WASATCH COUNTY

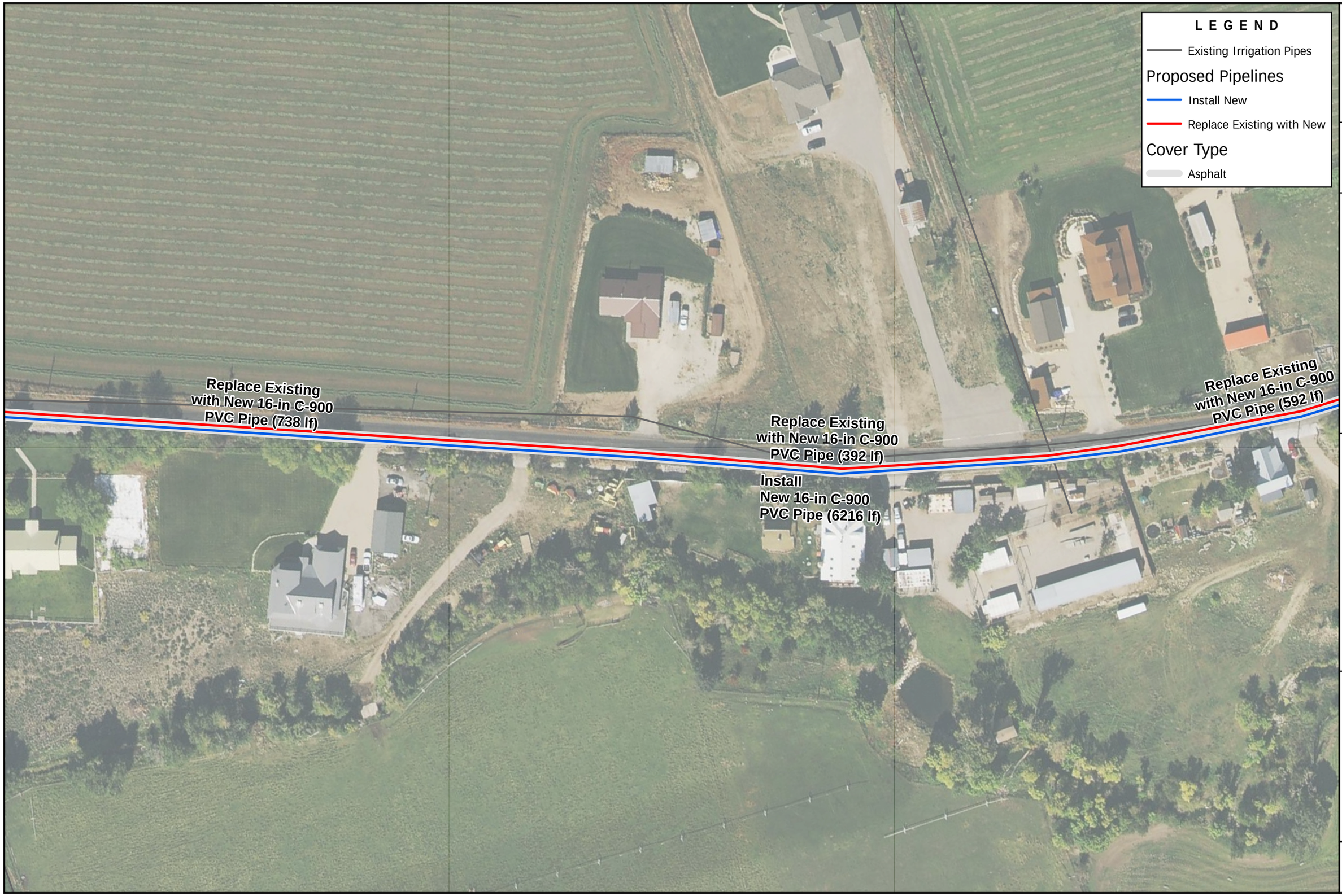
DANIEL IRRIGATION PROJECT

BOWEN COLLINS & ASSOCIATES

FIGURE NO.

5

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SCALE: 1 in = 80 ft

NORTH:

30% DESIGN - PROPOSED PIPELINE ALIGNMENTS

WASATCH COUNTY
DANIEL IRRIGATION PROJECT

BOWEN COLLINS & ASSOCIATES

FIGURE NO.
6

P:\Wasatch County\627-19-01 Tri-Valley Watershed Plan EA\6.0 Reports\01 - Daniels Irrigation\GIS\DanielsIrrigation\DanielsIrrigation.aprx cmoultrie 11/19/2022

Install New 10-in C-900 PVC Pipe (856 lf)

Install New 20-in C-900 PVC Pipe (879 lf)

Install New 16-in C-900 PVC Pipe (287 lf)

Install New 16-in C-900 PVC Pipe (621.6 lf)

Replace Existing with New 16-in C-900 PVC Pipe (592 lf)

Install New 16-in C-900 PVC Pipe (1679 lf)

LEGEND

Existing Irrigation Pipes

Proposed Pipelines

- Install New
- Replace Existing with New

Cover Type

- Asphalt
- Open Field/Dirt Road

SCALE: 1 in = 80 ft

NORTH:

30% DESIGN - PROPOSED PIPELINE ALIGNMENTS

WASATCH COUNTY

DANIEL IRRIGATION PROJECT

BOWEN COLLINS & ASSOCIATES

FIGURE NO. 7

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SCALE: 1 in = 80 ft

NORTH:

30% DESIGN - PROPOSED PIPELINE ALIGNMENTS

WASATCH COUNTY

DANIEL IRRIGATION PROJECT

BOWEN COLLINS & ASSOCIATES

FIGURE NO.

8

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SCALE: 1 in = 80 ft

NORTH:

30% DESIGN - PROPOSED PIPELINE ALIGNMENTS

WASATCH COUNTY

DANIEL IRRIGATION PROJECT

BOWEN COLLINS & ASSOCIATES

FIGURE NO.

9

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SCALE: 1 in = 80 ft

NORTH:

30% DESIGN - PROPOSED PIPELINE ALIGNMENTS

WASATCH COUNTY

DANIEL IRRIGATION PROJECT

BOWEN COLLINS & ASSOCIATES

FIGURE NO.

10

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SCALE: 1 in = 80 ft

NORTH:

30% DESIGN - PROPOSED PIPELINE ALIGNMENTS

WASATCH COUNTY

DANIEL IRRIGATION PROJECT

BOWEN COLLINS & ASSOCIATES

FIGURE NO.

11

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SCALE: 1 in = 80 ft

NORTH: NORTH

30% DESIGN - PROPOSED PIPELINE ALIGNMENTS

WASATCH COUNTY

DANIEL IRRIGATION PROJECT

BOWEN COLLINS & ASSOCIATES

FIGURE NO.

12

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SCALE: 1 in = 80 ft

NORTH:

30% DESIGN - PROPOSED PIPELINE ALIGNMENTS

WASATCH COUNTY

DANIEL IRRIGATION PROJECT

BOWEN COLLINS & ASSOCIATES

FIGURE NO.

13

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SCALE: 1 in = 80 ft

NORTH:

30% DESIGN - PROPOSED PIPELINE ALIGNMENTS

WASATCH COUNTY

DANIEL IRRIGATION PROJECT

BOWEN COLLINS & ASSOCIATES

FIGURE NO.

14

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SCALE: 1 in = 80 ft

NORTH:

30% DESIGN - PROPOSED PIPELINE ALIGNMENTS

WASATCH COUNTY

DANIEL IRRIGATION PROJECT

BOWEN COLLINS & ASSOCIATES

FIGURE NO.

15

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SCALE: 1 in = 80 ft

NORTH:

30% DESIGN - PROPOSED PIPELINE ALIGNMENTS

WASATCH COUNTY

DANIEL IRRIGATION PROJECT

BOWEN COLLINS & ASSOCIATES

FIGURE NO.

