STATE OF COLORADO

Cazier - DNR, Tim <tim.cazier@state.co.us>

response to DRMS TR10 preliminary adequacy review letter for Holcim (US) Inc. Portland, CO Plant

1 message

Peters, Chris <Chris.Peters@arcadis-us.com> Wed, Nov 19, 2014 at 1:05 PM
To: "tim.cazier@state.co.us" <tim.cazier@state.co.us>
Cc: "(justin.andrews@holcim.com)" <justin.andrews@holcim.com>, "Sueker, Julie" <Julie.Sueker@arcadis-us.com>, "Yusko, Lauri" <Lauri.Yusko@arcadis-us.com>

Mr. Cazier,

Attached please find ARCADIS' response to the DRMS TR 10 preliminary adequacy review letter for Holcim's request to remove sodium as a water quality parameter from the current Groundwater Monitoring Plan at Holcim's Portland, Colorado Plant.

Let me know if you would like a hard copy of the attached and we will send it out.

Feel free to contact me with any questions. Thank you.

Christopher Peters | Vice President | chris.peters@arcadis-us.com

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2014 1119 Response to TR 10 review letter .pdf
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Environment

Mr. Timothy A. Cazier, P.E.
Environmental Protection Specialist
Colorado Division of Reclamation, Mining and Safety
Department of Natural Resources
1313 Sherman Street, Room 215
Denver, Colorado 80203

Subject:
Response to DRMS Technical Revision (TR-10) Preliminary Adequacy Review
Holcim (US) Inc. Portland, Colorado Limestone Quarry, Permit No. M-1977-344

Date:
November 19, 2014

Contact:
Chris Peters

Phone:
517.324.5052

Email:
chris.peters@
arcadis-us.com

Our ref:
B0025510

Dear Mr. Cazier:

ARCADIS has prepared this letter on behalf of Holcim (US) Inc. (Holcim) to respond to the Division of Reclamation, Mining and Safety (DRMS) Technical Revision (TR-10) Technical Adequacy Review of the "Proposal to Remove Sodium as a Groundwater Quality Parameter – DRMS Permit No. M-1977-344, Technical Revision No. 6", dated August 4, 2014 and received by DRMS on October 20, 2014. The DRMS responded to the above proposal in a letter to Justin Andrews of Holcim dated October 31, 2014, requesting additional information be provided before they would authorize the removal of sodium as a water quality parameter to evaluate potential impact from leaching of cement kiln dust (CKD).

Presented below is a summary of the DRMS comment from the October 31 letter followed by ARCADIS' response. We believe this information will provide the justification to remove the numeric protection level (NPL) for sodium from the groundwater monitoring program, approved by the DRMS on February 24, 2009 and updated on November 27, 2012. We would propose as a revision to the groundwater monitoring program to continue to analyze groundwater samples for sodium in order to continue to determine the potassium to sodium ratio, which we would propose to replace the sodium NPL as the primary water quality indicator of impact from the CKD landfill.

1) Relationship between depth to water and sodium concentration in monitoring well MW-7:

The DRMS acknowledges that the higher concentrations of sodium observed in MW-7 may be partially attributable to lower water levels in that monitoring well, but commented that ARCADIS should provide further discussion as to why the increased sodium concentrations are not attributable to impacts from CKD.

ARCADIS Response:

As presented below, multiple lines of evidence support the conclusion that increasing concentrations of sodium in groundwater samples collected at MW-7 are not associated with leachate from the CKD landfill.

We have further evaluated the effect of depth to water in monitoring well MW-7 (see **Figure 1** for location) to water quality in that well by preparing concentration versus depth to groundwater graphs for sulfate and potassium, two of the other constituents analyzed as part of the Groundwater Monitoring Plan (GMP) for the site. These graphs are presented in **Figure 2** along with a sodium concentration versus depth to groundwater graph. The graphs demonstrate that while sodium concentration increase with increasing depth to groundwater, sulfate and sodium concentrations are inversely related to depth to groundwater. The correlation between and sulfate and potassium concentrations and depth to water is not as strong when compared to sodium after 2010, as indicated by the two observed “spikes” in concentration (**Figure 2**), particularly for sulfate. However, for both potassium and sulfate, when depth to groundwater decreases, constituent concentrations increase. All three constituents are present in the CKD (see **Table 1**), and potassium and sulfate are present in the CKD at much higher concentrations than sodium (see discussion below) and all three constituents are highly leachable.. It follows that if the observed increases in sodium concentrations were associated with the CKD landfill, then corresponding increases in sulfate and potassium should be observed. The historical data for these two constituents do not exhibit this pattern.

In addition to the observed relationship between depth to water and sodium, sulfate, and potassium concentrations, there are additional lines of evidence that the increase in sodium concentrations are not related to releases from the CKD landfill. The basis for this position is that the concentrations of sodium in the groundwater should reflect its concentration in the CKD as well as its concentration relative to other constituents in the CKD. We present below both compositional and leach test data from the CKD to demonstrate that sodium concentrations in groundwater at MW-7 are not attributable to leaching from CKD.

CKD chemistry indicates high concentrations of potassium and chloride relative to sodium. **Table 1** is a summary of compositional CKD analyses from the Portland plant for 2014 for sodium, potassium, and chloride. Sodium and potassium analyses are presented as oxides of these parameters. The data indicate that the average potassium concentration is greater than sodium by more than a factor of 10 (K:Na > 10). Chloride concentrations in the CKD exceed sodium concentrations in the CKD by nearly factor of 20 (Cl:Na >20). **Table 2** summarizes compositional potassium and sodium concentrations from the Portland plant and eight other Holcim plants in the United States from 2005 and 2006. Potassium concentrations on average exceed sodium concentrations by a factor of approximately 11. Sodium, potassium, and chloride are all highly leachable constituents and behave conservatively in the environment; that is, they are minimally affected by geochemical conditions in the receiving groundwater (for example pH, redox, cation exchange capacity). It therefore follows that concentration of these constituents in the groundwater, if leakage from the landfill was occurring, should mimic the concentrations in the CKD (thus, potassium concentrations should greatly exceed sodium concentrations). Based on several years of groundwater monitoring data from the site this is not the case. While chloride is not part of the GMP, previous analyses of chloride suggest the same conclusion. **Table 3** presents some historical chloride, potassium , and sodium concentrations in MW-7 between 1998 and 2009. Chloride concentrations ranged from approximately 25 to 42 mg/L during that time period, compared to 7 to 17 mg/L for potassium in that well over the same time frame, and 112 to 236 mg/L for sodium. If these concentrations were a result of leaching from the CKD, potassium and chloride concentrations should be much higher than sodium concentrations rather than the opposite. These conclusions are illustrated with graphs of groundwater sodium concentrations versus K:Na and Cl:Na values for groundwater samples (**Figure 3**). As shown in **Figure 3**, groundwater K:Na values are below 0.25 and Cl/Na values are below 0.3, both of which are more than an order of magnitude below the K:Na >10 and Cl:Na >20 values expected for CKD and CKD leachate.

