July 26, 2022

Mr. Patrick Lennberg Via Email
Environmental Protection Specialist
Department of Natural Resources
Division of Reclamation, Mining and Safety
Room 215
1313 Sherman Street
Denver, CO 80203

RE: Additional Information Request No. 3
Lyons Quarry, Permit No. M-1977-208
Y22Q1 Groundwater Monitoring Report, C-Pit

Dear Mr. Lennberg:

On July 8, 2022, CEMEX received a third letter from Division of Reclamation, Mining and Safety (DRMS) titled "AdditionalInfoNeeded_No3_M77208_1Q2022.pdf" related to our 2022 1st Quarter Groundwater Monitoring Report. Below are CEMEX's responses in *italic font* to items #1-5 in that letter:

1. The boring log and well construction diagram provided in the response is for CEM-005 installed in 2007 and was later abandoned due to a collapse of the well. Please provide the boring log and well construction diagram for CEM-005 that was installed in 2012.

   CEMEX Response:

   See attached CEM-005 Compliance Well Report prepared by Pacific Western Technologies on behalf of CEMEX. The report submittal to DRMS is dated April 27, 2012.

2. The Operator provided field data sheet for CEM-005 is difficult to understand. It appears there is approximately 3 feet of water contained in the 4-inch monitoring well and approximately 2.3 casing volumes or 4.5 gallons of water were removed prior to the well going dry. Please confirm this is the case. Additionally, what method is being used to purge the well?

   CEMEX Response:

   Yes, those calculations are correct and that was the case during the Q1 2022 sampling event.

   The well is purged using a stainless steel 2-inch bailer with a bottom ball valve and a mechanical winch.

3. What times were the initial and final water levels taken? Typical industry standard operating procedures for sampling low yielding wells is to return to the well within 24 hours of purging the well dry to collect another water level to determine if there is sufficient volume to collect a sample, was this done at CEM-005? If not why?

CEMEX Response:

Initial water level was 393.98' @ 10:00. After bailing, the water level was 398.03' @ 12:00. CEM-005 water level was checked at the end of the day (17:30) and there was not enough volume to collect sample (398.09'). This method of bailing and later checking the water levels has been conducted for several years with no significant recharge to be able to collect a sample, even days or weeks following bailing.

4. It is apparent to the Division that CEM-005 is not a dry well and does recover in time. Any water that enters the well after purging dry is considered representative of formation water. The Operator needs to collect a sample from CEM-005 beginning in the 3rd Quarter 2022.

CEMEX Response:

Based on historic sampling observations, CEM-005 does not produce enough water to collect representative samples of the groundwater conditions; the well takes significantly longer than 24 hours to recover to a level needed to collect a sample and can take days to weeks, even months to recover. During this time, the groundwater is exposed to the atmosphere and surrounding formation, meaning it is less likely to represent the groundwater conditions in the aquifer.

5. The purpose of passive or no purge sampling devices is to eliminate the need to purge a well at all. Please explain why the Operator contends such sampling methods would not provide accurate water quality data?

CEMEX Response:

Passive samplers are designed for well conditions where the groundwater flows across the sampler; this is not the case with CEM-005. Below are excerpts from USGS Techniques and Methods 1-D8 (Imbrigiotta 2020) describing why the conditions of CEM-005 are not suitable for passive samplers.

> *"Passive sampling of groundwater relies on the ambient exchange of groundwater in the formation with water in the screened or open interval of a well."*
>
> *"If the well is screened in a less permeable or a hydraulically tight formation, the concentrations of constituents measured using a passive sampler may represent the concentrations in the well over the past few days but not the concentrations present in the formation. The reason for this is the slow flushing times of wells in low-permeability formations, where mixing or chemical reactions may be taking place in the well, such as volatilization losses of VOCs in the water column of the well (McAlary and Barber, 1987), which are not occurring in the formation. Mixing or chemical reactions may cause a passive sampler in such a well to collect samples with concentrations different from those in the formation."*

The intent of CEM-005 is to sample groundwater within the Carlile Shale formation, though the groundwater in CEM-005 is likely coming from fractures within the Fort Hayes limestone formation above or from the contact between the limestone and shale. It is not clear from the lithological logs during well installation what interval the water is coming from exactly. The well is completed in the shale and there is likely no flow through the shale to accommodate passive sampling techniques.

If there are any questions regarding this Response Letter, please feel free to contact me at scotta.harcus@cemex.com or via phone at 303-823-2124.