16

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SCALE: 1 in = 80 ft

NORTH:

30% DESIGN - PROPOSED PIPELINE ALIGNMENTS

WASATCH COUNTY
DANIEL IRRIGATION PROJECT

BOWEN COLLINS & ASSOCIATES

FIGURE NO.
17

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SCALE: 1 in = 80 ft

NORTH:

30% DESIGN - PROPOSED PIPELINE ALIGNMENTS

WASATCH COUNTY

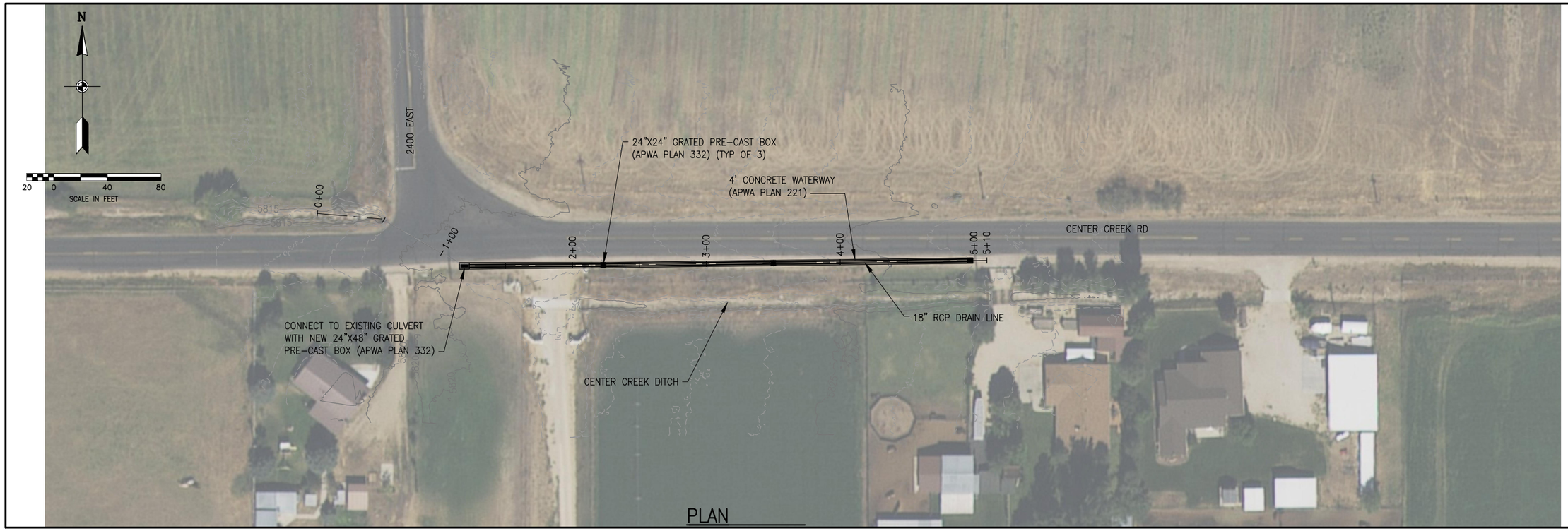
DANIEL IRRIGATION PROJECT

BOWEN COLLINS & ASSOCIATES

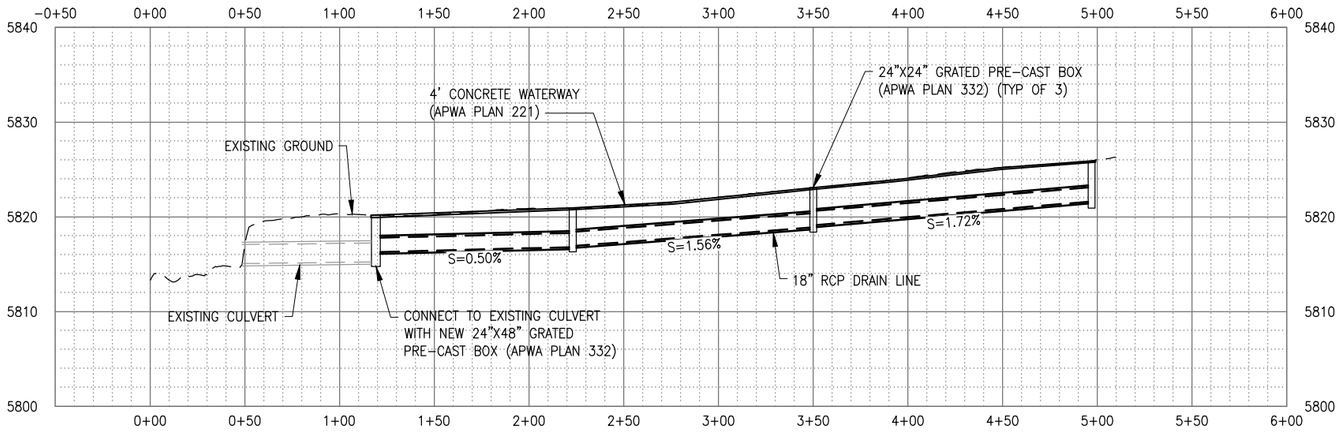
FIGURE NO.

18

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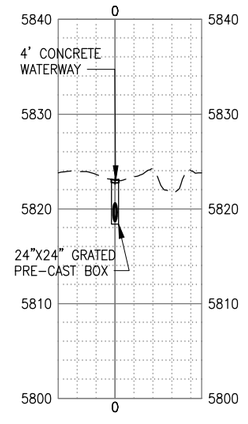


PLAN



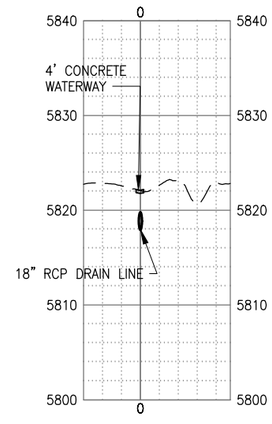
PROFILE

SCALE: H: 1" = 40'-0"
V: 1" = 8'-0"



SECTION 1 (STA 3+50)

SCALE: H: 1" = 40'-0"
V: 1" = 8'-0"



SECTION 1 (STA 3+83)

SCALE: H: 1" = 40'-0"
V: 1" = 8'-0"

BOWEN COLLINS & ASSOCIATES

30% REVIEW

NOT FOR CONSTRUCTION
FOR REVIEW ONLY

NO.	DATE	REV. BY	DESCRIPTION
			REVISIONS

WASATCH COUNTY
TRI-VALLEY WATERSHED PLAN EA
WASATCH COUNTY

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING

REVIEW

DESIGN C. MOULTRIE
DRAWN C. MOULTRIE
CHECKED
APPROVED

CENTER CREEK
OVERFLOW PIPE
PLAN AND PROFILE

DATE: MARCH 2022
PROJECT NUMBER 627-19-01

DRAWING NO.
C-1
SHEET 22 OF 22

P:\Wasatch County\627-19-01 Tri-Valley Watershed Plan EA\7.0 Drawings\2.7 Drawings\sht\Center Creek Overflowdwg.dwg Plotted: 3/26/2022 5:17 PM By: Cody Moultrie

Cultural Resource Assessment

COVER PAGE

Must Accompany All Project Reports Submitted to the Utah SHPO

Utah Division of State History

Report Title: *A Cultural Resource Assessment for the Tri-Valley Watershed Plan-EA, Wasatch County, Utah*

UDSH Project Number: U21HY0435
Org. Project Number: BCA39
Report Date: August 20, 2021
County(ies): Wasatch
Report Author(s): Sheri Murray Ellis
Principal Investigator: Sheri Murray Ellis
Record Search Date(s): June 6, 2021
Field Supervisor(s): Sheri Murray Ellis
Intensive Acres Surveyed (<15m intervals): 63 acres
Recon Acres Surveyed (<15m intervals): 0 ac.
USGS 7.5' Series Map Reference(s): Charleston, UT and Center Creek, UT

Sites Reported	Count	Smithsonian Trinomials
Revisits (no updated site forms)	0	
Updates (updated site forms attached)	3	42WA218, 42WA245, 42WA293
New recordings (site forms attached)	2	42WA533, 42WA534
Total Count of Archaeological Sites in APE	5	42WA218, 42WA245, 42WA293, 42WA533, 42WA534
Historic Structures (structures forms Attached)	0	
Total National Register Eligible Sites	4	42WA218, 42WA245, 42WA293, 42WA534

*Please list all site numbers per category. Number strings are acceptable (e.g. "42TO1-13; 42TO15"). Cells should expand to accommodate extensive lists.