CKD leachate testing data also suggests that the landfill is not the source of sodium in groundwater at MW-7. **Table 4** is a summary of Synthetic Precipitation Leaching Procedure (SPLP) test data for CKD and alkali bypass dust generated from the Portland plant, from 2002 and 1999. While the data set is limited, the results of both tests show that the concentrations of sodium (158 and 159 mg/L) are less than the recent and historical concentrations of sodium in groundwater at MW-7. Based on these results it is not feasible that releases from the landfill could be the cause of the increasing sodium concentrations in groundwater at MW-7. Furthermore, the elevated chloride concentration in the alkali bypass dust from the SPLP test (4,600 mg/L) relative to the sodium concentration (158 mg/L) results in a Cl:Na value of 29, generally consistent with the chloride to sodium ratio values greater than 20 in the CKD composition analysis results (**Table 1**).

Groundwater data were evaluated further to better understand the potential cause of increasing sodium concentrations at MW-7. **Figure 4** demonstrates little relation between sodium and sulfate concentrations for groundwater monitoring locations with the exception of MW-7, which shows a strong inverse relation between sodium and sulfate concentrations. These results suggest that water with different compositional “types” is entering into the MW-7 monitoring well. Trilinear diagrams, also known as Piper diagrams, were developed for select samples that had sufficient data for plotting. As shown in **Figure 5**, most groundwater samples plotted within the calcium plus magnesium, sulfate [Ca+Mg–SO_4] type water field shown in the upper portion of the diamond. However, the MW-7 2008 sample is shifted away from the primary group of samples towards the sodium plus potassium, bicarbonate [Na+K–HCO_3] type water while the MW-7 2009 sample is clearly a Na+K–HCO_3 type water. These shifts in water composition occurred when depth to groundwater increased.

MW-7 is completed within the Codell Sandstone and the underlying Blue Hill Shale. The MW-7 borehole was completed to a total depth of 70 feet below ground surface (ft bgs) with the upper 30 feet in the sandstone and the lower 40 feet in the underlying shale (**Figure 6**). The borehole was backfilled with silica sand to a depth of 42 ft bgs. The borehole was cased and a slotted screen interval was completed from 17 to 42 feet bgs across both the sandstone and shale bedrock. When the depth to groundwater increases at MW-7, the proportion of groundwater that may be contributed from the shale increases and may result in the observed shifts in groundwater quality with increased depth to groundwater. No other site groundwater monitoring wells intersect the Blue Hill Shale and no other site groundwater monitoring wells exhibit the wide variability in constituent concentrations observed at MW-7. The borehole log is included as Attachment 1 to this letter.

2) Literature Data:

The DRMS has requested that ARCADIS provide some discussion related to the referenced Report to Congress as to whether or not bio-solids are included in the characterization of CKD at similar cement plants. The basis for this statement is that they indicated sludge samples analyzed for TR-06 suggest the addition of the bio-solids alter the chemistry of that typical for CKD.

Response:

We are not aware of biosolids being used as an admixture for CKD at other cement plants, and we were not able to obtain any data in that regard. Biosolids were originally used as a dust control measure. However, biosolids have not been used at the Portland facility for at least 10 years and represent a small percentage of the total waste in the facility. As such, it is unlikely that they will have a significant impact on the overall chemistry of the highly leachable constituents, such as potassium, sodium, and chloride present in the CKD and be observed in measurements taken 10 years later.

3) The use of the K/Na ratio:

The DRMS has stated: “The 2009-2010 K:Na ratio for reported values are roughly 0.05, an order of magnitude less. Furthermore, if Na concentrations continue to increase, while K concentrations remain essentially the same, the proposed ratio of 0.5 will be quite easy to achieve. Of greater concern is that both Na and K concentrations could increase over time, but as long as the concentration of Na is at least twice that the K, the proposed standard would be met. Significant increases in either Na or K and Na should be viewed as a concern from the Division’s viewpoint. A greater discussion on the K:Na chemistry as it relates to CKD and a more compelling argument for the K:Na ratio needs to be provided to the Division before this approach can be considered.”

Response:

While we concur that significant increases in sodium or potassium should be closely monitored, the discussion provided in this letter has demonstrated that increases in sodium are not related to releases from CKD. If they were, a correspondingly greater increase in potassium concentration should be observed. This is clearly not the case. As shown in **Figure 3**, K:Na values for all site groundwater samples were less than 0.25 and most were less than 0.15; well below the K:Na value of greater than 10 for CKD. When sodium concentrations increased in groundwater at MW-7, the K:Na value decreased substantially, demonstrating a behavior that is the *opposite* of what would be expected from contributions of CKD leachate.

We believe that we have provided a convincing argument that the ratio of potassium and sodium is a useful indicator of CKD impacts. ARCADIS has successfully used K:Na ratios in other states, particularly Michigan to assess impacts to groundwater from CKD waste areas. A K:Na ratio threshold of 0.5 is a reasonable, and we believe conservative indicator of groundwater impact from CKD leaching.

If the Division has additional questions or concerns about the suggested monitoring approach, we would suggest that a meeting be convened to further discuss this issue. Please let us know a convenient meeting time.

Furthermore , we propose to complete an additional round of groundwater monitoring at the site in December In addition to the current list of parameters included in the GMP, we will analyze groundwater samples for chloride.

