

MEMORANDUM

DATE: September 2, 2026
TO: Chance Baxter
Bear River Water Conservancy District
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Brigham City, Utah 84302

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SUBJECT: Brigham City Delivery Request Evaluation
PROJECT NO.: 091.63.100

DRAFT

INTRODUCTION

This memorandum summarizes the hydraulic modeling completed to evaluate whether the Harper/Brigham City wholesale connection can convey 800 gpm from the Bear River Water Conservancy District (BRWCD) Harper Ward system to Brigham City and identify the infrastructure needed to provide Brigham City with their requested flow rate.

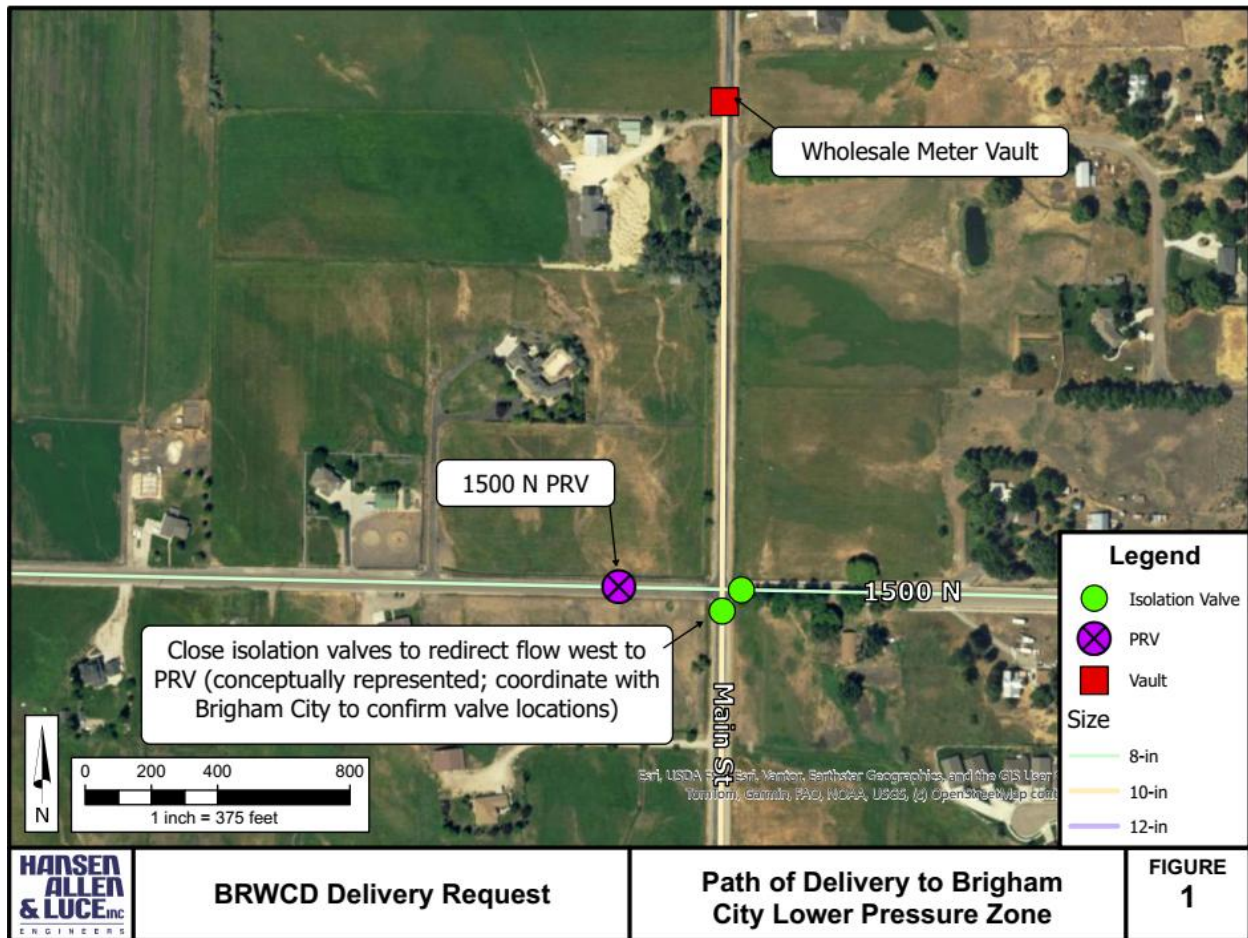
BACKGROUND

In Summer 2026, Brigham City asked BRWCD to consider delivering water from the BRWCD Harper Ward system to the Brigham City system at a constant flow rate of 800 gpm for a period of 5 years.