Checklist of Required Items for Submittal to SHPO

- ☒ "Born Digital" Report in a PDF/A format
  - ☒ SHPO Cover Sheet
  - ☒ File Name is the UDSH Project Number with no hyphens or landowner suffixes
- ☒ "Born Digital" Site forms in PDF/A format
  - ☒ UASF with embedded maps and photos
  - ☒ File name is Smithsonian Trinomial without leading zeros (e.g. 42TO13 not 42TO00013)
  - ☒ Photo requirements (including size and quality)
- ☒ Archaeological Site Tabular Data
  - ☒ Single spreadsheet for each project
  - ☒ Follows UTSHPO template (info here: https://goo.gl/7SLMqj)
- ☒ GIS data
  - ☒ Zipped polygon shapefile or geodatabase of survey (if different from APE) or other activity area with required field names and variable intensity denoted
  - ☒ Zipped polygon shapefile or geodatabase of site boundaries with a the required field name

A Cultural Resource Assessment for the Tri-Valley Watershed Plan-EA, Wasatch County, Utah

Prepared for

Bowen Collins & Associates

Prepared by

Sheri Murray Ellis, MS, RPA
Owner/Consultant

Certus Environmental Solutions, LLC
Salt Lake City, Utah
801.230.7260

PLPCO Permit No. 176
Utah Antiquities Project No. U21Y0435

Certus Project Number: BCA39

August 20, 2021

PROJECT ABSTRACT SHEET

Report Title: *A Cultural Resource Assessment for the Tri-Valley Watershed Plan-EA, Wasatch County, Utah*

State Project No.: U21HY0435

Project Description: Wasatch County is evaluating plans to update the piping and pumping system to improve irrigation delivery methods and allow better access for pipe maintenance in the Daniel area of the Heber Valley. Additionally, they would like to address flooding of Center Creek near Center Creek Road and 2400 East with an overflow pipe and several catch basins. The projects are hereafter referred to as the Tri-Valley Watershed Plan-EA. The project falls under the regulatory oversight of the Natural Resources Conservation Service (NRCS), which is serving as the lead federal agency for the undertaking. Other state and federal agencies, including the U.S. Army Corps of Engineers (USACE), may also have regulatory actions for the project. These regulatory actions by the NRCS and USACE constitute an undertaking per the National Historic Preservation Act and its implementing regulations at 36 CFR 800. Certus Environmental Solutions (Certus) carried out a cultural resource assessment for the project, the results of which are presented herein for use by the NRCS, USACE, and other agencies in applying with the applicable federal (and state) regulations.

Survey Area: The survey area for cultural resources was defined as a series of linear corridors and small polygons within which piping, pumping systems, channel armoring or other flood control measures, and other activities would occur. In total, the survey area contained approximately 63 acres. The NRCS, USACE, and other agencies will define the formal area of potential effects (APE) as part of their individual permitting or approval actions.

Agencies: Wasatch County; Natural Resources Conservation Service; U.S. Army Corps of Engineers

Location: Daniel, Wasatch County; T. 4 S, R. 5 E, Secs. 9, 10, 15–18 and 20–22

Land Ownership: Private and Municipal

Date(s) of Fieldwork: June 17, 2021

Methods: Intensive-level archaeological survey

Acres Surveyed: 63 acres

Total # of Cultural Resource Sites in Survey Area: 5 (42WA218, 42WA245, 42WA293, 42WA533, 42WA534)

Resources Recommended Eligible for the NRHP: 4 (42WA218, 42WA245, 42WA293, 42WA534)

Resources Recommended Ineligible for the NRHP: 1 (42WA533)

Table of Contents

Project Abstract Sheet i
Table of Contents ii
List of Figures iii
Project Purpose and Definition of the Undertaking 1
Personnel Qualifications 1
Cultural Resources Survey Area and Area of Potential Effects 1
Project Setting 5
File Search and Archival Research 5
Field Methods 7
Resource Evaluation Methods 8
Findings 8
Site 42WA218, Timpanogos Canal 8
Site 42WA245, Center Creek Canal 10
Site 42WA293, Old Extension Canal 11
Site 42WA533, Historical Foundations 13
Site 42WA534, Daniel Irrigation Company Canal 14
Potential for Buried Resources 16
Summary 16
References Cited 17

List of Figures

Figure 1. General location of the cultural resources survey area 2
Figure 2. Location of cultural resources survey area; Topographic Map 3
Figure 3. Cultural resource survey area detail; Aerial Map 4
Figure 4. Typical survey area in Daniel; looking east 6
Figure 5. Typical setting along Timpanogos Canal; looking south 6
Figure 6. Survey results 9
Figure 7. 42WA245; Typical channel along documented segment; looking west 10
Figure 8. 42SM2935, Abandoned turnout on lateral ditch; looking north 12
Figure 9. 42WA533. Overview of larger foundation; looking southeast 13
Figure 10. 42WA534. Turnout and ditch channel along Little Sweden Road; looking southeast 15

PROJECT PURPOSE AND DEFINITION OF THE UNDERTAKING

Wasatch County is evaluating plans to update the piping and pumping system to improve irrigation delivery methods and allow better access for pipe maintenance in the Daniel area of the Heber Valley (see **Figure** 1 for location). Additionally, they would like to address flooding of Center Creek near Center Creek Road and 2400 East with an overflow pipe and several catch basins. The projects are hereafter referred to as the Tri-Valley Watershed Plan-EA. The project falls under the regulatory oversight of the Natural Resources Conservation Service (NRCS), which is serving as the lead federal agency for the undertaking. Other state and federal agencies, including the U.S. Army Corps of Engineers (USACE), may also have regulatory actions for the project. These regulatory actions by the NRCS and USACE constitute an undertaking per the National Historic Preservation Act and its implementing regulations at 36 CFR 800.

Bowen Collins & Associates (BCA) was contracted to serve as the design and environmental study lead for the undertaking on behalf of the County. BCA acquired the services of Certus Environmental Solutions (Certus) to assist them in assessing the potential project effects to cultural resources in the project area. The results of the assessment carried out by Certus are presented herein for use by the NRCS, USACE, and other agencies in applying with the applicable federal (and state) regulations.

Fieldwork, which was carried out June 17, 2021, consisted of an intensive-level survey for archaeological resources. No buildings or structures that are not directly associated with the project facilities would be altered or otherwise directly affected by the project. As such, these resources were excluded from the assessment present herein. The cultural resource assessment was carried out under Utah State Antiquities Project No. U21HY0435.

PERSONNEL QUALIFICATIONS

Sheri Murray Ellis, Principal Investigator for Certus under State of Utah Public Lands Policy Coordination Office Permit No. 176, conducted fieldwork for the project and served as the principal investigator. Ms. Ellis meets all standards for professional qualifications for both archaeology and architectural history and for both prehistoric and historic period resources. Ms. Ellis holds an M.S. in American Studies (a multi-disciplinary degree that includes archaeology and history). Ms. Ellis has 30 years of professional experience in cultural resource assessments in Utah and the western United States.

CULTURAL RESOURCES SURVEY AREA AND AREA OF POTENTIAL EFFECTS

The survey area for cultural resources was defined as a series of linear corridors and small polygons within which piping, pumping systems, channel armoring or other flood control measures, and other activities would occur (see **Figures 2 and 3**). In total, the survey area contained approximately 63 acres. The NRCS, USACE, and other agencies will define the formal area of potential effects (APE) as part of their individual permitting or approval actions.

The survey area is located in Township 4 South, Range 5 East, Sections 9, 10, 15–18, and 20–22 of the Salt Lake Base and Meridian. This area can be found on USGS 7.5 minute topographic quadrangles Charleston, Utah, and Center Creek, Utah (see **Figure 2**).