We look forward to your response. Please contact me at 517.324 5052 (office) or 517.927.3611 (cell) if you have any questions.

Sincerely,
ARCADIS

Christopher S. Peters, CPG
Vice President

Tables:

Table 1	Compositional Concentrations for Alkali Bypass Dust at Holcim Portland Plant - 2014 (weight percent)
Table 2	Summary of Compositional Potassium and Sodium Concentrations in Cement Kiln Dust/Alkali Bypass Dust
Table 3	Historical Cl, K, and Na Concentrations in Monitoring Well MW-7
Table 4	Synthetic Precipitation Leaching Procedure Test Results

Figures:

Figure 2	Sulfate, Sodium, and Potassium versus Depth to Groundwater
Figure 3	Sodium Concentrations versus Potassium to Sodium and Chloride to Sodium Ratios
Figure 4	Sodium and Sulfate Concentrations
Figure 5	General Geochemistry
Figure 6	MW-7 Well Completion, Depth to Groundwater, and Water Quality

Attachments:

1	Boring Log for Monitoring Well MW-7

Copies:

Justin Andrews, Holcim (US) Inc.
Lauri Yusko, ARCADIS
Julie Sueker, ARCADIS
File

ARCADIS

Tables

Table 1. Compositional Concentrations for Alkali Bypass Dust at Holcim Portland Plant - 2014 (weight percent)

	SiO2 (%)	Al2O3 (%)	Fe2O3 (%)	CaO (%)	MgO (%)	SO3 (%)	Na2O (%)	K2O (%)	NaEq (%)	Cl (%)
Average	15.4	4.2	1.98	46.89	1.33	4.95	0.43	5.14	3.81	8.1
Median	15.71	4.25	2.03	47.25	1.33	4.46	0.4	4.7	3.6	5.84
Std. Dev.	1.61	0.47	0.22	6.35	0.07	2.24	0.14	2.09	1.5	3.31
Maximum	18.11	5.21	2.43	60.94	1.62	11.25	1.01	12.64	9.14	19.3
Minimum	9.64	2.58	1.18	29.68	1.11	1.37	0.19	1.45	1.14	1.68
N	189	189	189	189	189	190	190	190	190	190

N = sample count

Source: Holcim (US) Inc.

Table 2. Summary of Compositional Potassium and Sodium Concentrations in Cement Kiln Dust/Alkali Bypass Dust Holcim (US) Inc. Plants (weight percent)

Plant / Year/ Quarter	Ada	Devils Slide	Dundee	Midlothian	Portland	Trident	Artesia	Clarksville	Holly Hill	ave.
2005/1st										
Na_2O	0.25	0.62	0.37	0.45	0.56	0.51	0.81	0.17	0.31	0.45
K_2O	2.68	3.82	4.14	3.36	0.95	6.9	6.55	3.18	4.31	3.99
2005/2nd										
Na_2O	0.32	0.56	NA	NA	0.61	0.49	NA	0.3	NA	0.46
K_2O	2.14	3.7	NA	NA	7.17	8.38	NA	3.74	NA	5.03
2005/3rd										
Na_2O	0.21	0.74	0.43	0.47	0.58	0.69	NA	0.24	NA	0.48
K_2O	1.57	9.1	3.95	4.31	6.05	8.21	NA	3.77	NA	5.28
2005/4th										
Na_2O	0.15	0.65	0.4	0.27	0.38	NA	NA	0.14	NA	0.35
K_2O	1.81	8.99	3.7	3.57	7.64	NA	NA	3.84	NA	4.9
2006/1st										
Na_2O	0.18	0.74	0.41	0.11	NA	0.11	1.5	0.19	NA	0.46
K_2O	2.52	8.27	1.72	2.67	NA	3	9.97	2.97	NA	4.4

NA - data not available

Table 3. Historical Cl, K, and Na Concentrations in Monitoring Well MW-7
Holcim (US) Inc. Portland Plant (mg/L)

Date	Cl	K	Na
9/11/1998	32.6	17	112
11/30/1999	26.5	13	144
5/5/2000	29.4	15.6	185
8/11/2000	25.9	16	164
11/7/2000	27.2	12.8	161
2/8/2001	27.6	11.2	177
5/21/2001	28.1	11.1	186
8/7/2003	25.0 J	11	170
3/1/2008	37	10.4	226
4/1/2009	42	7.2	236

J- concentration below reportable limit but above method detection limit

Table 4. Synthetic Precipitation Leaching Procedure Test Results
Holcim (US) Inc., Portland Plant

Date	**11/14/2002**	**1999**
Material	Alkali Bypass Dust	Sludge/CKD Mix
Parameter		
Calcium	1680	251
Chloride	4600	77.2
Sodium	158	195
Sulfate	2680	3800
Conductivity (mS/cm)	29900	10600/12300
pH (std. units)	12.4	12.5/12.7

1999 sample from Resource Geoscience, Inc. 1999. Hydrogeologic Assessment Holnam, Inc. Portland, CO. Prepared for Holnam, Inc. January 27, 1999.

