



# REPORT

## REPORT ON 32C GROUNDWATER MONITORING PROGRAM

**Marathon Oil Company 596-32C Pond  
Facility #421284, COGCC REM #7734  
Garfield County, Colorado**

**Submitted To:** Marathon Oil Company  
743 Horizon Court, Suite 220  
Grand Junction, Colorado 81506

**Submitted By:** Golder Associates Inc.  
44 Union Boulevard, Suite 300  
Lakewood, Colorado 80228

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## 1.0 INTRODUCTION

This report has been prepared for Marathon Oil Company (MOC) by Golder Associates Inc. (Golder) to describe groundwater monitoring and groundwater technical evaluations conducted for the MOC 596-32C produced water facility located in Garfield County, Colorado. This facility is shown on Figures 1 and 2 and is referred to herein as the 32C pond or pit.

As a result of a monthly inspection, water within the pond's leak detection system was reported to MOC's local leadership on April 12, 2013. As previously reported to the Colorado Oil and Gas Conservation Commission (COGCC), MOC has proactively and systematically responded to the 32C pond liner damage. In support of this response, COGCC submittals have included a Spill/Release Report, an initial Site Investigation and Remediation Work Plan, and the May 31, 2013 *Work Plan, Investigation and Remediation of 596-32C Produced Water Pond, Facility #421284, COGCC REM #7732* (Golder, 2013a), referred to herein as the Work Plan. Other COGCC communications have included a series of 32C conference calls, a June 6, 2013 COGCC site visit, and supplemental technical submittals. MOC's response to the pond liner damage and the resulting soil contamination culminated in submittal of the August 29, 2013 *Report on 32C Soil Remediation Program, MOC 596-32C Pond* (Golder, 2013b), which is referred to herein as the Soil Remediation Report.

### 1.1 32C Project Overview

The overall objectives of the 32C project have been to investigate and/or remediate areas of soil and groundwater affected by the 32C pond liner damage in a timely and safe manner. Assessment of the 32C pond has been performed by MOC and Golder as an iterative process, with investigative results dictating subsequent steps in the investigation. These 32C assessments have included the following.

- 32C pond water quality and water level evaluations;
- Surface water sampling of Little Creek since April 24, 2013;
- Test pit excavations west of the 32C pond near the liner breach area;
- Geologic mapping of the 32C pond area as detailed in the Work Plan;
- Investigatory drilling and groundwater monitoring well installation;
- Aquifer testing and monitoring of groundwater quality and elevations; and
- 32C pond subgrade investigations and confirmation of soil remediation.

While this report focuses on the 32C groundwater assessment activities and results, removal of contaminated soil at 32C is described in the Soil Remediation Report. It is important to note that the 32C contaminant source area has been removed, and that there is no longer a source for ongoing groundwater contamination at the site (as of August 5, 2013), as detailed in the Soil Remediation Report.





## 1.2 32C Pond Description

The 32C pond was constructed 324 feet (ft) long, 120 ft wide, approximately 15 ft deep, and with a capacity of 42,272 barrels, as shown on the as-built drawings provided in the Work Plan. Construction features included primary and secondary 60-mil geomembrane liners, geonet layers between the liners and below the secondary liner, and layers of geotextile fabric above and below the lower geonet layer. This pond was excavated into sedimentary rock of the Uinta Formation, which is up to approximately 1,000 ft thick in the region and is comprised of silty sandstone, siltstone, and marlstone. Filling of the 32C pond with produced water started on September 13, 2010. 32C facility drawings and other pertinent background information are provided in the Work Plan so are not included herein.

Although the 32C pond is currently permitted under COGCC Form 15, MOC plans to permit the pond as a centralized exploration and production waste management facility (Form 28). This permitting is being performed in accordance with COGCC requirements, which include submittal of pertinent geologic data, hydrologic data, groundwater monitoring results, and surface water monitoring results. The Geology Report prepared by Olsson and provided in the Work Plan includes background information pertinent to the 32C investigation, such as site topography, soils, bedrock geology, geologic structure, surface water features, groundwater occurrence, aquifer properties, vicinity water wells, groundwater quality, and the potential for surface water and groundwater impacts.

## 1.3 Report Organization

Section 2 of this report describes the groundwater monitoring field program, 32C groundwater evaluations are presented in Section 3, a groundwater monitoring summary and corresponding conclusions are provided in Section 4, and references are listed in Section 5. Supporting project documentation is provided in the appendices.



## 2.0 GROUNDWATER MONITORING FIELD PROGRAM

The 32C groundwater data collection and monitoring program was performed based on the Golder Technical Procedures provided in the Work Plan. This field program was designed to be useful in the COGCC Form 28 permitting process. Therefore, groundwater monitoring wells were designed and installed so as to accomplish the objectives of both the 32C remediation program and the Form 28 permitting.

As shown on Figure 3, four groundwater monitoring wells were installed on or near the 32C pad to monitor the uppermost aquifer beneath the site. This number of wells exceeds COGCC requirements for Form 28 permitting. Having four instead of three monitoring locations allows more definitive determinations of groundwater flow directions and hydraulic gradients, and provides a more robust and conservative groundwater monitoring network at the site.

MW-1 was designed as a hydraulically up-gradient well and was installed in the southern portion of the pad, and MW-2, MW-3, and MW-4 were designed as down-gradient/cross-gradient wells to the north. MW-2 was designed to monitor potential groundwater flow to the northeast, MW-3 is located near the pond liner breach area, and MW-4 was designed to monitor potential groundwater flow to the northwest. Although it was initially expected that MW-3 would be drilled adjacent to the northwest corner of the 32C pond, this boring was relocated approximately 50 ft to the south because of an underground gas line present near the originally planned location.

### 2.1 Groundwater Monitoring Wells

Golder subcontracted D.A. Smith Drilling Company of Loma, Colorado (D.A. Smith) for the groundwater monitoring well drilling and installation program. As detailed in Appendix A-1, this field program included: 1) air coring of two boreholes (MW-1 and MW-3); 2) air rotary drilling of three boreholes (MW-2, MW-3A, and MW-4); geological logging of rock core (from MW-1 and MW-3) and drill cuttings (from MW-2 and MW-4); and 4) completing four boreholes as groundwater monitoring wells. These groundwater monitoring wells were installed to depths ranging from approximately 138 ft below ground surface (bgs) at MW-1 and 240 ft bgs at MW-4.

Monitoring well construction details, including coordinates, elevations, depths, construction date and screened intervals, are summarized in Table 1. Representative photos of the field program are provided in Appendix A-2, rock core photos are included in Appendix A-3, borehole logs are provided in Appendix A-4, well construction logs are presented in Appendix A-5, and the monitoring well survey drawing is included in Appendix A-6.

As discussed with the COGCC in connection with Work Plan preparation, these monitoring wells were installed with screen lengths of at least 30 ft; as detailed in Table 1, actual screen lengths range from 30



to 50 ft. The intent of this well design feature was to provide interception of sufficient fractures within the potentially low transmissivity bedrock units to allow reasonable collection of groundwater samples. However, despite this design feature, the initial MW-3 well did not produce groundwater, so this well was decommissioned and new well MW-3 (also referred to as MW-3A) was drilled and installed 9 ft south of the initial MW-3 borehole.

## 2.2 Groundwater Monitoring

### 2.2.1 Groundwater Levels

Groundwater levels in the monitoring wells were periodically measured using an electronic water level meter. Groundwater depths and groundwater elevations from monitoring performed from June 27 through August 15, 2013 are presented in Tables 2 and 3.

### 2.2.2 Groundwater Quality

Groundwater quality sampling was performed by InterTech for MOC based on Golder Technical Guidance TG-1.2-20, which is included in the Work Plan. Groundwater quality analyses included the following groundwater parameters specified in Table 910-1 of the COGCC E&P Waste Management Rules: 1) benzene, toluene, ethylbenzene, and total xylenes (BTEX); and 2) total dissolved solids (TDS), chloride, and sulfate. In addition, as detailed in Table 4, supplemental analytes were included by MOC to allow more comprehensive groundwater quality evaluations. Other aspects of the groundwater quality sampling program included the following.

- When feasible, disposable sampling equipment was used to collect samples. To avoid cross contamination, non-dedicated sampling equipment was thoroughly cleaned prior to initiation of sampling activities, and as otherwise necessary based on TG-1.2-20.
- Samples were placed in laboratory-supplied containers and stored in a cooler containing ice. Sample chain of custody procedures were based on TG-1.2-20.
- Analytical testing was performed by Accutest Mountain States, which maintains Colorado and national accreditation programs. EPA SW 846 analytical testing methods were used in accordance with COGCC requirements.

Groundwater monitoring wells at the site were initially sampled from July 9 through July 12, 2013. Groundwater quality laboratory reports for these samples are provided in Appendices C-1 through C-3. Based on the initial groundwater quality results, subsequent sampling and analyses focused on MW-2 and MW-4. Analytical laboratory reports for the other groundwater quality samples collected through August 16, 2013 are presented in Appendices C-4 through C-8.



## 2.3 Hydraulic Testing

### 2.3.1 *Rising Head Hydraulic Testing*

During the drilling program, Golder performed rising head tests in four of the borings, as detailed in Appendix B-1. After these borings were drilled to their termination depths, groundwater in the borings was evacuated using filtered, compressed air forced through the drill rods. After removing the drill rods, rising water levels in the borings were measured using an electronic water level meter. The objective of this rising head hydraulic testing was to allow initial estimation of hydraulic conductivity at the locations tested, with the understanding that these estimates would only be approximate because of various testing constraints, such as the lag time required for removal of drill rods. Test results are summarized in Section 3.1.3.1.

### 2.3.2 *Constant Rate Pumping Test*

On August 13, 2013, Golder provided MOC with guidance for the MW-4 constant rate pumping test, including pumping duration, data requirements, and data collection frequency. MOC started the constant rate pumping test on August 15, 2013 (Appendix B-2). The duration of the constant rate test was 24 hours at an average pumping rate of approximately 1.74 gallons per minute (gpm). Manual water level readings were taken and recorded by MOC at various intervals at the pumping well (MW-4) and observation wells (MW-1, MW-2 and MW-3A). Due to personnel and equipment limitations, water levels at the observation wells were monitored less frequently than at the pumping well. Upon completion of the constant rate test, MOC monitored recovery at MW-4 for a period of approximately 4 hours. Test results are summarized in in Section 3.1.3.2.



## 3.0 GROUNDWATER EVALUATIONS

### 3.1 Hydrogeologic Conditions

Hydrogeologic conditions at the site have been influenced by the 32C facility design and construction. The 32C pad was constructed by removing the native soil, excavating into bedrock in the eastern portion of the pad, and placing rocky fill in the western portion of the pad; the approximate 32C cut/fill line is shown on Figure 2. Because the 32C pond was excavated into bedrock, hydrogeologic conditions near the 32C pond are controlled by bedrock characteristics instead of soil characteristics, as described below.

#### 3.1.1 Site Geology

Geologic conditions at the site were investigated by test pitting, geologic mapping, and drilling. As described in the Work Plan, two test pits were excavated immediately west of the 32C pond perimeter fence near the liner breach area (Figure 2). Weathered silty sandstone of the Uinta Formation was encountered in both test pits to a depth of 4 ft bgs, and trackhoe refusal was encountered in well-indurated shale at depths of 4.5 to 5 ft bgs (Golder, 2013a).

Geologic mapping at the site (Golder, 2013a) resulted in the following observations.

- Bedrock exposed in the excavated slopes adjacent to the 32C pond primarily consisted of interbedded: 1) fine to medium grained silty sandstone, 2) marlstone, 3) siltstone, and 4) claystone. These sedimentary rocks are consistent with the Uinta Formation units present in the region.
- Bedrock weathering and induration varied across the mapped areas, but generally ranged from highly weathered (particularly near the exposed surfaces) to slightly weathered in the more cemented zones.
- Although bedding thicknesses were variable across the mapped areas, bedding tended to be relatively massive in the bedrock units present in the tall cut slope located east of the pond, as shown on Photo 3 in the Work Plan.
- Of the 13 locations where geologic structure was measured, bedrock bedding was relatively flat-laying at eight locations east of the pond, with beds dipping an average 10 degrees. At the five locations mapped northwest and southwest of the pond, the beds dipped an average of 30 degrees.

Additional details about the bedrock at the site were provided by drilling boreholes MW-1 through MW-4; excellent core recovery was obtained at MW-1 and MW-3. As detailed on the drilling logs presented in Appendix A-4, the Uinta Formation bedrock underlying the site was generally characterized as follows.

- Tan to gray sandstone with varying silt content and some interbedded siltstone;
- Variable weathering and iron oxide staining, typically becoming fresher with increasing depth;
- Variable grain size, but generally fine grained to medium grained;
- Variable bedding, typically ranging from thinly bedded to massive;



- Well cemented, with hardness generally ranging from R3 (medium strong rock) to R4 (strong rock);
- Portions of the bedrock at MW-1 and MW-3 contained closely spaced bedding plane fractures and other joints;
- Fractures at MW-1 and MW-3 were typically clean, but some oxide staining, iron staining, calcite coatings, and other infillings (e.g., clay, silt, rubble) were noted;
- Bedding plane fractures at MW-1 generally dipped at 5 to 20 degrees from horizontal;
- Other fractures at MW-1 generally dipped at 10 to 50 degrees;
- Bedding plane fractures at MW-3 generally dipped at 10 to 30 degrees;
- Other fractures at MW-3 generally dipped at 10 to 50 degrees;
- The primary (interstitial) porosity of the bedrock matrix appeared relatively low, with zones of enhanced transmissivity attributable to bedrock fracturing (secondary porosity).

### 3.1.2 Groundwater Occurrence

As detailed in Table 2, groundwater was present on August 15, 2013 at depths (below ground surface) ranging from approximately 104 ft at MW-1 to 194 ft at MW-4. The drilling program determined that groundwater was present under confined conditions within the Uinta bedrock units, with water levels in the wells rising above the top of the aquifer. For example, when MW-4 was drilled, careful monitoring of groundwater conditions below a depth of 160 ft bgs confirmed that over 40 ft of excess potentiometric head was present, with the stabilized water elevation 42.2 ft above where water was encountered during drilling.

Based on the groundwater elevation data summarized in Table 3, the degree of confinement generally increased to the northwest, from 14.3 ft of excess potentiometric head at MW-1 to 42.2 ft of excess potentiometric head at MW-4. The exception to this trend is MW-3, where an anomalously low excess potentiometric head of 9.0 ft was measured.

Well yield was also anomalously low at the MW-3 location. The initial MW-3 monitoring well borehole did not yield sufficient water so was decommissioned, and the replacement well yielded groundwater at a low rate compared to the other wells. As shown on the well development summary in Appendix A-5, development of MW-3A (the MW-3 replacement) required four days of bailing and pumping, with a total of only 65 gallons purged from this well because of well yield constraints.

Except for a spring located adjacent to the ephemeral Little Creek (approximately 4,000 ft north from the 32C pond), no seeps or springs have been observed between the 32C pad and Little Creek to the northwest and House Log Gulch to the southeast. As a precautionary measure, MOC has sampled Little Creek both upstream and downstream of 32C, and the noted spring adjacent to Little Creek was also sampled. This surface water sampling program is described in the Work Plan, along with sampling locations, and results are discussed in Section 3.2.1.



### 3.1.3 Hydraulic Conductivity

Golder used the software package AQTESOLV (Duffield, 2007) to analyze hydraulic test data collected at the site. The results of these analyses are discussed below.

#### 3.1.3.1 Rising Head Test Results

Rising head hydraulic test results from the open boreholes before monitoring wells were installed are detailed in Table B-1 and the test plots provided in Appendix B-1. Although these results are considered rough approximations because of the test limitations noted in Section 2.3.1, these tests resulted in hydraulic conductivity (K) estimates ranging from  $2 \times 10^{-5}$  centimeters per second (cm/sec) to  $12 \times 10^{-5}$  cm/sec; these K values correspond to approximately 0.06 to 0.3 ft/day.

#### 3.1.3.2 Pumping Test Results

Based on drawdown data provided by MOC for the constant rate pumping test of MW-4, the observed drawdowns at wells MW-1, MW-2, MW-3, and MW-4 were 0.05 ft, -0.04 ft, 0.16 ft, and 42.45 ft, respectively. Due to the minimal drawdown observed at wells MW-1 and MW-2, data from these wells were not analyzed. Although observation well MW-3 only had 0.16 ft of drawdown, the MW-3 data were analyzed to provide at least a rough estimate of aquifer storage.

These constant rate pumping test data were analyzed using the Cooper-Jacob solution for a confined aquifer, as detailed in Appendix B-2. The observed drawdown at pumping well MW-4, plotted on a semi-log scale, indicates a confined, fractured (dual porosity) system. Kruseman and de Ridder (1994) characterize this sort of system by fractures of high K and low aquifer storage (S), and matrix blocks of significantly lower K and higher S. In this type of system, three time periods can be observed, each with characteristic flow behavior:

1. Early time, when all of the flow comes from storage in the fractures;
2. Mid-time, when the matrix blocks contribute flow at an increased rate to the fractures, resulting in partially stabilized drawdown; and
3. Late time, when flow comes from storage from both the fractures and the matrix blocks.

Because of this behavior, a range of K values from the Cooper-Jacob analyses are reported for the pumping well MW-4 in Appendix B-2. Considering the dual-porosity behavior noted above, the Barker solution for a fractured (dual-porosity) aquifer with slab-shaped blocks was also evaluated. However, the Barker solution was not selected due to the poor fit to the observed data, while the Cooper-Jacob analyses provided a good fit to the observed data. Using the Cooper-Jacob solution, the low K value of  $1.4 \times 10^{-5}$  cm/sec (0.04 ft/day) is considered representative of the combined K of fractures and matrix blocks, and the high value  $6.5 \times 10^{-5}$  cm/sec (0.2 ft/day) is considered representative of the K of the fractures. This range of K values correlates reasonably well with the rising head test results.





Based on the limited data available from observation well MW-3, aquifer storage was estimated to be  $2.3 \times 10^{-3}$ , which is within the expected range for a confined aquifer. However, due to data limitations, this S value may not be representative of the system as a whole, and is only presented as a rough estimate.

### 3.1.4 Groundwater Flow

Based on water level monitoring of the 32C groundwater wells through August 15, 2013 (Figure 3 and Table 2), groundwater at the site generally flows to the northwest, which is consistent with regional flow in the context of site-vicinity topography. This groundwater flow characterization does not consider vertical components of flow, and assumes horizontal flow in a horizontal aquifer. The horizontal component of hydraulic gradient was approximately 0.17 ft/ft at the site based on the potentiometric data shown on Figure 3. This hydraulic gradient is reasonable based on the relatively steep topography in the site vicinity, which generally slopes at about 0.22 to 0.28 ft/ft.

Groundwater flow within the silty sandstone at the site is largely controlled by the effective (interconnected) porosity of these generally well-indurated bedrock units. In well-cemented sedimentary units, effective porosities of less than 0.01 have been reported (Freeze and Cherry, 1979). For the groundwater flow evaluations reported herein, an overall effective porosity of 0.01 is assumed.

Based on an overall effective porosity of 0.01, a horizontal hydraulic gradient component of 0.17 ft/ft, and a representative K value of 0.2 ft/day, the overall rate of groundwater flow through the saturated zone is estimated to be approximately 3.4 ft/day. This estimated transport rate does not apply to transport through the unsaturated zone present above the uppermost aquifer at the site.

As described in Section 3.1.2, hydrogeologic conditions at MW-3 were somewhat anomalous based on where groundwater was first encountered at this location and the ultimate stabilized groundwater elevation. Because the primary porosity of bedrock units at the site was relatively low, and zones of enhanced transmissivity were likely attributable to bedrock fracturing, it is understandable that not all wells at the site would intercept fractures that are in good hydraulic communication. Based on the assumption that the bedrock at MW-3 was hydraulically isolated relative to the other site wells, the anomalously low groundwater elevation at MW-3 was not used in the contouring shown on Figure 3. Inclusion of the MW-3 data in Figure 3 would result in some adjustment of the groundwater elevation contours near this well, although the overall groundwater flow direction would still be to the northwest.

To allow evaluation of potential seasonal variations in groundwater flow beneath the site, water levels in the site groundwater monitoring wells will be measured at least bimonthly for a minimum of one year. For the period of June 27, 2013 through August 15, 2013 (Table 2), groundwater elevations at the site generally varied by approximately 1 ft. These groundwater elevation variations have not resulted in significant changes in the groundwater flow regime near 32C.





### 3.1.5 Conceptual Hydrogeologic Model

As described above, the conceptual hydrogeologic model for the site is controlled by geologic structure, site-vicinity topography, and hydraulic properties of the subsurface units. Major components of this conceptual hydrogeologic model are summarized below.

- The site is primarily underlain by well-cemented sandstone with varying silt content and some interbedded siltstone. While the primary porosity of the generally well-cemented bedrock was noted to be relatively low, fractures within the bedrock provided zones of enhanced transmissivity.
- Groundwater was present under confined conditions within the Uinta bedrock units, and the degree of confinement generally increased to the northwest. Based on hydrogeologic conditions at MW-3, approximately 170 ft of unsaturated bedrock was present beneath the 32C pond.
- Because the groundwater flow regime at the site is not controlled by primary porosity, groundwater migration was not necessarily vertically downward through the unsaturated zone and horizontal in the saturated zone. Instead, groundwater migration through the fractured bedrock beneath the site is largely controlled by the fracture systems present.
- Groundwater flow at the site was also strongly influenced by topography, with flow from topographically high groundwater recharge areas towards the drainages in the region. The topographic high in the site vicinity is located south of 32C at an elevation of approximately 8,600 ft, and the 32C pad is at an elevation of 8,333 ft. Consistent with site-vicinity topography, groundwater flow at the site was from the south, resulting in MW-1 being a hydraulically upgradient well.
- As expected, groundwater flow from the site was northwestward towards the ephemeral Little Creek, which is about 350 ft lower than the 32C pad and is the nearest surface drainage channel. The northwesterly horizontal component of hydraulic gradient was approximately 0.17 ft/ft. This groundwater flow regime resulted in MW-4 being hydraulically downgradient from the 32C pond.

## 3.2 Groundwater Contamination

In support of groundwater contamination evaluations, the following contaminant source concentrations were considered.

