

WATER QUALITY MONITORING PLAN
Rush South 4-65 29-30
Location ID 449806

Crestone Peak Resources Operating, LLC
1801 California Street #2500
Denver, CO 80202

May 28, 2020

Prepared by:



Heather Shideman
Environmental Scientist

Reviewed by:



Jana Nilsen
Project Manager

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ATTACHMENTS

1. Rush South 4-65 29-30 and area map with DWR Water Sources identified within a ½ mile radius
2. Associated Water Wells Table 1
3. Site Specific Schedule
4. DWR Correspondence

INTRODUCTION

This Water Quality Monitoring Plan (plan) was developed by Apex Companies, LLC (Apex) for Crestone Peak Resources Operating, LLC (Crestone) as required by the City of Aurora (City) Operator Agreement. The plan complies with the procedures, guidelines, and reporting requirements in accordance with the Colorado Oil and Gas Conservation Commission (COGCC) Model Sampling and Analysis Plan (COGCC SAP, 2020) and COGCC Rule 609.

DESKTOP ASSESSMENT

The following describes the process Crestone used for identifying sampling / monitoring locations, and frequency of sampling / monitoring to establish a baseline of existing conditions prior to the construction of the Rush South 4-65 29-30 Pad.

Water sources and associated reference data for this effort were acquired from publicly available datasets, including the Colorado Division of Water Resources (DWR). Spatial analysis will be completed using queries in a geographic information system (GIS) desktop environment.

For purposes of the assessment, water sources included water wells that are registered with DWR, including household, domestic, livestock, irrigation, municipal/public, and commercial wells; permitted or adjudicated springs; and monitoring wells installed for the purpose of complying with groundwater baseline sampling / monitoring requirements under COGCC Rule 609.

When evaluating locations as potential available water sources (AWS) for sampling / monitoring, Crestone considered water sources for which the water well owner, owner of a spring, or a land owner, as applicable, had given consent for sampling and testing and has consented to having the sample data obtained made available to the public, including without limitation, being posted on the COGCC website.

Water Well Identification

Crestone identified all AWS within a ½ mile radius of the Rush South and evaluated the DWR water sources using the selection, exception, and timing criteria identified in COGCC Rule 609. Those criteria include DWR permit status, proximity to the proposed oil and gas production surface location, type of water source, orientation of sampling locations, source aquifer, direction of groundwater flow, and condition of water sources among others.

As shown on the attached map and associated water well (Table 1), no available water sources were identified within the ½ mile radius. A variance request will be submitted for City approval.

Requested and City Easement Well(s)

As required by the City, Crestone will drill and construct a Westbay System or equivalent for multilevel monitoring on a City of Aurora Service Area property. See Site Specific Schedule for further details. A well diagram is available upon request.

FIELD ASSESSMENT / DATA EVALUATION

Field assessment, sampling processes, and data evaluation for identified water wells, requested wells and City Easement wells have been completed in accordance with the COGCC SAP (2020).