Best Regards,

Scott A. Harcus
Lyons Plant
Environmental Manager

REFERENCES:

Imbrigiotta, T.E., and Harte, P.T., 2020, Passive sampling of groundwater wells for determination of water chemistry: U.S. Geological Survey Techniques and Methods, chap. 8, section D, book 1, 80 p., https://doi.org/10.3133/tm1d8.

ENCLOSURES:

- TR-11: CEM-005 Compliance Well Report, submitted to DRMS on 4/27/2012

April 27, 2012

Mr. Michael Cunningham
Environmental Protection Specialist
Division of Reclamation, Mining and Safety
1313 Sherman Street, Room 215
Denver, Colorado 80203

Via Certified Mail
Return Receipt Requested
7011 0470 0002 0359 4047

Re: CEMEX Lyons Mine Permit M-1977-208
Technical Revision No. 11, Compliance Well Report

Dear Mr. Cunningham:

Enclosed is the CEM-005 compliance well drilling report prepared by Pacific Western Technologies for CEMEX.

If there are any questions regarding the above information or the attachments, please contact me at (303) 823-2115.

Sincerely,

Denise Arthur, Ph.D.
Environmental Manager
5134 Ute Hwy PO Box 529
Lyon, CO 80540

Encls.\ Compliance Well Report

PACIFIC WESTERN TECHNOLOGIES, LTD. 11049 W. 44th Ave., Ste. 200, Wheat Ridge CO 80033 • 303.274.5400 • FAX 303.274.6160

April 24, 2012

Dr. Denise Arthur
Environmental Manager
CEMEX Lyons Cement Plant
5134 Ute Highway
Lyons, CO 80540

Subject: Geologic Well-Site Report for Replacement Compliance Well, CEM-005

The following is a summary of drilling and well construction activities for replacement Compliance Well, CEM-005 for the CEMEX Lyons Cement Plant. Mr. Richard McPeek, Pacific Western Technologies Field Geologist, compiled this report.

Figure 1: Photograph of well site prior to the start of drilling on 3/28/12, looking east.

Summary: The CEMEX cement plant is located east of Lyons Colorado. The facility consists of a quarry for the mining of high calcium carbonate shale and the Fort Hays Limestone, both at the base of the Niobrara Formation, for the production of cement. Previously drilled water monitoring well CEM-005 became damaged at a depth of approximately 50 feet below ground surface (BGS) when the Schedule 40 Polyvinal Carbonate (PVC) pipe broke. Well CEM-005 is intended to sample water within the Carlile Shale, which directly underlies the Fort Hays Limestone in an effort to monitor the water that may migrate from the cement kiln dust disposal site (C-Pit) to groundwater. In an effort to reduce the likelihood of repeated well damage, the new well was constructed with Schedule 80 PVC pipe. The new well was designed to mirror the previous CEM-005 as closely as possible.

Drilling Timeline: Drilling started on Wednesday March 28, 2012. Conditions on March 28, 2012 were partly cloudy and 70°F with 5-10 miles per hour (mph) winds from variable directions (predominantly southeast and south). On this date, the well was drilled from ground surface to a total depth of 400' BGS. Conditions on Thursday March 29, 2012 were partly cloudy and mid 70s °F with 5-10 mph winds from predominantly southeast and south. On this date, the well casing was set to total depth, the sand filter pack was placed, and the bentonite grout seal was placed to a depth of 204 feet BGS. The grout was not placed to surface on this date because the grout set up too quickly in the tremie pipe, rendering the tremie pipe unusable.

Conditions on Friday March 30, 2012 were partly cloudy and mid 70s °F with 5-10 mph winds from the southeast and south. On this date, the well grout was placed to surface, the conductor casing was pulled and the well was bailed and developed. On Monday April 2, 2012 drillers returned to the site, reported that the well was not producing water (only a few gallons were in the bottom of the well, as indicated by a water level indicator). Subsequently they backfilled the cuttings sump, placed a converter on the top of the casing to convert the top to accept a J-plug designed for Schedule 40 PVC (no J-plug is made for Schedule 80), placed the protective metal casing on the well, constructed a concrete well pad and demobilized from the site. PWT was not on site on Monday April 2, 2012. CEMEX personnel verified the work conducted on April 2, 2012..

Lithologic Descriptions: The well lithology was similar from the first encounter with bedrock at (approximately) 36 feet to the first contact with bedded limestone at (approximately) 273 feet BGS.