- Monthly water quality analyses were performed for the 32C pond, as detailed in the Work Plan. April 2013 analyses of 32C pond produced water included the following key organic parameters: 119,000 micrograms per liter ( $\mu\text{g/L}$ ) gasoline range organic petroleum hydrocarbons (GRO), 25,000  $\mu\text{g/L}$  diesel range organic petroleum hydrocarbons (DRO), 17,500  $\mu\text{g/L}$  benzene, 33,800  $\mu\text{g/L}$  toluene, 922  $\mu\text{g/L}$  ethylbenzene, and 12,500  $\mu\text{g/L}$  total xylene.
- To allow water quality comparisons for samples from the 32C pond and leak detection system, MOC sampled the 32C pond leak detection system on April 12, 2013. As detailed in the Work Plan, organic constituent analyses for the leak detection system water included 11,100  $\mu\text{g/L}$  GRO, 11,000  $\mu\text{g/L}$  DRO, 840  $\mu\text{g/L}$  benzene, 1,890  $\mu\text{g/L}$  toluene, 83  $\mu\text{g/L}$  ethylbenzene, and 2,270  $\mu\text{g/L}$  total xylene. The leak detection system water had a TDS of 10,800 milligrams per liter (mg/L).



### 3.2.1 Contaminant Occurrence

Groundwater contamination at the site was evaluated based on the groundwater quality data summarized in Table 4. These data support the following observations.

- As expected, groundwater contamination was not present at MW-1, which is located up-gradient from the 32C pond and is the background water quality monitoring location.
- Maximum observed concentrations of benzene were present at MW-4, which is located northwest from the 32C pond, and contamination was also indicated at MW-2, which is located northeast from the 32C pond.
- Benzene concentrations exceeded the COGCC standard of 5 µg/L at MW-4 (34.0 to 94.7 µg/L) and at MW-2 (25.7 to 43.6 µg/L). Other organic compound concentrations measured in these wells did not exceed COGCC standards, but included up to 15.9 µg/L total xylene, 272 µg/L DRO, and 276 µg/L GRO.
- Although contaminant concentrations in the groundwater at MW-4 and MW-2 were highly diluted relative to the produced water in the 32C pond, and toluene was not present in the groundwater monitoring wells, the overall organic chemical signatures of the produced water and these groundwater samples were similar.
- Based on COGCC requirements, inorganic compound concentrations were compared to background concentrations x 1.25, as detailed in Table 5. Using MW-1 as the background well, it is noted that TDS, chloride, and sulfate concentrations exceeded background x 1.25 at MW-2 and MW-4, with the highest exceedances at MW-4.
- As detailed in Table 4, TDS concentrations at MW-4 decreased from 1,550 mg/L on July 10, 2013 to 1,200 mg/L as of August 16, 2013. In addition, slight concentration decreases were noted at MW-4 for each of the constituents analyzed in the August 16, 2013 sample collected following the pumping test. For MW-2, DRO concentrations increased for samples collected through August 1, 2013. No other overall constituent concentration trends are noted based on the data in Table 4.
- Groundwater sampling of MW-3 confirmed that groundwater contamination was not present at this location. This is consistent with the following related observations: 1) based on photo-ionization detector (PID) screening of the materials recovered when drilling MW-3 to a depth of 185 ft bgs, contaminated materials were not present at this location; and 2) as described in the Work Plan, contaminated materials were not present in the test pits excavated near the liner breach location (Figure 2).

These observations are also consistent with trends noted for the major ion groundwater data, which are presented on Piper diagrams (Figure 4). These data support the following observations.

- Groundwater at MW-1 and MW-3 was very similar, and was characterized as a calcium-bicarbonate water type.
- Groundwater at MW-4 was distinctly different than the MW-1/MW-3 groundwater, and was characterized as a sodium-chloride water type.
- Groundwater at MW-2 was intermediate between the groundwater at MW-1/MW-3 and MW-4, and was characterized as a sodium-bicarbonate water type.
- Based on inorganic constituent concentrations, the Piper diagrams illustrate a groundwater progression from uncontaminated (MW-1 and MW-3), to contaminated (MW-2), to most contaminated (MW-4).



Finally, it should be noted that Little Creek has not been impacted by groundwater contamination from 32C. Beginning in April 2013, Little Creek has been sampled by MOC nine times. To supplement the Little Creek analytical results provided in the Work Plan, analyses for samples collected from May 13 through August 2, 2013 are summarized in Table 6. These analytical results confirm that contamination has not been detected at Little Creek, as further discussed in Section 3.2.2.

### **3.2.2 Contaminant Transport**

The 32C pond is underlain by well-indurated bedrock units that mitigate contaminant transport by partial geologic containment of 32C produced water. This is supported by the observation that groundwater contamination was not present at MW-3, which is located near the liner breach area. In addition, the geologic structure at the site (with beds primarily dipping to the northeast and southeast) would tend to minimize contaminant transport to the west and northwest towards Little Creek.

As noted above, groundwater contamination was detected at MW-2, which is located hydraulically cross-gradient from the 32C pond based on the data shown on Figure 3. This groundwater contamination present northeast of the 32C pond may be due to some combination of the following factors: 1) the geologic structure at the site (with bedding plane fractures primarily dipping to the northeast and southeast, thereby providing a preferential groundwater contamination pathway towards MW-2); 2) other bedrock fractures that provide a preferential groundwater contamination pathway towards MW-2; 3) transient groundwater mounding related to the produced water leak from the 32C pond; 4) possible seasonal fluctuations in site-vicinity groundwater flow directions; and/or 5) a source of contamination other than the 32C facility. It is noted that no other MOC facilities are located in the vicinity of well MW-2.

As described in Appendix D, contaminant transport evaluations were performed using the American Petroleum Institute (API) AMIGO online decision support tool (API, 2005). These evaluations were based on: 1) site-vicinity hydraulic gradient of 0.17; 2) fractured bedrock hydraulic conductivity of 0.2 ft/day; 3) fractured bedrock porosity of 0.01; and 4) the other assumptions listed in Appendix D. The first two assumptions are based on field data and the third assumption is based on model calibration to the observed travel time to MW-4. Although groundwater transport at the site is likely controlled by the collective hydraulic characteristics of the individual fractures present, these fractures have not been sufficiently characterized to allow detailed analyses. However, based on the limited hydrogeologic characterization data available for the site, it is estimated that transport of contaminated groundwater from the 32C pond to Little Creek (approximately 1,400 ft northwest) would require approximately 2.8 years for non-sorbing, non-degrading contaminants such as chloride and TDS. Other contaminants, such as BTEX, would have longer travel times and would likely be degraded compared to TDS, which was used for the modeling analysis noted in Appendix D.



### 3.2.3 *Potential Receptors and Exposure Pathways*

The ephemeral drainages of Little Creek and House Log Gulch may be considered potential receptors and exposure pathways for 32C contamination. However, no seeps or springs have been observed between the 32C pad and these drainages, except for one spring located adjacent to Little Creek (approximately 4,000 ft north from the 32C pond). Sampling of Little Creek both upstream and downstream of 32C and the noted spring adjacent to Little Creek has confirmed that these locations have not been impacted by groundwater contamination from 32C.

A search of the Colorado Division of Water Resources (DWR) database confirmed that the only permitted wells within 3 miles of the site are as follows.

- Three shallow groundwater monitoring wells (24-34 ft deep) are located approximately 1.5 miles north of the site.
- Four remediation wells of unreported depth are located approximately 1.2 miles east of the site.

None of these wells would provide an exposure pathway for potential human receptors of 32C groundwater contamination. In addition, the DWR database confirmed that the following types of wells are not present within 3 miles of the site: domestic, municipal, commercial, irrigation, recreation, stock, wildlife, or other wells that would provide an exposure pathway.

Therefore, it is concluded that potential human receptors are not present within 3 miles of the site, and that there is minimal potential for human exposure to groundwater contamination from the 32C pond. In addition, the 32C contaminant source area has been removed, and there is no longer a source for ongoing groundwater contamination at the site.



## 4.0 SUMMARY AND CONCLUSIONS

A groundwater data collection and monitoring program was performed at the site in response to 32C pond liner damage. The groundwater monitoring network installed for the 32C facility exceeds COGCC requirements. Investigations performed to date support the following observations and conclusions.

1. The site is primarily underlain by well-cemented sandstone with varying silt content and some interbedded siltstone. While the primary porosity of the generally well-cemented Uinta Formation bedrock was noted to be relatively low, fractures within the bedrock provided zones of enhanced transmissivity.
2. Groundwater was present under confined conditions within the Uinta bedrock units. Based on hydrogeologic conditions at MW-3, approximately 170 ft of unsaturated bedrock was present beneath the 32C pond. Groundwater migration through the fractured bedrock beneath the site was largely controlled by the fracture systems present.
3. Groundwater flow at the site was also strongly influenced by topography, with flow from topographically high groundwater recharge areas towards the drainages in the region. Groundwater flow from the site was primarily northwestward to MW-4 and towards the ephemeral Little Creek.
4. As expected, groundwater contamination was not present at MW-1, which is located up-gradient from the 32C pond. In addition, groundwater sampling of MW-3 confirmed that groundwater contamination was not present at this location.
5. Maximum observed contaminant concentrations of benzene and GRO petroleum hydrocarbons were present at MW-4, which is located northwest from the 32C pond. Maximum observed contaminant concentrations of DRO petroleum hydrocarbons were present at MW-2, which is located northeast from the 32C pond. This groundwater contamination at MW-2 indicates that there has been an eastward component of groundwater flow or a second source of groundwater contamination located east of 32C; no other MOC facilities are located in the vicinity of well MW-2.
6. Benzene concentrations exceeded the COGCC standard of 5 µg/L at MW-4 and at MW-2. Although other organic compound concentrations measured in these wells did not exceed COGCC standards, TDS, chloride, and sulfate concentrations exceeded background x 1.25 at MW-2 and MW-4, with the highest exceedances at MW-4.
7. Contaminant concentrations in the groundwater at MW-4 and MW-2 were highly diluted relative to the produced water in the 32C pond, and toluene was not present in the 32C groundwater monitoring wells, but the overall organic chemical signatures of the produced water and these groundwater samples were similar.
8. These groundwater quality results are consistent with the major ion groundwater analyses, which illustrate a groundwater progression from uncontaminated (MW-1 and MW-3), to contaminated (MW-2), to most contaminated (MW-4) based on inorganic constituent concentrations,
9. Contaminated surface water has not been detected at Little Creek or in a spring located adjacent to Little Creek. Based on the limited hydrogeologic characterization data available for the site, it is estimated that transport of contaminated groundwater from the 32C pond to Little Creek would require approximately 2.8 years for species such as TDS or chloride, while contaminants such as BTEX would require longer travel times.
10. Potential human receptors are not present within 3 miles of the site, and there is minimal potential for human exposure to groundwater contamination from the 32C pond. It is also important to note that the 32C contaminant source area has been removed, and there is no longer a source for ongoing groundwater contamination at the site.



## 5.0 REFERENCES

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## TABLES

**Table 1. Groundwater Monitoring Well Installation Summary**

Monitoring Well ID Number	Northing (ft)	Easting (ft)	Ground Surface Elevation (ft)	Casing Stick-Up Height (ft)	Top of PVC Casing Elevation (ft)	Borehole Depth (ft)	Top of Screen		Bottom of Screen		Screen Length (ft)	Well Diameter (in)	Date Constructed
							Depth Below Ground (ft)	Screen Elevation (ft)	Depth Below Ground (ft)	Screen Elevation (ft)			
MW-1	1642668.8	2240781.2	8333.2	2.98	8336.18	170.0	97.7	8,235.5	137.7	8,195.5	40	2	6/21/2013
MW-2	1643125.9	2240955.8	8364.1	2.70	8366.80	197.0	161.9	8,202.2	191.9	8,172.2	30	2	6/24/2013
MW-3 (initial)	1643059.0	2240698.5	8333.7	NA	NA	185.0	131.0	8,202.7	181.0	8,152.7	50	2	6/19/2013
MW-3 (new)	1643050.4	2240699.0	8333.7	-0.33	8333.37	215.0	181.4	8,152.3	211.4	8,122.3	30	2	6/27/2013
MW-4	1643111.7	2240484.7	8333.5	2.97	8336.47	240.0	189.2	8,144.3	239.2	8,094.3	50	2	6/25/2013

The initial MW-3 well was decommissioned, and new well MW-3 (also called MW-3A) was installed approximately 9 feet south.

Northing and Easting values are based on Colorado Central Zone NAD83

Elevations are based on NAVD88



**Table 2. Groundwater Level Summary**

Date	MW-1		MW-2		MW-3 (new)		MW-4	
	Depth to Water (ft)	Water Level Elevation (ft)	Depth to Water (ft)	Water Level Elevation (ft)	Depth to Water (ft)	Water Level Elevation (ft)	Depth to Water (ft)	Water Level Elevation (ft)
6/27/2013	102.74	8233.44	171.37	8195.43	186.93	8146.44	193.90	8142.57
7/1/2013					185.87	8147.50		
7/8/2013	102.84	8233.34			186.80	8146.57		
7/10/2013							194.09	8142.38
7/11/2013			171.30	8195.50				
7/18/2013							194.41	8142.06
7/19/2013			171.31	8195.49				
7/23/2013	102.95	8233.23	171.33	8195.47	185.93	8147.44	194.90	8141.57
7/25/2013			171.32	8195.48			194.38	8142.09
8/9/2013							194.35	8142.12
8/15/2013	103.85	8232.33	171.23	8195.57	186.65	8146.72	194.30	8142.17

The initial MW-3 well was decommissioned, and new well MW-3 (also called MW-3A) was installed approximately 9 feet south. Water level elevations are based on NAVD88. Depths shown are below ground surface.

**Table 3. Summary of Groundwater Occurrence**

<b>Monitoring Well ID Number</b>	<b>Ground Surface Elevation (ft)</b>	<b>Depth Where Groundwater Was First Encountered (ft)</b>	<b>Elev. Where Groundwater Was First Encountered (ft)</b>	<b>Stabilized Groundwater Elevation (ft)</b>	<b>Excess Potentiometric Head (ft)</b>
MW-1	8333.2	115.2	8218.0	8232.33	14.3
MW-2	8364.1	191.0	8173.1	8195.57	22.5
MW-3 (new)	8333.7	196.0	8137.7	8146.72	9.0
MW-4	8333.5	233.5	8100.0	8142.17	42.2

The initial MW-3 well was decommissioned, and new well MW-3 (also called MW-3A) was installed approximately 9 feet south.

Stabilized groundwater elevations are based on August 15, 2013 measurements.

Elevations are based on NAVD88



**Table 5. Comparison of Inorganic Groundwater Analytical Results**

Monitoring Well ID Number	Unit	TDS	Chloride	Sulfate
MW-1	mg/L	426	17.1	47.1
MW-2	mg/L	596	95.1	68.3
MW-3	mg/L	450	3.7	50.7
MW-4	mg/L	1550	462	118
Background x 1.25	mg/L	533	21.4	58.9

Highlighted values exceed background x 1.25  
mg/L = milligrams per liter

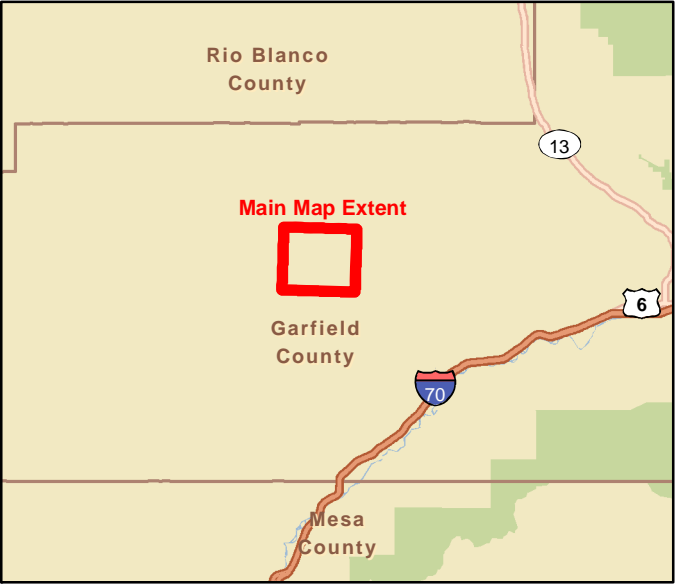
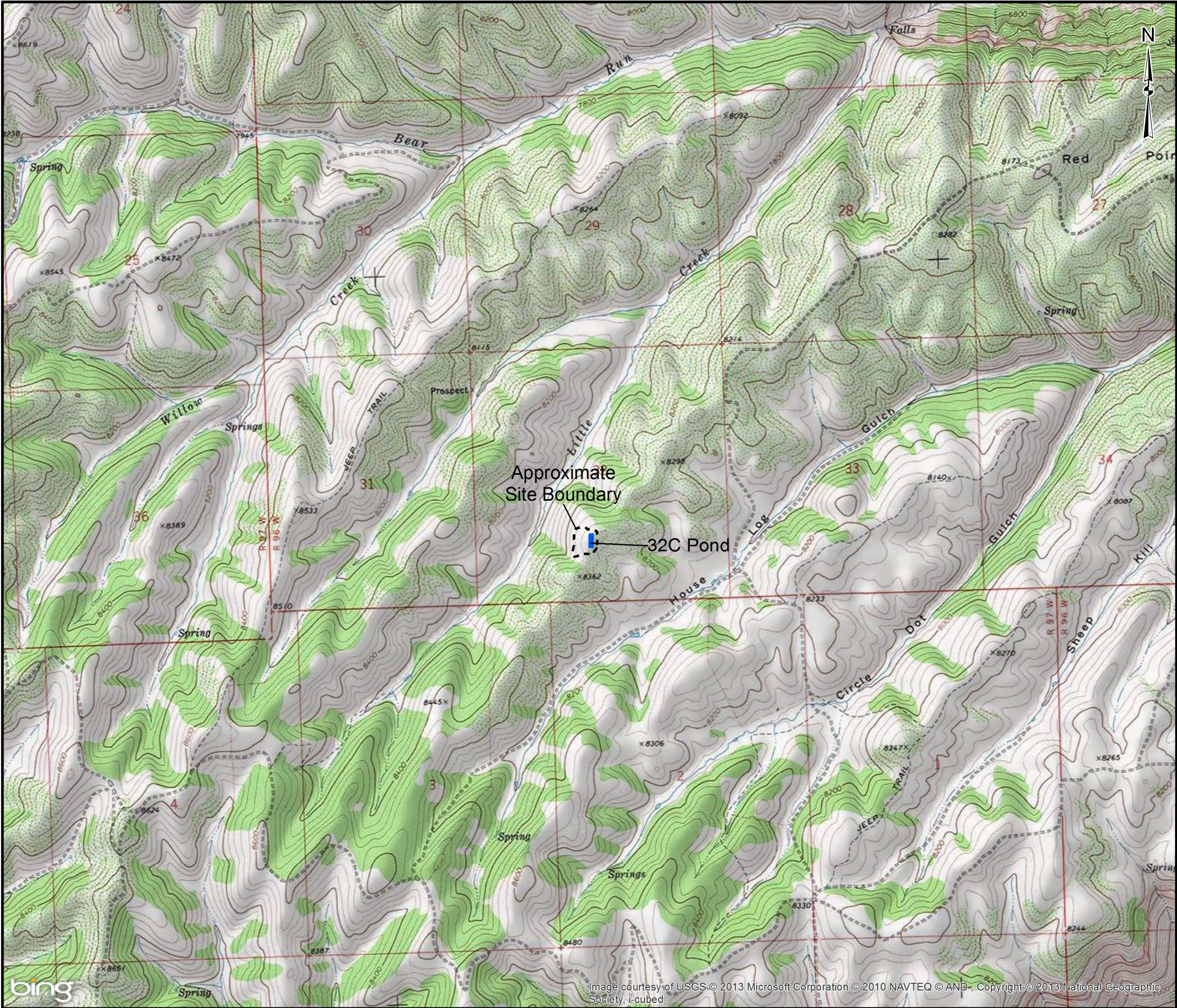
Table 6. Summary of Little Creek Analytical Results

Detection		Exceedance																
Client Sample ID:		CO GW - Oil and Gas Conservation Commission Levels (2 CCR 404-1.9/30/07)1	SW_LC_UPSTREAM1	SW_LC_UPSTREAM2	SW_LC_DOWNSTREAM1	SW_LC_DOWNSTREAM_S PRING	SW_LC_UPSTREAM1	SW_LC_DOWNSTREAM1	SW_LC_UPSTREAM1	SW_LC_DOWNSTREAM1	SW_LC_UPSTREAM1	SW_LC_DOWNSTREAM1	MOC_UP STREAM_1	MOC_DOWNSTREAM_2	SW_LC_UPSTREAM1	SW_LC_DOWNSTREAM1	SW_LC_UPSTREAM_1	SW_LC_DOWNSTREAM_2
Lab Sample ID:			D46200-2	D46200-1	D46200-3	D46200-4	D46703-1	D46703-2	D46850-1	D46850-2	D47490-1	D47490-2	D47718-1	D47718-2	D47903-1	D47903-2	D48862-1	D48862-2
Date Sampled:			5/13/2013	5/13/2013	5/13/2013	5/13/2013	5/29/2013	5/29/2013	6/4/2013	6/4/2013	6/21/2013	6/21/2013	6/28/2013	6/28/2013	7/5/2013	7/5/2013	8/2/2013	8/2/2013
Matrix:			Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water
GC/MS Volatiles (SW846 8260B)																		
Benzene	mg/l	0.005	ND (0.00027)	ND (0.00027)	ND (0.00027)	ND (0.00027)	ND (0.00027)	ND (0.00027)	ND (0.00027)	ND (0.00027)	ND (0.00027)	ND (0.00027)	ND (0.00027)	ND (0.00027)	ND (0.00027)	ND (0.00027)	ND (0.00025)	ND (0.00025)
Toluene	mg/l	1	ND (0.0010)	ND (0.0010)	ND (0.0010)	ND (0.0010)	ND (0.0010)	ND (0.0010)	ND (0.0010)	ND (0.0010)	ND (0.0010)	ND (0.0010)	ND (0.0010)	ND (0.0010)	ND (0.0010)	ND (0.0010)	ND (0.0010)	ND (0.0010)
Ethylbenzene	mg/l	0.7	ND (0.00033)	ND (0.00033)	ND (0.00033)	ND (0.00033)	ND (0.00033)	ND (0.00033)	ND (0.00033)	ND (0.00033)	ND (0.00033)	ND (0.00033)	ND (0.00033)	ND (0.00033)	ND (0.00033)	ND (0.00033)	ND (0.00025)	ND (0.00025)
Xylene (total)	mg/l	10	ND (0.0020)	ND (0.0020)	ND (0.0020)	ND (0.0020)	ND (0.0020)	ND (0.0020)	ND (0.0020)	ND (0.0020)	ND (0.0020)	ND (0.0020)	ND (0.0020)	ND (0.0020)	ND (0.0020)	ND (0.0020)	ND (0.0020)	ND (0.0020)
GC Volatiles (SW846 8015B)																		
TPH-GRO (C6-C10)	mg/l	-	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)
Methanol	mg/l	-	ND (0.40)	ND (0.40)	ND (0.40)	ND (0.40)	ND (0.40)	ND (0.40)	ND (0.40)	ND (0.40)	ND (0.40)	ND (0.40)	ND (0.40)	ND (0.40)	ND (0.40)	ND (0.40)	ND (0.40)	ND (0.40)
GC Semi-volatiles (SW846-8015B)																		
TPH-DRO (C10-C28)	mg/l	-	ND (0.18)	ND (0.18)	ND (0.18)	ND (0.18)	ND (0.17)	ND (0.17)	ND (0.17)	ND (0.17)	ND (0.17)	ND (0.17)	ND (0.17)	ND (0.17)	ND (0.17)	ND (0.17)	ND (0.17)	ND (0.17)
General Chemistry																		
Chloride	mg/l	*	-	-	-	-	-	-	-	-	-	-	15.8	15.7	-	-	13.7	13.6
Solids, Total Dissolved	mg/l	*	326	304	306	388	452	344	350	340	358	356	352	364	524	425	292	312
Solids, Total Suspended	mg/l	-	17	15	14	<5.0	26.5	24	9	38.5	30	36.8	-	-	13	10	14	<5.0
Sulfate	mg/l	*	-	-	-	-	-	-	-	-	-	-	53.2	52.3	-	-	54.7	55
pH	su	-	8.63 <sup>a</sup>	8.35 <sup>a</sup>	8.82 <sup>a</sup>	7.66 <sup>a</sup>	8.4	8.55	8.47 <sup>a</sup>	8.58 <sup>a</sup>	8.32	8.29	-	-	8.11	8.07	8.88	8.43
Footnotes:																		
<sup>a</sup> Analysis performed past the required 15 minutes from collection time/holding time.																		