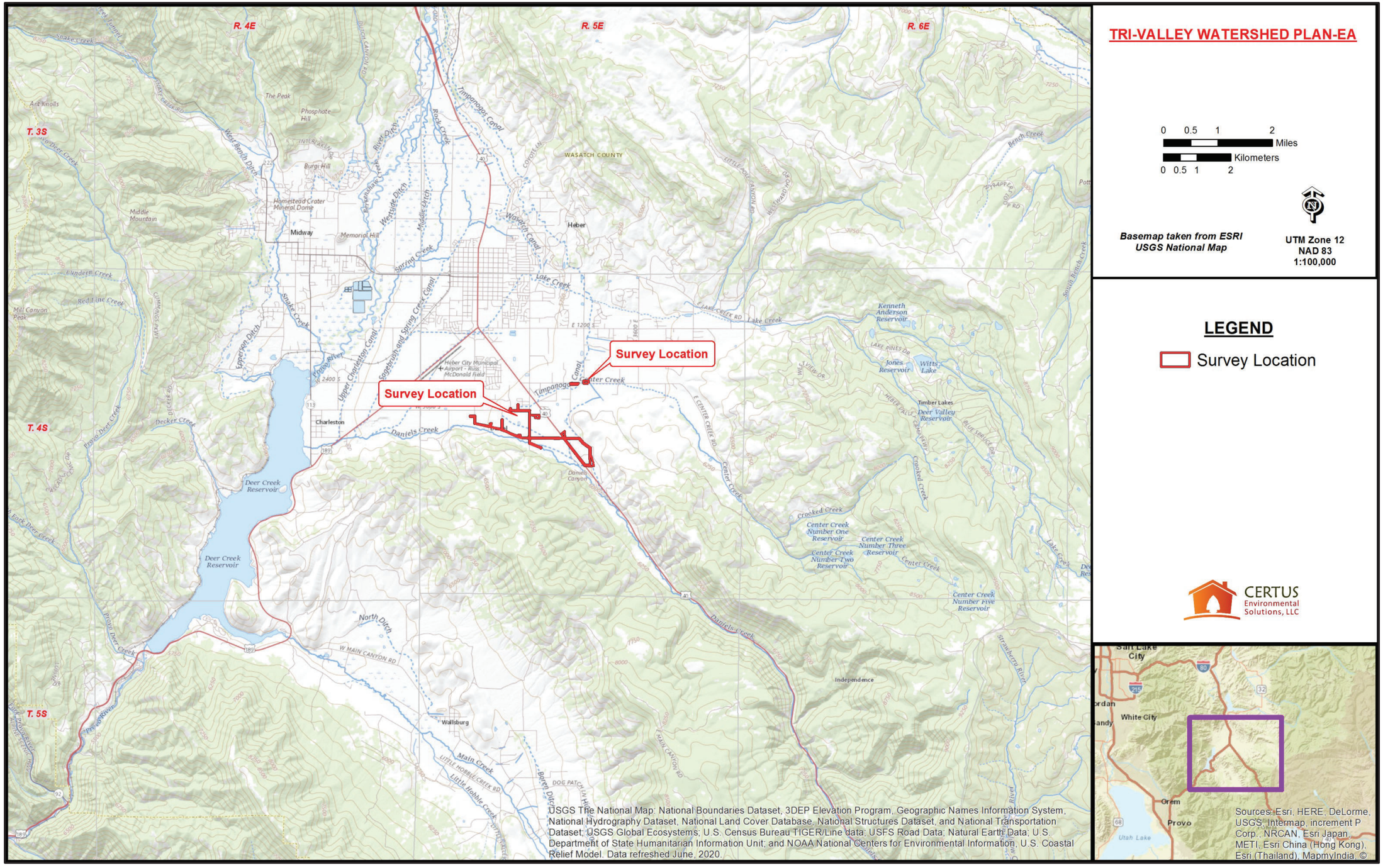
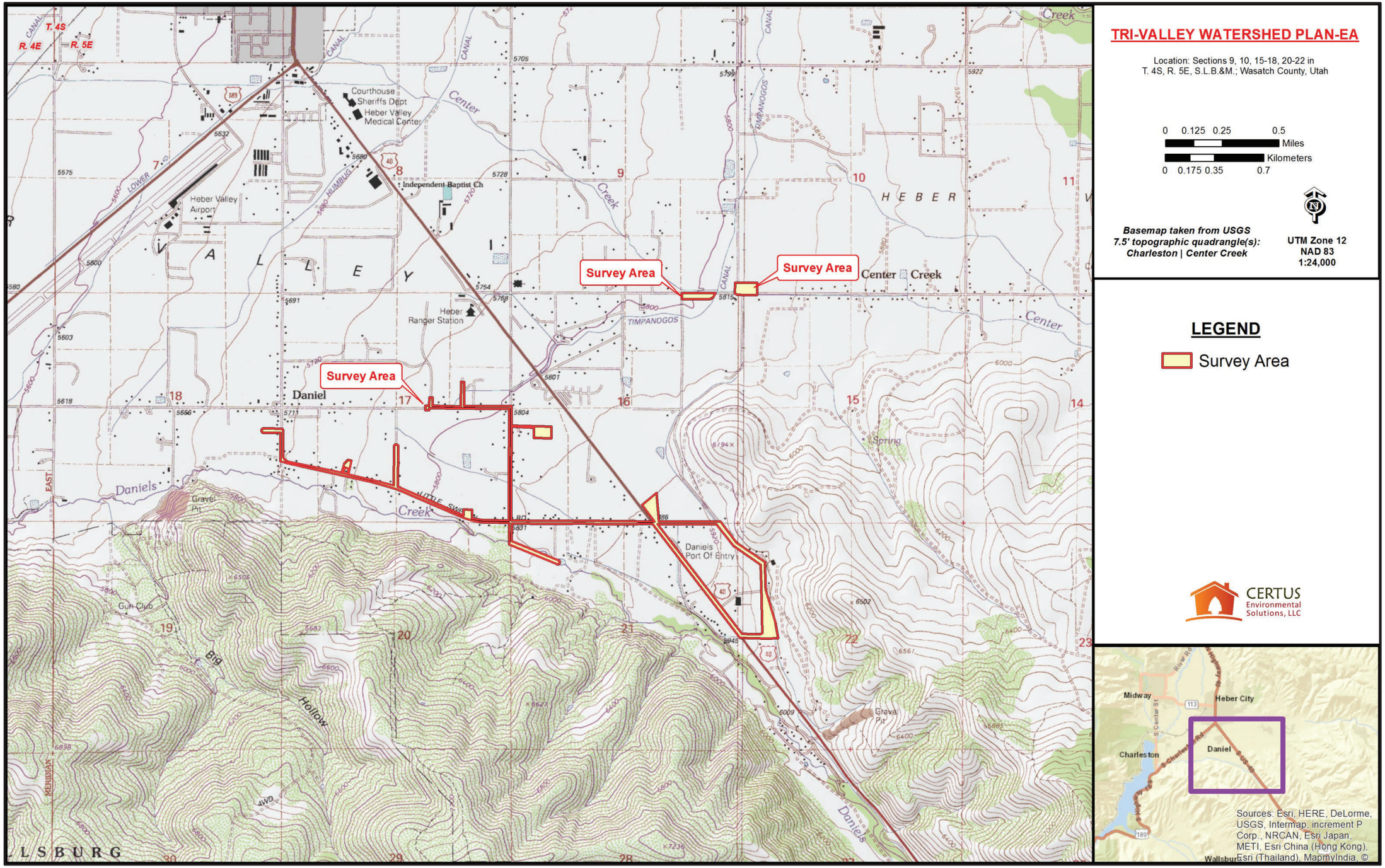


Figure 1. General location of the cultural resources survey area



TRI-VALLEY WATERSHED PLAN-EA

Location: Sections 9, 10, 15-18, 20-22 in
T. 4S, R. 5E, S.L.B.&M.; Wasatch County, Utah

0 0.125 0.25 0.5 Miles
0 0.175 0.35 0.7 Kilometers

Basemap taken from USGS 7.5' topographic quadrangle(s): Charleston | Center Creek