The Smoky Hill Shale is described as follows:
Black (Munsell Color 5Y 2.5/1), carbonaceous, moderately hard, platy to blocky, fair to good fissility, petroliferous smell, silty and overall increasing in calcareous content with depth.

Accessory minerals included:

Chert: Brown (Munsell Color 10 YR 5/3), moderately hard.
Limestone: White (Munsell Color Gley 1 8/), moderately hard, crystalline.
Pyrite: Crystalline, hard.

The Fort Hays Limestone is described as follows:

Limestone: Dark grayish brown (Munsell Color 10YR 4/2), moderately hard, platy, fossiliferous.

The underlying Carlile Shale is described as follows:
Sandy Shale: Very dark gray (Munsell Color Gley 1 3/), sandy, poor fissility, moderately hard, argillaceous, thin bedded, non calcareous, bordering on a very fine grained sandstone.

For additional detail, the hand written log can be found in Attachment A to this report.

Well Construction Details: After the successful drilling of CEM-005 to 400 feet BGS, the details for the well construction were discussed first with Ingram drilling and then with the CEMEX Environmental Manager. It was desired by CEMEX that the well mimic, as closely as possible, previous well CEM-005. The goal was to have the screen fall into the Fort Hays Limestone and the underlying Carlile Shale Formation, with the goal of monitoring the groundwater that may be influenced by C-Pit. The total depth for the original compliance well, CEM-005 was 401 feet BGS, with the screened interval spanning from 388 feet to 398 feet BGS. The boring log from the previous contractor indicated the casing could not be placed to total depth, and showed a cobble symbol from 398-401 feet BGS. It was presumed that the interval between 398 and 401 feet BGS was filled in with slough from the overlying lithology, that was caved in as the casing was run into the hole.

For the replacement well, the 10 foot section of Schedule 80, 10 slot PVC screen was capped with a 6-inch end cap. As a protective measure, 6 inches of filter pack sand was placed in the hole to provide a cushion layer on which the casing to sit. A PVC centralizer was added at the base of the screen, where the end cap was attached. The next centralizer was placed on the casing section 8 feet above the screen. Centralizers were placed every 20 feet up the hole at depths of 320 feet, 240 feet, 160 feet and 80 feet BGS. Upon placement of the casing to total depth, it was found that the casing could not be placed to total depth and that approximately 3 feet had caved in upon casing placement. This placed the new total depth at 397 feet BGS. With the 0.5 foot of cushion sand meant that the bottom of the hole was now at 396.5 feet. After subtracting 0.5 foot for the end cap, it meant that the screened interval would instead be from 386-396 feet BGS. The corrective action of removing the casing, rewashing the hole and re-placing the casing was considered. Ingram indicated that they could do this but cautioned that the more you wash a shale hole and disturb with casing placement, the more friable the walls could become, making the cave-in worse, ultimately resulting in a lost hole. CEMEX was informed of the situation and agreed that placing the screened interval 2 feet higher than intended was acceptable, as long as the Fort Hays Limestone was still screened into the Carlile Shale. According to the well log, it would still be cased as desired and Ingram was directed to start with placement of the sand filter pack.

The sand filter pack used 8/12 mesh sand. The previous well had sand placed from 378 to 388 feet BGS. Ingram indicated that, as a general practice, having only 10 feet above the screen was not advisable because this was not always enough to prevent grout intrusion into the screen. Ingram recommended a minimum of 20 feet of sand above a screen. Because the screened interval on the new well would be from 386-396 feet BGS, 20 feet of sand would place the filter pack into the Smoky Hill Shale. Because monitoring the Smoky Hill Shale is not the intent of

this well, 20 feet of filter pack sand was not possible on this well without deepening the hole. The first solid limestone bed encountered, as indicated by a distinct change in drilling characteristics (harder drilling), was from 373-374 feet BGS. It is for this reason that the filter pack could not be above 373 feet in the well. After consulting with CEMEX, an extra 3 feet of transition sand was added to give an extra degree of protection to the screen from grout intrusion. The fine transition sand was added from 373-376 feet BGS. The well was grouted and developed (see Drilling Timeline section), the surface casing set, and the protective pad constructed.

If you require any further clarification or information, please contact Richard McPeek at 274-5400, extension 23.

Sincerely,

PACIFIC WESTERN TECHNOLOGIES, LTD.