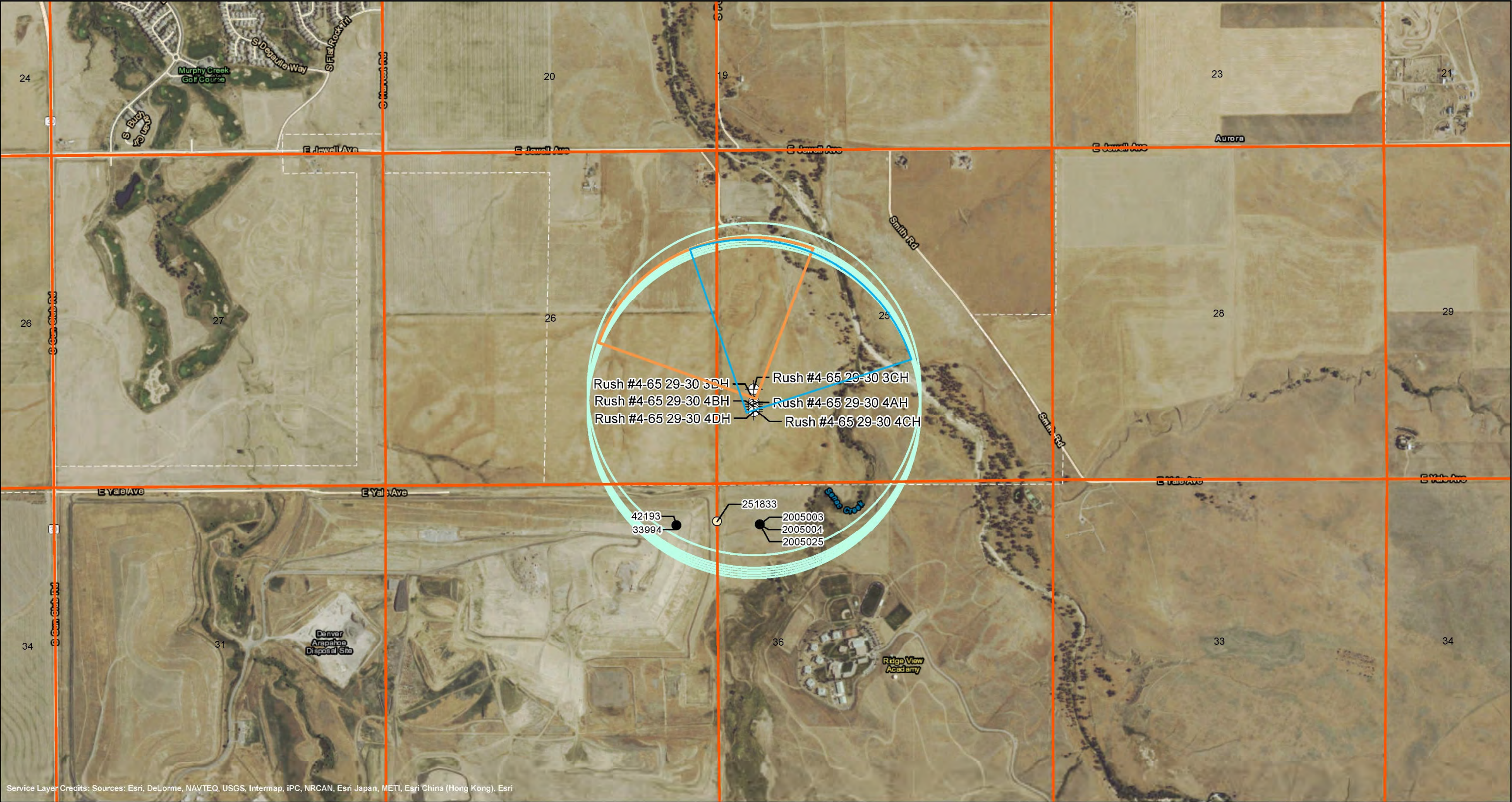
PROTECTION AND MITIGATION MEASURES

Mitigation

If needed, a mitigation plan will be developed on a case-by-case basis depending on the degradation observed and the degree of impairment. The plan will identify locations and frequency for sampling to document baseline groundwater conditions prior and subsequent to drilling activities.

REFERENCES

Colorado Oil & Gas Conservation Commission. (2020, April). *Model Sampling and Analysis Plan Rules 609 and 318A.e(4) Colorado Oil and Gas Conservation Commission Version 2* Retrieved May 28, 2020, from https://cogcc.state.co.us/documents/about/COGIS_Help/COGCC_Model_SAP_20200414.pdf



Service Layer Credits: Sources: Esri, DeLorme, NAVTEQ, USGS, Intermap, iPC, NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri



Table 1 Associated Water Wells

COP Well	Water Well Permit No.	Receipt #	Approximate Distance from COP (Ft)	Well Status (DWR)	Well Completion date	TD'	Aquifer	Sampling Priority	Determination of Sampling Priority	Well Info Available	Well Use Designation	Parcel ID No.	Property Owner (tax records)	Property Owner Mailing Address (tax records)	Well Owner (well permit)	Well Owner Mailing Address (DWR)	Well Location (well permit, tax records)	UTM_X	UTM_Y	x_COSPcft	y_COSPcft
RUSH 4-65 29-30 3CH	251833	0512484	2181.675301	Well Constructed	37770	42	ALL UNNAMED AQUIFERS	1	Only well available to sample within 1/2 mile . However, well is upgrade from the location and a monitoring well and is therefore not a viable sample option.	well construction and test report, permit to use an existing well, monitoring/observation well permit application, see permit no. 42193MH	monitoring well	1977-00-0-00-289	DENVER, CITY & COUNTY OF	1525 SHERMAN ST DENVER, CO 80203-1714	WASTE MANAGEME NT OF COLORADO	C/O AQUAETER INC 7340 EAST CALEY AVE #200 CENTENNIAL , CO 80111	AURORA, CO NE NE 32 4.0S 65.0W Sixth 611 N 9 E	527554.4	4390715.3	3231192.74	1668443.43
RUSH 4-65 29-30 3CH	2005003AB	2005003	2151.878007	Well Abandoned	NA	20	ALL UNNAMED AQUIFERS	NA	well plugged 08/16/2004 - will not be able to sample	well abandonment report (well plugged 08/16/2004)	monitoring well	1977-00-0-00-282	DEPARTMEN T OF HUMAN SERVICES	1525 SHERMAN ST DENVER, CO 80203-1714	LAYNE - WESTERN	17800 EAST 22ND AVENUE AURORA, CO 80011	AURORA, CO NW NW 33 4.0S 65.0W Sixth	527761.6	4390699.5	3231873.06	1668395.29
RUSH 4-65 29-30 3CH	2005004AB	2005004	2151.878007	Well Abandoned	NA	20	ALL UNNAMED AQUIFERS	NA	well plugged 08/16/2004 - will not be able to sample	well abandonment report (well plugged 08/16/2004)	monitoring well	1977-00-0-00-282	DEPARTMEN T OF HUMAN SERVICES	1525 SHERMAN ST DENVER, CO 80203-1714	LAYNE- WESTERN	17800 EAST 22ND AVENUE AURORA, CO 80011	AURORA, CO NW NW 33 4.0S 65.0W Sixth	527761.6	4390699.5	3231873.06	1668395.29
RUSH 4-65 29-30 3CH	2005025AB	2005025	2151.878007	Well Abandoned	NA	78	ALL UNNAMED AQUIFERS	NA	well plugged 08/16/2004 - will not be able to sample	well abandonment report (well plugged 08/16/2004)	monitoring well	1977-00-0-00-282	DEPARTMEN T OF HUMAN SERVICES	1525 SHERMAN ST DENVER, CO 80203-1714	LAYNE- WESTERN	17800 EAST 22ND AVENUE AURORA, CO 80011	AURORA, CO NW NW 33 4.0S 65.0W Sixth	527761.6	4390699.5	3231873.06	1668395.29
RUSH 4-65 29-30 3CH	33994MH	0033994	2489.770204	Well Abandoned	36003	50	ALL UNNAMED AQUIFERS	NA	well plugged 09/21/1999 - will not be able to sample	well abandonment report (well plugged 09/21/1999), notice of intent to construct monitoring hole	monitoring well	1977-00-0-00-289	DENVER, CITY & COUNTY OF	1525 SHERMAN ST DENVER, CO 80203-1714	WASTE MANAGEME NT OF COLORADO	C/O GOLDER ASSOCIATES INC 44 UNION BLVD STE 300 LAKEWOOD, CO 80127	AURORA, CO NE NE 32 4.0S 65.0W Sixth	527356.7	4390697.8	3230544.2	1668382.45
RUSH 4-65 29-30 3CH	42193MH	0042193	2489.770204	Well Abandoned	37771	49	ALL UNNAMED AQUIFERS	NA	well plugged 5/03/2003 - will not be able to sample	well abandonment report (well plugged 5/03/2003), notice of intent to construct monitoring hole	monitoring well	1977-00-0-00-289	DENVER, CITY & COUNTY OF	1525 SHERMAN ST DENVER, CO 80203-1714	DENVER CITY & COUNTY OF	C/O AQUAETER INC 7340 EAST CALEY AVE #200 CENTENNIAL , CO 80111	AURORA, CO NE NE 32 4.0S 65.0W Sixth	527356.7	4390697.8	3230544.2	1668382.45