## FIGURES

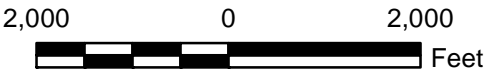


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## REFERENCES

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PROJECT MARATHON OIL COMPANY  
32C PRODUCED WATER POND  
GARFIELD COUNTY, COLORADO

TITLE  
**SITE LOCATION MAP**

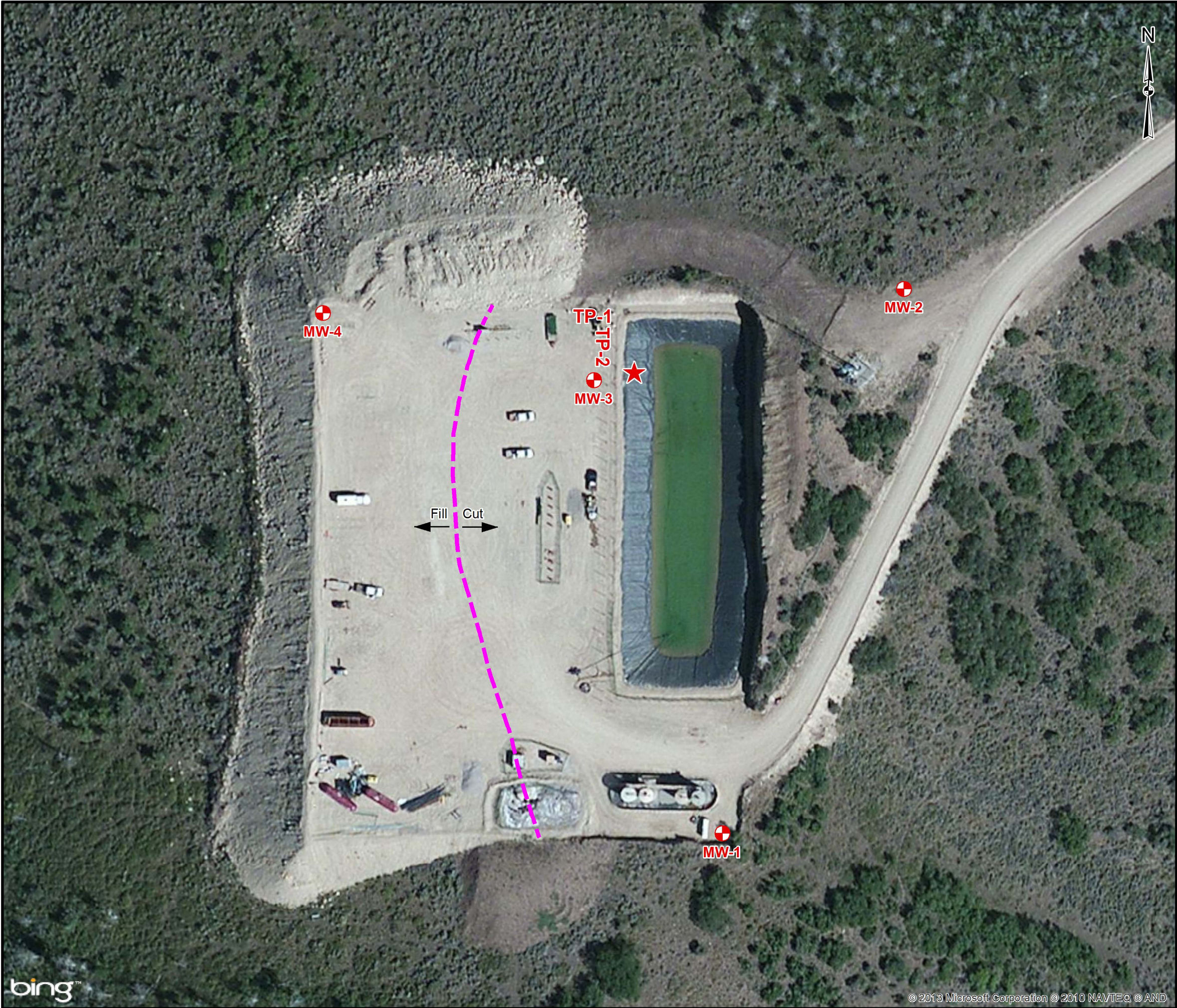
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CHECK	RM	8/23/2013		
REVIEW	EK	8/23/2013		



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## LEGEND

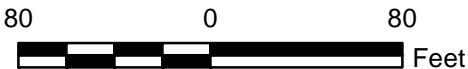
- ★ Location of Pond Breach
- ⊕ Groundwater Monitoring Well Location
- Pad Construction
- Cut/Fill Delineation (approximate)
- TP-1 Test Pit Location (approximate)

## NOTES

1.) AERIAL PHOTO WAS TAKEN PRIOR TO 32C POND DECONSTRUCTION.

## REFERENCES

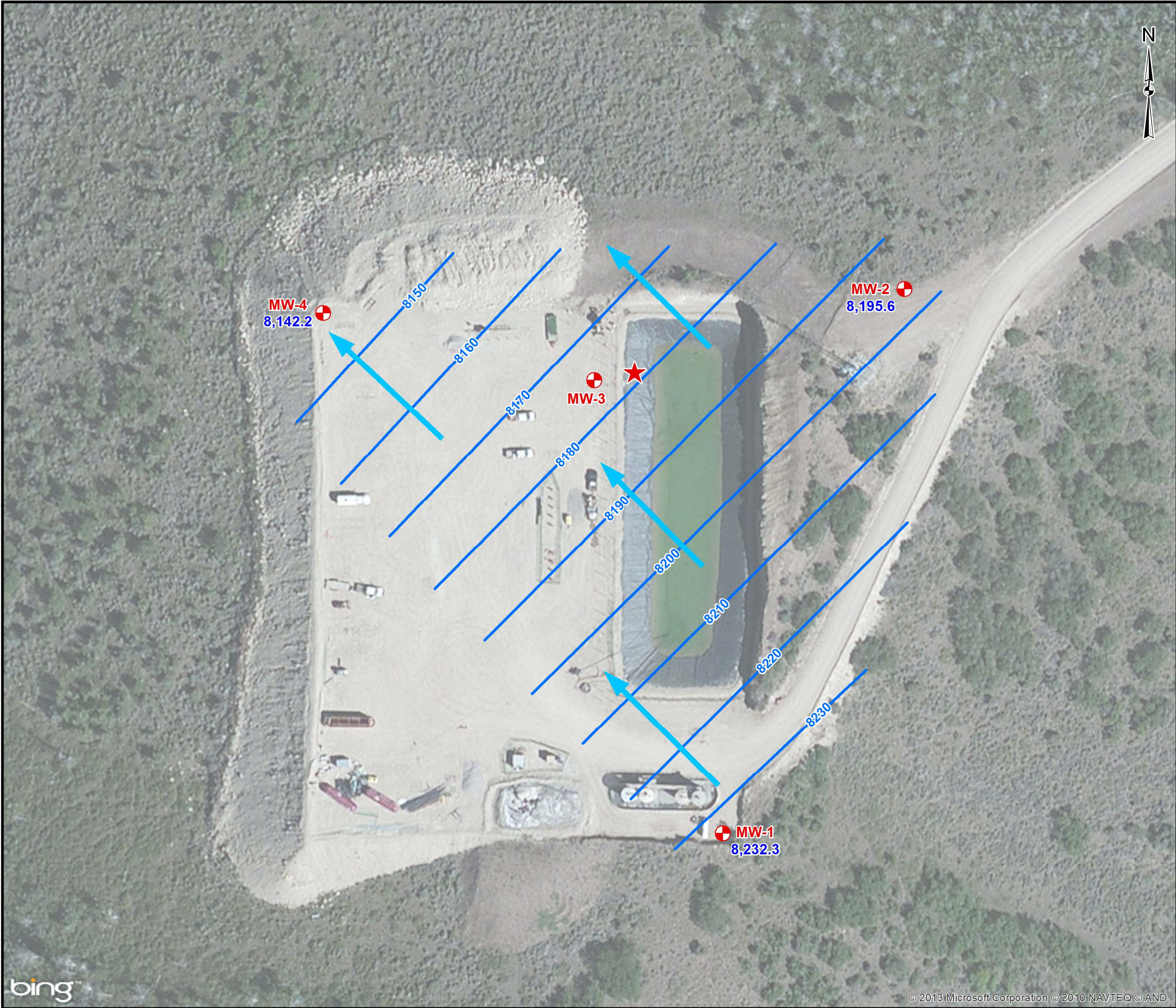
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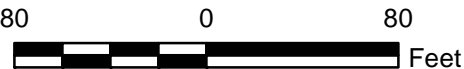
- ★ Location of Pond Breach
- ⊕ Groundwater Monitoring Well Location
- Groundwater Elevation Contours (ft)
- Groundwater Flow Direction


## NOTES

- 1.) AERIAL PHOTO WAS TAKEN PRIOR TO 32C POND DECONSTRUCTION.
- 2.) AUGUST 15, 2013 GROUNDWATER ELEVATIONS ARE SHOWN.
- 3.) SEE TEXT FOR DISCUSSION OF GROUNDWATER CONDITIONS AT MW-3.
- 4.) GROUNDWATER ELEVATION AT MW-3 ON AUGUST 15, 2013 WAS 8,146.7 FT.

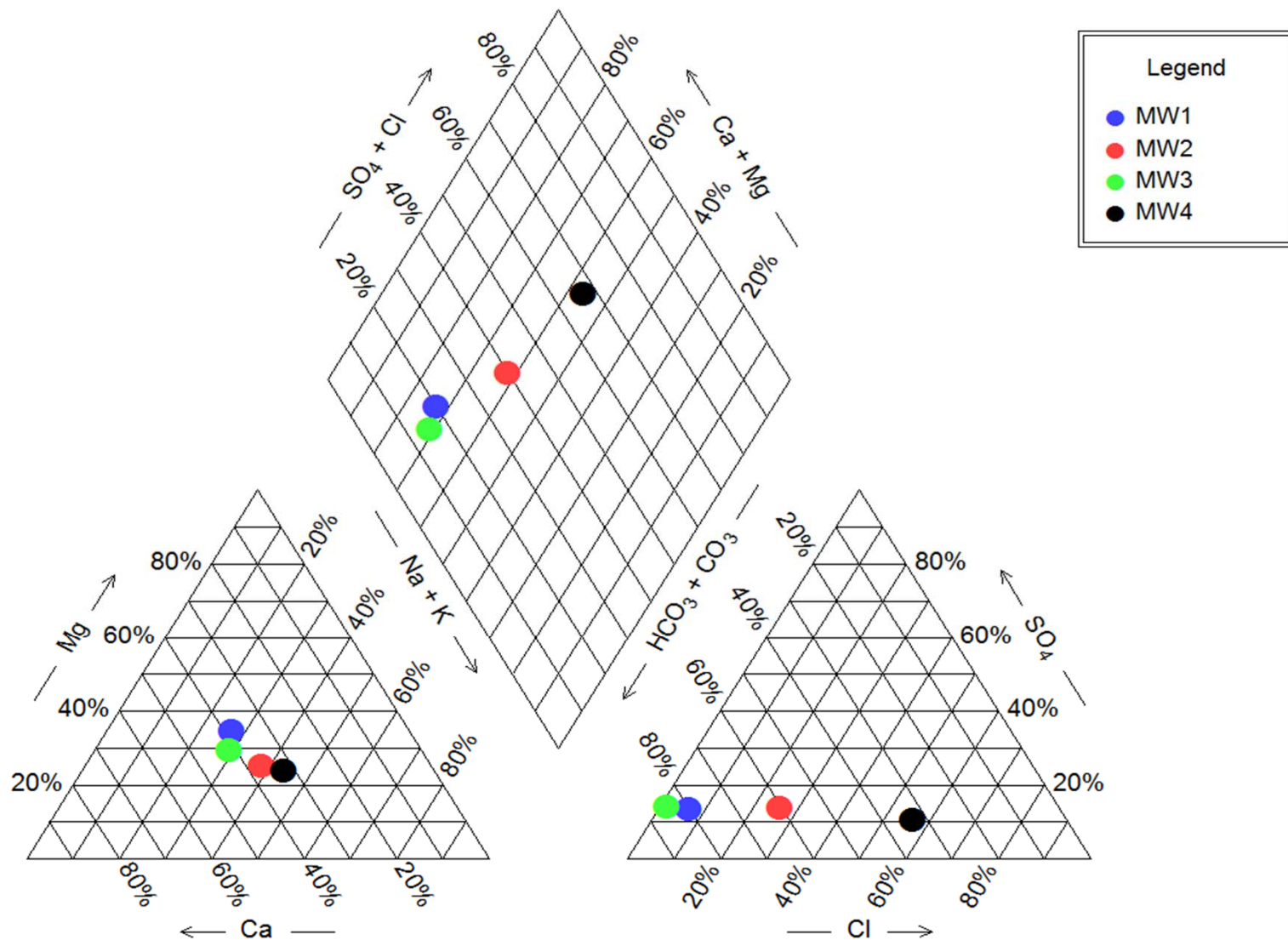
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AERIAL IMAGERY: (C) 2010 MICROSOFT CORPORATION AND ITS DATA SUPPLIERS.



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	REVIEW	EK	8/23/2013		





Title

## Piper Plot of Groundwater Quality Samples

Project Name

32C Produced Water Pond

Project No.

130-0253

Client Name

Marathon Oil Company

Date

9/11/2013

FIGURE

4

**APPENDIX A**  
**MONITORING WELL INSTALLATION**

**APPENDIX A-1**  
**DRILLING AND WELL INSTALLATION PROGRAM**

## DRILLING AND WELL INSTALLATION PROGRAM

### 1.0 INVESTIGATORY DRILLING

The 32C investigative program described herein was performed based on the Golder Technical Procedures provided in the Work Plan. Representative photos of the field program are provided in Appendix A-2. Investigatory drilling used a SIMCO 9100 truck-mounted drilling rig, compressed air for removing drill cuttings, and a BelAir in-line air filtration system. As described in Section 3, all borings were completed as groundwater monitoring wells.

Boreholes MW-1 and MW-3 were advanced using a 4 5/8-inch diameter split tube air rotary drilling method. This drilling method uses a coring mechanism to recover rock core samples for geological logging. It is also designed to remove drill cuttings using air rather than water, allowing observations for groundwater to occur. Borehole MW-3 was advanced to 185 feet below ground surface (bgs) and reaming was completed on June 18, 2013. Borehole MW-1 was advanced to a depth of 170 feet bgs and reaming was completed on June 20, 2013. The upper 19 feet of these boreholes were advanced with a 7 7/8-inch diameter tricone drill bit and temporary casing was set to approximately 19 feet bgs with 7 7/8-inch diameter casing in order to prevent caving during air coring. These boreholes were reamed using a 5 5/8-inch diameter drag drill bit.

Boreholes MW-2, MW-3A and MW-4 were advanced using air rotary drilling methods. This method advanced the boreholes at a more efficient rate than air coring, however intact rock core samples were not recovered. Geological characterization of these boreholes was limited to observation of drill cuttings. Borehole MW-2 was advanced to 197 feet bgs, with drilling completed on June 23, 2013. Borehole MW-3A was advanced to 215 feet bgs, with drilling completed on June 22, 2013. Borehole MW-4 was advanced to 240 feet bgs, with drilling completed on June 25, 2013.

Drilling of MW-1 and MW-3 using air coring methods was planned. This method of drilling injects compressed air into the corehole to remove drill cuttings while advancing the corehole. This method allows for the recovery of rock core and the observation of moisture conditions for evidence of groundwater. However, drilling with air alone did not allow the drill cuttings to be removed from the corehole, so clean water was injected into the air stream to aid in removal of cuttings. The introduction of water into the coreholes made it difficult to observe moisture conditions of the material. Therefore, groundwater observations were made based on drilling action, return of the air, water and cuttings, and trace evidence of groundwater movement through the rock core such as staining, fracture zones and fracture face weathering. At depth zones with evidence of groundwater, drilling was halted and groundwater levels were recorded using a water level meter.

## 2.0 GEOLOGICAL LOGGING

Rock core recovered from boreholes MW-1 and MW-3 was examined and logged based on Golder Technical Procedure TP-1.2-1. This provided information about the hydrogeologic properties and rock structure in support of monitoring well design and installation. In addition, information about groundwater flow paths was provided by observing where fracture zones are located, discontinuity types, discontinuity aperture thicknesses, and evidence of staining and weathering of discontinuity surfaces.

Golder observed and recorded geological information for the rock core recovered from boreholes MW-1 and MW-3. Three-inch diameter rock core was recovered using a split tube sampling system. Three split tubes were available during drilling, which allowed the recovered rock core to be logged in the tubes by Golder while the borehole was being advanced. Rock core data collection included:

- Rock Quality Designation (RQD)
- Total Core Recovery
- Number of Joints per Foot
- Rock Type and Description
- Discontinuity Type and Description

Each core run was observed and logged for geological properties, placed in core-boxes, photographed, and archived in MOC storage. Geological data were electronically recorded on a field tablet computer using geological logging software. Borehole logs containing the observed and recorded geological properties are provided in Appendix A-4. Rock core photos are provided in Appendix A-3.

Geological samples collected from boreholes MW-3 and MW-1 were scanned for Volatile Organic Compounds (VOCs) using a Photoionization Detector (PID). No VOCs were detected in the samples collected from these boreholes.

## 3.0 GROUNDWATER MONITORING WELLS

Groundwater monitoring wells at 32C were designed and installed based on field observations of saturated zones during borehole advancement and associated water level measurements. Golder verified well construction depths using a weighted tape measure and also based on tremie pipe stickup measurements. Well construction details were recorded in a field book, and well construction summaries are provided in Appendix A-5.

Groundwater monitoring wells were installed using 2-inch ID, threaded, flush-joint, schedule 80 polyvinyl chloride (PVC) casing in 20-foot long sections. Screen zones were constructed with 30 to 50 feet of 10-foot long sections of 2-inch ID, threaded, flush-joint, schedule 80, PVC screen, perforated with 0.010-inch wide milled slots. Stainless steel centralizers were installed at 10-foot intervals along the

screened zones. The bottoms of the well screens were fitted with a 2-inch ID end cap. The tops of the wells were extended approximately 2 to 3 feet above the ground surface and 2-inch J-Plugs sealed the top of each well. The annular space around the well screen was backfilled with 10/20 filter sand, which was tremie-fed around the well screen until it extended approximately 5 feet above the top of the screen interval. Above the sand pack, time-released ¼-inch diameter bentonite pellets were tremie-fed until the bentonite seal extended to approximately 5 feet above the top of the sand pack. The bentonite pellets were hydrated using potable water and allowed to set for a minimum of 24 hours prior to sealing the remaining annulus. Above the bentonite pellets, fine filter sand was tremie-fed until it extended approximately 1 foot above the top of the bentonite pellets. The remainder of the annulus was backfilled with a Type II Portland cement and 5% bentonite gel grout mixture that was tremie-fed. Protective lockable steel covers were placed over the PVC riser. The protective covers are 6 inches in diameter and 5 feet in length, with approximately 2 feet of the steel cover cemented bgs. A concrete pad and three, 6-inch diameter protective bollards were placed around each of the protective covers.

Monitoring well boreholes were completed with a 5 7/8 inch diameter annulus. Monitoring well MW-1 was completed to 138.0 feet bgs with its screen set between 97.7 and 137.7 feet bgs, on June 21, 2013. The MW-1 borehole extended to 170 feet bgs. The over-drilled section of this borehole was backfilled with filter sand and a bentonite plug from 142 to 149 feet bgs. Monitoring well MW-2 was completed to 192.2 feet bgs with its screen set between 161.9 and 191.9 feet bgs, on June 24, 2013. Monitoring well MW-3 was completed to 181.4 feet bgs with its screen set between 131.0 and 181.0 feet bgs, on June 18, 2013. MW-3 did not produce any water after installation and was decommissioned by removing the top 20 feet of the PVC well casing and backfilling with a Type II Portland Cement and 5% bentonite gel grout mixture that was tremie-fed. Monitoring well MW-3A was completed to 211.7 feet bgs with its screen set between 181.4 and 211.4 feet bgs, on June 27, 2013. The MW-3A borehole extended to 215 feet bgs and the over drilled section of this borehole was backfilled with filter sand. Monitoring well MW-4 was completed to 239.5 feet bgs with its screen set between 189.2 and 239.2 feet bgs, on June 25, 2013.