Dorthea Hoyt, PE, PMP
PWT Project Manager

Attachments:
Attachment A-Lithologic Borehole Log
Attachment B-Project Log Book Copies

ATTACHMENT A

LITHOLOGIC BOREHOLE LOG

BOREHOLE LOG

SITE NAME AND LOCATION: CEMEX Compliance well

Lyons, CO

NORTHING: No Survey Was Conducted

EASTING: ELEVATION:

DRILLING METHOD: Downhole hammer, air

BORING NO. CEM-005

SHEET 1 OF 7

SAMPLING METHOD: Mud logging from cuttings

DRILLING: START TIME 0910 DATE 3-28-12; FINSH TIME 1450 DATE 3-28-12

COMMENTS: Ingram was drilling contractor. Steve, Jonathon and Kevin Ingram was on site personnel.

DRILL RIG: GefCo Ster 30 KDH

ANGLE: NA BEARING: NA

SAMPLE HAMMER: Downhole air hammer

SURFACE CONDITIONS: Level pasture

DRILLING CONTRACTOR: Ingram

DRILLER NAME: Jonathon Ingram

DEPTH IN FEET (ELEVATION)	Blow/ 6 in on sampler	RECOVERY	SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
1–13				Conductor casing was set to a depth of 38' b.g.s. Few samples were collected in this section. Of the samples that were collected at 20', 27' and 30' The description was: Weathered clay, yellowish brown (10YR 5/4), moist, unconsolidated. The first sign of consolidated bedrock was at 36' b.g.s.		

LOGGED BY: Richard McPeek

CHECKED BY:

PROJECT NUMBER: Cemex

PROJECT NAME: Compliance well CEM-005

DEPTH IN FEET (ELEVATION)	Blow/ 6 in on sampler	RECOVERY	SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
						Note change in scale from page 1

14

18 22 26 30 34

Conductor casing set from surface - 38' B.G.S. Hole is making 8.5 gpm.

Unweathered bedrock contact @ ~36' B.G.S.

38 42 46 50 54 58 62 66 70 74 78 82 86 90

Sample@36' BGS:
Shale: Black, 5Y 2.5/1, carbonaceous, endurated, blocky, fair fissility, 1/4" thick bedding, mod. hard non calcareous

~~Sample@47' BGS~~ RM

Sample@54' BGS: Shale, Black (5Y2.5/1), Thin bedded, mod soft, non calcareous, good fissility petroliferous smell

Sample@59' BGS: As above, non calcareous

Sample@64' BGS: As above, non calcareous

Sample@69' BGS: As above, non-calcareous.

Sample@74' BGS As above, non-calcareous

Sample@79' BGS: As above, non calcareous

PROJECT NUMBER: Century Compliance well
PROJECT NAME: Compliance well CCM-005
LOGGED BY: Richard McPeek
CHECKED BY: ____
DRILLING CONTRACTOR: Ingram
DRILLER NAME: Jonathan Ingram

DEPTH IN FEET (ELEVATION)	Blow/ 6 in on sampler	RECOVERY	SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS

94 — Sample@94' BGS: Shale: Black (Gley1 2.5), Mod hard, silty, good fissility, non calcareous, Thin bedded, petroliferous smell.

98

102 — Sample@104' BGS: Shale as above, non calcareous

106

110 — Sample@109' BGS: As above, non calcareous

114 — Sample@114' BGS: As above, non calcareous

Switch to 10' sample intervals due to sample uniformity.

118

122 — Sample@124' BGS. As above, non calcareous

126

130 — Sample@134' BGS: As above, non calcareous

134

138

142 — Sample@~~134~~ 144' BGS. Very slightly calcareous

146

150

154 — Sample@154' BGS: as above, increasingly calcareous

158

162 — Sample@164' BGS: as above, ~~V~~ slightly calcareous.

166

PROJECT NUMBER: CEMEX Compliance well
PROJECT NAME: Compliance well CEM-005
LOGGED BY: Richard McPeek
CHECKED BY: _____
DRILLING CONTRACTOR: Engram
DRILLER NAME: Jonathan Engram

DEPTH IN FEET (ELEVATION)	Blow/ 6 in on sampler	RECOVERY	SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS

170

174

178

182

186

190

194

198

202

206

210

214

218

222

226

230

234

238

242

Sample@174' BGS: Shale, black (GLey1 2.5), hard, indurated, silty, good fissility, thin bedded, Petroliferous Smell, v. calcareous (increased calcareous from 164')

Sample@184' BGS Shale as above, v. calcareous Interbeds of Limestone, white (GLey 1 8), hard, indurated, crystalline.