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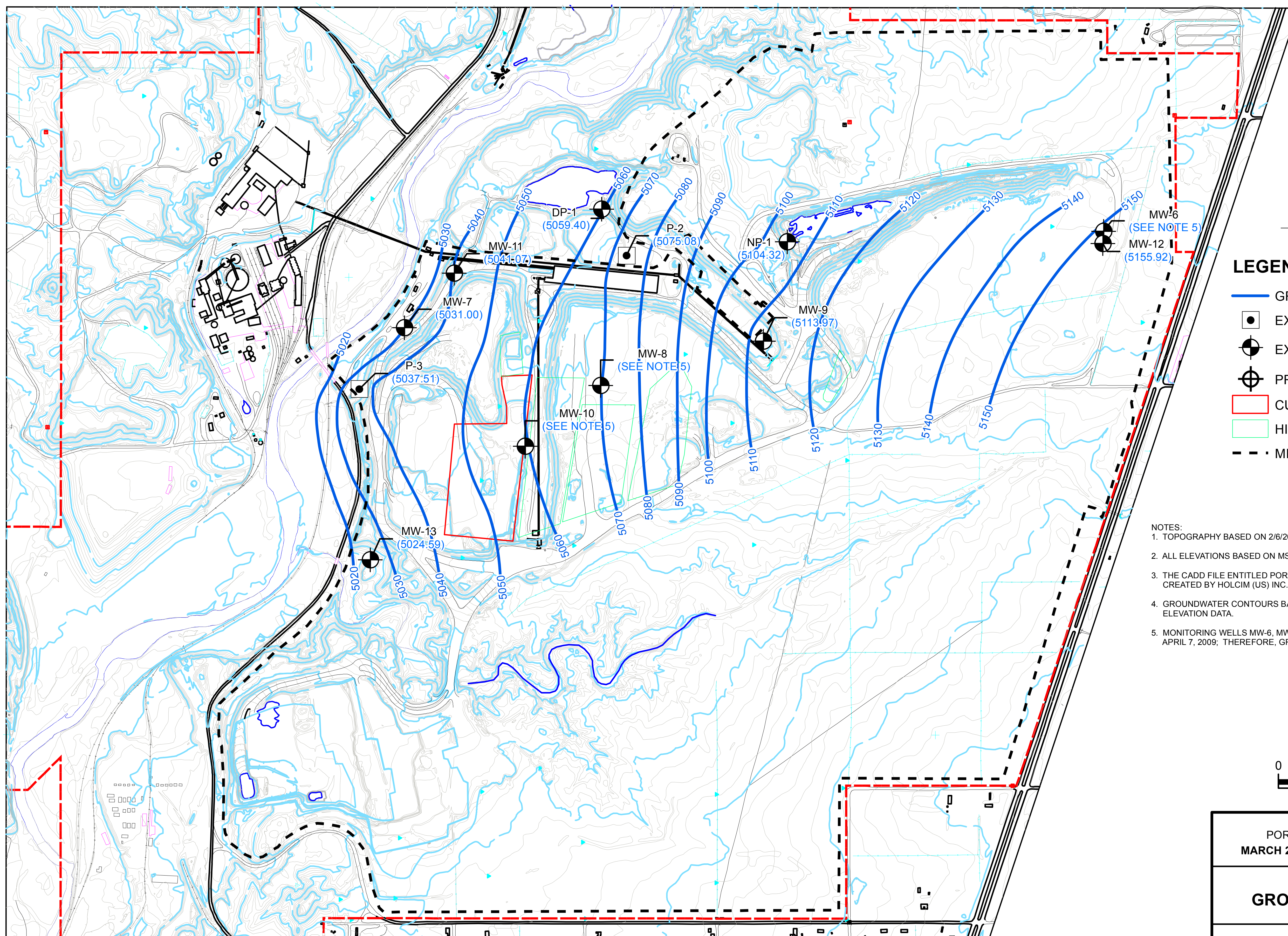
Figures



LEGEND:

- GROUNDWATER CONTOUR
- EXISTING PIEZOMETER
- EXISTING WELL
- PROPOSED WELL
- CURRENT BYPASS DUST DISPOSAL AREA
- HISTORIC CKD DISPOSAL AREA
- MINE PERMIT BOUNDARY

NOTES:

1. TOPOGRAPHY BASED ON 2/6/2004 AERIAL PHOTOGRAPH.
2. ALL ELEVATIONS BASED ON MSL.
3. THE CADD FILE ENTITLED PORTLAND 2005 UPDATED 2-21-05.DWG CREATED BY HOLCIM (US) INC. WAS UTILIZED AS THE BASE MAP.
4. GROUNDWATER CONTOURS BASED ON MARCH 2014 GROUNDWATER ELEVATION DATA.
5. MONITORING WELLS MW-6, MW-8, AND MW-10 WERE ABANDONED ON APRIL 7, 2009; THEREFORE, GROUNDWATER LEVELS ARE UNAVAILABLE.

0 1,000 2,000

GRAPHIC SCALE IN FEET

HOLCIM (US) INC.
PORTLAND PLANT, FLORENCE, COLORADO
MARCH 2014 GROUNDWATER MONITORING REPORT

GROUNDWATER CONTOUR MAP

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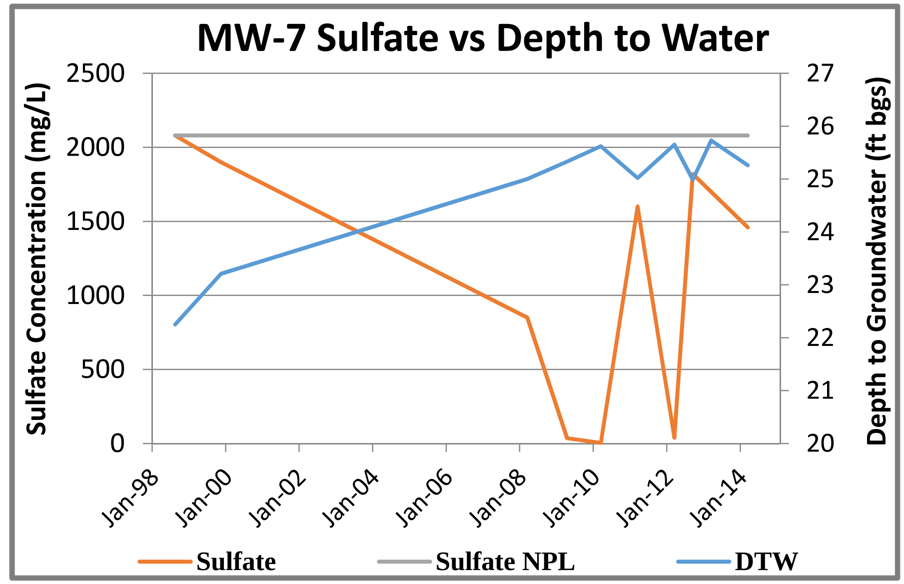
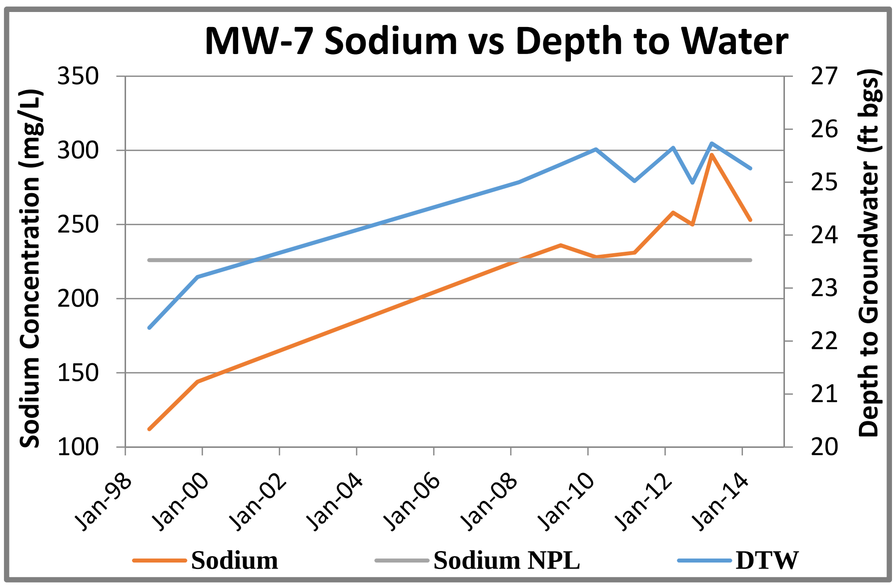
FIGURE
1