Site Specific Schedule*

Rush South 4-65 29-30-Scheduled Commencement of Drilling Activities - TBD Pending Permit Approval

Conduct Phase I – Due Diligence:	Prior to permit submittal
Contact landowners to obtain sample permission:	As soon as possible - N/A No suitable wells identified for sampling within ½
Contact surface landowners to obtain surface rights to install Requested Well(s):	Began week of September 3, 2019
Coordinate Requested Well location, construction, and installation schedule with City:	Crestone Peak Resources Operating, LLC met with Josh Godwin 3/5/2020, and received verbal approval of Westbay System for multilevel monitoring on the well pad.
If needed, coordinate Easement Well location, construction and installation schedule with City:	Not Needed.
Submit monitoring well permit application(s) to SEO:	3/30/2020 MW application submitted and approve by State DWR.
Monitoring well(s) installation:	TBD
Sample monitoring well(s):	Prior to well completion activities
Commence O&G Drilling activities:	TBD Pending Permit Approval

*Any timelines listed above may be subject to change based on City requirements and O&G location specific issues which may be outside of APTIM or Crestone's control.



March 31, 2020

Jeffrey Anderson, PG
Jeff.Anderson@LREwater.com

RE: BOE Variance Approval 2020-017A, Permit Receipt No. 10002696

On March 3, 2020 we received a variance request to allow for the construction of a multi-level groundwater monitoring well which will use less casing and grout than required in the construction of a Type I well that will penetrate more than one confining layer. Rule 14.1.1 states that all monitoring and observation holes or wells that penetrate a confining layer between two (or more) distinct aquifers must be drilled by a licensed contractor and must comply with the standards of Rule 10. Rule 10.4.5.2 requires steel casing and approved grout from the base of the confining layer overlying the production zone to 60 feet above the uppermost confining layer. Additionally, this well will have perforated casing adjacent to the Denver, Upper Arapahoe, Lower Arapahoe, and Laramie-Fox Hills aquifers and rather than employ the typical plain casing and grout to prevent the intermingling of groundwater from different sources through the borehole (Rule 10.1d), will utilize a multi-packer Westbay System tubing string to comply with Rule 10.1d.

NextSource Water Solutions LLC's variance request proposes to first drill and install 40 feet of 20-inch conductor casing, then drill a 13.75-inch borehole to approximately 1840 feet. Based on a pending geophysical log from this well, 40 feet of 6-inch inside diameter (ID) 0.030-inch mill-slotted screen will be placed across the most favorable aquifer materials within each of the Denver, Upper Arapahoe, Lower Arapahoe, and Laramie-Fox Hills aquifers, while 6-inch ID 0.288-inch wall thickness blank steel casing will be used for the rest of the well. Adjacent to each section of screen the annular space will be filled with approximately 40 feet of filter pack, topped with approximately 5 feet of bentonite, while the remaining annular space will be filled with cement-bentonite grout. Each aquifer zone would then be developed and the Westbay System installed by Westbay technicians. The surface casing will be grouted with neat cement, a 4'x4'x6" concrete pad with 3-foot stovepipe protective cover will be placed around the well casing, and traffic bollards will be installed.