Sample@194' BGS Shale as above, Limestone interbeds as above.

Sample@204' BGS: shale as above, Limestone interbeds as above, trace pyrite.

Sample@214' BGS: shale as above, trace LS as above, trace Pyrite, Trace interbedded chert, brown (10YR 5/3), hard, bedded

Sample@224' BGS: shale as above, v. calcareous, trace pyrite, LS and chert

Sample@234' BGS shale as above, moderately calcareous, trace chert, trace LS, trace platy Pyrite

PROJECT NUMBER: Cemex Compliance well
PROJECT NAME: Compliance well CEM-005
LOGGED BY: Richard McPeek
CHECKED BY:
DRILLING CONTRACTOR: Engeln
DRILLER NAME: Jonathan Engeln

DEPTH IN FEET (ELEVATION)	Blow/ 6 in on sampler	RECOVERY	SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS

246

250

254

258

262

266

270

274

278

282

286

290

294

298

302

306

310

314

318

Sample@244'BGS: Shale (Gley 1 2.5), Mod. hard, platy, good fissility, silty, thin bedded, moderately calcareous, petroliferous smell; interbedded chert, mod hard, brown (10YR 5/3); interbedded LS, white (Gley 1/8), Crystalline, trace pyrite.

Sample@254'b.g.s: Shale, as above, mod calcareous, trace chert and pyrite

Sample@264'B.G.S: shale, as above, mod. calcareous, trace pyrite

Sample@274'BGS: shale as above, mod calcareous, increasingly harder, pyrite.

Sample@284'BGS: shale as above, v. calcareous, trace chert & pyrite.

Sample@294'BGS: shale as above, v. calcareous, trace chert and pyrite.

Sample@304'BGS: shale as above, v. calcareous, trace pyrite

Sample@314'BGS Shale as above, v. calcareous, trace pyrite

PROJECT NUMBER: Sewer Compliance well

PROJECT NAME: Compliance well CEMBS

LOGGED BY: Richard McBeth

CHECKED BY: _____

DRILLING CONTRACTOR: Engram

DRILLER NAME: Jonathan Ingram

DEPTH IN FEET (ELEVATION)	Blows/6 in on sampler	RECOVERY	SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS

322

326

330

334

338

342

346

350

354

358

362

366

370

374

378

382

386

390

394

Sample@ 324'BGS: Shale (Gley 1/2.5), Mod. Calcareous, mod hard, silty, endurated, platy, good fissility, thin bedded, petroliferous smell. Interbedded chert, mod hard, brown (10YR 5/3). Trace pyrite

Sample@ 334'BGS: shale as above, v. calc. Trace pyrite and LS (Gley 1/8) hard, crystalline

Sample@ 344' BGS: Shale as above, v. calc. trace L.S.

Sample@ 354'BGS: shale as above w/ lesser carbonaceous content, interbedded shale, lighter - dk greenish grey (Gley 4/1) - This shale is hard, more silty and more carbonaceous than the dark shale.

Sample@ 360'BGS: shale as dark shale above, sl calcitic.

Sample@ 364'BGS: shale as dk gr. grey shale above, v. calcitic

Sample@ 369'BGS shale as above w/ beds of brown (7.5 YR 5/2), hard LS.

Sample@ 374'BGS: Shale, as above, mod. calc. Trace LS as above

Hard LS bed encountered from ~ 373-374

Sample@ 379' BGS: Predominantly Limestone, platy, mod hard, fossiliferous with lesser amounts of shale, as above

Sample@ 382'BGS Limestone as above Trace shale as above

Sample@ 388'BGS: Limestone as above Trace ~~limestone~~ Run shale. Increasing white calcium carbonate veins.

Sample@ 394: Sandy shale, poor fissility, mod hard, non calcareous, argillaceous thin bedded

DRILLING CONTRACTOR: Ingram

DRILLER NAME: Jonathon Ingram

LOGGED BY: Richard McPeek

CHECKED BY: _____

PROJECT NUMBER: Cemex Compliance well

PROJECT NAME: Compliance well CEMEX

DEPTH IN FEET (ELEVATION)	Blow/ 6 in on sampler	RECOVERY	SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER TYPE	REMARKS
				Page 7 of 7		
400				Sample@400 Mixed argillaceous shale-sandy, non-calcareous, poor fissility Mod hard argillaceous, with increasing amounts of very fine grained Sandstone - Mod hard, mod. well sorted, Subrounded, non-calcareous. Sandstone is increasing from above.		400' = T. D.