CITY:(DEN-TECH) DIV/GROUP:(ENV/GIS) DB: GMCKINNEY LD: PIC: PM: TM:
PROJECT: PATH: Z:\GISPROJECTS_ENV\Holcim\GIS\ArcMap_MXD\2014\GroundwaterElevations_2014.mxd

Figure 2. Sulfate, Sodium, and Potassium versus Depth to Groundwater

- Sodium concentrations increase with increasing depth to groundwater
- Sulfate and potassium concentrations are inversely related to depth to groundwater





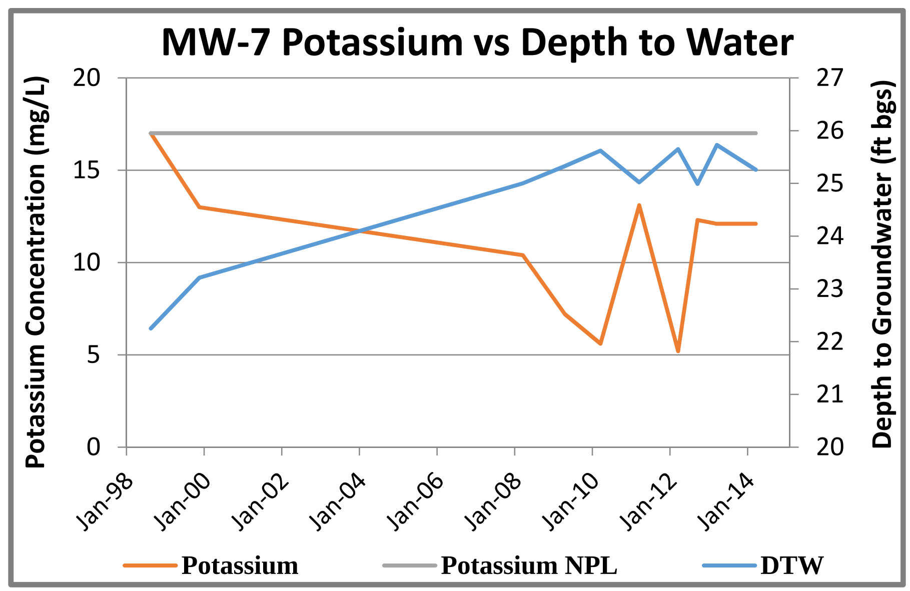


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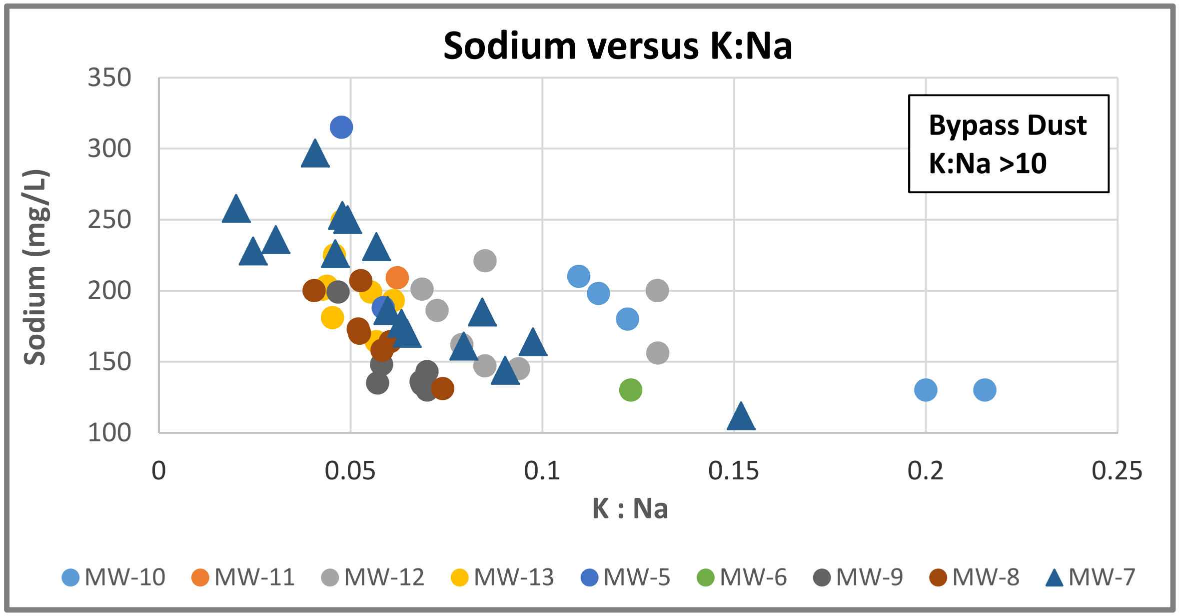
Figure 3. Sodium Concentrations versus Potassium to Sodium and Chloride to Sodium Ratios