This request has been reviewed by the Board and pursuant to Rule 18, a variance is granted subject to the following conditions:

1. The construction must be in accordance with the Rules with the exception of the variance granted herein. Unless written approval for a modification to this variance is obtained, all conditions and requirements of this variance approval must be satisfied, or the entire variance will be void, and all standards of the Rules applicable.
2. The construction must be in accordance with the description and design submitted March 3, 2020, including the following modifications:



- a. A variance to Rule 10.4.5.2 is granted to use less steel well casing and grout than required for a Type I aquifer with multiple confining units.
 - b. Each screened-casing and filter-packed interval must be within only one administratively-defined Denver Basin aquifer.
 - c. Approved grout must be placed adjacent to each administratively-defined aquifer interval and must be placed by tremie pipe.
 - d. Approved grout must be placed adjacent to the steel surface casing and must be placed by tremie pipe in one, continuous pour.
 - e. The well construction and Westbay System together must adequately prevent the intermingling of groundwater from different sources through the borehole.
3. The licensed contractor identified in the variance request, Hydro Resources (Lic. 1355), must construct the well. In the event another licensed contractor or private driller proposes to construct the well, that individual must apply for and receive a new variance.
4. The licensed contractor must provide advanced notification to the State Engineer prior to starting the work allowed by this variance **as well as prior to the installation of the Westbay System**. Any change in the anticipated date of construction/installation must be re-noticed prior to the revised anticipated date. The notice must be received by 11:59 pm the day before starting the work approved in this variance. The Notification Process information can be found on the following webpage;

<http://water.state.co.us/groundwater/BOE/Pages/VariancesWaivers.aspx>

The owner and constructor are also advised that Rule 6.6 requires that the construction comply with any federal, state, county, municipal or local government laws, regulations or codes that are more stringent than the Rules. This includes distance requirements from sources of contaminants and standards not covered by the Rules.

Approval of this request does not relieve the owner of potential responsibility or liability in the event contamination of the water source results from construction, nor does the grantor assume any responsibility or liability should contamination occur.

If you have any questions, please contact this office.

Sincerely,

Andy Flor

Hydrogeology Section

andrew.flor@state.co.us

ec: Well Permit File
Dallas Werner, Hydro Resources, d Werner@hydroresources.com



(wholly owned subsidiary of LREWater)

WELL# **Crestone Peak Resources Monitoring Well on Rush South Pad**
39.67120 N, -104.677120 W