It was initially expected that a pump station would be needed to meet Brigham City's request. However, after initial coordination, HAL, BRWCD, and Brigham City personnel identified a potential way to serve Brigham City's lower pressure zone from the Harper Ward system without pumping. The following actions would be required:

- Reconfigure the existing Harper Ward connection vault to provide water from the Harper Ward system to the Brigham City system.
- Close several isolation valves in the Brigham City system to create a dedicated path of delivery from the Harper Ward system to the Brigham City Lower Pressure Zone.
- Adjust PRV settings in the Brigham City system as needed to achieve the requested flow rate.

Figure 1 shows the proposed path of delivery to the Brigham City Lower Pressure Zone.



Hydraulic models of the Harper Ward and Brigham City systems were used to evaluate the feasibility of this delivery option. The evaluation also considered head loss through the existing wholesale connection and whether the vault can be modified to support the requested delivery.

HYDRAULIC EVALUATION – EXISTING CONDITIONS

The Harper Ward system hydraulic model was used to evaluate a range of pipe roughness scenarios. The model assumed peak demands in the Harper Ward system and an additional 800 gpm demand from Brigham City. Head losses were also calculated through the existing wholesale meter vault.

Existing Wholesale Connection Vault

Head loss through the wholesale connection vault was evaluated to determine whether losses through the vault would significantly affect delivery capacity. It was assumed that the existing vault would be retrofitted to add a flow control valve and a magnetic flow meter.

Under the existing configuration, water passes through 4-inch pipe sections, bends, and valves that create energy losses through the vault. At a flow rate of 800 gpm, estimated head loss through the existing connection is about 63 feet, or 27 psi. Friction losses are significant because water needs to flow at a velocity of roughly 20 ft/sec to achieve a flow rate of 800 gpm.

Pipe Roughness Sensitivity Analysis

The internal roughness of water system pipes can significantly affect the ability of a system to deliver flow and maintain pressure. Pipe roughness can vary based on pipe material, pipe age, and the chemical composition of the water in the system. While roughness can often be reasonably estimated, field testing is required to confirm roughness in a water system pipe.

Where field data isn't available, standard practice is to perform a sensitivity analysis based on a range of reasonable pipe roughness values to determine whether field testing is necessary.

The Harper Ward System hydraulic model was used to test four pipe roughness scenarios in the Harper Ward system and determine the hydraulic grade line (HGL) available at the upstream (north) end of the wholesale connection vault under each scenario. The sensitivity analysis indicated significant potential for variation based on pipe roughness. Results from the analysis are summarized in the following section.

Results – Existing System

The HGL in the Lower Zone of the Brigham City system is about 4,461 ft. A comparison of the HGL in the Brigham City system to the available HGL through the existing system (including addition of a check valve and meter in the existing vault) is shown in Table 1.

Table 1
Comparison of Available HGL to Brigham City HGL - Existing

Roughness Coefficient	HGL Upstream of Vault (ft)	Head Loss through Vault (ft)	Available HGL (ft)	HGL in Brigham City System (ft)	Difference (ft)
120 (Roughest)	4465	63	4,402	4,461	-59
130	4487	63	4,424	4,461	-37
140	4504	63	4,441	4,461	-20
150 (Smoothest)	4519	63	4,456	4,461	-5

The results indicate that there is most likely not enough available hydraulic grade to deliver 800 gpm through the existing pipe and meter vault. However, in the case where pipes are smooth, the difference in projected HGL is only 5 feet. It's possible that the HGL in the Brigham City Lower Zone could be adjusted downward slightly to produce the requested flow rate.

WHOLESALE CONNECTION VAULT EVALUATION

Reducing head losses through the wholesale connection vault was explored as a way to increase available delivery capacity. Two alternative configurations were evaluated as described in the following sections.

Increase Pipe Size Within Vault

This configuration assumes the pipe segments and appurtenances within the vault would be increased from 4 inches in diameter to 10 inches in diameter. A flow control valve and magnetic flow meter would also be installed. This configuration results in a total calculated head loss of about 48 feet, or 21 psi through the vault and its associated piping. Significant head losses would continue to occur in the 4-inch diameter inlet and outlet piping.

A comparison of the HGL in the Brigham City system to the available HGL through the vault under this configuration is shown in Table 2.

Table 2
Comparison of Available HGL to Brigham City HGL – Increase Within Vault

Roughness Coefficient	HGL Upstream of Vault (ft)	Head Loss through Vault (ft)	Available HGL (ft)	HGL in Brigham City System (ft)	Difference (ft)
120 (Roughest)	4465	48	4,417	4,461	-44
130	4487	48	4,439	4,461	-22
140	4504	48	4,456	4,461	-5
150 (Smoothest)	4519	48	4,471	4,461	+10

The results indicate that the modified meter vault may provide enough available hydraulic grade to deliver 800 gpm only under the smoothest pipe-roughness scenario. Under rougher pipe conditions, the available HGL remains below the Brigham City Lower Zone HGL.