- Bypass Dust K:Na values typically > 10
- Groundwater K:Na values <0.25
- MW-7 K:Na decreases with increasing Na concentration
- MW-7 K:Na values not consistent with Bypass Dust source of Na



- Bypass Dust Cl:Na values typically > 20
- Groundwater K:Na values <0.3
- MW-7 no relation between sodium concentration and Cl:Na
- MW-7 Cl:Na values not consistent with Bypass Dust source of Na

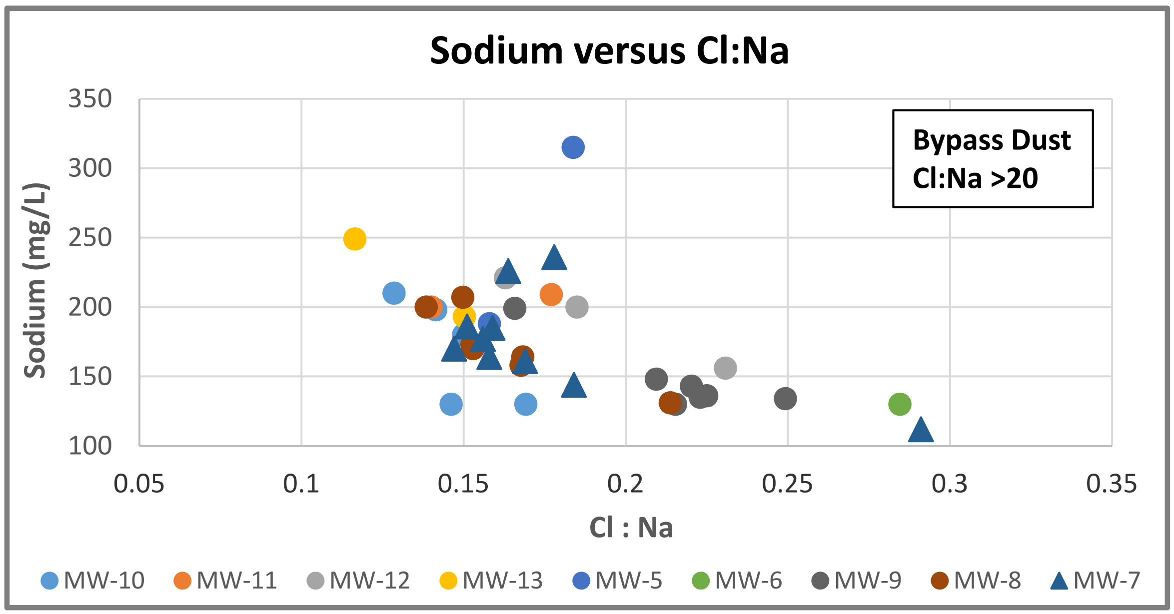


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Figure 4. Sodium and Sulfate Concentrations

- Most groundwater monitoring locations have no relation between sodium and sulfate concentrations
- MW-7 samples exhibit strong inverse relation between sodium and sulfate concentrations