Calculated
BGS/ ft

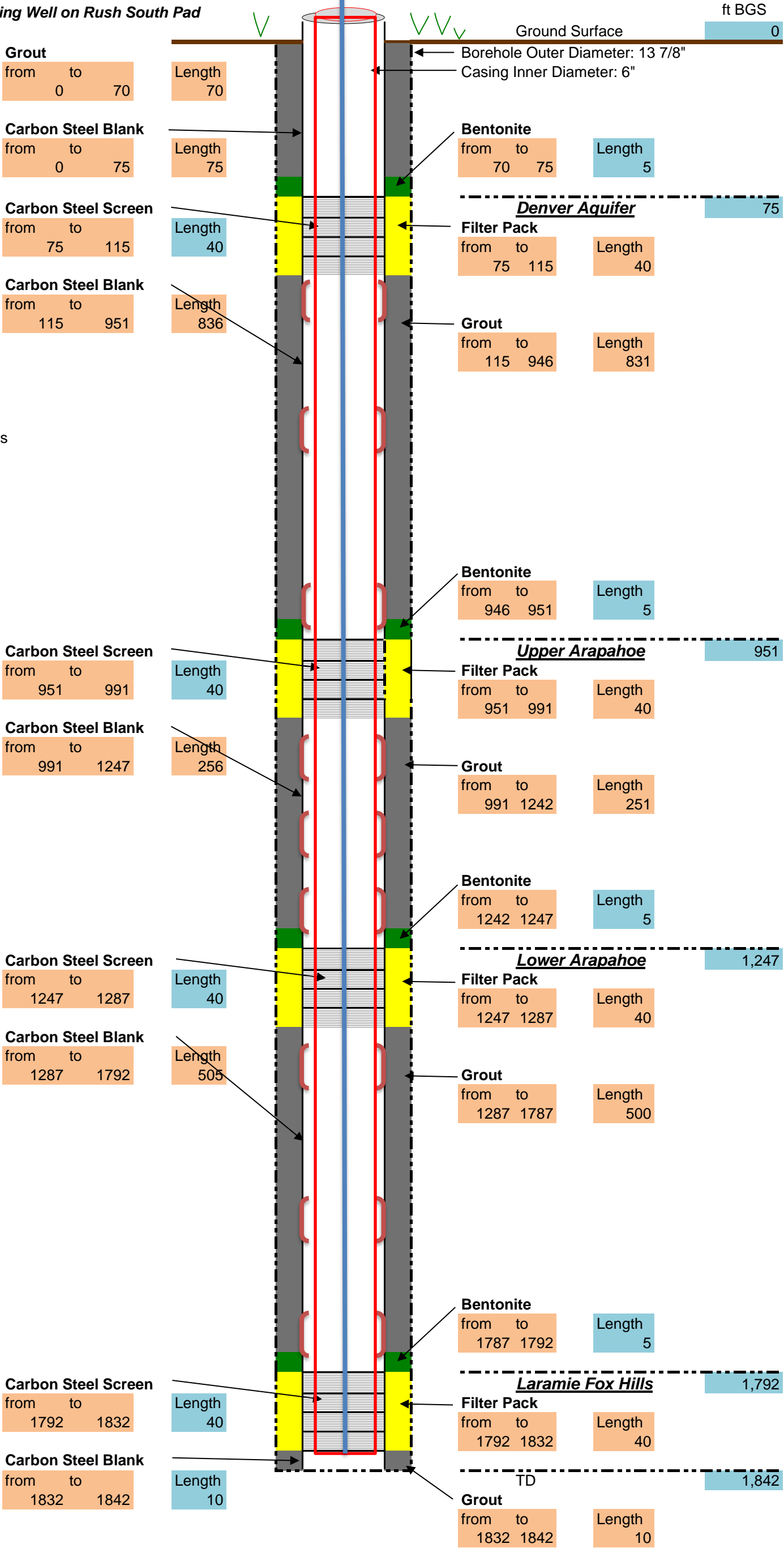
Inputs
BGS/ ft

	Length (ft)	
Total Screen:	160	
Total Blank:	1682	
Total Casing length	1842	
	Length (ft)	Approx. Vol. ft^3
Grout	1662	1354
Bentonite	20	17
Filter Pack	160	131
Total	1842	1502

Specs

Screen: 0.030" slotted carbon steel casing
Blank: 6" milled carbon steel, 0.288" wall thickness

Filter pack: 8-12 sand
Bentonite: pellets
Grout - blend of neat cement and bentonite





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February 27, 2020

NextSource Water Solutions, LLC
1221 Auraria Parkway
Denver, CO 80204

**ATTN: Mr. Jeff Anderson, PG
Manager**

Project: Crestone Peak Resources – Monitoring Wells
Subject: Proposal for Well Drilling Services

Mr. Anderson:

Hydro Resources (HR) is pleased to present the following proposal for well drilling services for the potential monitoring well installations for Crestone Peak Resources. Before reviewing the project details, HR would first like to stress our commitment to NextSource with providing a company committed to making Health & Safety our number one priority on this project. HR has broken down the proposal into the following units:

- I. Key Equipment to be supplied to the Project
- II. Technical Approach
- III. Unit Cost Breakdown