UTM Zone 12
NAD 83
1:24,000

LEGEND

Survey Area

CERTUS Environmental Solutions, LLC

Figure 2. Location of cultural resources survey area; Topographic Map

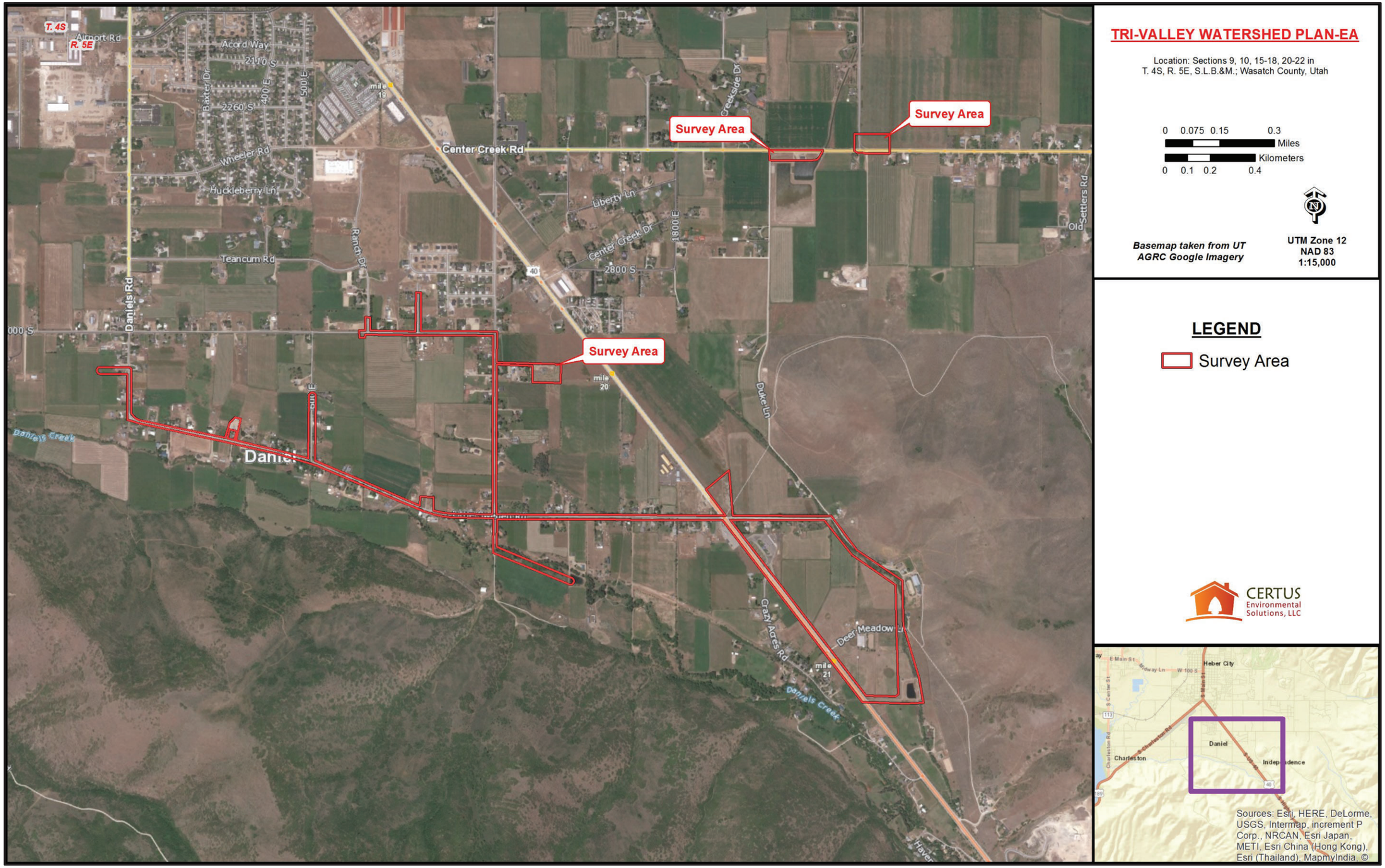


Figure 3. Cultural resource survey area detail; Aerial Map

PROJECT SETTING

The project area is located in the southern part of the Heber Valley in and around the community of Daniel. The area is a mix of rural and suburban development with many former agricultural properties having been subdivided into new residential subdivisions within the last 10 years. Settlement of the community occurred during the 1870s, at which time subsistence agriculture served as the basis of the culture and economy. Irrigation networks were soon established throughout the area to support these agricultural pursuits, and many open canal and ditch channels associated with these systems are found along roadways and extending through fields.

The natural terrain of the area slopes gently downward from southeast to northwest and averages roughly 5850 feet above sea level. The steep slopes of the Wasatch Mountains climb sharply upward just south of the project area. The southeast corner of the project area is situated at the mouth of Daniels Canyon, a long narrow drainage connecting the Heber Valley to the Strawberry Valley. Daniels Creek flows through the project area, exiting the canyon and wrapping around the foothills to the northwest.

Vegetation community and ground cover varied across the survey area. Along the creek and irrigation canal channels, riparian vegetation was present and relatively dense. Invasive plants were common in the larger block survey areas where past ground disturbance had facilitated their incursion, and introduced grasses, trees, shrubs, and forbs are present on residential and commercial properties throughout the area as were a few locations of introduced cultigens found in agricultural fields. Ground cover averaged roughly 50-percent across the entire survey area but ranged from barren to 100-percent depending on location.

Figures 4 and 5 provide overviews of various portions of the survey area.

FILE SEARCH AND ARCHIVAL RESEARCH

Certus conducted a search of the online site and project files of the Utah Division of State History (UDSH) on June 6, 2021. The file search encompassed an area extending 1/2 mile in all directions from the edge of the survey area. The file search was conducted to:

a) identify any areas of the survey area that may not require additional field inventory;

b) identify any previously documented sites in the survey area that should be considered relative to potential project impacts; and

c) assess the potential for encountering cultural resources during the field survey for the project and obtain information about the types of cultural resources likely to be present.

According to UDSH records, 11 prior regulatory-based cultural resource assessments have taken place in or within 1/2 mile of the current survey area. These surveys occurred between 1986 and 2017. Several of these surveys encompassed portions of the current survey area but did so in a sufficiently minimal way that Certus resurveyed all such areas in their entirety as part of the current undertaking for logistical reasons.

The file search indicated that five archaeological sites have been reported in or within 1/2 mile of the current survey area. These are sites 42WA217, 42WA218, 42WA240, 42WA245, and 42WA293. All of the sites are historical canals. Three of them—42WA218 (Timpanogos Canal), 42WA245 (Center Creek Canal), and 42WA293 (Old Extension Canal)—extend into the current survey area.



Figure 4. Typical survey area in Daniel; looking east



Figure 5. Typical setting along Timpanogos Canal; looking south

The portion of site 42WA218, the Timpanogos Canal, in the current survey area was most recently documented in 2002. The site was determined eligible for the National Register under Criteria A and C as a result, and the segment in the current survey area was found to contribute to that eligibility. Certus revisited this site as part of the current undertaking and updated the site record to reflect the present condition of the canal in the project area.

The portion of site 42WA245, the Center Creek Canal, in the current survey area has not been documented previously, but a segment immediately adjacent to it has been. That segment was documented in 1999 and resulted in a determination that the site is eligible for the National Register under Criteria A and C. Certus located the portion of this canal site in the current survey area and updated the site record to document that previously unreported segment.

The portion of site 42WA293, the Old Extension Canal, in the current survey area was most recently documented in 2015. That documentation addressed the portion of the main canal beginning at the diversion on Daniel Creek and extending north then west to a point just north of 3000 South in Daniel. Certus reexamined this segment of the canal as part of the current undertaking and updated the site record to include additional components of the site, including lateral ditches, and segments of canal channel that have been piped underground. Site 42WA293 has been determined eligible for the National Register under Criteria A and C as a result of the 2015 documentation and earlier documentation of other segments of the canal.

See the **Findings** section of this report for more information about sites 42WA218, 42WA245, and 42WA293 in the current survey area.

Field Methods

Certus applied intensive-level survey methods accepted by the Utah State Historic Preservation Office (SHPO) and other agencies in Utah to identify cultural resources that could be affected by the undertaking. Sheri Murray Ellis of Certus inventoried the survey area by walking parallel transects spaced no more than 15 meters (50 feet) apart. Navigation within the survey area was accomplished using aerial photographs and a handheld GPS unit capable of sub-meter accuracy.