Replace Entire Vault and Connecting Piping

This configuration assumes the entire wholesale connection will be replaced with a new vault with 10-inch diameter pipe. The calculated head loss through the vault is reduced to roughly 2 feet (about 1 psi). However, this option would require complete replacement of the vault and connection points and would be the most expensive infrastructure alternative.

A comparison of the HGL in the Brigham City system to the available HGL through the new meter vault described under this configuration is shown in Table 3.

Table 3
Comparison of Available HGL to Brigham City HGL – Vault Replacement

Roughness Coefficient	HGL Upstream of Vault (ft)	Head Loss through Vault (ft)	Available HGL (ft)	HGL in Brigham City System (ft)	Difference (ft)
120 (Roughest)	4465	2	4,463	4,461	+2
130	4487	2	4,485	4,461	+24
140	4504	2	4,502	4,461	+41
150 (Smoothest)	4519	2	4,517	4,461	+56

Replacing the vault and connecting piping would enable delivery of the requested flow rate of 800 gpm under each modeled pipe-roughness scenario.

SUMMARY OF RESULTS

Preliminary results are as follows:

- If the existing vault is used as-is:
 - A flow rate of 800 gpm is most likely not available to the Brigham City Lower Pressure Zone regardless of pipe roughness.
 - The available flow rate significantly depends on roughness in the Harper Ward system pipes.
- If pipes inside the vault are replaced with 10-inch diameter pipes:
 - A flow rate of 800 gpm is likely achievable to the Brigham City Lower Pressure Zone if pipes in the Harper Ward system are smooth.
 - If the pipes are rough, the requested flow rate likely could not be delivered.
 - The available flow rate significantly depends on roughness in the Harper Ward system pipes.
- If the vault is replaced with a new vault with 10-inch diameter pipes, and its connecting 4-inch diameter pipes are replaced with 10-inch diameter pipes:
 - The requested flow rate of 800 gpm could likely be delivered regardless of pipe roughness within the Harper Ward system.
- The hydraulic grade in the Brigham City system affects the ability of the Harper Ward system to deliver water.
 - If the hydraulic grade in the Brigham City Lower Pressure Zone can be reduced, available flow can be increased.

RECOMMENDATIONS

The following are recommended as next steps in the delivery evaluation:

1. Because available flow rate significantly depends on pipe roughness, a field test is recommended to measure available flow to Brigham City under existing conditions and identify pipe roughness in the Harper Ward system.
2. Coordinate with Brigham City to determine whether it's possible to reduce the HGL in their Lower Pressure Zone to enable higher delivery flow rates, if flow testing reveals limitations in flow capacity.

FLOW TESTING PROCEDURE

Suggestions for preparing for the flow test are listed below:

- Adjust settings at the Harper Ward Well as needed to deliver flow rates up to 800 gpm higher than it has recently been delivering.
- Remove standing water from the wholesale connection vault and test the atmosphere of the vault for safety. Identify a way to keep water out of the vault during the test, if possible.
- Verify whether there are any service connections in the Brigham City system along Main Street north of 1500 N. If so, sequencing of valve operations should be coordinated to avoid service interruptions.
- Verify which isolation valves in the Brigham City system will be used during the flow test. Operate the valves ahead of time to make sure they are in good working condition.
- Consider the duration of the flow test. A 24-hour testing period may be useful to understand the effects of diurnal variation in system pressure. At a minimum, the test should be long enough to achieve stable flow rates and pressures and give time for the SCADA system to log multiple data points.

The measurements that should be taken during the flow test (and notes about each) are shown in Table 4.

Table 4
Measurements for the Flow Test

Measurement	Notes
Flow Rate Delivered to Brigham City	The Harper Ward Tank outflow meter can be used to estimate flow rate delivered to Brigham City. Deliveries to the Harper Ward system will need to be subtracted but can be estimated based on SCADA data from previous days.
Pressure upstream of the meter vault	Use a hydrant in the Harper Ward system. Note which hydrant was used.
Pressure in the meter vault	Use the existing pressure gauge in the wholesale meter vault.
Pressure downstream of the meter vault	Use a hydrant in the Brigham City system or the upstream pressure gauge in Brigham City's PRV vault.

To perform the flow test, close isolation valves in the Brigham City system and fully open the bypass pipe in the wholesale meter station. Allow flow rates and pressures to stabilize and record the measurements described in Table 4.