I. Key Equipment to be supplied to the Project

Based upon the project scope and desired schedule, HR is proposing a drilling program that will utilize a Midway 3500 drill rig. HR intends to mobilize the following equipment to the drilling site:

- The primary drilling rig for the well will be a Midway 3500 portable crane carrier rig. The Midway rig has a fixed 54' mast rated at 125,000 lbs. with an 18" Howard Turner rotary table.
- The rig will be equipped with 1,800 ft of appropriate-sized drill pipe, a Sullair 900 CFM compressor and a Sullair 375 CFM compressor. HR has assumed a support truck for pipe and miscellaneous parts to complete the work.
- The drilling package includes a three-man drilling crew working 24 hours per day.
- HR will provide a pump rig for installation of the Westbay system.



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Picture 1 – Midway 3500 Drill Rig



The equipment listed above will be dedicated to this project on a full-time basis and all the equipment is up to date with annual inspections and certifications. HR has several other drill rigs and support equipment that may be utilized for the project as needed to successfully complete the project in the anticipated timeline.

II. Technical Approach

HR is providing the following summary of our technical approach regarding the drilling plan. The scope is based upon the drilling specifications that have been provided.

1. Mobilize Midway 3500 drill rig to site and set up auxiliary drilling equipment.
2. Install 40' of 20" conductor casing.
3. Drill 13.75" mud rotary borehole to ~ 1650'
4. Run logs in the hole to delineate sandstones from shales to finalize well design
5. Complete the borehole as a monitoring well with 6" .288 wall carbon steel casing with 40 feet of mill slotted pipe adjacent to the aquifers and blank pipe between to separate the aquifers.
6. The approximate slots would be as follows (from the bottom of the borehole):
 - a. Laramie Fox Hills 1600-1640'
 - b. Lower Arapahoe 1200-1240'
 - c. Upper Arapahoe 800-840'
 - d. Denver 400-440'
 - e. Alluvium (if present) 40-80'
7. In the annular space, there would be about 50 feet of filter pack adjacent the slots, with ~ 5' of bentonite pellets above the filter pack and then bentonite grout to the base of the next set of slots. This alternating sequence/process would repeat to near the ground surface, where a standard cement grout would be set to surface.
8. Develop using straddle packers to isolate the zone being cleaned up. Use bailing, swabbing, air lifting or pumping to remove drilling mud and clean up well. Develop the 5 zones inside each well for estimated 12 hours each.



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9. Mobilize drill rig to next site.
10. Set Westbay System inside 6" pipe. Westbay will provide technicians to assist in setting their equipment to ensure proper installation. Hydro will mobilize a pump rig to install the system.
11. Complete the surface with an approximately 4 foot x4 foot x 6 inch thick concrete pad. A 3-foot stove pipe protective cover for the well casing and bollards installed for traffic guards.



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Hydro Resources can currently mobilize a drill rig in early April after receiving an executed contract. We are confident that NextSource and Crestone will be impressed with our professional water supply services and look forward to the opportunity to provide this service. Please contact our office at your earliest convenience with any questions or concerns you may have.

Sincerely,

Hydro Resources

Jason Barnum

Jason Barnum
Business Development Manager
Rocky Mountain and West Regions
jbarnum@hydroresources.com



Westbay MP38 System Packer Seal Verification

Introduction

Leonard Rice Engineers (LRE) has requested Westbay to provide a document regarding verification of the packer seals between monitoring zones in a Westbay System Completion. This document describes the Westbay completion in a cased well and how to evaluate the WB packer integrity. This text is taken from the Westbay document number WB-P-002, MP38 Westbay System Field Verification Plan dated October 21, 2013.