The National Park Service (NPS) defines five cultural resource types that can be listed on the National Register of Historic Places (NRHP): buildings, sites, districts, structures, and objects (NPS 2002). For the purpose of this project, the following criteria, which are derived from definitions set forth by the Utah SHPO and Bureau of Land Management, were used to define a resource as an archaeological site:

- At least 10 artifacts of a single class (e.g., 10 sherds) within a 10-meter diameter area, except when all pieces appear to originate from a single source (e.g., one ceramic pot or one glass bottle)
- At least 15 artifacts that include at least 2 classes of artifact types (e.g., sherds, nails, glass) within a 10-meter area
- One or more archaeological features in temporal association with any number of artifacts
- Two or more temporally associated archaeological features without artifacts

RESOURCE EVALUATION METHODS

Certus employs regulatory standard methods for evaluating the historical significance of cultural resources encountered during the field inventory. To that end, Certus evaluates all identified cultural resources for their eligibility for listing on the NRHP. The evaluation considers the four criteria of the NRHP as listed in 36 CFR 60.4 and followed the guidelines issued by the NPS in Bulletin 15, *How to Apply the National Register Criteria for Evaluation* (NPS 2002). The NRHP criteria state that a resource may be considered eligible for listing on the NRHP if it:

- **Criterion A** – is associated with events that have made a significant contribution to the broad patterns of our history; OR
- **Criterion B** – is associated with the lives of persons significant in our past; OR
- **Criterion C** – embodies the distinctive characteristics of a type, period, or method of construction, or represents the work of a master, or possesses high artistic values, or represents a significant and distinguishable entity whose components may lack individual distinction; OR
- **Criterion D** – has yielded, or may be likely to yield, information important in prehistory or history.

Resources considered potentially eligible for the National Register pursuant to one of the above criteria are also to be assessed for integrity of location, design, setting, materials, workmanship, feeling, and association. To be eligible for listing on the National Register, the resource must possess integrity of those elements directly related to the criterion or criteria under which it would be determined eligible.

FINDINGS

Certus identified five cultural resource sites in the survey area. The sites are include the three previously noted canals—42WA218 (Timpanogos Canal), 42WA245 (Center Creek Canal), and 42WA293 (Old Extension Canal)—a newly documented historical foundations site (42WA533) and a newly documented canal (42WA534—the Daniel Irrigation Company Canal). The locations of the sites relative to the survey area are depicted in **Figure 6**, and descriptions and National Register evaluations are provided below.

Site 42WA218, Timpanogos Canal

Site 42WA218 is the Timpanogos Canal, a roughly 13-mile long irrigation canal constructed in 1895 to carry water from the Provo River to lands along the east side of the Heber Valley (Nielson 2002a). The entire segment of the Timpanogos Canal in the current survey area was documented most recently in 2002 as part of a recordation effort in advance of planned improvements to the 3000 South roadway in Daniel (Nielson 2002a). That recordation effort identified 47 features along the canal, including three (a concrete culvert, a 2-way slider diversion, and a concrete-capped steel culvert) located in the current survey area. The 2002 documentation reported that the canal channel was largely open and unlined along 3000 South and measured approximately 1.5 meters wide by 0.8 meter deep (Nielson 2002a).

In revisiting the portion of the site in the current survey area, Certus observed that the entirety of canal in this area has been piped underground to accommodate modern residential development and roadway improvements. The former route of the canal is no longer visible on the ground surface, as the once open channel was filled in and now appears as a simple unpaved roadway shoulder. The piped segment of the canal extends at least 0.4 mile west of the current survey area along 3000 South and northeast to at least US-40. Other portions of the overall canal channel remain open outside of the current survey area.

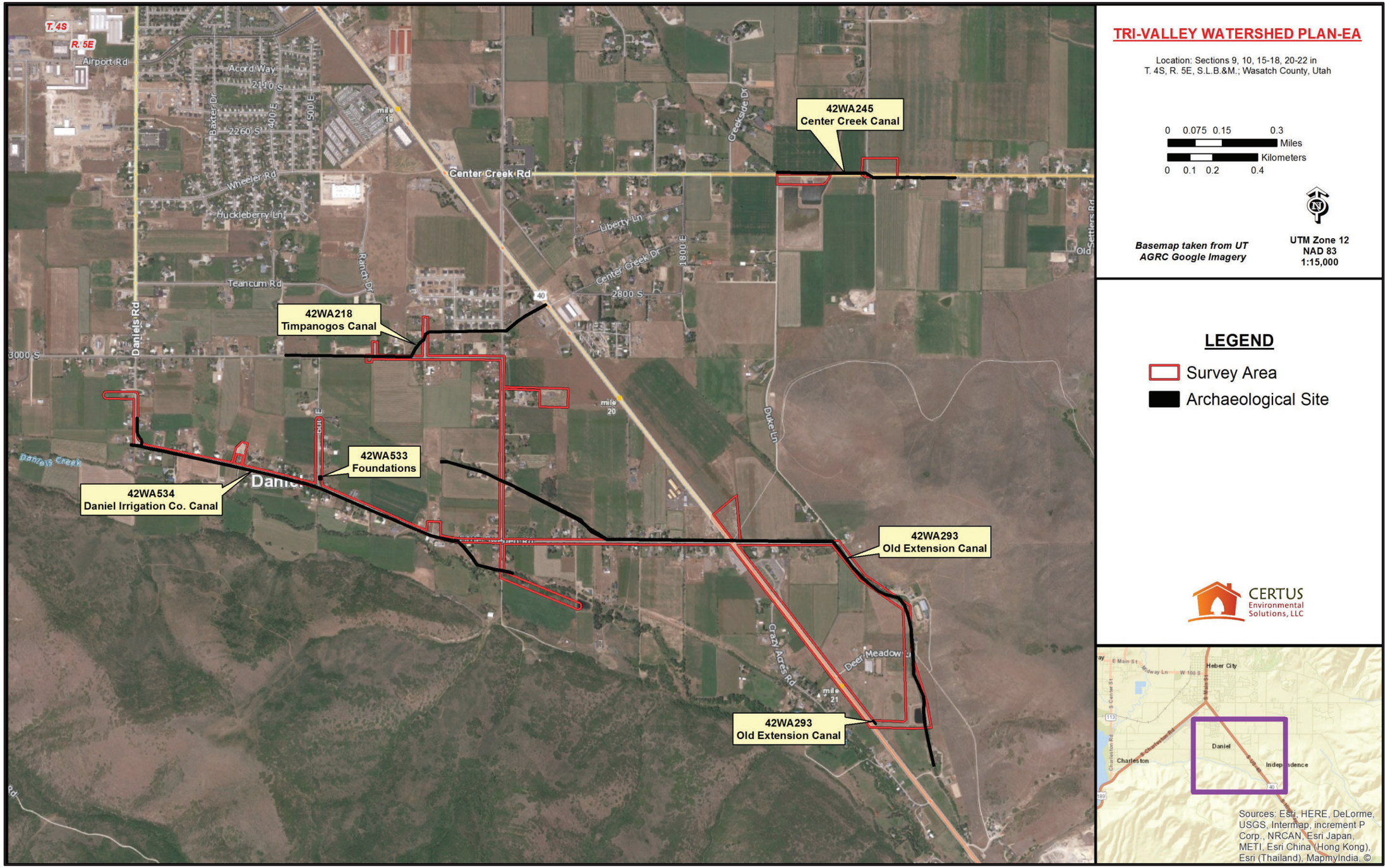


Figure 6. Survey results

National Register Evaluation for Site 42WA218

Site 42WA218—the Timpanogos Canal—was ***determined eligible*** for the National Register under Criteria A and C as a result of documentation and evaluation carried out in 2002 and earlier. The basis for the determination was the important role the canal played in facilitating settlement and economic development in the area and in the history of irrigation law as it relates to beneficial use as well as for the structural and engineering character of the system. Certus believes this determination is appropriate for the canal as a whole, but recommends the segment of the canal in the current survey area be considered ***non-contributing*** to the eligibility of the overall site. The segment of the canal in the current survey area has been piped underground. As such, it no longer retains integrity of materials, design, workmanship, setting, feeling, or association. Additionally, as the path of the new pipe is not readily distinguishable on the ground surface, it is unclear if this segment retains integrity of location. As such, this segment can no longer contribute to the eligibility of the canal site as a whole.