**APPENDIX A-2**  
**REPRESENTATIVE PHOTOGRAPHS**



**Marathon Oil Company 32C Produced Water Pond****PHOTO 1**

D.A. Smith Drilling  
Company  
SIMCO 9100 Drill Rig

**PHOTO 2**

Inline air filters



**Marathon Oil Company 32C Produced Water Pond****PHOTO 3**

Decontaminating core barrel and split tube assembly with power washer and Alconox

**PHOTO 4**

Installing 7 7/8-inch temporary casing







## Marathon Oil Company 32C Produced Water Pond

**PHOTO 5**

Placing rock core barrel through temporary casing



**PHOTO 6**

Split tube core barrel





## Marathon Oil Company 32C Produced Water Pond

**PHOTO 7**

Split tube core barrel  
opened with core



**PHOTO 8**

Drag bit for reaming air core  
boreholes





**Marathon Oil Company 32C Produced Water Pond****PHOTO 9**

Tricone roller bit for  
advancing air rotary  
boreholes

**PHOTO 10**

Advancing air rotary  
borehole





## Marathon Oil Company 32C Produced Water Pond

**PHOTO 11**

Cuttings piles for logging of  
air rotary boreholes



**PHOTO 12**

Outwash from rock core  
boreholes





**Marathon Oil Company 32C Produced Water Pond****PHOTO 13**

Monitoring well screen preparation with centralizers

**PHOTO 14**

Monitoring well installation





## Marathon Oil Company 32C Produced Water Pond

**PHOTO 15**

Filter sand placed through tremie pipe



**PHOTO 16**

Time release bentonite pellets





**Marathon Oil Company 32C Produced Water Pond****PHOTO 17**

Portland cement used in  
grout mixture

**PHOTO 18**

Bentonite gel used in grout  
mixture



**Marathon Oil Company 32C Produced Water Pond****PHOTO 19**

Installing grout to seal monitoring well annular space

**PHOTO 20**

Example of monitoring well surface completion



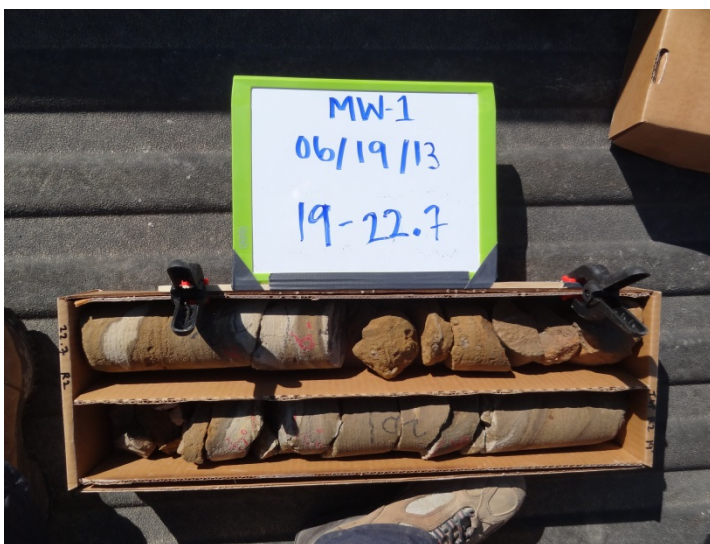
**APPENDIX A-3**  
**ROCK CORE PHOTOGRAPHS**

**MW-1**

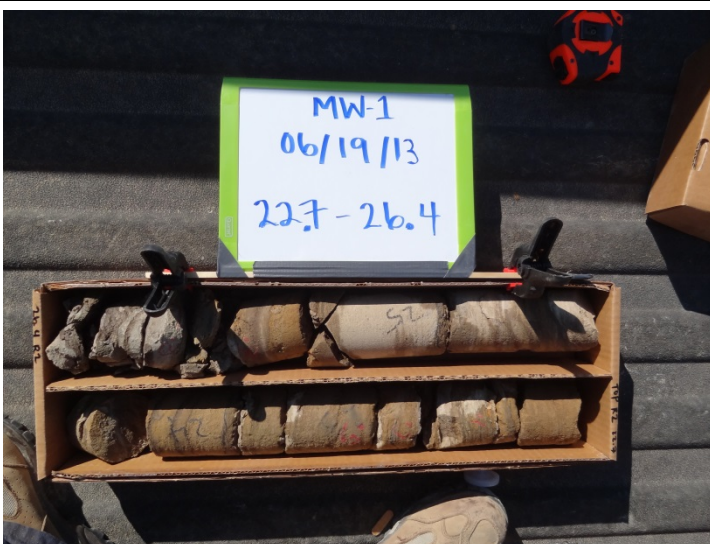


**Marathon Oil Company 32C Produced Water Pond****PHOTO 1**

MW-1 (19.0-22.7 FT)

**PHOTO 2**

MW-1 (22.7-26.4 FT)

**PHOTO 3**

MW-1 (26.4-30.2 FT)



**Marathon Oil Company 32C Produced Water Pond****PHOTO 4**

MW-1 (30.2-33.8 FT)

**PHOTO 5**

MW-1 (33.8-37.7 FT)

**PHOTO 6**

MW-1 (37.7-41.4 FT)





**Marathon Oil Company 32C Produced Water Pond****PHOTO 7**

MW-1 (41.4-45.3 FT)

**PHOTO 8**

MW-1 (45.3-48.8 FT)

**PHOTO 9**

MW-1 (48.8-52.5 FT)



**Marathon Oil Company 32C Produced Water Pond****PHOTO 10**

MW-1 (52.5-56.7 FT)

**PHOTO 11**

MW-1 (56.7-60.3 FT)

**PHOTO 12**

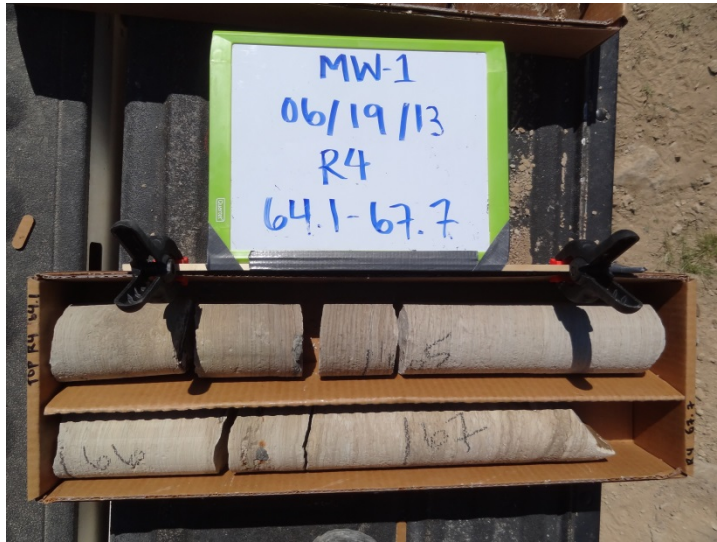
MW-1 (60.3-64.1 FT)





**Marathon Oil Company 32C Produced Water Pond****PHOTO 13**

MW-1 (64.1-67.7 FT)

**PHOTO 14**

MW-1 (67.7-71.2 FT)

**PHOTO 15**

MW-1 (71.2-75.0 FT)



**Marathon Oil Company 32C Produced Water Pond****PHOTO 16**

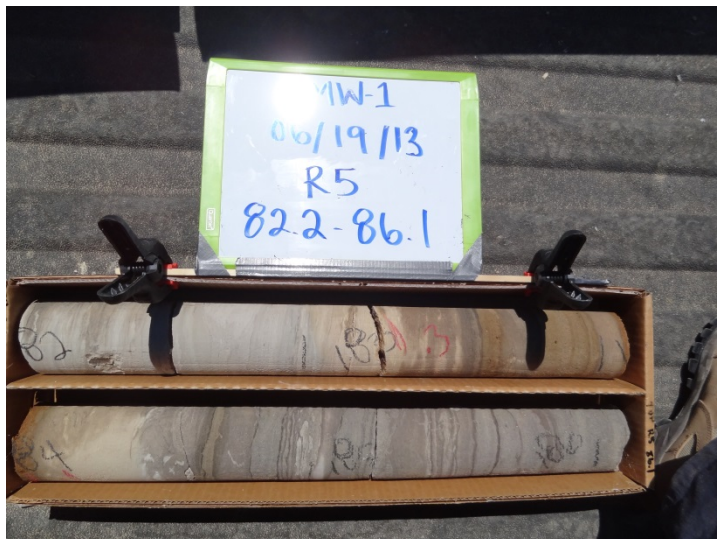
MW-1 (75.0-78.4 FT)

**PHOTO 17**

MW-1 (78.4-82.2 FT)

**PHOTO 18**

MW-1 (82.2-86.1 FT)





**Marathon Oil Company 32C Produced Water Pond****PHOTO 19**

MW-1 (86.1-89.7 FT)

**PHOTO 20**

MW-1 (89.7-92.3 FT)

**PHOTO 21**

MW-1 (92.3-96.7 FT)



**Marathon Oil Company 32C Produced Water Pond****PHOTO 22**

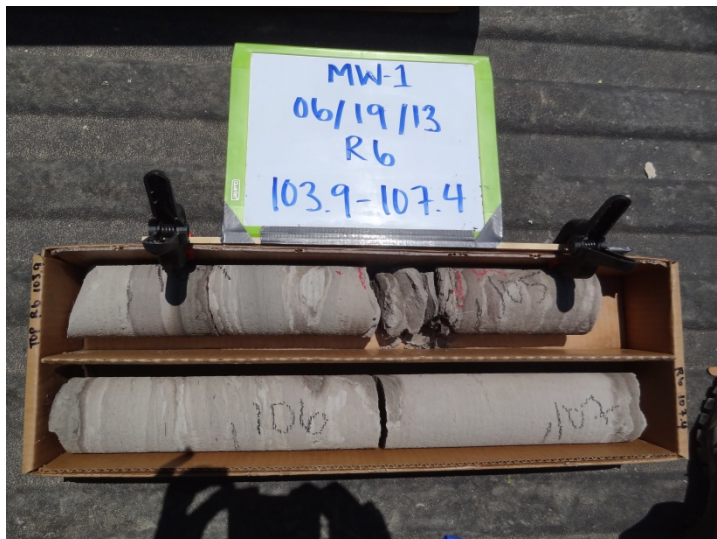
MW-1 (96.7-100.2 FT)

**PHOTO 23**

MW-1 (100.2-103.9 FT)

**PHOTO 24**

MW-1 (103.9-107.4 FT)





**Marathon Oil Company 32C Produced Water Pond****PHOTO 25**

MW-1 (107.4-111.0 FT)

**PHOTO 26**

MW-1 (111.0-115.0 FT)

**PHOTO 27**

MW-1 (115.0-118.6 FT)



**Marathon Oil Company 32C Produced Water Pond****PHOTO 28**

MW-1 (118.6-122.6 FT)

**PHOTO 29**

MW-1 (122.6-126.0 FT)

**PHOTO 30**

MW-1 (126.0-129.7 FT)





**Marathon Oil Company 32C Produced Water Pond****PHOTO 31**

MW-1 (129.7-133.2 FT)

**PHOTO 32**

MW-1 (133.2-136.8 FT)

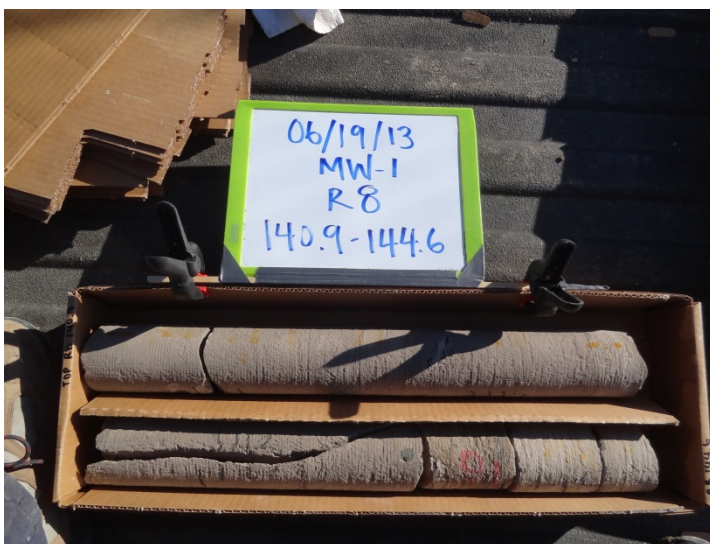
**PHOTO 33**

MW-1 (136.8-140.9 FT)



**Marathon Oil Company 32C Produced Water Pond****PHOTO 34**

MW-1 (140.9-144.6 FT)

**PHOTO 35**

MW-1 (144.6-147.9 FT)

**PHOTO 36**

MW-1 (147.9-152.0 FT)





**Marathon Oil Company 32C Produced Water Pond****PHOTO 37**

MW-1 (152.0-155.7 FT)

**PHOTO 38**

MW-1 (155.7-163.0 FT)

**PHOTO 39**

MW-1 (163.0-167.2 FT)





**Marathon Oil Company 32C Produced Water Pond**

**PHOTO 40**

MW-1 (167.2-170.0 FT)



**MW-3**



**Marathon Oil Company 32C Produced Water Pond****PHOTO 1**

MW-3 (19.0-22.3 FT)

**PHOTO 2**

MW-3 (22.3-27.7 FT)

**PHOTO 3**

MW-3 (27.7-31.6 FT)



**Marathon Oil Company 32C Produced Water Pond****PHOTO 4**

MW-3 (31.6-35.0 FT)

**PHOTO 5**

MW-3 (35.0-38.8 FT)

**PHOTO 6**

MW-3 (38.8-42.5 FT)





**Marathon Oil Company 32C Produced Water Pond****PHOTO 7**

MW-3 (42.5-46.3 FT)

**PHOTO 8**

MW-3 (46.3-50.0 FT)

**PHOTO 9**

MW-3 (50.0-53.4 FT)





**Marathon Oil Company 32C Produced Water Pond****PHOTO 10**

MW-3 (53.4-57.7 FT)

**PHOTO 11**

MW-3 (57.7-61.0 FT)

**PHOTO 12**

MW-3 (61.0-64.6 FT)



**Marathon Oil Company 32C Produced Water Pond****PHOTO 13**

MW-3 (64.6-68.5 FT)

**PHOTO 14**

MW-3 (68.5-72.4 FT)

**PHOTO 15**

MW-3 (72.4-76.7 FT)





**Marathon Oil Company 32C Produced Water Pond****PHOTO 16**

MW-3 (76.7-80.6 FT)

**PHOTO 17**

MW-3 (80.6-84.3 FT)

**PHOTO 18**

MW-3 (84.3-93.5 FT)





**Marathon Oil Company 32C Produced Water Pond****PHOTO 19**

MW-3 (93.5-97.6 FT)

**PHOTO 20**

MW-3 (97.6-101.6 FT)

**PHOTO 21**

MW-3 (101.6-105.2 FT)



**Marathon Oil Company 32C Produced Water Pond****PHOTO 22**

MW-3 (105.2-108.6 FT)

**PHOTO 23**

MW-3 (108.6-112.2 FT)

**PHOTO 24**

MW-3 (112.2-116.1 FT)





**Marathon Oil Company 32C Produced Water Pond****PHOTO 25**

MW-3 (116.1-119.8 FT)

**PHOTO 26**

MW-3 (119.8-123.0 FT)

**PHOTO 27**

MW-3 (123.0-126.5 FT)





**Marathon Oil Company 32C Produced Water Pond****PHOTO 28**

MW-3 (126.5-130.0 FT)

**PHOTO 29**

MW-3 (130.0-133.9 FT)

**PHOTO 30**

MW-3 (133.9-137.1 FT)



**Marathon Oil Company 32C Produced Water Pond****PHOTO 31**

MW-3 (137.1-141.0 FT)

**PHOTO 32**

MW-3 (141.0-144.4 FT)

**PHOTO 33**

MW-3 (144.4-148.1 FT)





**Marathon Oil Company 32C Produced Water Pond****PHOTO 34**

MW-3 (148.1-152.5 FT)

**PHOTO 35**

MW-3 (152.5-156.4 FT)

**PHOTO 36**

MW-3 (156.4-160.3 FT)





**Marathon Oil Company 32C Produced Water Pond****PHOTO 37**

MW-3 (160.3-164.1 FT)

**PHOTO 38**

MW-3 (164.1-168.2 FT)

**PHOTO 39**

MW-3 (168.2-171.8 FT)



**Marathon Oil Company 32C Produced Water Pond****PHOTO 40**

MW-3 (171.8-176.0 FT)

**PHOTO 41**

MW-3 (176.0-179.8 FT)

**PHOTO 42**

MW-3 (179.8-183.5 FT)







**Marathon Oil Company 32C Produced Water Pond**

**PHOTO 43**

MW-3 (183.5-185.0 FT)





**APPENDIX A-4**  
**COREHOLE AND DRILLHOLE LOGS**

PROJECT: Marathon - 32C Pond  
 PROJECT NUMBER: 130-0253  
 DRILLED DEPTH: 170.0 ft  
 LOCATION: SE corner of 32C Pad

# RECORD OF COREHOLE MW-1

DRILL METHOD: Air Rotary/Air Coring  
 DRILL RIG: SIMCO 9100  
 DRILL DATE: 6/18/2013 4:02:18 PM

COORDINATES:  
 N: 1,642,668.80 E: 2,240,781.20  
 GS ELEVATION: 8333.2 ft  
 TOC ELEVATION: 8336.2 ft

SHEET 1 of 4

INCLINATION: -90  
 DEPTH W.L.: 103.85  
 ELEVATION W.L.: 8232.33  
 DATE W.L.: 8/15/2013

DEPTH (ft)	ROCK TYPE		WELL CONSTRUCTION DETAILS									
	DESCRIPTION	GRAPHIC LOG	J-Joint Fr-Fracture RB-Rubble BF-Bedding		FO-Foliation PL-Planar C-Curved U-Undulating		ST-Stepped I-Irregular P-Polished K-Slickensided		SM-Smooth R-Rough VR-V.Rough Fr-Fracture		CA-Calcite CL-Clay CT-Contact RD-Redrilled Fe-Iron Oxides	
			ELEV. (ft)	RUN NO.	CORE RECOVERY (in)	RQD %	FRACTURES PER FOOT	TYPE and SURFACE DESCRIPTION	WELL GRAPHICS	WELL CONSTRUCTION DETAILS		
0	0.0-3.0 ft FILL. <i>Borehole was advanced from 0.0 to 19.0 ft using air rotary. No rock structure data was acquired.</i> <i>Temporary casing set from 0.0 to 19.0 ft.</i>		8330.2									
5	3.0-19.0 ft ARGILLACEOUS SANDSTONE, slightly weathered to moderately weathered, bedded, pale green gray, coarse grained to medium grained, calcareous, R-3 to R-4			R-1								
10												
15												
20	19.0-35.0 ft SANDSTONE, slightly weathered to moderately weathered, medium bedded, yellow tan, iron oxide staining, fine grained to medium grained, R-3		8314.2					19.6m - J - 68° - U to PL - R - calcite 20.3m - J - 74° - I - R - oxide staining 20.9m - J - 54° - I - R - oxide staining 21.1m - J - 46° - I - R - silt 21.9m - J - 63° - I - SM - oxide staining 22.1m - J - 72° - I - R - Fe staining 23m - J - 75° - I - R - clean				
25												
30				R-2	15.5			25.7m - RB - 74° - I - R - rubble  30.5m - J - 86° - C - R - calcite  32.7m - J - 62° - I - R - oxide staining				
35	35.0-55.0 ft SANDSTONE, slightly weathered, medium bedded, yellow tan and light gray, iron oxide staining, fine grained to coarse grained, R-3		8298.2					35.6m - J - 68° - PL - R - clean 35.8m - J - 62° - PL - R - clean 36.2m - J - 73° - PL - R - clean 36.4m - J - 85° - I - VR - clean 36.9m - J - 72° - I - R - oxide staining 38.2m - J - 65° - PL - R - clean  39.6m - J - 56° - I - R - Fe  43.3m - J - 56° - I - R - oxide staining 43.5m - J - 56° - I - R - clean 43.6m - J - 56° - I - R - oxide staining  45.3m - J - 87° - U to PL - R - oxide staining 45.8m - J - 74° - I - R - silt 46m - RB - 83° - I - R - rubble  47.9m - J - 68° - ST - R - oxide staining				
40												
45				R-3	20.0							
50												

Log continued on next page

DRILLING COMPANY: D.A. Smith Drilling  
 DRILLER: Darryl Smith

GA INSPECTOR: J. Kugel  
 CHECKED BY: R. March  
 DATE: 7/1/2013



PROJECT: Marathon - 32C Pond  
 PROJECT NUMBER: 130-0253  
 DRILLED DEPTH: 170.0 ft  
 LOCATION: SE corner of 32C Pad

# RECORD OF COREHOLE MW-1

DRILL METHOD: Air Rotary/Air Coring  
 DRILL RIG: SIMCO 9100  
 DRILL DATE: 6/18/2013 4:02:18 PM