PROJECT NUMBER: Camps Compliance well
PROJECT NAME: Compliance Well CEM-005
LOGGED BY: Richard McClain
CHECKED BY: _____
DRILLING CONTRACTOR: Easyman
DRILLER NAME: Jonathon Engram

ATTACHMENT B

PROJECT LOGBOOK COPIES

Projects (continued)

3-28-12
Weeks
McPeek

11

Weather: Mostly clear, low 50's, winds 0-3 from E.

0800: Onsite @ CEMEX for health and safety briefing. Safety switches were shown to me.

0830: Onsite @ well for driller safety briefing with drillers. Drillers are Steve Ingram and Jonathon Ingram. The well will be drilled with air. 0-40' will be conductor casing. Samples will be collected by the drillers at this time due to safety concerns. A polymer will be added to the hole to help eliminate swelling of the shale.

0910: ~~Bgm~~ Drilling starts. Due to the Nature of the drilling, samples will not be collected regularly during the surface casing. CEMEX agreed this was acceptable. This is due to the cuttings collection system not being set up until regular drilling starts.

0920: Cuttings collection @ 20' still shows weathered clay. Not yet into the 1st shale unit.

0924: Bag sample collected @ 27' bgs 10YR 5/4 weathered shale, soft, unconsolidated, clayey

3-28-12
McPeek
Weds

2

0924 Bag sample @ 30' Bgs - As above

0932: Bag sample @ 36' BGS. Start encountering rock. Shale - 5Y 2.5/1, Black, endurated, blocky, fair fissility, 1/4" bedding mod. hard, mod bedding, non-calcareous.

0935: Washing hole. It is making water at the surface.

0943: 8.5gpm is being produced from top 38'

0951: Running surface casing
(Note Client asked for a topsoil measurement, it is 12 inches).

1000 Welding surface casing joints

1010: Running 8" bit into hole

Rig information:
Rig is a Gefco Star 30K DH with a Rig Tender RTT support truck with crane. Air drilling is being used with a downhole hammer implement. Bit diameter is 10" from surface - 38' and 8" to TD.
6 7/8 drill collar is used on the auger.

1020 Start down hole hammer.

1035: Hard drilling @ 47' & 51'
Sample @ 54', Shale Black 5Y 2.5/1
Thin bedded mod soft, non calc, good fissility
Petroliferous smell

3-28-12
McPeek
Weds

1041: 59' [illegible] S sample

1044: 64' [illegible] S sample

1046 69' BGS sample
No lith[illegible]

1050 79' BGS

1053 94' BGS
No lithology change, 94' is very calcareous

1055 : 99' BGS

1100 : 114' BGS

1113 144 - Start collecting @ 10' movements due to similiar lithology.

1120 : 164'
No lithologic changes other than chert in sample.

1122 : 174' - Softer drilling 172-174'
Increase in chert in this sample

1127 : 184' sample

1133 : 194' sample, calcareous
Pyrite in 194' sample

1137 : 204' sample

1141 : 214 sample Limestone in sample
VERY Petroliferous smell around rig.

1145 : 224' Pyrite in sample

1151 : 234'
Water for drilling is getting low. Will need more soon.

3-28-12
McPeak
Harren wells

Note: Overall drilling got harder around 160-170'. Also, hole is making ~4 gpm.

1220 244' sample

1225: 254' sample - pyrite, LS

1229: 264' sample - pyrite

1233 274' sample - pyrite

1239 284' sample

1244: 294' sample - abund pyrite,

1250 304' sample

1254 314 sample

1300: 324 sample

1304: 334 sample

1311: 344 sample,

1315: 354 sample Very calcareous

353 started a LS bed

LS is dk grayish brown 10YR 4/2, platy, mod hard, v. calcareous, mottled w/ grayish green GLey 1 5/2.

The drillers have run out of water. They are on a water run.

Note: for preliminary logging purposes, The lithology from 54-353' was primarily a Carbonaceous, Black 5Y 2.5/1 Thin bedded, mod soft, fair fissility, petroliferous Shale with varying calcareous content. accessory minerals have been listed in the log book.

3-28-12
McPeak
wells

1400: Visitor to site, Patrick Fischer discussed logging new wells as early as next week.