Packers in cased well

A common installation method for Westbay System well completions is to install the multi-packer Westbay System tubing string inside a steel cased well. The steel tubing has annular seal material (grout, bentonite or other low-permeability material) in the borehole annulus to seal against the native formation materials. The steel tubing has perforations at selected intervals to provide hydraulic access to desired monitoring zones. Sometimes these perforations consist of slotted or screened well tubing sections, separated by blank tubing sections, and the annular fill materials can consist of engineered granular filter packs, separated in the annulus by grout or cement.

With such a system, the Westbay System is deployed inside the well tubing, with packers positioned above and below the perforated intervals, providing hydraulic isolation of the intervals from the well annulus. On occasion, multiple redundant packers and ports are installed within continuous lengths of blank well tubing, for the express purpose of allowing extended capability for testing and verification of packer seal performance.

The test methods described below are applicable to cased well installations and open- borehole installations.

a) Natural distribution of piezometric levels

By examining the fluid pressure data for evidence of differences in piezometric levels across a packer it is frequently possible to verify the presence of a seal. Differences in piezometric levels which exceed the accuracy of the measuring instruments indicate that the packer is achieving an effective seal.

If multiple redundant packers are installed within a continuous length of blank well tubing a “Q/A zone” can be created. Such a zone contains only trapped fluids that have no direct hydraulic connection with either the inside of the MP Tubing or the formation. Measurement of a pressure difference between this isolated Q/A zone and the pressures in adjacent monitoring zones provides a positive indication of effective packer seals and annular isolation.

b) Pulse-interference tests

In zones of low hydraulic conductivity, testing the zone between two packers may be accomplished by the use of a sampler probe with or without a sample container. The sampler provides a means of opening the measurement port valve and allowing communication

between the zone and the sample container or between the zone and the fluids inside the Westbay tubing.

With the probe activated, the sampling valve is opened for a period of time. If the hydraulic conductivity is very low, little or no measurable flow might take place, but the test zone will be exposed to the pressure in the sample container (or inside the Westbay tubing) for a period of time. The sampling valve may then be closed and the response of the shut-in pressure vs. time is recorded. The response of the shut-in pressure reflects on the hydraulic conductivity of the monitored interval and the effectiveness of the adjacent packer seals.

The pulse-interference test is a particularly convenient test of packer seals of a "Q/A zone". A measurement port located in the Q/A zone is used for periodically carrying out the pulse-interference test. The use of Q/A zones is common in Westbay System installations both in fractured rock and inside cased wells. Tests results indicating a zone of low hydraulic conductivity (or no hydraulic conductivity in the case of a cased well) between two monitoring zones of higher hydraulic conductivity are a positive indication of effective packer seals and annular isolation.

c) Induced distribution of piezometric levels (vertical interference test)

In the event that an interpretation of the natural distribution of piezometric levels between two adjacent monitoring zones is not conclusive, the intervening seal may be further evaluated by inducing a pressure change in one of the zones and observing the response in the other. The induced fluid pressure test is generally accomplished by opening a pumping port in the monitoring zone at one end of a packer and using a sampler probe or pressure probe to observe the fluid pressure at the other side of one or more packers.

With a MOSDAX probe measuring the fluid pressure inside the Westbay tubing, the fluid level or fluid pressure is rapidly altered (ie, "slugged") and the probe is used to observe the response in the zone bearing the open pumping port (this test is commonly referred to as a slug test). During this test, a second MOSDAX probe is activated so as to be measuring the pressure in the monitoring zone on the opposite side of the packer(s) from the open pumping port. The response (magnitude and delay) of the fluid pressure in the monitored interval as compared to the slugged interval directly reflects the effectiveness of the packer seal.

A MOSDAX sampler probe and a MOSDAX pressure probe may be operated in tandem to conduct the test described above. In this manner, both the "slugged" zone and the neighboring zone can be monitored simultaneously.

d) Tracer tests

A tracer can be introduced through any measurement port. Samples can be collected at the port through which the tracer was introduced and at other measurement ports and analysed for the tracer. The results of such analyses can be used to interpret the nature of any intervening seals.