COORDINATES:  
 N:1,642,668.80 E: 2,240,781.20  
 GS ELEVATION: 8333.2 ft  
 TOC ELEVATION: 8336.2 ft

SHEET 2 of 4

INCLINATION: -90  
 DEPTH W.L.: 103.85  
 ELEVATION W.L.: 8232.33  
 DATE W.L.: 8/15/2013

DEPTH (ft)	ROCK TYPE		WELL CONSTRUCTION DETAILS									
	DESCRIPTION	GRAPHIC LOG	J-Joint Fr-Fracture RB-Rubble BF-Bedding		FO-Foliation PL-Planar C-Curved U-Undulating		ST-Stepped I-Irregular P-Polished K-Slickensided		SM-Smooth R-Rough VR-V. Rough Fr-Fracture		CA-Calcite CL-Clay CT-Contact RD-Redrilled Fe-Iron Oxides	
			ELEV. (ft)	RUN NO.	CORE RECOVERY (in)	RQD %	FRACTURES PER FOOT	TYPE and SURFACE DESCRIPTION	WELL GRAPHICS	WELL CONSTRUCTION DETAILS		
50	35.0-55.0 ft SANDSTONE, slightly weathered, medium bedded, yellow tan and light gray, iron oxide staining, fine grained to coarse grained, R-3 (Continued)			R-3	20.0			50.4m - RB - 87° - I - R - clay and gravel				
55	55.0-60.0 ft SANDSTONE, slightly weathered, medium bedded, yellow tan and light gray, iron oxide staining, fine grained to coarse grained, R-3		8278.2					55.4m - J - 73° - I - R - Fe staining 55.6m - J - 73° - PL - R - oxide staining 55.7m - J - 82° - PL - R - oxide staining 56.1m - BF - 68° - C - R - clean 56.7m - BF - 70° - C - R - clean 57.3m - BF - 81° - C - R - clean 57.5m - BF - 79° - C - R - clean				
60	60.0-75.0 ft SANDSTONE, slightly weathered, thinly bedded, light gray, very fine grained to fine grained, R-3		8273.2					59m - J - 80° - U to PL - VR - oxide staining 59.2m - J - 84° - I - R - Fe staining 59.7m - J - 84° - I - R - Fe staining 60.2m - RB - 82° - I - R - rubble 60.9m - J - 81° - U to PL - SM - clean				
65				R-4	20.0			62.8m - J - 40° - I - R - Fe staining				
70								67.6m - J - 38° - C - R - clean 68.5m - J - 26° - I - R - clean				
75	75.0-95.0 ft SANDSTONE, slightly weathered, thinly bedded, light gray, iron oxide staining, fine grained to medium grained, R-3		8258.2					71.9m - BF - 83° - U to PL - R - oxide staining 73.9m - BF - 88° - I - R - clean				
80								75.6m - J - 21° - U to PL - R - Fe staining 77.3m - J - 36° - U to PL - R - oxide staining 77.7m - J - 80° - I - R - strong Fe staining 78.6m - J - 34° - I - VR 79m - J - 34° - U to PL - R - oxide staining 79.8m - BF - 83° - I - R - clean				
85				R-5	20.0			83.3m - J - 82° - I - R - oxide staining 84.1m - J - 84° - I - R - Fe staining				
90								91.6m - J - 70° - I - R - Fe staining 93m - J - 74° - I - R - Fe staining 93.2m - J - 78° - PL - R - oxide staining				
95	95.0-115.0 ft SANDSTONE, slightly weathered, medium bedded, light gray, fine grained to coarse grained, R-3		8238.2					95.8m - J - 63° - I - R - oxide staining 96.7m - J - 81° - I - R - oxide staining 97.5m - J - 78° - I - R - clean 97.6m - RB - 87° - I - R - rubble 98.4m - J - 77° - I - R - clean				
100	Log continued on next page			R-6	20.0							

88-89 feet - Fine Sand  
 89-94 feet - Time Released  
 Bentonite Chips  
 97.7-137.7 feet - 2"  
 diameter, Schedule 80, PVC,  
 0.010" Milled Slotted, Flush  
 Threaded, Screen

DRILLING COMPANY: D.A. Smith Drilling  
 DRILLER: Darryl Smith

GA INSPECTOR: J. Kugel  
 CHECKED BY: R. March  
 DATE: 7/1/2013





INCLINATION: -90  
DEPTH W.L.: 103.85  
ELEVATION W.L.: 8232.33  
DATE W.L.: 8/15/2013

[illegible]

PROJECT: Marathon - 32C Pond  
 PROJECT NUMBER: 130-0253  
 DRILLED DEPTH: 170.0 ft  
 LOCATION: SE corner of 32C Pad

# RECORD OF COREHOLE MW-1

DRILL METHOD: Air Rotary/Air Coring  
 DRILL RIG: SIMCO 9100  
 DRILL DATE: 6/18/2013 4:02:18 PM

COORDINATES:  
 N: 1,642,668.80 E: 2,240,781.20  
 GS ELEVATION: 8333.2 ft  
 TOC ELEVATION: 8336.2 ft

SHEET 4 of 4

INCLINATION: -90  
 DEPTH W.L.: 103.85  
 ELEVATION W.L.: 8232.33  
 DATE W.L.: 8/15/2013

DEPTH (ft)	ROCK TYPE		WELL CONSTRUCTION DETAILS									
	DESCRIPTION	GRAPHIC LOG	J-Joint Fr-Fracture RB-Rubble BF-Bedding		FO-Foliation PL-Planar C-Curved U-Undulating		ST-Stepped I-Irregular P-Polished K-Slickensided		SM-Smooth R-Rough VR-V.Rough Fr-Fracture		CA-Calcite CL-Clay CT-Contact RD-Redrilled Fe-Iron Oxides	
			ELEV. (ft)	RUN NO.	CORE RECOVERY (in)	RQD %	FRACTURES PER FOOT	TYPE and SURFACE DESCRIPTION	WELL GRAPHICS	WELL CONSTRUCTION DETAILS		
150	135.0-155.0 ft SANDSTONE, fresh rock, thinly bedded, light gray, very fine grained to medium grained, R-3 to R-4 (Continued)			R-8	20.0			153.4m - J - 76° - I - R - oxide staining				
155	155.0-170.0 ft SANDSTONE, fresh rock, thinly bedded, light gray, very fine grained to fine grained, R-3 to R-4 155 ft: Core too badly spun to identify discontinuities or RQD		8178.2							149-170 feet - 10/20 Filter Sand Backfill		
160				R-9	11.8							
165												
170			8163.2									

JUNE 2013 MOC ROCK LITHOLOGY/WELL IMPORT.GPJ 2013 AMULSAR.GDT 9/12/13

DRILLING COMPANY: D.A. Smith Drilling  
 DRILLER: Darryl Smith

GA INSPECTOR: J. Kugel  
 CHECKED BY: R. March  
 DATE: 7/1/2013



PROJECT: Marathon - 32C Pond  
 PROJECT NUMBER: 130-0253  
 DRILLED DEPTH: 197.0 ft  
 LOCATION: On ridge above pond, by Tower  
 6

## RECORD OF COREHOLE MW-2

DRILL METHOD: Air Rotary  
 DRILL RIG: SIMCO 9100  
 DRILL DATE: 6/23/2013 9:20:59 AM

COORDINATES:  
 N: 1,643,125.90 E: 2,240,955.80  
 GS ELEVATION: 8364.1 ft  
 TOC ELEVATION: 8366.8 ft

SHEET 1 of 4

INCLINATION: -90  
 DEPTH W.L.: 171.23  
 ELEVATION W.L.: 8195.57  
 DATE W.L.: 8/15/2013

DEPTH (ft)	ROCK TYPE		J-Joint Fr-Fracture RB-Rubble BF-Bedding										FO-Foliation PL-Planar C-Curved U-Undulating		ST-Stepped I-Irregular P-Polished K-Slickensided		SM-Smooth R-Rough VR-V.Rough Fr-Fracture		CA-Calcite CL-Clay CT-Contact RD-Redrilled Fe-Iron Oxides		WELL CONSTRUCTION DETAILS	
	DESCRIPTION	GRAPHIC LOG	ELEV. (ft)	RUN NO.	CORE RECOVERY (in)	RQD %	FRACTURES PER FOOT	DISCONTINUITY DATA		WELL GRAPHICS	WELL CONSTRUCTION DETAILS											
								TYPE and SURFACE DESCRIPTION														
0	0.0-3.0 ft TOPSOIL 0.0 ft		8361.1																			
3.0-60.0 ft	SANDSTONE, tan, fine grained to coarse grained																					
5																						
10																						
15																						
20																						
25																						
30																						
35																						
40																						
45																						
50																						

+2.70- 161.9 feet - 2" diameter, Schedule 80, PVC, Flush Threaded, Casing

0-152 feet - Portland, Type 2, with 5% bentonite gel

Log continued on next page

DRILLING COMPANY: D.A. Smith Drilling  
 DRILLER: Darryl Smith

GA INSPECTOR: J. Kugel  
 CHECKED BY: R. March  
 DATE: 7/1/2013



PROJECT: Marathon - 32C Pond  
 PROJECT NUMBER: 130-0253  
 DRILLED DEPTH: 197.0 ft  
 LOCATION: On ridge above pond, by Tower  
 6

## RECORD OF COREHOLE MW-2

DRILL METHOD: Air Rotary  
 DRILL RIG: SIMCO 9100  
 DRILL DATE: 6/23/2013 9:20:59 AM

COORDINATES:  
 N: 1,643,125.90 E: 2,240,955.80  
 GS ELEVATION: 8364.1 ft  
 TOC ELEVATION: 8366.8 ft

SHEET 2 of 4

INCLINATION: -90  
 DEPTH W.L.: 171.23  
 ELEVATION W.L.: 8195.57  
 DATE W.L.: 8/15/2013

DEPTH (ft)	ROCK TYPE												WELL CONSTRUCTION DETAILS	
	DESCRIPTION	GRAPHIC LOG	J-Joint Fr-Fracture RB-Rubble BF-Bedding		FO-Foliation PL-Planar C-Curved U-Undulating		ST-Stepped I-Irregular P-Polished K-Slickensided		SM-Smooth R-Rough VR-V.Rough Fr-Fracture		CA-Calcite CL-Clay CT-Contact RD-Redrilled Fe-Iron Oxides		WELL GRAPHICS	WELL CONSTRUCTION DETAILS
			ELEV. (ft)	RUN NO.	CORE RECOVERY (ft)	RQD %	FRACTURES PER FOOT	DISCONTINUITY DATA						
								TYPE and SURFACE DESCRIPTION						
50	3.0-60.0 ft SANDSTONE, tan, fine grained to coarse grained <i>(Continued)</i>													
55	55 ft: Moist													
60	60.0-197.0 ft SANDSTONE, tan and gray, very fine grained to medium grained 60 ft: Gray siltstone chips		8304.1											
65	65 ft: Discharge of cuttings in clods, indicating increased moisture													
70														
75														
80														
85														
90	91 ft: Possible high transmissivity zone, small loss of circulation and highest point to which second air lift was able to reach													
95														
100	Log continued on next page													

DRILLING COMPANY: D.A. Smith Drilling  
 DRILLER: Darryl Smith

GA INSPECTOR: J. Kugel  
 CHECKED BY: R. March  
 DATE: 7/1/2013



PROJECT: Marathon - 32C Pond  
 PROJECT NUMBER: 130-0253  
 DRILLED DEPTH: 197.0 ft  
 LOCATION: On ridge above pond, by Tower  
 6

# RECORD OF COREHOLE MW-2

DRILL METHOD: Air Rotary  
 DRILL RIG: SIMCO 9100  
 DRILL DATE: 6/23/2013 9:20:59 AM

COORDINATES:  
 N: 1,643,125.90 E: 2,240,955.80  
 GS ELEVATION: 8364.1 ft  
 TOC ELEVATION: 8366.8 ft

SHEET 3 of 4

INCLINATION: -90  
 DEPTH W.L.: 171.23  
 ELEVATION W.L.: 8195.57  
 DATE W.L.: 8/15/2013

DEPTH (ft)	ROCK TYPE												WELL CONSTRUCTION DETAILS	
	DESCRIPTION	GRAPHIC LOG	J-Joint Fr-Fracture RB-Rubble BF-Bedding		FO-Foliation PL-Planar C-Curved U-Undulating		ST-Stepped I-Irregular P-Polished K-Slickensided		SM-Smooth R-Rough VR-V.Rough Fr-Fracture		CA-Calcite CL-Clay CT-Contact RD-Redrilled Fe-Iron Oxides		WELL GRAPHICS	WELL CONSTRUCTION DETAILS
			ELEV. (ft)	RUN NO.	CORE RECOVERY (ft)	RQD %	FRACTURES PER FOOT	DISCONTINUITY DATA						
								TYPE and SURFACE DESCRIPTION						
100	60.0-197.0 ft SANDSTONE, tan and gray, very fine grained to medium grained <i>(Continued)</i>				80 60 40 20	2 4 6 8 10								
105														
110														
115														
120														
125														
130														
135														
140	140 ft: Moist cuttings, iron staining													
145														
150														

Log continued on next page

Log continued on next page

DRILLING COMPANY: D.A. Smith Drilling  
 DRILLER: Darryl Smith

GA INSPECTOR: J. Kugel  
 CHECKED BY: R. March  
 DATE: 7/1/2013



PROJECT: Marathon - 32C Pond  
 PROJECT NUMBER: 130-0253  
 DRILLED DEPTH: 197.0 ft  
 LOCATION: On ridge above pond, by Tower  
 6

# RECORD OF COREHOLE MW-2

DRILL METHOD: Air Rotary  
 DRILL RIG: SIMCO 9100  
 DRILL DATE: 6/23/2013 9:20:59 AM

COORDINATES:  
 N: 1,643,125.90 E: 2,240,955.80  
 GS ELEVATION: 8364.1 ft  
 TOC ELEVATION: 8366.8 ft

SHEET 4 of 4

INCLINATION: -90  
 DEPTH W.L.: 171.23  
 ELEVATION W.L.: 8195.57  
 DATE W.L.: 8/15/2013

DEPTH (ft)	ROCK TYPE		WELL CONSTRUCTION DETAILS									
	DESCRIPTION	GRAPHIC LOG	J-Joint Fr-Fracture RB-Rubble BF-Bedding		FO-Foliation PL-Planar C-Curved U-Undulating		ST-Stepped I-Irregular P-Polished K-Slickensided		SM-Smooth R-Rough VR-V.Rough Fr-Fracture		CA-Calcite CL-Clay CT-Contact RD-Redrilled Fe-Iron Oxides	
			ELEV. (ft)	RUN NO.	CORE RECOVERY (in)	RQD %	FRACTURES PER FOOT	TYPE and SURFACE DESCRIPTION	WELL GRAPHICS	WELL CONSTRUCTION DETAILS		
150	60.0-197.0 ft SANDSTONE, tan and gray, very fine grained to medium grained (Continued)											
155												152-153 feet - Fine Sand
160												153-158 feet - Time Released Bentonite Chips
165	165 ft: Oxide staining											Centralizer
170												161.9-191.9 feet - 2" diameter, Schedule 80, PVC, 0.010" Milled Slotted, Flush Threaded, Screen
175												Centralizer
180												158-192 feet - 10/20 Filter Sand
185												Centralizer
190	191 ft: Wet cuttings, mud on rods											191.9-192.2 feet - 2" diameter, Schedule 80, PVC, Flush Threaded, End Cap
195												192-197 feet - 10/20 Filter Sand Backfill
			8167.1									

JUNE 2013 MOC ROCK LITHOLOGY/WELL IMPORT.GPJ 2013 AMULSAR.GDT 9/12/13

DRILLING COMPANY: D.A. Smith Drilling  
 DRILLER: Darryl Smith

GA INSPECTOR: J. Kugel  
 CHECKED BY: R. March  
 DATE: 7/1/2013





PROJECT: Marathon - 32C Pond  
 PROJECT NUMBER: 130-0253  
 DRILLED DEPTH: 185.0 ft  
 LOCATION: West of 32C Pond

# RECORD OF COREHOLE MW-3 (Initial)

DRILL METHOD: Air Rotary/Air Coring  
 DRILL RIG: SIMCO 9100  
 DRILL DATE: 6/13/2013 8:06:05 AM

COORDINATES: not surveyed  
 GS ELEVATION: not surveyed  
 TOC ELEVATION: not surveyed

SHEET 1 of 4

INCLINATION: -90  
 DEPTH W.L.: N/A  
 ELEVATION W.L.: N/A  
 DATE W.L.: N/A

DEPTH (ft)	ROCK TYPE		WELL CONSTRUCTION DETAILS									
	DESCRIPTION	GRAPHIC LOG	J-Joint Fr-Fracture RB-Rubble BF-Bedding		FO-Foliation PL-Planar C-Curved U-Undulating		ST-Stepped I-Irregular P-Polished K-Slickensided		SM-Smooth R-Rough VR-V.Rough Fr-Fracture		CA-Calcite CL-Clay CT-Contact RD-Redrilled Fe-Iron Oxides	
			ELEV. (ft)	RUN NO.	CORE RECOVERY (in)	RQD %	FRACTURES PER FOOT	TYPE and SURFACE DESCRIPTION	WELL GRAPHICS	WELL CONSTRUCTION DETAILS		
0	0.0-3.0 ft FILL <i>Borehole was advanced from 0.0 to 19.0 ft using air rotary. No rock structure data was acquired.</i> <i>Temporary casing set from 0.0 to 19.0 ft.</i>		8330.7									
5	3.0-19.0 ft SANDSTONE											
10				R-1								
15												
20	19.0-37.5 ft Silty SANDSTONE, moderately weathered to highly weathered, tan, iron oxide staining, fine grained, R-2 to R-3		8314.7	R-2	2.4			20.7m - J - 70° - ST to U - R 21.9m - J - 43° - U - R - Fe staining				
25				R-3	3.3			23.7m - J - 60° - U - R - Ca 24.2m - J - 64° - U - R 24.6m - J - 77° - U - R - Fe staining				
30				R-4	8.8			27.5m - J - 38° - ST to U - R - Ca and Fe coated 27.6m - RB - 30° - ST to U - R - clay and gravel 28.8m - J - 60° - PL - R - Fe staining				
35	34.0 ft SANDSTONE, 1ft thick fracture zone with weak rock.							33.5m - J - 30° - PL - R to SM - clay 33.9m - J - 49° - PL - R to SM - Fe staining 34.1m - J - 54° - PL - R to SM - Fe staining 34.3m - J - 57° - PL - R to SM - Fe staining 34.6m - J - 63° - PL - R to SM - Fe staining 35.5m - J - 78° - PL - SM - clay 35.8m - J - 81° - U to PL - SM - clay				
40	37.4-55.0 ft SANDSTONE, slightly weathered, thinly bedded, gray and tan, iron oxide staining, fine grained to medium grained, calcareous, R-3 to R-4		8296.2									
45				R-5	20.0							
50								47.7m - J - 34° - U - R - calcite 48.8m - J - 30° - U - R - Fe staining				

Log continued on next page

DRILLING COMPANY: D.A. Smith Drilling  
 DRILLER: Darryl Smith

GA INSPECTOR: J. Kugel  
 CHECKED BY: R. March  
 DATE: 7/1/2013



PROJECT: Marathon - 32C Pond  
PROJECT NUMBER: 130-0253  
DRILLED DEPTH: 185.0 ft  
LOCATION: West of 32C Pond

# RECORD OF COREHOLE MW-3 (Initial)

DRILL METHOD: Air Rotary/Air Coring  
DRILL RIG: SIMCO 9100  
DRILL DATE: 6/13/2013 8:06:05 AM

COORDINATES: not surveyed  
GS ELEVATION: not surveyed  
TOC ELEVATION: not surveyed

SHEET 2 of 4

INCLINATION: -90  
DEPTH W.L.: N/A  
ELEVATION W.L.: N/A  
DATE W.L.: N/A

DEPTH (ft)	ROCK TYPE		J-Joint Fr-Fracture RB-Rubble BF-Bedding										FO-Foliation PL-Planar C-Curved U-Undulating		ST-Stepped I-Irregular P-Polished K-Slickensided		SM-Smooth R-Rough VR-V. Rough Fr-Fracture		CA-Calcite CL-Clay CT-Contact RD-Redrilled Fe-Iron Oxides		WELL CONSTRUCTION DETAILS	
	DESCRIPTION	GRAPHIC LOG	ELEV. (ft)	RUN NO.	CORE RECOVERY (ft)	RQD %	FRACTURES PER FOOT	DISCONTINUITY DATA		TYPE and SURFACE DESCRIPTION	WELL GRAPHICS	WELL CONSTRUCTION DETAILS										
50	37.4-55.0 ft SANDSTONE, slightly weathered, thinly bedded, gray and tan, iron oxide staining, fine grained to medium grained, calcareous, R-3 to R-4 <i>(Continued)</i>			R-5	20.0					50m - J - 84° - PL - R - clay 50.3m - J - 82° - PL - R - Fe staining 51.1m - J - 81° - PL - R - clay 51.2m - J - 84° - U - R - clay  52.9m - J - 88° - PL - R												
55	55.0-61.0 ft Silty SANDSTONE, slightly weathered, thinly bedded, gray and tan, iron oxide staining, fine grained to medium grained, calcareous, R-3 to R-4		8278.7		R-6	6.0				54.5m - J - 39° - PL - R - Fe staining  55.6m - RB - 30° - ST to U - R - clay and gravel 56.4m - RB - 90° - ST to U - R - clay and gravel 57.5m - J - 75° - ST to U - R - Fe flakes platy 57.8m - RB - 75° - ST to U - R - clay and gravel 59m - J - 62° - PL - R to SM - clay 59.5m - J - 79° - U to PL - R - clay 60.5m - RB - 70° - ST to U - R - clay and gravel 60.8m - J - 81° - U to PL - SM - clay 62.1m - J - 79° - I - R - oxide staining 62.6m - RB - 84° - I - VR - clay and gravel												
60	61.0-87.0 ft SILICEOUS SANDSTONE, slightly weathered to moderately weathered, thinly bedded, gray, iron oxide staining, fine grained to medium grained, R-2 to R-3		8272.7							64.1m - J - 84° - I - R - oxide staining 64.3m - J - 76° - PL - R - sand 64.6m - J - 84° - U - R - clay 64.9m - J - 80° - U - R - clay 65.1m - J - 82° - U - R - clay 65.2m - J - 83° - U - R - clean 65.5m - J - 79° - PL - R - cemented 65.9m - J - 82° - C - VR - clean												
65	61 ft: <i>Rods getting stuck due to build up of cuttings in annulus. Began adding water to facilitate borehole advancement.</i>			R-7	13.6					68.9m - J - 81° - I - VR - oxide staining 69.2m - J - 79° - C - R - sand 69.3m - J - 79° - I - R - sand 69.5m - J - 85° - U - R - sand 69.9m - J - 74° - U - R - oxide staining 70.2m - RB - 58° - I - R - clay and gravel												
70										73.5m - RB - 28° - PL - R - Fe stained												
75										79.4m - J - 87° - rolled core												
80										84.7m - J - 74° - I - R - oxide staining												
85			8246.7	R-8	13.5																	
90	87.0-92.5 ft NO CORE RECOVERED																					
95	92.5-95.0 ft SILICEOUS SANDSTONE, slightly weathered to moderately weathered, thickly bedded, gray, iron oxide staining, fine grained to coarse grained, R-3 to R-4		8241.2																			
	95.0-100.0 ft SILTSTONE, fresh rock, very thinly bedded, gray, very fine grained, R-1 to R-2		8238.7																			
	95 ft: <i>Highly fractured zone with breaks along lamination.</i>			R-9	20.0																	
100	Log continued on next page																					

DRILLING COMPANY: D.A. Smith Drilling  
DRILLER: Darryl Smith

GA INSPECTOR: J. Kugel  
CHECKED BY: R. March  
DATE: 7/1/2013



PROJECT: Marathon - 32C Pond  
PROJECT NUMBER: 130-0253  
DRILLED DEPTH: 185.0 ft  
LOCATION: West of 32C Pond

# RECORD OF COREHOLE MW-3 (Initial)

DRILL METHOD: Air Rotary/Air Coring  
DRILL RIG: SIMCO 9100  
DRILL DATE: 6/13/2013 8:06:05 AM