Site 42WA245, Center Creek Canal

Site 42WA245 is the Center Creek Canal, an irrigation canal that reportedly extends from the Provo/Duchesne River divide to the Sagebrush/Spring Creek Canal and Lower Canal (Christensen 1999). The canal was constructed during the late-1880s under the auspices of the Center Creek Irrigation Company, which was incorporated in 1886 and then reincorporated as the Center Creek Water and Irrigation Company in 1887 (Christensen 1999). According to the Utah Division of Water Rights (2021), the water rights for canal were issued in 1887, and the system irrigates 2,300 acres.



Figure 7. 42WA245; Typical channel along documented segment; looking west

The portion of site 42WA245 in the current survey area had not been documented prior to the present undertaking, but a segment immediately adjacent to it has been. The segment of the canal in the current survey area is part of a roughly 1.9-mile long segment of Center Creek that was realigned sometime between 1967 and 1993. Approximately 160 meters (525 feet) of the realigned channel are located in the current survey area along Center Creek Road. Running east to west, the canal parallels the south side of Center Creek Road until it reaches 2400 East, at which point it is piped under Center Creek Road on a diagonal to the north side of the road, where it continues west paralleling the road. The channel continues west for approximately 390 meters (1,280 feet) to where it rejoins the historical channel, which is effectively the natural channel of Center Creek that has been altered to serve as the canal. As part of the current undertaking, Certus documented approximately 800 meters (0.5 mile) of the canal channel along Center Creek Road. Here, the channel generally remains open and unlined though filled with concrete rubble in some areas (see **Figure 7**). The channel has a relatively shallow U-shaped cross-section measuring between 3 and 4 meters wide at the top and up to 0.8 meter deep, though the actual flow channel averages roughly 2 meters wide and 0.5 meter deep. No historical features were observed along the documented segment of the canal, but several modern culvert

pipes, two concrete box culverts, and several modern slab bridges providing access to residential properties across the canal were present.

National Register Evaluation for Site 42WA245

Site 42WA245 is the Center Creek Canal. Portions of the canal site were documented in 1999 and resulted in a determination that the site is ***eligible*** for the National Register under Criteria A and C. The basis for this finding was the canal's significant role in facilitating settlement and economic development in the area as well as its architectural and engineering character. Certus finds no reason to dispute the existing determination of eligibility under Criterion A but notes that the segment of the canal discussed here lacks any notable character that would render it eligible for the National Register under Criterion C. Certus also recommends that the segment of the canal reported here be considered a ***non-contributing*** segment given that it represents a late-historic period realignment (new channel) of the system that was built well outside the period of significance for the overall site.

Site 42WA293, Old Extension Canal

Site 42WA293 is the Old Extension Canal (also referred to as the Old Main Extension Canal). The segments of the canal in the current survey area were documented first in 2002 and again in 2015. The canal system reportedly comprises a main channel, which follows the foothills of the Wasatch Mountains east of US-40, and several laterals, including one that diverts from the main channel at the mouth of Daniels Canyon and extends west into the community of Daniel (Nielson 2002b). Segments of both the main channel and this western lateral are present in the current survey area, and both were part of the 2002 and 2015 documentation.

Little archival information about the Old Extension Canal is available. The 2002 site record indicates the main canal diverts from Daniels Creek near the mouth of Daniels Canyon but also states that the canal is "diverted from the Wasatch Canal, which is diverted from the Provo River" and that the Extension Canal "may also receive water from the Humbug Canal" (Nielson 2002b). This documentation also suggests the canal may have been built around 1868, though that suggestion appears to be tied to the general fact that "the earliest diversion of tributaries of the Provo River began" around that time (Nielson 2002b). Certus was not able to vet this information as it relates to the Old Extension Canal or locate an alternate date of initiation for the system.

Certus revisited each previously documented portion of the Old Extension Canal system where it is located in the current survey area. This included a 0.7-mile section of the main canal, a contiguous 0.6-mile segment of the western lateral, and one discontiguous crossing of the western lateral. The main canal channel and western lateral channel have been abandoned along the revisited segments. Water once conveyed by these channels is now distributed through an underground pipeline that appears to largely follow the original channel alignments and, in a few areas along the western lateral, appears to have been buried in the backfilled channel.

Along the main canal, the channel is unlined and ranges from 1.5 to 2 meters wide and approximately 0.5 meter deep with a tall earthen berm on the east side of the channel and a lower berm on the west side (see **Figure 5**, above). The channel is generally flat-bottomed. Certus identified two historical features (both turnouts) along the segment of the main canal in the current survey area. The northern of the two turnouts diverted water into the aforementioned western lateral where it extends west along the north side of 3600 South. The southern turnout was reported in the 2015 site form (Jordan 2015), but the northern turnout was not.

East of US-40, the abandoned lateral ditch is an unlined channel is filled in with sediment and choked with vegetation for most of its length. Generally speaking, the channel measures roughly 1 meter wide by 0.5 meter deep and has a U-shaped cross-section. Certus did identify two apparently historical features (a box culvert and a turnout) along this portion of lateral (see **Figure 8**). West of US-40, the lateral channel is discontinuous with both open and backfilled sections. Four turnouts (three historical and one modern) and one modern diversion structure were located along the lateral on the west side of US-40. All of these features were previously reported in the 2002 site record as were several modern concrete slab and wood deck bridges providing residential and farm access across the open channel segments (Nielson 2002b). At roughly 1150 East on 3600 South, the lateral channel, which parallels the north side of 3600 South until this point, turns to the northwest and extends through agricultural fields to where it crosses 1200 East and continues to the northwest. This entire segment of the lateral appears to have been piped underground, and the ditch channel has been backfilled.



Figure 8. 42SM2935, Abandoned turnout on lateral ditch; looking north

In addition to the main and lateral canal channels, Certus documented a short segment of what appears to be a remnant of a tertiary ditch once fed by the Old Extension Canal system. This ditch segment measures only 18 meters long and is found along the edge of a field (now a livestock pasture) on the east side of US-40 at the mouth of Daniels Canyon. It is approximately 3 meters wide by 0.4 meter deep. The ditch is sufficiently isolated that no specific physical connection to the Old Extension Canal could be defined. Two historical features (a push gate and a turnout) were documented along this remnant ditch.

National Register Evaluation for Site 42WA293

Site 42WA293 is the Old Extension Canal. The site was ***determined eligible*** for the National Register under Criteria A and C as a result of the 2002 and 2015 documentation. This determination was based on the role of the canal as "part of a broad pattern of regional and local history relating to settlement, agricultural development, and economics" and as a "contributing element to the history of irrigation law" (Nielson 2002b). Certus found no specific evidence to either support or refute this determination due to a general lack of archival information about the canal system. As such, Certus recommends the existing determination be retained, at least for the purpose of the current undertaking.

The portions of the main canal and lateral channels discussed here retain integrity of location. The main canal also retains integrity of materials, design, workmanship, setting, feeling, and association. The lateral channel, which has been partially backfilled, generally lacks integrity of materials, design, workmanship, and feeling but retains integrity of setting and association where the open channel remnants remain.

Certus recommends that the portion of the lateral ditch and the tertiary ditch in this area be considered non-contributing to the site's eligibility due to an overall lack of integrity resulting from backfilling many portions of the channels, which has created a discontiguous series of open channel segments that are deflating and overgrown with vegetation.

Site 42WA533, Historical Foundations

Site 42WA533 is a small historical site located on the east side of 600 East near Little Sweden Road in Daniel. The site measures 12 meters long north-south by 10 meters east-west and comprises two small foundation remnants. One is a short L-shaped foundation curb wall, and the other is a rectangular foundation composed of low concrete curb walls and a concrete slab (see **Figure 9**). The only artifacts observed in association with the foundations were half of red-orange, pressed clay brick and three short lengths of highly weathered milled lumber.