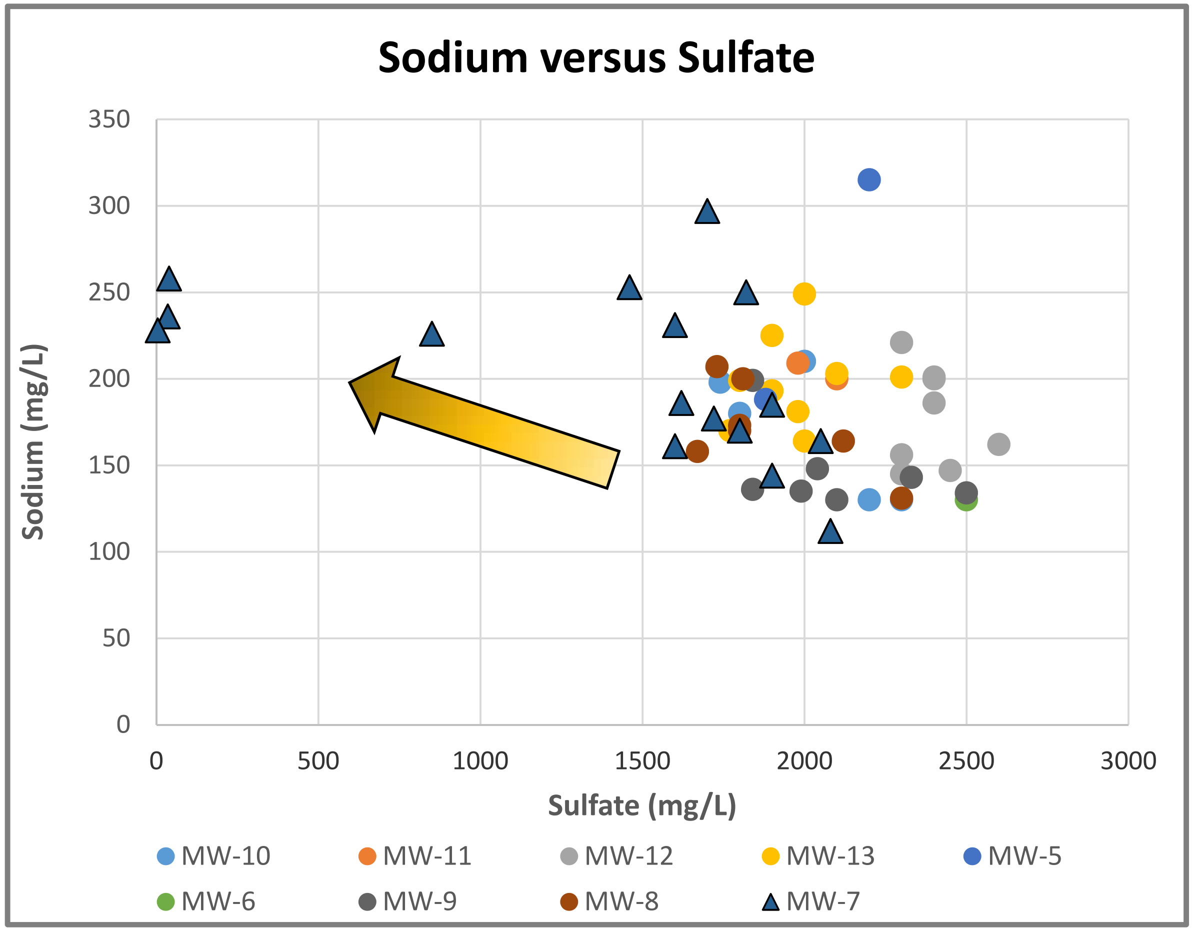

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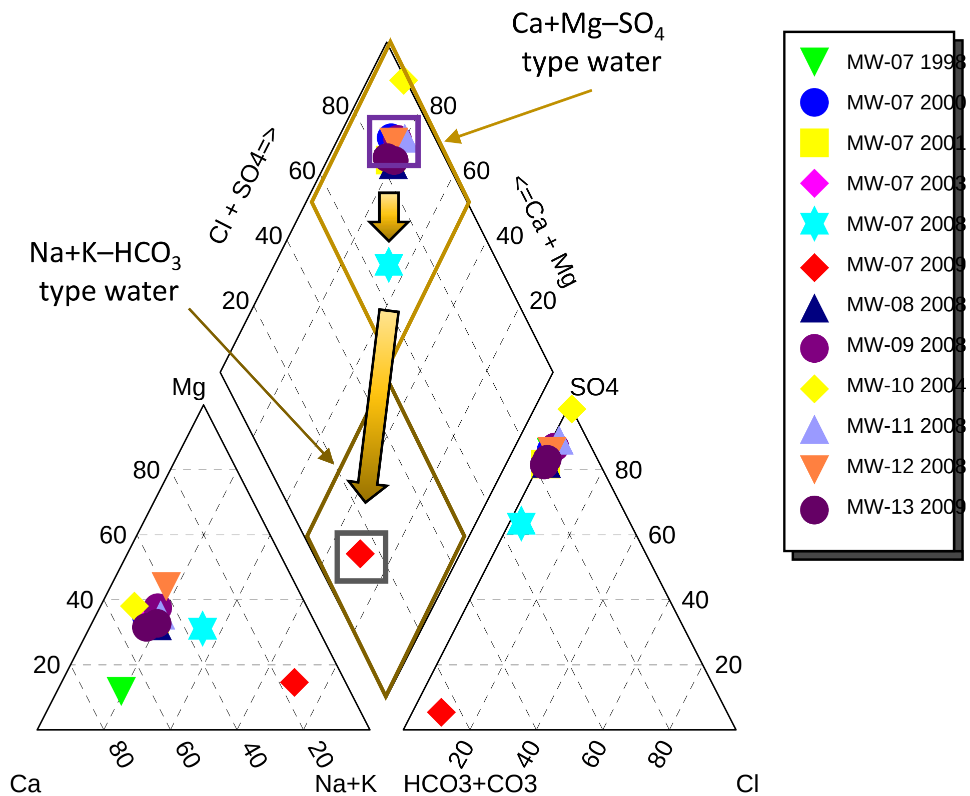
Figure 5. General Geochemistry

- Most samples plot within the Ca,Mg–SO_4 water type
- MW-7 shift to Na–HCO_3 type water with increasing depth to water
- Contributions of water to MW-7 from different geologic strata