COORDINATES: not surveyed  
GS ELEVATION: not surveyed  
TOC ELEVATION: not surveyed

SHEET 3 of 4

INCLINATION: -90  
DEPTH W.L.: N/A  
ELEVATION W.L.: N/A  
DATE W.L.: N/A

DEPTH (ft)	ROCK TYPE		WELL CONSTRUCTION DETAILS									
	DESCRIPTION	GRAPHIC LOG	J-Joint Fr-Fracture RB-Rubble BF-Bedding		FO-Foliation PL-Planar C-Curved U-Undulating		ST-Stepped I-Irregular P-Polished K-Slickensided		SM-Smooth R-Rough VR-V.Rough Fr-Fracture		CA-Calcite CL-Clay CT-Contact RD-Redrilled Fe-Iron Oxides	
			ELEV. (ft)	RUN NO.	CORE RECOVERY (in)	RQD %	FRACTURES PER FOOT	TYPE and SURFACE DESCRIPTION	WELL GRAPHICS	WELL CONSTRUCTION DETAILS		
100	100.0-112.0 ft SILTCEOUS SANDSTONE, fresh rock, medium bedded, wavy, fossiliferous, gray brown and brown, iron oxide staining, fine grained to coarse grained, R-2 to R-3		8233.7									
105				R-9	20.0							
110			8221.7					111.2m - J - 60° - U - VR - Fe staining				
115	112.0-124.0 ft SILTSTONE, fresh rock, very thinly bedded, gray, very fine grained, R-3 to R-4											
120	117 ft: Evidence of water in fault zones.			R-10	8.9			116.6m - J - 58° - I - R - clean 117.7m - RB - 9° - PL - R - Fe staining 119.4m - RB - 9° - U - R - Fe staining				
125	124.0-132.4 ft SANDSTONE, fresh rock, medium, gray, very fine grained to medium grained, R-4 to R-5		8209.7					123.3m - J - 38° - PL - R - oxide staining				
130				R-11	11.0			128.2m - J - 73° - U - R - oxide staining				
135	132.4-135.0 ft SILTSTONE, fresh rock, very thinly bedded, fossiliferous, olive, very fine grained, R-2 to R-3, Interbedded with coal		8201.3					132.4m - J - 78° - PL - SM - oxide staining 133.4m - J - 80° - U - SM - clean 134.2m - J - 78° - PL - SM - calcite 134.4m - RB - 79° - I - VR - rubble				
140	135.0-154.0 ft SANDSTONE, fresh rock, thinly foliated, wavy, gray, fine grained, R-3 to R-4		8198.7					135.6m - BF - 80° - U - SM - clean 136.1m - BF - 80° - C - R - clean 136.2m - BF - 76° - U - R - clean 136.4m - BF - 76° - U to PL - R - Fe staining 137.2m - BF - 70° - PL - SM - Fe staining				
145	138 ft: Lost water and air circulation.			R-12	19.0			139.1m - J - 68° - PL - R - calcite 139.2m - J - 81° - U - R - Fe staining 142.7m - J - 84° - PL - R - clean 143.5m - J - 90° - U to PL - R - pyrite 143.9m - J - 86° - U - SM - oxide staining				
150								146.1m - J - 76° - PL - R - clean 146.6m - RB - 84° - I - VR - rubble 147.3m - J - 72° - I - VR - clean 147.5m - RB - 86° - C - VR - rubble 148.1m - RB - 80° - I - R - rubble 148.8m - BF - 80° - PL - R - clean 149.3m - BF - 83° - I - R - clean				

Log continued on next page

DRILLING COMPANY: D.A. Smith Drilling  
DRILLER: Darryl Smith

GA INSPECTOR: J. Kugel  
CHECKED BY: R. March  
DATE: 7/1/2013





PROJECT: Marathon - 32C Pond  
 PROJECT NUMBER: 130-0253  
 DRILLED DEPTH: 185.0 ft  
 LOCATION: West of 32C Pond

## RECORD OF COREHOLE MW-3 (Initial)

DRILL METHOD: Air Rotary/Air Coring  
 DRILL RIG: SIMCO 9100  
 DRILL DATE: 6/13/2013 8:06:05 AM

COORDINATES: not surveyed  
 GS ELEVATION: not surveyed  
 TOC ELEVATION: not surveyed

SHEET 4 of 4

INCLINATION: -90  
 DEPTH W.L.: N/A  
 ELEVATION W.L.: N/A  
 DATE W.L.: N/A

DEPTH (ft)	ROCK TYPE		GRAPHIC LOG	WELL CONSTRUCTION DETAILS														
	DESCRIPTION	ELEV. (ft)		RUN NO.	CORE RECOVERY (ft)	J-Joint Fr-Fracture RB-Rubble BF-Bedding		FO-Foliation PL-Planar C-Curved U-Undulating		ST-Stepped I-Irregular P-Polished K-Slickensided		SM-Smooth R-Rough VR-V.Rough Fr-Fracture		CA-Calcite CL-Clay CT-Contact RD-Redrilled Fe-Iron Oxides				
						RQD %	FRACTURES PER FOOT	DISCONTINUITY DATA				TYPE and SURFACE DESCRIPTION	WELL GRAPHICS	WELL CONSTRUCTION DETAILS				
150	135.0-154.0 ft SANDSTONE, fresh rock, thinly foliated, wavy, gray, fine grained, R-3 to R-4 (Continued)			R-12	19.0	80	60	40	20	2	4	6	8	10	149.6m - BF - 84° - I - R - clean 149.8m - BF - 84° - I - R - clean 151.2m - RB - 82° - I - R - clay and gravel			
		8179.7													153.1m - BF - 80° - PL - R - Fe staining	127-181.4 feet - 10/20 Filter Sand		
155	154.0-185.0 ft SILICEOUS SANDSTONE, fresh rock to slightly weathered, thickly bedded, interbedded, brown gray and light gray, fine grained to medium grained, R-4														157.6m - J - 41° - PL - R - clean	Centralizer		
160															161m - J - 78° - I - R - clean			
				R-13	20.0										162.8m - J - 82° - U to PL - R - silt			
165															164.2m - RB - 75° - I - R - rubble 164.4m - J - 28° - U to PL - SM - clean	Centralizer		
															165.6m - J - 85° - ST to U - SM - clean 165.7m - J - 72° - PL - R - oxide staining 166.2m - J - 80° - U to PL - R - silica			
170															171.3m - J - 32° - C - SM - clean			
175																Centralizer		
180				R-14	11.0											181-181.4 feet - 2" diameter, Schedule 80, PVC, Flush Threaded, End Cap		
185		8148.7														181.4-185 feet - 10/20 Filter Sand Backfill		

JUNE 2013 MOC ROCK LITHOLOGY/WELL IMPORT.GPJ 2013 AMULSAR.GDT 9/12/13

DRILLING COMPANY: D.A. Smith Drilling  
 DRILLER: Darryl Smith

GA INSPECTOR: J. Kugel  
 CHECKED BY: R. March  
 DATE: 7/1/2013



PROJECT: Marathon - 32C Pond  
 PROJECT NUMBER: 130-0253  
 DRILLED DEPTH: 215.0 ft  
 LOCATION: 9 ft south of MW- 3 (Initial)

# RECORD OF COREHOLE MW-3 (New)

DRILL METHOD: Air Rotary  
 DRILL RIG: SIMCO 9100  
 DRILL DATE: 6/22/2013 3:10:47 PM

COORDINATES:  
 N:1,643,050.40 E: 2,240,699.00  
 GS ELEVATION: 8333.7 ft  
 TOC ELEVATION: 8333.4 ft

SHEET 1 of 5

INCLINATION: -90  
 DEPTH W.L.: 186.65  
 ELEVATION W.L.: 8146.72  
 DATE W.L.: 8/15/2013

DEPTH (ft)	ROCK TYPE		J-Joint Fr-Fracture RB-Rubble BF-Bedding										FO-Foliation PL-Planar C-Curved U-Undulating		ST-Stepped I-Irregular P-Polished K-Slickensided		SM-Smooth R-Rough VR-V.Rough Fr-Fracture		CA-Calcite CL-Clay CT-Contact RD-Redrilled Fe-Iron Oxides		WELL CONSTRUCTION DETAILS	
	DESCRIPTION	GRAPHIC LOG	ELEV. (ft)	RUN NO.	CORE RECOVERY (in)	RQD %	FRACTURES PER FOOT	DISCONTINUITY DATA		WELL GRAPHICS	WELL CONSTRUCTION DETAILS											
								TYPE and SURFACE DESCRIPTION														
0	0.0-163.0 ft NO CORE See MW-3 (initial) drillhole for detailed log																					
5																						
10																						
15																						
20																						
25																						
30																						
35																						
40																						
45																						
50																						


0.33-181.4 feet - 2"  
diameter, Schedule 80, PVC,  
Flush Threaded, Casing

0-174 feet - Portland, Type  
2, with 5% bentonite gel

Log continued on next page

DRILLING COMPANY: D.A. Smith Drilling  
 DRILLER: Darryl Smith

GA INSPECTOR: J. Kugel  
 CHECKED BY: R. March  
 DATE: 7/1/2013



PROJECT: Marathon - 32C Pond  
 PROJECT NUMBER: 130-0253  
 DRILLED DEPTH: 215.0 ft  
 LOCATION: 9 ft south of MW- 3 (Initial)

# RECORD OF COREHOLE MW-3 (New)

DRILL METHOD: Air Rotary  
 DRILL RIG: SIMCO 9100  
 DRILL DATE: 6/22/2013 3:10:47 PM

COORDINATES:  
 N: 1,643,050.40 E: 2,240,699.00  
 GS ELEVATION: 8333.7 ft  
 TOC ELEVATION: 8333.4 ft

SHEET 2 of 5

INCLINATION: -90  
 DEPTH W.L.: 186.65  
 ELEVATION W.L.: 8146.72  
 DATE W.L.: 8/15/2013

DEPTH (ft)	ROCK TYPE												WELL CONSTRUCTION DETAILS	
	DESCRIPTION	GRAPHIC LOG	J-Joint Fr-Fracture RB-Rubble BF-Bedding		FO-Foliation PL-Planar C-Curved U-Undulating		ST-Stepped I-Irregular P-Polished K-Slickensided		SM-Smooth R-Rough VR-V.Rough Fr-Fracture		CA-Calcite CL-Clay CT-Contact RD-Redrilled Fe-Iron Oxides		WELL GRAPHICS	WELL CONSTRUCTION DETAILS
			ELEV. (ft)	RUN NO.	CORE RECOVERY (ft)	RQD %	FRACTURES PER FOOT	DISCONTINUITY DATA						
								TYPE and SURFACE DESCRIPTION						
50	0.0-163.0 ft NO CORE (Continued)													
55														
60														
65														
70														
75														
80														
85														
90														
95	93 ft: Check for water: wait 10 minutes, air surge, watch discharge													
100	Log continued on next page													

93 ft: Check for water: wait 10  
 minutes, air surge, watch discharge

Log continued on next page

DRILLING COMPANY: D.A. Smith Drilling  
 DRILLER: Darryl Smith

GA INSPECTOR: J. Kugel  
 CHECKED BY: R. March  
 DATE: 7/1/2013





PROJECT: Marathon - 32C Pond  
 PROJECT NUMBER: 130-0253  
 DRILLED DEPTH: 215.0 ft  
 LOCATION: 9 ft south of MW- 3 (Initial)

# RECORD OF COREHOLE MW-3 (New)

DRILL METHOD: Air Rotary  
 DRILL RIG: SIMCO 9100  
 DRILL DATE: 6/22/2013 3:10:47 PM

COORDINATES:  
 N: 1,643,050.40 E: 2,240,699.00  
 GS ELEVATION: 8333.7 ft  
 TOC ELEVATION: 8333.4 ft

SHEET 3 of 5

INCLINATION: -90  
 DEPTH W.L.: 186.65  
 ELEVATION W.L.: 8146.72  
 DATE W.L.: 8/15/2013

DEPTH (ft)	ROCK TYPE												WELL CONSTRUCTION DETAILS		
	DESCRIPTION	GRAPHIC LOG	J-Joint Fr-Fracture RB-Rubble BF-Bedding		FO-Foliation PL-Planar C-Curved U-Undulating		ST-Stepped I-Irregular P-Polished K-Slickensided		SM-Smooth R-Rough VR-V.Rough Fr-Fracture		CA-Calcite CL-Clay CT-Contact RD-Redrilled Fe-Iron Oxides		WELL GRAPHICS	WELL CONSTRUCTION DETAILS	
			ELEV. (ft)	RUN NO.	CORE RECOVERY (ft)	RQD %	FRACTURES PER FOOT	DISCONTINUITY DATA							
								TYPE and SURFACE DESCRIPTION							
100	0.0-163.0 ft NO CORE (Continued)				80	60	40	20	2	4	6	8	10		
103	103 ft: Check for water: wait 10 minutes, air surge, watch discharge														
105															
108	108.0 ft Decreased dust from diverter														
110															
113	113.0 ft Finer material, iron staining, moist enough to form clod, decreased dust from diverter 113 ft: Check for water: wait 10 minutes, air surge, watch discharge														
115															
120															
123	123 ft: Check for water: wait 10 minutes, air surge, watch discharge														
125															
130															
133	133 ft: Check for water: wait 10 minutes, air surge, watch discharge														
135	135.0 ft Decrease in cuttings return, less dust from diverter														
140															
143	143.0 ft Recovering rock chips from hole without advancing bit, indicates loose zone 143 ft: Check for water: wait 10 minutes, air surge, watch discharge														
145															
150	Log continued on next page														

JUNE 2013 MOC ROCK LITHOLOGY/WELL IMPORT.GPJ 2013 AMULSAR.GDT 9/12/13

DRILLING COMPANY: D.A. Smith Drilling  
 DRILLER: Darryl Smith

GA INSPECTOR: J. Kugel  
 CHECKED BY: R. March  
 DATE: 7/1/2013



PROJECT: Marathon - 32C Pond  
 PROJECT NUMBER: 130-0253  
 DRILLED DEPTH: 215.0 ft  
 LOCATION: 9 ft south of MW- 3 (Initial)

# RECORD OF COREHOLE MW-3 (New)

DRILL METHOD: Air Rotary  
 DRILL RIG: SIMCO 9100  
 DRILL DATE: 6/22/2013 3:10:47 PM

COORDINATES:  
 N:1,643,050.40 E: 2,240,699.00  
 GS ELEVATION: 8333.7 ft  
 TOC ELEVATION: 8333.4 ft

SHEET 4 of 5

INCLINATION: -90  
 DEPTH W.L.: 186.65  
 ELEVATION W.L.: 8146.72  
 DATE W.L.: 8/15/2013

DEPTH (ft)	ROCK TYPE												WELL CONSTRUCTION DETAILS	
	DESCRIPTION	GRAPHIC LOG	J-Joint Fr-Fracture RB-Rubble BF-Bedding		FO-Foliation PL-Planar C-Curved U-Undulating		ST-Stepped I-Irregular P-Polished K-Slickensided		SM-Smooth R-Rough VR-V.Rough Fr-Fracture		CA-Calcite CL-Clay CT-Contact RD-Redrilled Fe-Iron Oxides		WELL GRAPHICS	WELL CONSTRUCTION DETAILS
			ELEV. (ft)	RUN NO.	CORE RECOVERY (ft)	RQD %	FRACTURES PER FOOT	DISCONTINUITY DATA						
								TYPE and SURFACE DESCRIPTION						
150	0.0-163.0 ft NO CORE (Continued)													
153	153 ft: Check for water: wait 10 minutes, air surge, watch discharge													
155														
160														
163	163 ft: Check for water: wait 10 minutes, air surge, watch discharge		8170.7											
165														
170														
175													174-175 feet - Fine Sand	
180													175-180 feet - Time Released Bentonite Chips	
185													180-211.7 feet - 10/20 Filter Sand	
190													Centralizer	
195													181.4-211.4 feet - 2" diameter, Schedule 80, PVC, 0.010" Milled Slotted, Flush Threaded, Screen	
200													Centralizer	

Log continued on next page

Log continued on next page

DRILLING COMPANY: D.A. Smith Drilling  
 DRILLER: Darryl Smith

GA INSPECTOR: J. Kugel  
 CHECKED BY: R. March  
 DATE: 7/1/2013



PROJECT: Marathon - 32C Pond  
 PROJECT NUMBER: 130-0253  
 DRILLED DEPTH: 215.0 ft  
 LOCATION: 9 ft south of MW- 3 (Initial)

## RECORD OF COREHOLE MW-3 (New)

DRILL METHOD: Air Rotary  
 DRILL RIG: SIMCO 9100  
 DRILL DATE: 6/22/2013 3:10:47 PM

COORDINATES:  
 N:1,643,050.40 E: 2,240,699.00  
 GS ELEVATION: 8333.7 ft  
 TOC ELEVATION: 8333.4 ft

SHEET 5 of 5

INCLINATION: -90  
 DEPTH W.L.: 186.65  
 ELEVATION W.L.: 8146.72  
 DATE W.L.: 8/15/2013

DEPTH (ft)	ROCK TYPE		WELL CONSTRUCTION DETAILS													
	DESCRIPTION	GRAPHIC LOG	J-Joint Fr-Fracture RB-Rubble BF-Bedding		Fracture		FO-Foliation PL-Planar C-Curved U-Undulating		ST-Stepped I-Irregular P-Polished K-Slickensided		SM-Smooth R-Rough VR-V.Rough Fr-Fracture		CA-Calcite CL-Clay CT-Contact RD-Redrilled Fe-Iron Oxides		WELL GRAPHICS	WELL CONSTRUCTION DETAILS
			ELEV. (ft)	RUN NO.	CORE RECOVERY (ft)	RQD %	FRACTURES PER FOOT	DISCONTINUITY DATA								
								TYPE and SURFACE DESCRIPTION								
200																
205																
210																
215																



DRILLING COMPANY: D.A. Smith Drilling  
 DRILLER: Darryl Smith

GA INSPECTOR: J. Kugel  
 CHECKED BY: R. March  
 DATE: 7/1/2013



PROJECT: Marathon - 32C Pond  
 PROJECT NUMBER: 130-0253  
 DRILLED DEPTH: 240.0 ft  
 LOCATION: NW corner of 32C Pad

# RECORD OF COREHOLE MW-4

DRILL METHOD: Air Rotary  
 DRILL RIG: SIMCO 9100  
 DRILL DATE: 6/24/2013 2:32:03 PM

COORDINATES:  
 N: 1,643,111.70 E: 2,240,484.70  
 GS ELEVATION: 8333.5 ft  
 TOC ELEVATION: 8336.5 ft

SHEET 1 of 5

INCLINATION: -90  
 DEPTH W.L.: 194.3  
 ELEVATION W.L.: 8142.17  
 DATE W.L.: 8/15/2013

DEPTH (ft)	ROCK TYPE												WELL CONSTRUCTION DETAILS	
	DESCRIPTION	GRAPHIC LOG	J-Joint Fr-Fracture RB-Rubble BF-Bedding		FO-Foliation PL-Planar C-Curved U-Undulating		ST-Stepped I-Irregular P-Polished K-Slickensided		SM-Smooth R-Rough VR-V.Rough Fr-Fracture		CA-Calcite CL-Clay CT-Contact RD-Redrilled Fe-Iron Oxides		WELL GRAPHICS	WELL CONSTRUCTION DETAILS
			ELEV. (ft)	RUN NO.	CORE RECOVERY (ft)	RQD %	FRACTURES PER FOOT	DISCONTINUITY DATA						
								TYPE and SURFACE DESCRIPTION						
0	0.0-32.0 ft FILL													
5														
10														
15														
20	20 ft: Difficult drilling, collapsing fill													
25														
30	30 ft: Roots in cuttings													
32.0-36.0 ft SOIL			8301.5											
36.0-54.0 ft SANDSTONE, tan			8297.5											
40														
45														
50														

+2.97-189.2 feet - 2" diameter, Schedule 80, PVC, Flush Threaded, Casing

0-176.5 feet - Portland, Type 2, with 5% bentonite gel

JUNE 2013 MOC ROCK LITHOLOGY/WELL IMPORT.GPJ 2013 AMULSAR.GDT 9/12/13

DRILLING COMPANY: D.A. Smith Drilling  
 DRILLER: Darryl Smith

GA INSPECTOR: J. Kugel  
 CHECKED BY: R. March  
 DATE: 7/1/2013



PROJECT: Marathon - 32C Pond  
 PROJECT NUMBER: 130-0253  
 DRILLED DEPTH: 240.0 ft  
 LOCATION: NW corner of 32C Pad

# RECORD OF COREHOLE MW-4

DRILL METHOD: Air Rotary  
 DRILL RIG: SIMCO 9100  
 DRILL DATE: 6/24/2013 2:32:03 PM

COORDINATES:  
 N:1,643,111.70 E: 2,240,484.70  
 GS ELEVATION: 8333.5 ft  
 TOC ELEVATION: 8336.5 ft

SHEET 2 of 5

INCLINATION: -90  
 DEPTH W.L.: 194.3  
 ELEVATION W.L.: 8142.17  
 DATE W.L.: 8/15/2013

DEPTH (ft)	ROCK TYPE		WELL CONSTRUCTION DETAILS									
	DESCRIPTION	GRAPHIC LOG	J-Joint Fr-Fracture RB-Rubble BF-Bedding		FO-Foliation PL-Planar C-Curved U-Undulating		ST-Stepped I-Irregular P-Polished K-Slickensided		SM-Smooth R-Rough VR-V.Rough Fr-Fracture		CA-Calcite CL-Clay CT-Contact RD-Redrilled Fe-Iron Oxides	
			ELEV. (ft)	RUN NO.	CORE RECOVERY (in)	RQD %	FRACTURES PER FOOT	TYPE and SURFACE DESCRIPTION	WELL GRAPHICS	WELL CONSTRUCTION DETAILS		
50	36.0-54.0 ft SANDSTONE, tan (Continued)											
55	54.0-59.0 ft Silty SANDSTONE, tan and light gray, very fine grained to medium grained		8279.5									
60	59.0-84.0 ft SANDSTONE, red tan, iron oxide staining, fine grained to medium grained		8274.5									
70												
75												
80	79 ft: Brief loss of circulation, came back											
85	84.0-97.0 ft Silty SANDSTONE, light gray, very fine grained to medium grained		8249.5									
90												
95												
100	97.0-115.0 ft SANDSTONE, tan, iron oxide staining, fine grained to medium grained		8236.5									

