



September 26, 2019

Project No. 219-344

Mr. Eric Brynildson, P.E.
Colorado River Engineering
136 E. 3rd Street
Rifle, Colorado 81650

Subject: Summary Letter of 2019 Water Level Readings, Team Findings and Proposed Updated Gravel Column Design for Gravity Drainage, Railroad Avenue Improvements Project, City of Rifle, Garfield County, Colorado.

Dear Mr. Brynildson,

As requested, Yeh and Associates, Inc. (YA) has reviewed our geotechnical investigation report on subgrade conditions and recommended improvements to Railroad Avenue in Rifle, Colorado, YA report 216-197, dated July 1, 2016. Additionally, a subsequent letter regarding gravel column design for gravity drainage was provided to the City of Rifle on November 21, 2016. Tasks for this study undertaken based on your electronic mail notice to proceed to YA on September 4, 2019, included water checks at remaining piezometers along Railroad Avenue. Readings included a new baseline reading and evaluation of the existing condition of piezometers, and before and after readings from a rainfall event as noted to us by the client. During the period of our readings, the client performed a video analysis of the existing condition of the storm sewer along Railroad Avenue between 3rd and 4th Streets. This letter provides a summary of our findings, evaluation, and updated recommendations for gravel drain spacing and construction.

Water Level Summary. Water levels of existing standpipe piezometers were recorded by YA staff members between September 4 and 13, 2019. During our evaluation it was confirmed that Piezometers P-4, P-5, P-8, P-10, and P-12 were abandoned and filled with grout. Piezometers P-1, P-2, P-3, P-6, and P-11 were found in the same condition as installed with the following exceptions. Readings at Piezometer P-6 could not go below 4.90 feet due to material in the bottom of the PVC standpipe. Readings at Piezometer P-11 were made to a depth of 7.50 feet, which extends beyond the previous depth of 6.80 feet and is likely due to the bottom cap being pushed off during our 2016 investigation for more accurate groundwater readings. Please refer to YA report 216-197 for the piezometer locations. In our opinion, the piezometers not abandoned are operational and do provide information regarding subgrade water conditions. Piezometer P-1 appears to record groundwater conditions south of the project site which and did exhibit an apparent water level rise of 0.15 feet after storm events between September 8 and 10, 2019. Piezometer P-6, located within the proposed improvement area between 3rd and 4th Streets, exhibited a water level increase of 0.15 feet after these same storm events, which may indicate water is likely entering subgrade soils from surface and/or storm water utilities. Piezometer P-11, located north of 4th Street, exhibited a slight water level increase after the same storm events. Although it was difficult to evaluate standing water levels at P-11, the base of the piezometer was muddy, which likely indicates some water is entering subgrade soils from surface and/or storm water utilities located north of 4th Street along Railroad Avenue. In our opinion, the area north of 4th street should either be evaluated and/or improved, or a catchment drain at 4th street be installed to divert any subsurface water away from entering 3rd Street. It

appears that the subgrade area in this study most affected by rainfall is between 3rd and 4th Streets along Railroad Avenue. Water level readings can be found in Figure 3 in attachments.

Stormwater Drainage Video Findings. We understand a video of the existing storm drain between 3rd Street and 4th Street was performed by the client. YA staff observed some of this video footage which showed rocks penetrating the concrete storm drain and significant cracking just south of the 4th Street intersection with Railroad Avenue. We understand that based on this information, the client is recommending the storm drain be replaced between 3rd and 4th Street and that recommendations for replacement of the storm drain north of 4th street may also be included.