Figure 9. 42WA533. Overview of larger foundation; looking southeast

The nature of the former structures at the site remains unclear. The site is located on a historical farmstead property with a residence the Wasatch County Assessor records indicate was constructed in 1935 but which appears to be a somewhat earlier Victorian structure more likely constructed in the 1910s. A small gable-roofed building is visible in aerial images of the area taken in 1938. The location of this structure appears to correspond with the smaller L-shaped foundation at the site, but its size is more comparable to that represented by the larger foundation. Aerial images suggest the buildings were demolished by 1964.

Given the extremely limited nature of the smaller foundation, no interpretation of its former function can be offered. This foundation, which is located on the edge of a gravel "driveway" leading to a 1960s or 1970s carport structure, may have been a landscaping curb instead of a foundation for a structure.

The larger foundation exhibits a wide opening (break in the curb wall) on its west side. The opening appears to be intact in that it does not appear to have been created by removal of a section of the curb wall after the superstructure was abandoned. If one assumes the size of the opening is original to the structure, the building is best interpreted as an outbuilding, such as a garage or equipment shed and not a dwelling.

National Register Evaluation for Site 42WA533

Site 42WA533 is a small historical site comprising two concrete foundation features and a single brick artifact and a few lengths of weathered lumber. Certus ***recommends this site ineligible*** for the National Register under all criteria. The site retains integrity of location and materials (at least for the foundations) but lacks integrity of design, workmanship, setting, feeling, and association.

Site 42WA533 appears to represent former outbuildings associated with the residential/farmstead property on which it is located. Although no specific information about them was found during research into the site, it is very unlikely such outbuildings would be meaningfully associated with significant historical events or patterns of history. Therefore, the site would be ineligible for the National Register under Criterion A.

No information was located that indicated a direct and meaningful association of the site with a person or persons of historical importance. As such, the site is recommended ineligible under Criterion B.

Due to demolition of the superstructures, the key features comprising the site do not represent a type, style, or manner of construction or the work of a master. Further, they do not possess high artistic value or appear to be part of district whose parts lack individual distinction. As such, the site is recommended ineligible under Criterion C.

The site has not yielded information important to improving our understanding of history and does not appear to have the potential to do so. The site area has been cleared of most artifacts and is maintained as such. The site does not appear to have been a dwelling or similar property that may have had associated privies or storage cellars that could yield additional information. Therefore, this site is recommended ineligible for the National Register under Criterion D.

Site 42WA534, Daniel Irrigation Company Canal

Site 42WA534 is a historical canal located on the south side of Little Sweden Road in Daniel. The canal is not shown or labeled on any historical or modern topographic maps and does not appear on Utah Division of Water Rights maps for canals in the area. Certus identified the possible association of the canal with the Daniel Irrigation Company (Daniels Creek Irrigation Company) through investigation of water rights records. The canal diverts water from Daniel Creek and carries it through the southern part of the Daniel community. No date of construction for the canal was located during research, but records indicate the Daniel Irrigation Company was incorporated in April 1887 (Mead 1903:101). Water rights records indicate the company filed a due diligence claim—a legal claim of surface water rights where the use of that water was initiated prior to 1903—with a right dating back to 1879. Given this information, it appears likely the initial ditch system of the irrigation company was constructed between 1879 and 1887, though this does not mean the main canal reported here was constructed at that time. Minimally, one could expect the main canal to have been constructed around the time of the irrigation company's incorporation in 1887. The total acres irrigated from the Daniel Irrigation Company system is not stated in available online water rights records. Mead (1903) notes the company's system was irrigating 300 acres around the turn-of-the-last-century, but it is unclear if that acreage accounts for the entire system or only a portion of its water rights.

The site comprises an unlined ditch with occasional historical water control features (see **Figure 10**). Segments of the channel have been lined with river cobbles, presumably by adjacent property owners as

an aesthetic treatment of the canal, but most are simply earthen. The channel is shallow, generally less than 0.6 meter, and varies in width from 1.5 to 3 meters; the channel is not specifically constrained by concrete lining or such and, therefore, it widens and narrows more akin to a natural creek channel than a maintained canal. Certus documented approximately 1.1 miles of the canal. These limits represent the maximum portion of the canal accessible to Certus in and near the current survey area due to private property and trespass permissions. This documented segment extends from near the north side of Daniel Creek just east of 1200 East to a point just west of where Little Sweden Road turns sharply to the north and becomes Daniels Road. Nine water control features (eight turnouts and one more complex diversion) were identified along this segment of the canal. Most, if not all, appear to date to the historical period. Numerous small culverts, including smooth and corrugated metal pipe and concrete box culverts, and slab bridges are present along this segment of the canal as well. These features provide both pedestrian and vehicle passage over the open canal channel into adjacent properties. Some of the bridges and culverts may date to the historic period, though many, perhaps the majority, appear to date to the modern era and likely were constructed to replace older bridges and culverts that could no longer support modern vehicles.



Figure 10. 42WA534. Turnout and ditch channel along Little Sweden Road; looking southeast

In addition to the main canal, Certus documented a short segment of a lateral ditch associated with the system. It is located on the east side of Daniels Road and connects to the main canal via a pipe under Little Sweden Road. This ditch is unlined, roughly 1 meter wide and 0.4 meter deep, and includes both open and partially backfilled sections. One historical turnout was identified along this ditch segment.

National Register Evaluation for Site 42WA534

Site 42WA534 is a historical irrigation canal that appears to be operated by the Daniel Irrigation Company. Certus ***recommends this site eligible*** for the National Register under Criterion A for the reasons discussed below. The documented portion of the canal retains integrity of location, materials, design, setting, and association. Its integrity of workmanship and feeling has been compromised somewhat by the replacement of historical features, especially bridges and culverts allowing passage across the canal channel, during the modern era and the ornamental landscaping of sections of the channel by adjacent property owners.

Site 42WA534 is directly associated with irrigation agriculture in the Daniel area dating back to the first few decades of settlement. As the initial community in the area at the time of settlement and for at least 30 to 40 years thereafter was dependent on agriculture as a means of personal subsistence and barter, the ability to grow crops and water livestock was fundamental to survival and economic viability. While the ditch comprising site 42WA534 may not have irrigated the most acreage among the irrigation systems of the area, it clearly contributed to the overall agricultural development of the area, especially in the extreme southern reaches of the

community. Therefore, the site would qualify as eligible for the National Register under Criterion A.

No information was located that indicated a direct and meaningful association of the site with a person or persons of historical importance. As such, the site is recommended ineligible under Criterion B.

The canal site is an engineering resource of sorts and does contain structural features in the form of water control structures; however, neither the canal channel nor its associated features exhibit any characteristics that would qualify them as being representative of a type, style, or manner of construction, the work of a master, or a resource of high artistic value. It is possible the site could contribute to a broader historical landscape or district of irrigation networks, but no such cultural entity has been officially established for this area. As such, site 42WA534 is recommended ineligible under Criterion C.

The site has not yielded information important to improving our understanding of history and does not appear to have the potential to do so. Therefore, this site is recommended ineligible for the National Register under Criterion D.

Potential for Buried Resources

The cultural resources survey discussed herein employed methods suitable for identifying surface-located prehistoric and historic sites. No subsurface testing was conducted. The potential for buried cultural artifacts or features of substance appears to be low across the entire survey area due to extensive historical and modern ground disturbance.

Summary

Certus identified five cultural resource sites in the survey area for the Tri-Valley Watershed Plan-EA. These sites are 42WA218 (the Timpanogos Canal), 42WA245 (the Center Creek Canal), 42WA293 (the Old Extension Canal), 42WA533 (a historical foundations site), and 42WA534 (the Daniel Irrigation Company Canal). Of these five sites, three (42WA218, 42WA245, and 42WA293) have been determined eligible for the National Register as a result of prior evaluations. Certus recommends these determinations be retained but also recommends that portions of each site in the current survey area be considered non-contributing to that eligibility. The two remaining sites (42WA533 and 42WA534) were newly documented as part of the current undertaking. Certus has recommended site 42WA533 ineligible for the National Register under all criteria and site 42WA534 eligible under Criterion A.

The NRCS and other agencies with regulatory action related to any of the proposed watershed improvements will issue official determinations of eligibility and findings of effect for those resources determined eligible for the National Register. These determinations and findings will be issued under separate cover.

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