Log continued on next page

DRILLING COMPANY: D.A. Smith Drilling  
 DRILLER: Darryl Smith

GA INSPECTOR: J. Kugel  
 CHECKED BY: R. March  
 DATE: 7/1/2013



PROJECT: Marathon - 32C Pond  
 PROJECT NUMBER: 130-0253  
 DRILLED DEPTH: 240.0 ft  
 LOCATION: NW corner of 32C Pad

# RECORD OF COREHOLE MW-4

DRILL METHOD: Air Rotary  
 DRILL RIG: SIMCO 9100  
 DRILL DATE: 6/24/2013 2:32:03 PM

COORDINATES:  
 N:1,643,111.70 E: 2,240,484.70  
 GS ELEVATION: 8333.5 ft  
 TOC ELEVATION: 8336.5 ft

SHEET 3 of 5

INCLINATION: -90  
 DEPTH W.L.: 194.3  
 ELEVATION W.L.: 8142.17  
 DATE W.L.: 8/15/2013

DEPTH (ft)	ROCK TYPE												WELL CONSTRUCTION DETAILS	
	DESCRIPTION	GRAPHIC LOG	J-Joint Fr-Fracture RB-Rubble BF-Bedding		FO-Foliation PL-Planar C-Curved U-Undulating		ST-Stepped I-Irregular P-Polished K-Slickensided		SM-Smooth R-Rough VR-V.Rough Fr-Fracture		CA-Calcite CL-Clay CT-Contact RD-Redrilled Fe-Iron Oxides		WELL GRAPHICS	WELL CONSTRUCTION DETAILS
			ELEV. (ft)	RUN NO.	CORE RECOVERY (ft)	RQD %	FRACTURES PER FOOT				DISCONTINUITY DATA			
							TYPE and SURFACE DESCRIPTION							
100	97.0-115.0 ft SANDSTONE, tan, iron oxide staining, fine grained to medium grained <i>(Continued)</i>													
105														
110														
115	115.0-150.0 ft Silty SANDSTONE, light gray, very fine grained to medium grained		8218.5											
120														
125	124 ft: Oxide staining													
130														
135														
140														
145														
150														

Log continued on next page

Log continued on next page

DRILLING COMPANY: D.A. Smith Drilling  
 DRILLER: Darryl Smith

GA INSPECTOR: J. Kugel  
 CHECKED BY: R. March  
 DATE: 7/1/2013





PROJECT: Marathon - 32C Pond  
 PROJECT NUMBER: 130-0253  
 DRILLED DEPTH: 240.0 ft  
 LOCATION: NW corner of 32C Pad

# RECORD OF COREHOLE MW-4

DRILL METHOD: Air Rotary  
 DRILL RIG: SIMCO 9100  
 DRILL DATE: 6/24/2013 2:32:03 PM

COORDINATES:  
 N:1,643,111.70 E: 2,240,484.70  
 GS ELEVATION: 8333.5 ft  
 TOC ELEVATION: 8336.5 ft

SHEET 4 of 5

INCLINATION: -90  
 DEPTH W.L.: 194.3  
 ELEVATION W.L.: 8142.17  
 DATE W.L.: 8/15/2013

DEPTH (ft)	ROCK TYPE		WELL CONSTRUCTION DETAILS									
	DESCRIPTION	GRAPHIC LOG	J-Joint Fr-Fracture RB-Rubble BF-Bedding		FO-Foliation PL-Planar C-Curved U-Undulating		ST-Stepped I-Irregular P-Polished K-Slickensided		SM-Smooth R-Rough VR-V.Rough Fr-Fracture		CA-Calcite CL-Clay CT-Contact RD-Redrilled Fe-Iron Oxides	
			ELEV. (ft)	RUN NO.	CORE RECOVERY (in)	RQD %	FRACTURES PER FOOT	TYPE and SURFACE DESCRIPTION	WELL GRAPHICS	WELL CONSTRUCTION DETAILS		
150	150.0-190.0 ft SANDSTONE, gray brown, no staining, fine grained to medium grained		8183.5									
155												
160												
165												
170												
175												
180												
185												
190	190.0-240.0 ft Silty SANDSTONE, gray, very fine grained to medium grained		8143.5									
195												
200												

Log continued on next page

176.5-177.5 feet - Fine Sand

177.5-183.0 feet - Time  
Released Bentonite Chips

Centralizer

DRILLING COMPANY: D.A. Smith Drilling  
 DRILLER: Darryl Smith

GA INSPECTOR: J. Kugel  
 CHECKED BY: R. March  
 DATE: 7/1/2013



PROJECT: Marathon - 32C Pond  
 PROJECT NUMBER: 130-0253  
 DRILLED DEPTH: 240.0 ft  
 LOCATION: NW corner of 32C Pad

# RECORD OF COREHOLE MW-4

DRILL METHOD: Air Rotary  
 DRILL RIG: SIMCO 9100  
 DRILL DATE: 6/24/2013 2:32:03 PM

COORDINATES:  
 N:1,643,111.70 E: 2,240,484.70  
 GS ELEVATION: 8333.5 ft  
 TOC ELEVATION: 8336.5 ft

SHEET 5 of 5

INCLINATION: -90  
 DEPTH W.L.: 194.3  
 ELEVATION W.L.: 8142.17  
 DATE W.L.: 8/15/2013

DEPTH (ft)	ROCK TYPE		WELL CONSTRUCTION DETAILS												
	DESCRIPTION	GRAPHIC LOG	J-Joint Fr-Fracture RB-Rubble BF-Bedding		FO-Foliation PL-Planar C-Curved U-Undulating		ST-Stepped I-Irregular P-Polished K-Slickensided		SM-Smooth R-Rough VR-V.Rough Fr-Fracture		CA-Calcite CL-Clay CT-Contact RD-Redrilled Fe-Iron Oxides		WELL GRAPHICS	WELL CONSTRUCTION DETAILS	
			ELEV. (ft)	RUN NO.	CORE RECOVERY (ft)	RQD %	FRACTURES PER FOOT	DISCONTINUITY DATA							
								TYPE and SURFACE DESCRIPTION							
200	190.0-240.0 ft Silty SANDSTONE, gray, very fine grained to medium grained (Continued)				80	60	40	20	2	4	6	8	10		
205														Centralizer	
210														189.2-239.2 feet - 2" diameter, Schedule 80, PVC, 0.010" Milled Slotted, Flush Threaded, Screen	
215														Centralizer	
220														183.0-240.0 feet - 10/20 Filter Sand	
225														Centralizer	
230															
235														Centralizer	
240			8093.5											239.2-239.5 feet - 2" diameter, Schedule 80, PVC, Flush Threaded, End Cap	

JUNE 2013 MOC ROCK LITHOLOGY/WELL IMPORT.GPJ 2013 AMULSAR.GDT 9/12/13

DRILLING COMPANY: D.A. Smith Drilling  
 DRILLER: Darryl Smith


GA INSPECTOR: J. Kugel  
 CHECKED BY: R. March  
 DATE: 7/1/2013



**APPENDIX A-5**  
**MONITORING WELL CONSTRUCTION SUMMARIES**



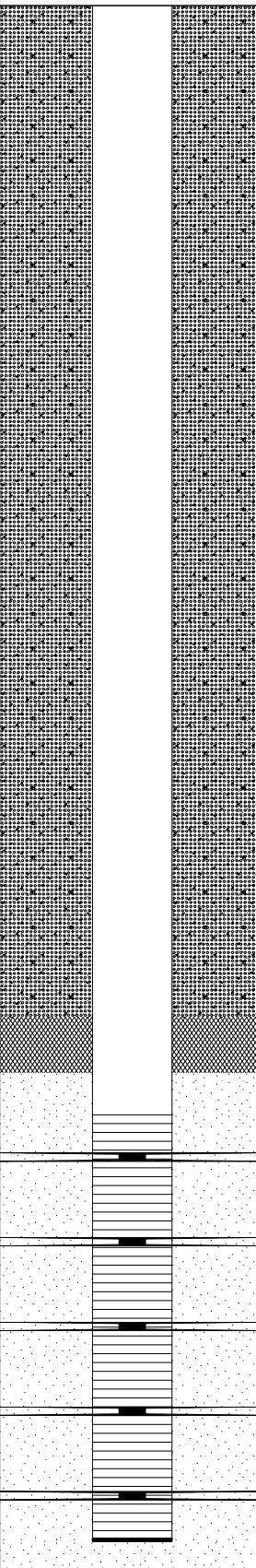

DF-WELL LOG-D IMPORT.GPJ 2013 DATATEMPLATE.GDT 9/16/13

Monitoring Well Detail		MW-1: WELL CONSTRUCTION SUMMARY											
DEPTH (ft)		Project Name: Marathon - 32C Pond Project Number: 130-0253		Coordinates: N: 1642668.8 E: 2240781.2 Elevation: 8333.2 ft									
		Borehole Drilling Summary		Well Development Summary									
		Total Depth: 170.0 ft Borehole Diameter: 5 7/8in Drilling Contractor: D.A. Smith Drilling Drill Rig Operator: Darryl Smith Drill Rig: SIMCO 9100 Drilling Method: Air Rotary/Air Coring Drilling Date: 6/18/2013 4:02:18 PM		<table><tr><th>Date</th><th>Depth to Water* (ft)</th><th>Volume Purged (gal)</th></tr><tr><td>07/08/2013</td><td>102.84</td><td>12.0</td></tr><tr><td>07/09/2013</td><td>102.95</td><td>91.0</td></tr></table>	Date	Depth to Water* (ft)	Volume Purged (gal)	07/08/2013	102.84	12.0	07/09/2013	102.95	91.0
Date	Depth to Water* (ft)	Volume Purged (gal)											
07/08/2013	102.84	12.0											
07/09/2013	102.95	91.0											
		Well Design and Specifications		Development Notes:  * Depth to water referenced from top of PVC casing. - 7/8/13 - Groundwater Purged Using a Bailer - 7/9/13 - Groundwater Purged Using a Pump									
		0-88.0ft: Grout 0.001-97.7ft: Casing 88-89.0ft: Fine Sand 89-94.0ft: Bentonite 94.001-138.0ft: 10/20 Filter Sand 97.7-137.7ft: Screen 102.2-103.2ft: Centralizer 112.2-113.2ft: Centralizer 122.2-123.2ft: Centralizer 132.2-133.2ft: Centralizer 137.7-138.0ft: End Cap 138-142.0ft: 10/20 Filter Sand 142-149.0ft: Bentonite 149-170.0ft: 10/20 Filter Sand											
		Quantity	Description										
		2.98 ft	Stickup										
		1	Protective Casing Type: 6" diameter, square, steel, lockable										
		5	Riser Type: 2" diameter, 20' long, Sch. 80, PVC, Flush Thread										
		3	Screen Type: 2" diameter, 10' long, Sch. 80, PVC, 0.010" Slotted, Flush Thread										
		4	Centralizer Type: 2" diameter, Stainless Steel										
		1	End Cap Type: 2" diameter, Sch 80, PVC, Flush Thread										
		100 gallons	Grout Seal Type: Portland Type 2 Cement with 5% Bentonite Gel										
		1.5	Bentonite Seal Type: 5 gallon bucket - 1/4", time release, pellets										
		17	Sand Pack Type: 50lb bags, 10/20 Filter										
		General Comments:											
		Completed advancing the borehole on 6/19/2013 at 15:30 hours											
		Completed reaming the borehole on 6/20/2013 at 11:05 hours											
		Completed sand and bentonite backfill via tremie on 6/21/2013 at 08:00 hours											
		Completed grout backfill via tremie on 6/21/2013 at 09:20 hours											
		LOGGED BY: J. Kugel CHECKED BY: R. March DATE: 7/1/2013											
													

DF-WELL LOG-D IMPORT.GPJ 2013 DATATEMPLATE.GDT 9/18/13

Monitoring Well Detail		ELEVATION (ft)	MW-2: WELL CONSTRUCTION SUMMARY				
			Project Name: Marathon - 32C Pond		Coordinates: N: 1643125.9 E: 2240955.8		
			Project Number: 130-0253		Elevation: 8364.1 ft		
DEPTH (ft)		ELEVATION (ft)	Borehole Drilling Summary		Well Development Summary		
			Total Depth: 197.0 ft Borehole Diameter: 5 7/8in Drilling Contractor: D.A. Smith Drilling Drill Rig Operator: Darryl Smith Drill Rig: SIMCO 9100 Drilling Method: Air Rotary Drilling Date: 6/23/2013 9:20:59 AM		Date	Depth to Water* (ft)	Volume Purged (gal)
					07/11/2013	NM	40.0
					07/11/2013	171.30	60.0
			Well Design and Specifications		Development Notes: * Depth to water referenced from top of PVC casing. - Groundwater Purged Using Both a Bailer and Pump		
			0-152.0ft: Grout 0.001-161.9ft: Casing 152-153.0ft: Fine Sand 152.001-192.2ft: 10/20 Filter Sand 153-158.0ft: Bentonite 161.9-191.9ft: Screen 166.4-167.4ft: Centralizer 176.4-177.4ft: Centralizer 186.4-187.4ft: Centralizer 191.9-192.2ft: End Cap 192.2-197.0ft: 10/20 Filter Sand				
			Quantity	Description			
			2.70 ft	Stickup			
			1	Protective Casing Type: 6" diameter, square, steel, lockable			
			8	Riser Type: 2" diameter, 20' long, Sch. 80, PVC, Flush Thread			
			3	Screen Type: 2" diameter, 10' long, Sch. 80, PVC, 0.010" Slotted, Flush Thread			
			3	Centralizer Type: 2" diameter, Stainless Steel			
			1	End Cap Type: 2" diameter, Sch 80, PVC, Flush Thread			
			300 gallons	Grout Seal Type: Portland Type 2 Cement with 5% Bentonite Gel			
			1.5	Bentonite Seal Type: 5 gallon bucket - 1/4", time release, pellets			
			13.5	Sand Pack Type: 50lb bags, 10/20 Filter			
			General Comments:				
			Completed advancing the borehole on 6/23/2013 at 14:30 hours				
			Completed flushing the borehole on 6/23/2013 at 17:15 hours				
			Completed casing and screen installation on 6/24/2013 at 08:10 hours				
			Completed sand and bentonite backfill via tremie pipe on 6/24/2013 at 09:20 hours				
			Completed grout backfill via tremie pipe on 6/24/2013 at 13:00 hours				

DF-WELL LOG-D IMPORT.GPJ 2013 DATATEMPLATE.GDT 9/16/13

Monitoring Well Detail		MW-3 (Initial): WELL CONSTRUCTION SUMMARY			
DEPTH (ft)		Project Name: Marathon - 32C Pond		Coordinates: N: 1643059 E: 2240698.5	
		Project Number: 130-0253		Elevation: 8333.7 ft	
ELEVATION (ft)		Borehole Drilling Summary		Well Development Summary	
0.0		Total Depth: 185.0 ft		Date	
5.0		Borehole Diameter: 5 7/8in			Depth to Water* (ft)
10.0		Drilling Contractor: D.A. Smith Drilling		Volume Purged (gal)	
15.0		Drill Rig Operator: Darryl Smith			Development Notes: * Depth to water referenced from top of PVC casing. - MW-3 (Initial) was decommissioned.
20.0		Drill Rig: SIMCO 9100			
25.0		Drilling Method: Air Rotary/Air Coring			
30.0		Drilling Date: 6/13/2013 8:06:05 AM			
35.0		Well Design and Specifications			
40.0		0-119.5ft: Grout			
45.0		0.01-131.0ft: Casing			
50.0		119.5-126.0ft: Bentonite			
55.0		126-127.0ft: Fine Sand			
60.0		127.0001-181.4ft: 10/20 Filter Sand			
65.0		131-181.0ft: Screen			
70.0		135.5-136.5ft: Centralizer			
75.0		145.5-146.5ft: Centralizer			
80.0		155.5-156.5ft: Centralizer			
85.0		165.5-166.5ft: Centralizer			
90.0		175.5-176.5ft: Centralizer			
95.0		181-181.4ft: End Cap			
100.0		181.4-185.0ft: 10/20 Filter Sand			
105.0		Quantity	Description		
110.0		0 ft	Stickup		
115.0		7	Riser Type: 2" diameter, 20' long, Sch. 80, PVC, Flush Thread		
120.0		5	Screen Type: 2" diameter, 10' long, Sch. 80, PVC, 0.010" Slotted, Flush Thread		
125.0		5	Centralizer Type: 2" diameter, Stainless Steel		
130.0		1	End Cap Type: 2" diameter, Sch 80, PVC, Flush Thread		
135.0		300 gallons	Grout Seal Type: Portland Type 2 Cement with 5% Bentonite Gel		
140.0		1.5	Bentonite Seal Type: 5 gallon bucket - 1/4", time release, pellets		
145.0		20.5	Sand Pack Type: 50lb bags, 10/20 Filter		
150.0		General Comments:			
155.0		Completed advancing the borehole on 6/18/2013 at 08:30 hours			
160.0		Completed casing and screen installation on 6/18/2013 at 12:10 hours			
165.0		Completed sand and bentonite backfill via tremie pipe on 6/18/2013 at 14:10 hours			
170.0		Completed grout backfill via tremie pipe on 6/19/2013 at 09:00 hours			
175.0		On 6/27/2013, PVC casing was removed to 18 feet bgs and the well was decommissioned by tremie grouting			
180.0					
LOGGED BY: J. Kugel CHECKED BY: R. March DATE: 7/1/2013					

DF-WELL LOG-D IMPORT.GPJ 2013 DATATEMPLATE.GDT 9/16/13

DEPTH (ft)	Monitoring Well Detail	ELEVATION (ft)	MW-3 (New): WELL CONSTRUCTION SUMMARY																						
			Project Name: Marathon - 32C Pond Project Number: 130-0253		Coordinates: N: 1643050.4 E: 2240699 Elevation: 8333.7 ft																				
0.0 10.0 20.0 30.0 40.0 50.0 60.0 70.0 80.0 90.0 100.0 110.0 120.0 130.0 140.0 150.0 160.0 170.0 180.0 190.0 200.0 210.0		8330 8320 8310 8300 8290 8280 8270 8260 8250 8240 8230 8220 8210 8200 8190 8180 8170 8160 8150 8140 8130	Borehole Drilling Summary		Well Development Summary																				
			Total Depth: 215.0 ft Borehole Diameter: 5 7/8in Drilling Contractor: D.A. Smith Drilling Drill Rig Operator: Darryl Smith Drill Rig: SIMCO 9100 Drilling Method: Air Rotary Drilling Date: 6/22/2013 3:10:47 PM		<u>Date</u> 07/01/2013 07/02/2013 07/08/2013 07/09/2013	<u>Depth to Water*</u> (ft) 185.87 186.71 186.80 186.12	<u>Volume Purged</u> (gal) 10.0 15.0 20.0 20.0																		
			Well Design and Specifications		Development Notes: * Depth to water referenced from top of PVC casing. - 7/1/13 - Groundwater Purged Using a Bailer - 7/2/13 - Groundwater Purged Using a Bailer - 7/8/13 - Groundwater Purged Using a Pump - 7/9/13 - Groundwater Purged Using a Pump																				
			0-174.0ft: Grout 0.001-181.4ft: Casing 174-175.0ft: Fine Sand 175-180.0ft: Bentonite 181.4-211.4ft: Screen 185.9-186.9ft: Centralizer 195.9-196.9ft: Centralizer 205.9-206.9ft: Centralizer 211.4-211.7ft: End Cap 211.7-215.0ft: 10/20 Filter Sand																						
		<table border="1"> <thead> <tr> <th>Quantity</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>-0.33 ft</td> <td>Stickup</td> </tr> <tr> <td>1</td> <td>Protective Casing Type: 6" diameter, square, steel, lockable</td> </tr> <tr> <td>9</td> <td>Riser Type: 2" diameter, 20' long, Sch. 80, PVC, Flush Thread</td> </tr> <tr> <td>3</td> <td>Screen Type: 2" diameter, 10' long, Sch. 80, PVC, 0.010" Slotted, Flush Thread</td> </tr> <tr> <td>3</td> <td>Centralizer Type: 2" diameter, Stainless Steel</td> </tr> <tr> <td>1</td> <td>End Cap Type: 2" diameter, Sch 80, PVC, Flush Thread</td> </tr> <tr> <td>420 gallons</td> <td>Grout Seal Type: Portland Type 2 Cement with 5% Bentonite Gel</td> </tr> <tr> <td>1.5</td> <td>Bentonite Seal Type: 5 gallon bucket - 1/4", time release, pellets</td> </tr> <tr> <td>10</td> <td>Sand Pack Type: 50lb bags, 10/20 Filter</td> </tr> </tbody> </table>		Quantity	Description	-0.33 ft	Stickup	1	Protective Casing Type: 6" diameter, square, steel, lockable	9	Riser Type: 2" diameter, 20' long, Sch. 80, PVC, Flush Thread	3	Screen Type: 2" diameter, 10' long, Sch. 80, PVC, 0.010" Slotted, Flush Thread	3	Centralizer Type: 2" diameter, Stainless Steel	1	End Cap Type: 2" diameter, Sch 80, PVC, Flush Thread	420 gallons	Grout Seal Type: Portland Type 2 Cement with 5% Bentonite Gel	1.5	Bentonite Seal Type: 5 gallon bucket - 1/4", time release, pellets	10	Sand Pack Type: 50lb bags, 10/20 Filter		
Quantity	Description																								
-0.33 ft	Stickup																								
1	Protective Casing Type: 6" diameter, square, steel, lockable																								
9	Riser Type: 2" diameter, 20' long, Sch. 80, PVC, Flush Thread																								
3	Screen Type: 2" diameter, 10' long, Sch. 80, PVC, 0.010" Slotted, Flush Thread																								
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420 gallons	Grout Seal Type: Portland Type 2 Cement with 5% Bentonite Gel																								
1.5	Bentonite Seal Type: 5 gallon bucket - 1/4", time release, pellets																								
10	Sand Pack Type: 50lb bags, 10/20 Filter																								
		General Comments:																							
		Completed advancing the borehole on 6/21/2013 at 15:15 hours Completed flushing the borehole on 6/26/2013 at 15:30 hours Completed casing and screen installation on 6/27/2013 at 08:50 hours Completed sand and bentonite backfill via tremie pipe on 6/27/2013 at 09:50 hours Completed grout backfill via tremie pipe on 6/27/2013 at 13:45 hours																							