1416: 360' sample. Back to predominantly shale w/ lesser amount LS.

1419 364' Shale, less carbonaceous than before, trace LS.

1421 369' Predominantly shale w/ lesser amounts of LS

1424: 374' Predominantly shale, less carbonaceous 373 was drilling break indicating a LS bed.

1428: 379' drilling changed, may be into Fort Hays Sample was ~50% shale, 50% LS

1430 382' sample. LS

1432 388' Sample LS / Shale mix.

1436: 391' sample Limestone

1438: 394' sample Grey shale, silty, Moderate fissility, mod soft, 10YR 4/1 Dark gray, micaceous,

1444: 397-98 sample

Richard McPeak

6

3-28-12
McPeek
Weeks

Based upon drilling characteristics the top of Fort Hays was gradational. The top was guessed to be 382' with alternating shale/LS above that. 388 was back into a Limestone/shale mix.
Therefore, it is assumed that 382-388' is solid L.S. The well construction will, therefore, mimic the last well with screen from 388-398' b.g.s.
(1) Sandpack was from 378-398. Because the well was drilled to 400', it will be discussed with CEMEX if they want the sand pack @ 378. or instead 380-400.
(2) In addition, the bottom 2-3' will either need a section of casing glued on (not preferred by the driller or me) or the bottom of the hole back filled with sand. This is better, as you will not have casing sitting on rock and the sand will be uniform from T.D to 20' above the screen. CEMEX will be consulted on this.
Also, hole is making 3.5 gpm at this point. The hole started making water @ ~194' bgs.
CEMEX Discussion (1) The construction is OK as was done with CEM-05 (2) A cushion layer of sand is O.K. from 398-400'.

7

3-28-12
McPeek
Weeks

1600: Briefing w/ CEMEX is done; Plan is to re convene @ ~0830 tomorrow.

RM

3-28-12

Richard McPeek

8

3-29-12
McPeek
Thurs

0830: Onsite @ CEMEX to set and develop well.

Weather: P. cloudy, wind is variable but predominantly 0-5 mph from the E, ~50's °F.

Plan of the day: Determine static water level, Determine T.D., backfill with sand (~23' to set screen at desired interval), set casing & grout.

Well development is scheduled for tomorrow.

1000 Water level is 17' bgs.
TD = 399'

1023: 6" of sand has been added to the bottom of the hole. This allows for the screen to be set @ 398', allowing for a 6" screen on endcap. This will mimic the previous well (CEM-005), as requested by the client. Screen was 388-398' with a PVC centralizer on the 6" endcap and another on the top of the sandpack. Screen size was 10 slot. Materials used were Colorado 8 x 12 sand and EZ-Seal granular Sodium bentonite grout.

1100: Tremie pipe is being run into the hole. Tremie pipe is placed to ~~370~~ ~370 and will be withdrawn to 368 when ready to grout.

3-29-12
McPeek
Thurs

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398'	Top of Fort Hays			Well construction detail (not to scale).
388' top of screen				388' = top of screen
394'				Bottom of Fort Hays
				Centralizers were placed on 6" endcap and at the top of the sandpack
~~398'~~ 398'		6" endcap		~~398'~~ 398'
398.5				6" endcap from 398-398.5'
399				6" of silica sand
400				12" of slough from hole ~~400~~

3-29-12
McKeen
Thurs

1130 Start running PVC casing.
Centralizer was placed at the base of the screen and @ ~~390'~~ 380'

1200: Next centralizer was placed @ 320'