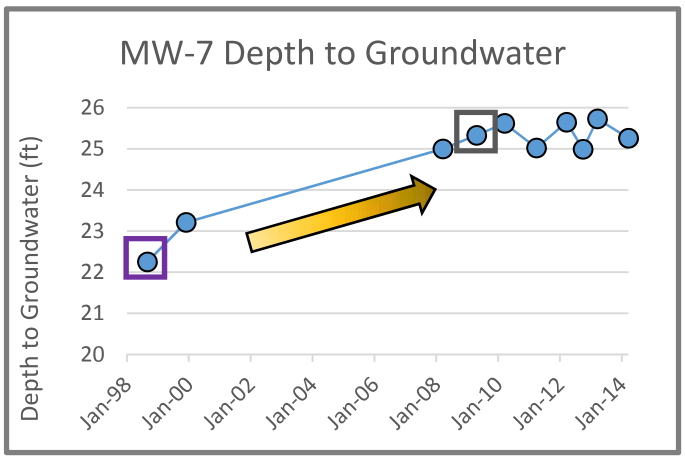


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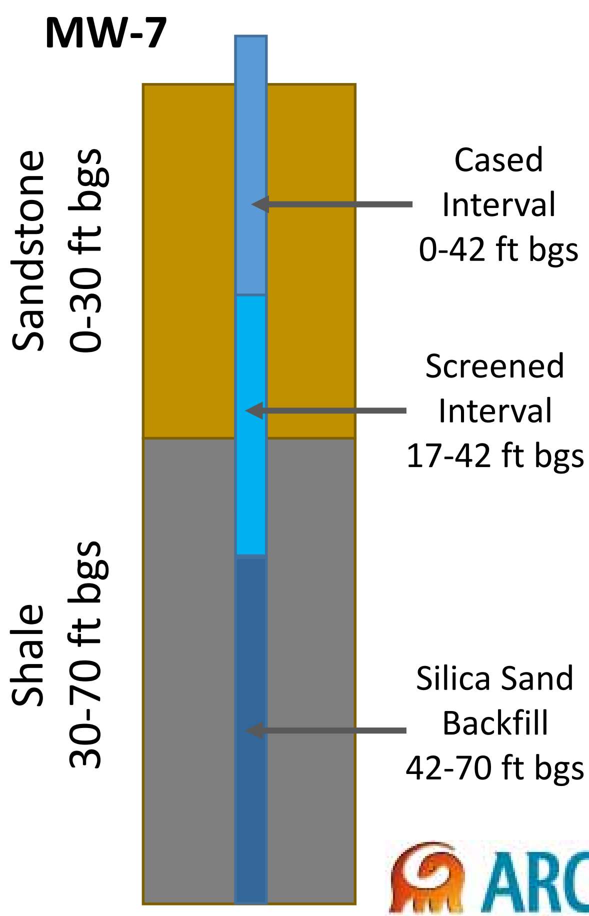
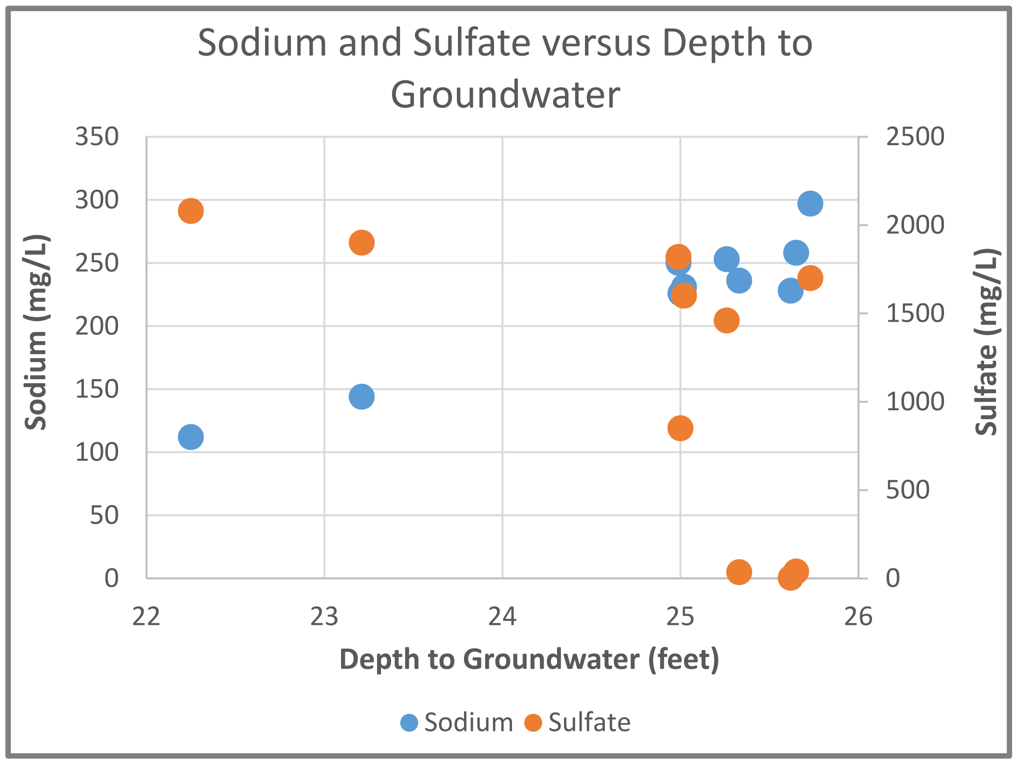
Figure 6. MW-7 Well Completion, Depth to Groundwater, and Water Quality

- MW-7 completed within sandstone and shale bedrock
- Greater contribution of water from shale with greater depth to groundwater
- Groundwater in shale may have different composition than in overlying sandstone





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Attachments

Boring Log for Monitoring Well MW-7

FORM NO. GWS-31 10/94

WELL CONSTRUCTION AND TEST REPORT

STATE OF COLORADO, OFFICE OF THE STATE ENGINEER

For Office Use only

1. WELL PERMIT NUMBER MH-35582 (MW-7)

2. OWNER NAME(S) Holnam, Inc.
Mailing Address 3500 Colorado Highway 120
City, St. Zip Florence, CO 81226
Phone (719) 784-6325

3. WELL LOCATION AS DRILLED: SE 1/4 SE 1/4, Sec. 17 Twp. 19 S, Range 68 W
DISTANCES FROM SEC. LINES:
800 ft. from south (north or south) Sec. line. and 750 ft. from east (east or west) Sec. line. OR
SUBDIVISION: LOT BLOCK FILING(UNIT)
STREET ADDRESS AT WELL LOCATION:

4. GROUND SURFACE ELEVATION 5053.4 ft. DRILLING METHOD air-rotary.
DATE COMPLETED 8-22-98. TOTAL DEPTH 70 ft. DEPTH COMPLETED 47 ft.

5. GEOLOGIC LOG:

Depth	Description of Material (Type, Size, Color, Water Location)
0-12'	lt. brn., fine-grained sandstone
12-25'	lt. gray, fine-grained cemented sandstone
25-30'	same as above
30-70	gray to blue-gray shale

REMARKS:

6. HOLE DIAM. (in.)

HOLE DIAM. (in.)	From (ft)	To (ft)
8	0	70

7. PLAIN CASING

OD (in)	Kind	Wall Size	From(ft)	To(ft)
4	PVC	sch 40	0	17
4	PVC	sch. 40	~~47~~	~~70~~
			(RSI) 42	47

PERF. CASING: Screen Slot Size: 0.010 in.

OD (in)	Kind	Wall Size	From(ft)	To(ft)
4	PVC	sch. 40	17	42

8. FILTER PACK:
Material silica sand
Size 10-20
Interval 15-70'

9. PACKER PLACEMENT:
Type
Depth

10. GROUTING RECORD:

Material	Amount	Density	Interval	Placement
silica sand	5'	loosed	10-15'	poured
grout	10'	std.	0-10'	"

11. DISINFECTION: Type None Amt. Used

12. WELL TEST DATA: ☐ Check box if Test Data is submitted on Form No. GWS 39 Supplemental Well Test.
TESTING METHOD NA
Static Level 19.85 ft. Date/Time measured 9-11-98, Production Rate gpm.
Pumping level ft. Date/Time measured, Test length (hrs.).
Remarks

13. I have read the statements made herein and know the contents thereof, and that they are true to my knowledge. [Pursuant to Section 24-4-104 (13)(a) C.R.S., the making of false statements herein constitutes perjury in the second degree and is punishable as a class 1 misdemeanor.]

CONTRACTOR Resource Geoscience, Inc. Phone (719) 635-0229 Lic. No.
Mailing Address 19 E. Willamette Ave., Colorado Springs, CO 80903

Name/Title (Please type or print)	Signature	Date