Gravel Drain Spacing and Construction. Based on the 2016 and latest water level data readings, the video study performed, and a potential replacement of the storm water drainage utility between 3rd Street and 4th Street and possibly extending to 5th Street, we have the following revised recommendations for the proposed gravel drain spacing and construction. A previous request to reduce the diameter of the dewatering system of gravel drains to an 8-inch diameter to accommodate city equipment is feasible. We recommend the following for this updated gravel column gravity drain system. At a minimum, gravel drains should be installed between the intersections of 3rd Street and 4th Street within Railroad Avenue. Longitudinal, or north-south, spacing should consist of a vertical 8-inch diameter gravel drains at 15-foot intervals center to center in a row. We recommend that two rows of drains be installed, one row approximately 5 feet east of the new utility installation along the west side of Railroad Avenue, and a second row approximately 5 feet west of the east side of Railroad Avenue. Recommended spacing can be seen in Figure 1. We recommend the drilling for gravel drains be extend a minimum of 3 feet into the subgrade native gravel layer. According to our previous drilling investigation, YA report 216-197, we estimate gravel drains will need to extend up to approximately 10 feet below the roadway surface grade. Penetration into gravels may cease if practical auger drilling refusal is encountered. We recommend a representative of YA be present during installation. Reaming of the drilled 8-inch diameter hole may be necessary. The hole should promptly be filled with granular material meeting specifications for CDOT Class C material. If a perforated PVC pipe is installed into the drain extending to subgrade gravels, granular material meeting CDOT Class A specifications may be utilized in construction. Gradation requirements for recommended granular drain materials are shown in Table 1 below. We anticipate a minimum pipe length of 8 feet may be required through the clay section and installation difficulty may be encountered due to caving. Granular drain material should extend upward and into roadbase material as shown in Figure 2. For full roadway reconstruction, the drains should be installed prior to roadbase placement in construction of the new pavement section.



Table 1 – Gradation Specifications for Gravity Drain Material

Sieve Size	Mass Percent Passing Square Mesh Sieves	
	Class A	Class C
3 inches	100	
¾ inches	20-90	100
No. 4	0-20	60-100
No. 50		10-30
No.100		0-10
No. 200	0-3	0-3

Existing and Future Piezometers. At this time we recommend Piezometers P-1, P-2, P-3, P-6, and P-11 be maintained for future data acquisition. However, Piezometers P-6 and P-11 will likely be damaged or destroyed during the construction process. We recommend that a minimum of two new piezometers be installed after construction for verification that improvements installed are functioning as designed to mitigate subsurface water concerns. A cost for these services can be provided upon request

We trust this provides you with the information you need at this time. Please keep us informed as to the timing of proposed improvements as we recommend observations by Yeh and Associates be performed. Additional services, including construction observations and materials testing can also be performed during construction and a cost for these services can be provided once construction improvements are known. If you have any questions, please contact our office.

Sincerely,

YEH AND ASSOCIATES, INC.



Scott W. Richards, P.E., P.G.
Colorado Northwest Region Manager

Attachments:

- Figure 1-Proposed Gravel Column Location Plan
- Figure 2-Gravity Drain Column Cross Section (typical)
- Figure 3-Summary of Piezometer Readings





YEH & ASSOCIATES, INC

Project No: 219-344

Project Name: Railroad Avenue Improvements

Summary of Piezometer Readings

Test Hole No.	Depth of PVC Pipe (ft)	Date & Time of Day (am/pm) of Observation							
		5/12/2016	5/20/2016	6/3/2016	6/10/2016	7/18/2016	9/4/2019	9/12/2019	9/13/2019
		Depth to Water (ft)							
P-1	16.8	14.30	14.35	14.30	14.30	14.50	14.50	14.40	14.35
P-2	5.5	Dry	5.20	5.20	5.20	5.25	Dry	Dry	Dry
P-3	8.3	Dry	8.05	7.95	8.09	7.95	Dry	Dry	Dry
P-4	6.0	Dry	Dry	Dry	Dry	5.70	Abandoned	X	X
P-5	7.2	Dry	Dry	Dry	7.08	6.95	Abandoned	X	X
P-6	6.7	Dry	6.05	6.57	6.27	6.55	Dry to 4.9*	4.90	4.75
P-8	7.3	Dry	Dry	Dry	Dry	Dry	Abandoned	X	X
P-10	6.3	Dry	Dry	Dry	Dry	Dry	Abandoned	X	X
P-11	6.8	Dry	6.75	6.80	6.65	6.45	Dry to 7.5**	7.40	7.50
P-12	15.7	Dry	Dry	Dry	Dry	Dry	Abandoned	X	X

Notes and Observations:

Drilling and Piezometer installation occurred between 5/10-2016 and 5/11/2016

Piezometer locations P-4, P-5, P-8, P-10, P-12 were abandoned and sealed with grout

Piezometer locations P-1, P-2, P-3, P-6, and P-11, were registered with State of Colorado Division of Water Resources and still in good condition for readings

* Piezometer P-6 depth is now 4.90 feet due to infilling of material

** Piezometer P-11 depth was deepened to 7.5 by breaking out the bottom cap in 2016

According to the client, Rifle received significant rainfall events between 9/8/19 and 9/11/19

An apparent increase in water levels was observed in Piezometers P-1, P-6 and P-11 after rainfall events of September 2019