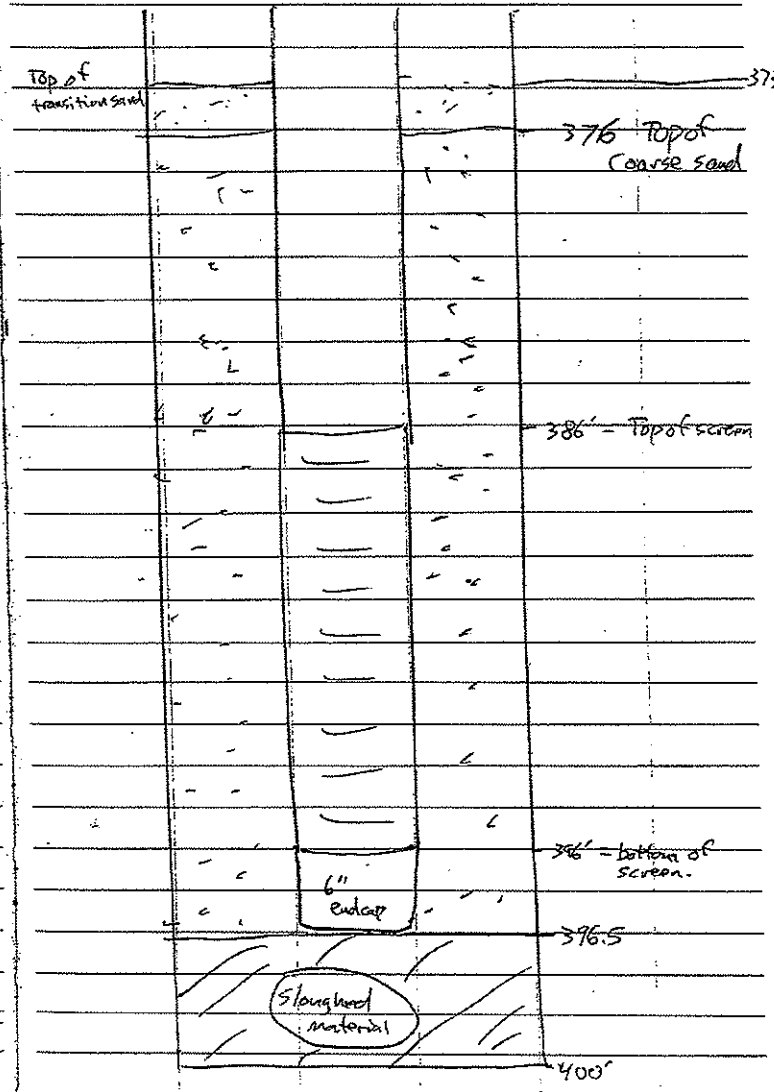
1220 Next centralizer was placed @ 140'

1245: Next centralizer was placed @ 160'

1300: Next centralizer was placed @ 80'

1317: Casing is run. It appears that the hole sloughed in 3.5'
This means that the screen will not be set exactly as the previous well (CEM-005) was, as requested by the client. A schematic drawing is shown on page 11. The screen section was 388-398' on CEM-005. This well, the screen section will be 386-396. CEM-005 contained 10' of sand above the screen, with top of sand being 378'. Ingram, the drilling contractor, advises against only 10' of sand above the screen to avoid grout intrusion into the screen. It is recommended that 10' of coarse (8×12) sand be placed from bottom (396.5) to 376. And 3 feet of fine transition sand be placed to 373'. The Start of Competent Limestone was 375-374', with solid LS @ 382'. It is believed that the extra transition sand would add protection and still be separated from the overlying Shale.

3-29-12
McKeen
Thurs



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~~RM~~ 7-29-12
Thurs
McDeer

1430: Contacted D. Arthur from CEMEX and informed her of the situation. She expressed concern about the screen being set in the Fort Hays. The following was discussed:

- The previous well was screened from 388-398 This one, by necessity will be screened 386-396
- The well will still be screened from on within solid Fort Hays Limestone, as well as the underlying shale, as desired.
- 2-3' of transition sand will be placed on top of the 8x12 sand to add extra protection against grout intrusion. The top of the transition sand will still be below the solid limestone bed found from 373-374.

·Based upon our discussion and CEMEX buy in, the well was set as illustrated on page 11.

1450: Transition sand is set to 373'
1500: Start grouting.
1615 Leave site. Well was grouted to ~260' b.g.s before tremie plugged.
Reconvene ~ 0930 tomorrow.

Richard McKeel

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3-30-12
~~RM~~ Fri
McDeer

Weather Mostly clear W = 0-5 from NW, ~60°F

0930: Reconvene with drillers. No rigid pvc tremie pipe was available. They must try again with the spooled line. They indicated this happened on the last well and that the pH of the formation water is unfavorable for bentonite grout. The grout is sets up faster than usual and flashes solid in the tremie line.

1125: Grout was tapped @ 204' B.G.S. Tremie pipe is in the hole to start grouting.

1154: Begin grouting

1218: Grout is @ surface

1245: Conductor casing is pulled.

1430: Bailing / development of well starts. Bailer removes ~~5~~ 5 gallons per trip.

1845: Well is bailed to the point where only ~.5 gallon is being produced. The water level will be checked Monday and the well pad set.

RM
7-30-12

Richard McKeel