LOGGED BY: J. Kugel  
 CHECKED BY: R. March  
 DATE: 7/1/2013





DF-WELL LOG-D IMPORT.GPJ 2013 DATATEMPLATE.GDT 9/16/13

DEPTH (ft)	Monitoring Well Detail	ELEVATION (ft)	MW-4: WELL CONSTRUCTION SUMMARY							
			Project Name: Marathon - 32C Pond Project Number: 130-0253		Coordinates: N: 1643111.7 E: 2240484.7 Elevation: 8333.5 ft					
0.0		8330	Borehole Drilling Summary		Well Development Summary					
10.0		8320	Total Depth: 240.0 ft Borehole Diameter: 5 7/8in Drilling Contractor: D.A. Smith Drilling Drill Rig Operator: Darryl Smith Drill Rig: SIMCO 9100 Drilling Method: Air Rotary Drilling Date: 6/24/2013 2:32:03 PM		<table border="1"> <thead> <tr> <th>Date</th> <th>Depth to Water (ft)</th> <th>Volume Purged (gal)</th> </tr> </thead> <tbody> <tr> <td>07/10/2013</td> <td>194.09</td> <td>115.0</td> </tr> </tbody> </table>	Date	Depth to Water (ft)	Volume Purged (gal)	07/10/2013	194.09
Date	Depth to Water (ft)	Volume Purged (gal)								
07/10/2013	194.09	115.0								
20.0		8310	Well Design and Specifications		Development Notes: * Depth to water referenced from top of PVC casing. - 7/10/13 - Groundwater Purged Using a Bailer and Pump					
30.0		8300	0-176.5ft: Grout 0.001-189.2ft: Casing 176.5-177.5ft: Fine Sand 177.5-183.0ft: Bentonite 189.2-239.2ft: Screen 193.7-194.7ft: Centralizer 203.7-204.7ft: Centralizer 213.7-214.7ft: Centralizer 223.7-224.7ft: Centralizer 233.7-234.7ft: Centralizer 239.2-239.5ft: End Cap 239.5-240.0ft: 10/20 Filter Sand							
40.0		8290	Quantity		Description					
50.0		8280	2.97 ft		Stickup					
60.0		8270	1	Protective Casing Type: 6" diameter, square, steel, lockable						
70.0		8260	10	Riser Type: 2" diameter, 20' long, Sch. 80, PVC, Flush Thread						
80.0		8250	4	Screen Type: 2" diameter, 10' long, Sch. 80, PVC, 0.010" Slotted, Flush Thread						
90.0		8240	5	Centralizer Type: 2" diameter, Stainless Steel						
100.0		8230	1	End Cap Type: 2" diameter, Sch 80, PVC, Flush Thread						
110.0		8220	300 gallons	Grout Seal Type: Portland Type 2 Cement with 5% Bentonite Gel						
120.0		8210	1.5	Bentonite Seal Type: 5 gallon bucket - 1/4", time release, pellets						
130.0		8200	17	Sand Pack Type: 50lb bags, 10/20 Filter						
140.0		8190	General Comments:							
150.0		8180	Completed advancing the borehole on 6/24/2013 at 13:20 hours							
160.0		8170	Completed flushing the borehole on 6/25/2013 at 13:45 hours							
170.0		8160	Completed casing and screen installation on 6/25/2013 at 15:30 hours							
180.0		8150	Completed sand and bentonite backfill via tremie pipe on 6/25/2013 at 17:00 hours							
190.0		8140	Completed grout backfill via tremie pipe on 6/26/2013 at 10:00 hours							
200.0		8130								
210.0		8120								
220.0		8110								
230.0		8100								
LOGGED BY: J. Kugel CHECKED BY: R. March DATE: 7/1/2013										



**APPENDIX A-6**  
**MONITORING WELL SURVEY DRAWING**

# PAD 596-32C

SCALE: 1"= 80'  
CONTOUR  
INTERVAL 1'

MONITOR WELL: MW2  
TOP PVC PIPE  
N: 1643125.93  
E: 2240955.77  
EL: 8366.80  
GROUND EL: 8364.1

MONITOR WELL: MW4  
TOP PVC PIPE  
N: 1643111.67  
E: 2240484.67  
EL: 8336.47  
GROUND EL: 8333.5

MONITOR WELL: MW3  
TOP PVC PIPE  
N: 1643050.42  
E: 2240698.97  
EL: 8333.37  
GROUND EL: 8333.7

MARATHON OIL CO.  
WELL SITE 596-32C

PROPOSED POND  
RECONSTRUCTION,  
SEE SHEET 2

596-32A-18  
596-32C-25

MONITOR WELL: MW1  
TOP PVC PIPE  
N: 1642668.76  
E: 2240781.16  
EL: 8336.18  
GROUND EL: 8333.2

## CONFIDENTIALITY NOTES:

The information contained in this plat is legally privileged and confidential information intended only for the use of the recipients. If you are not the intended recipients, you are hereby notified that any use, dissemination, distribution or copying of this information is strictly prohibited.



**WILLIAM H. SMITH  
& ASSOCIATES P.C.**

**SURVEYING CONSULTANTS**  
550 EAST SECOND NORTH PHONE: 307-875-3638  
GREEN RIVER, WY 307-875-3639  
www.whsmithpc.com

DRAWN BY: RR CHECKED BY: RR  
PROJECT NO: N/A JOB NO: 26099  
REVISIONS:

## NOTES:

COORDINATES SHOWN ARE STATE  
PLANE COLORADO CENTRAL ZONE  
NAD83

ELEVATIONS ARE NAVD88

## LOCATION:

**596-32C**  
WITHIN THE SW/4  
SECTION 32,  
T 5 S, R 96 W,  
6TH PM.  
GARFIELD COUNTY,  
COLORADO

**MARATHON OIL COMPANY**  
PO BOX 3128, HOUSTON TX, 77253  
5555 SAN FELIPE, HOUSTON TX, 77056

**MONITOR WELL LOCATIONS &  
PROPOSED POND RECONSTRUCTION**

SCALE: 1"= 80'  
DATE: 2013-08-04 EXHIBIT "A"  
SHEET 1 OF 2

**APPENDIX B**  
**HYDRAULIC TESTING RESULTS**



**APPENDIX B-1**  
**RISING HEAD HYDRAULIC TESTING**

**Table B-1. Rising Head Hydraulic Test Results**

Well ID	Aquifer Saturated Thickness (feet)	Transmissivity (cm <sup>2</sup> /s)	Hydraulic Conductivity (cm/s)	Hydraulic Conductivity (x 10 <sup>-5</sup> cm/s)
MW-1	32.0	0.019	1.9E-05	1.9
MW-2	21.8	0.080	1.2E-04	12.1
MW-3 (initial)	22.9	0.016	2.2E-05	2.2
MW-4	42.5	0.089	6.8E-05	6.8

## Notes:

All tests were performed in open boreholes before wells were installed

Prepared By:	JEA
Checked By:	MKS
Reviewed By:	ANH

**Date:** July 30, 2013  
**Project No.:** 130-0253  
**Client:** Marathon Oil Company

**Made by:** JEA  
**Checked by:** MKS  
**Reviewed by:** ANH

### 1.0 AQUIFER DATA

Saturated Thickness (b): 31.96 ft  
 Anisotropy Ratio ( $K_x/K_r$ ): 1

### 1.0 BOREHOLE DATA

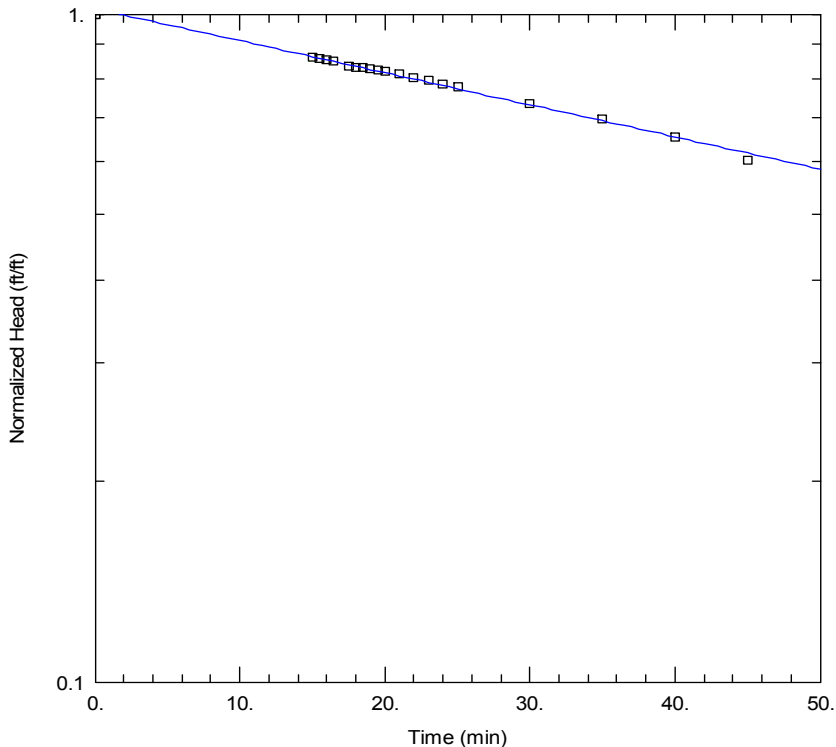
Test Well: MW-1  
 Test Date: 19 Jun 2013  
 Initial Displacement: 31.96 ft  
 Static Water Column Height: 31.96 ft  
 Borehole Radius: 0.245 ft

### 2.0 SOLUTION

Test Type: Open Hole Air Displacement  
 Aquifer Model: Unconfined  
 Solution Method: Bouwer-Rice

### 3.0 ESTIMATED PARAMETERS

Transmissivity (T): 0.01877  $\text{cm}^2/\text{s}$   
 Hydraulic Conductivity (K): 1.93E-05  $\text{cm/s}$





## SLUG TEST ANALYSIS MW-2

**Date:** July 30, 2013  
**Project No.:** 130-0253  
**Client:** Marathon Oil Company

**Made by:** JEA  
**Checked by:** MKS  
**Reviewed by:** ANH

### 1.0 AQUIFER DATA

Saturated Thickness (b): 21.8 ft  
Anisotropy Ratio ( $K_x/K_r$ ): 1

### 1.0 BOREHOLE DATA

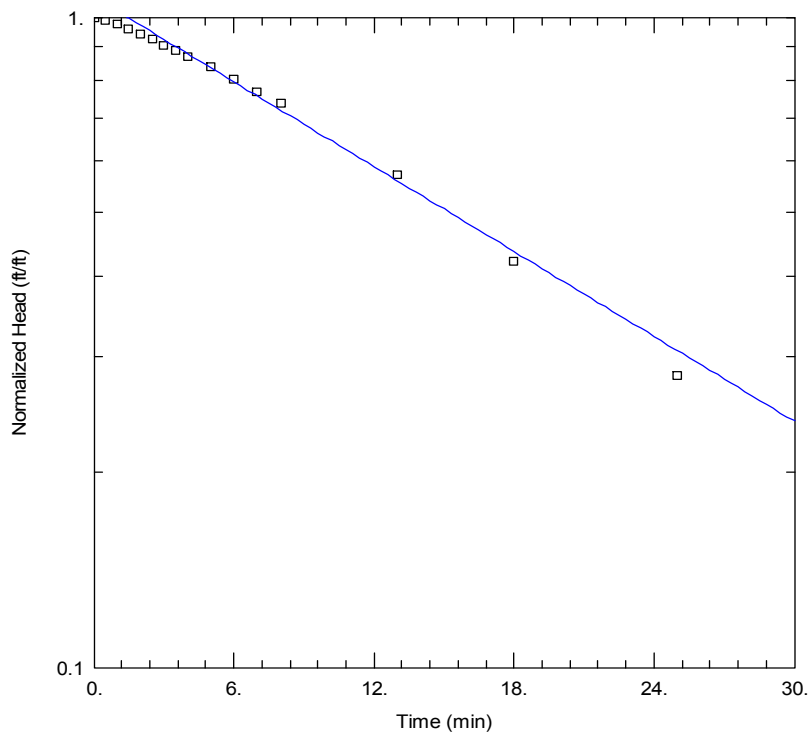
Test Well: MW-2  
Test Date: 23 Jun 2013  
Initial Displacement: 21.8 ft  
Static Water Column Height: 21.8 ft  
Borehole Radius: 0.245 ft

### 2.0 SOLUTION

Test Type: Open Hole Air Displacement  
Aquifer Model: Unconfined  
Solution Method: Bouwer-Rice

### 3.0 ESTIMATED PARAMETERS

Transmissivity (T): 0.08033  $\text{cm}^2/\text{s}$   
Hydraulic Conductivity (K): 1.21E-04  $\text{cm/s}$







## SLUG TEST ANALYSIS MW-3 (Initial)

**Date:** July 30, 2013  
**Project No.:** 130-0253  
**Client:** Marathon Oil Company

**Made by:** JEA  
**Checked by:** MKS  
**Reviewed by:** ANH

### 1.0 AQUIFER DATA

Saturated Thickness (b): 22.91 ft  
Anisotropy Ratio ( $K_x/K_r$ ): 1

### 1.0 BOREHOLE DATA

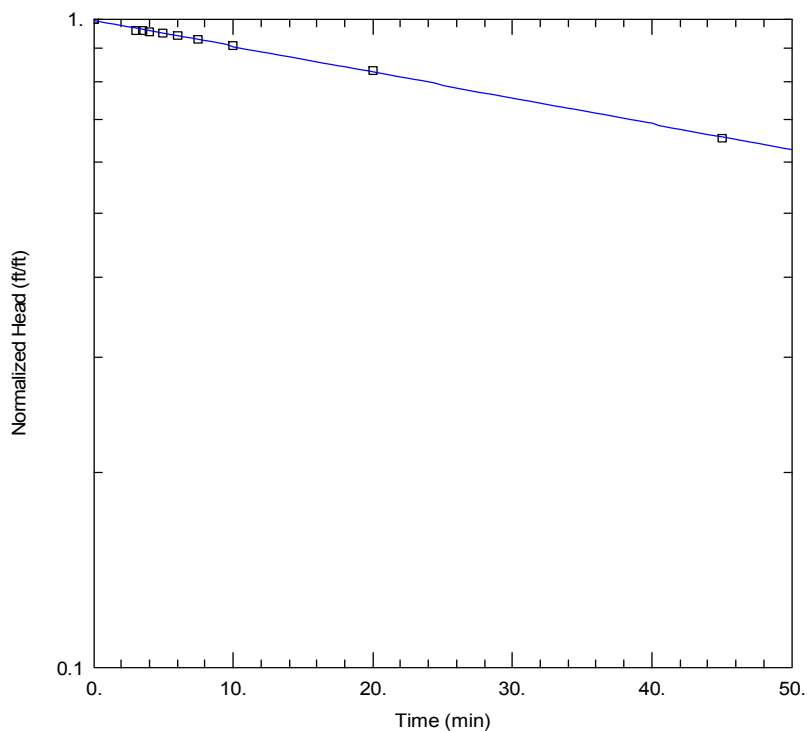
Test Well: MW-3  
Test Date: 17 Jun 2013  
Initial Displacement: 19.7 ft  
Static Water Column Height: 19.7 ft  
Borehole Radius: 0.245 ft

### 2.0 SOLUTION

Test Type: Open Hole Air Displacement  
Aquifer Model: Unconfined  
Solution Method: Bouwer-Rice

### 3.0 ESTIMATED PARAMETERS

Transmissivity (T): 0.01551  $\text{cm}^2/\text{s}$   
Hydraulic Conductivity (K): 2.22E-05  $\text{cm/s}$





## SLUG TEST ANALYSIS MW-4

**Date:** July 30, 2013  
**Project No.:** 130-0253  
**Client:** Marathon Oil Company

**Made by:** JEA  
**Checked by:** MKS  
**Reviewed by:** ANH

### 1.0 AQUIFER DATA

Saturated Thickness (b): 42.46 ft  
Anisotropy Ratio ( $K_x/K_r$ ): 1

### 1.0 BOREHOLE DATA

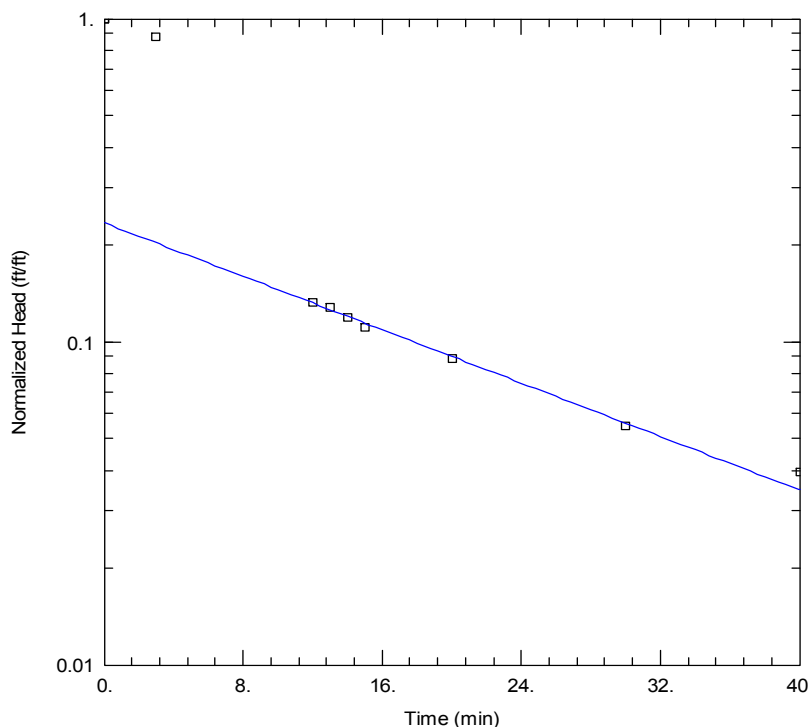
Test Well: MW-4  
Test Date: 25 Jun 2013  
Initial Displacement: 42.46 ft  
Static Water Column Height: 42.46 ft  
Borehole Radius: 0.245 ft

### 2.0 SOLUTION

Test Type: Open Hole Air Displacement  
Aquifer Model: Unconfined  
Solution Method: Bouwer-Rice

### 3.0 ESTIMATED PARAMETERS

Transmissivity (T): 0.08855  $\text{cm}^2/\text{s}$   
Hydraulic Conductivity (K): 6.84E-05  $\text{cm/s}$



**APPENDIX B-2**  
**MW-4 CONSTANT RATE PUMPING TEST**

Well ID: MW-3 (observation well)

Test Type: Constant Rate Test

---

**PROJECT INFORMATION**

Company: Golder Associates Inc.  
Client: Marathon Oil Company  
Project: 130-0253  
Location: Colorado

**AQUIFER DATA**

Saturated Thickness: 48.67 feet  
Anisotropy Ratio ( $K_x/K_r$ ): 1

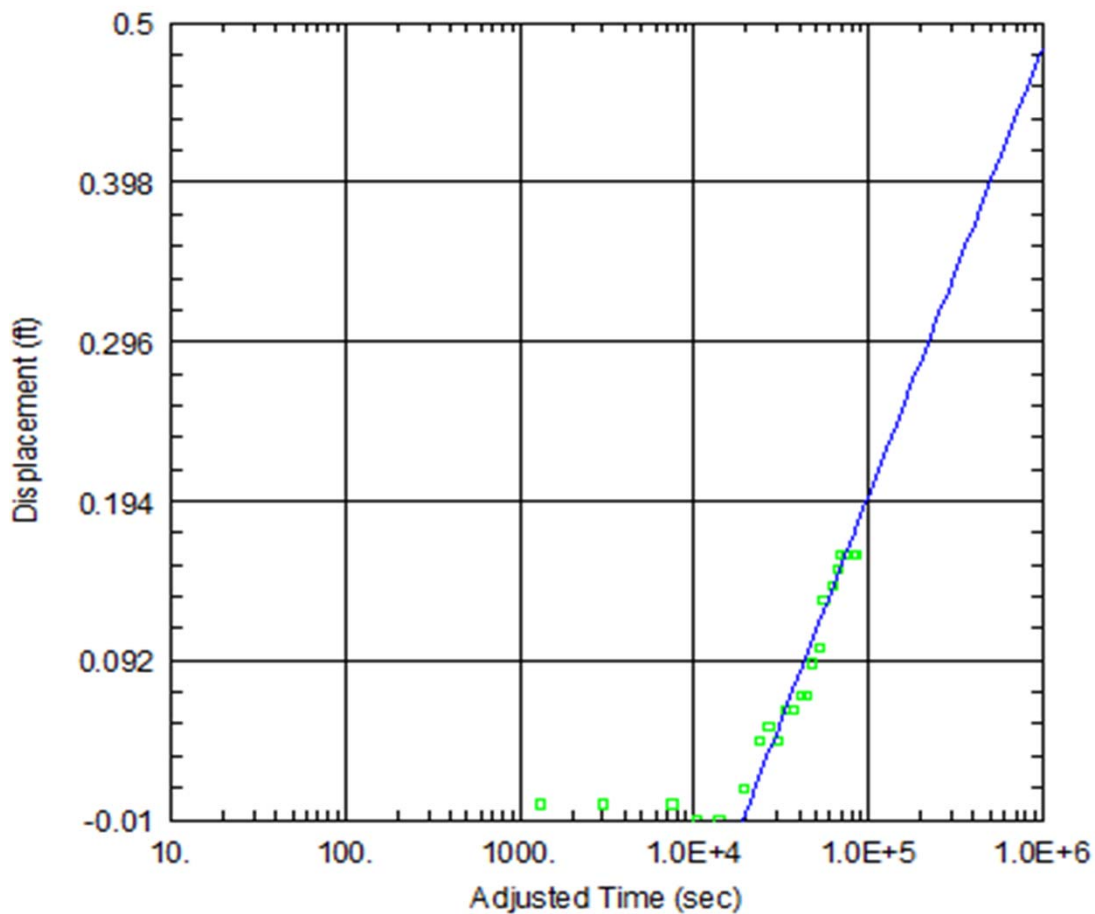
**SOLUTION**

Test Type: Constant Rate Pumping Test  
Aquifer Model: Confined  
Solution Method: Cooper-Jacob

**ESTIMATED PARAMETERS**

T 2.30E+00  $\text{cm}^2/\text{s}$   
K 1.55E-03  $\text{cm/s}$   
S 2.30E-03

---





Well ID: MW-4 (pumping well)

Test Type: Constant Rate Test

---

**PROJECT INFORMATION**

Company: Golder Associates Inc.  
Client: Marathon Oil Company  
Project: 130-0253  
Location: Colorado

**AQUIFER DATA**

Saturated Thickness: 48.67 feet  
Anisotropy Ratio ( $K_x/K_r$ ): 1

**SOLUTION**

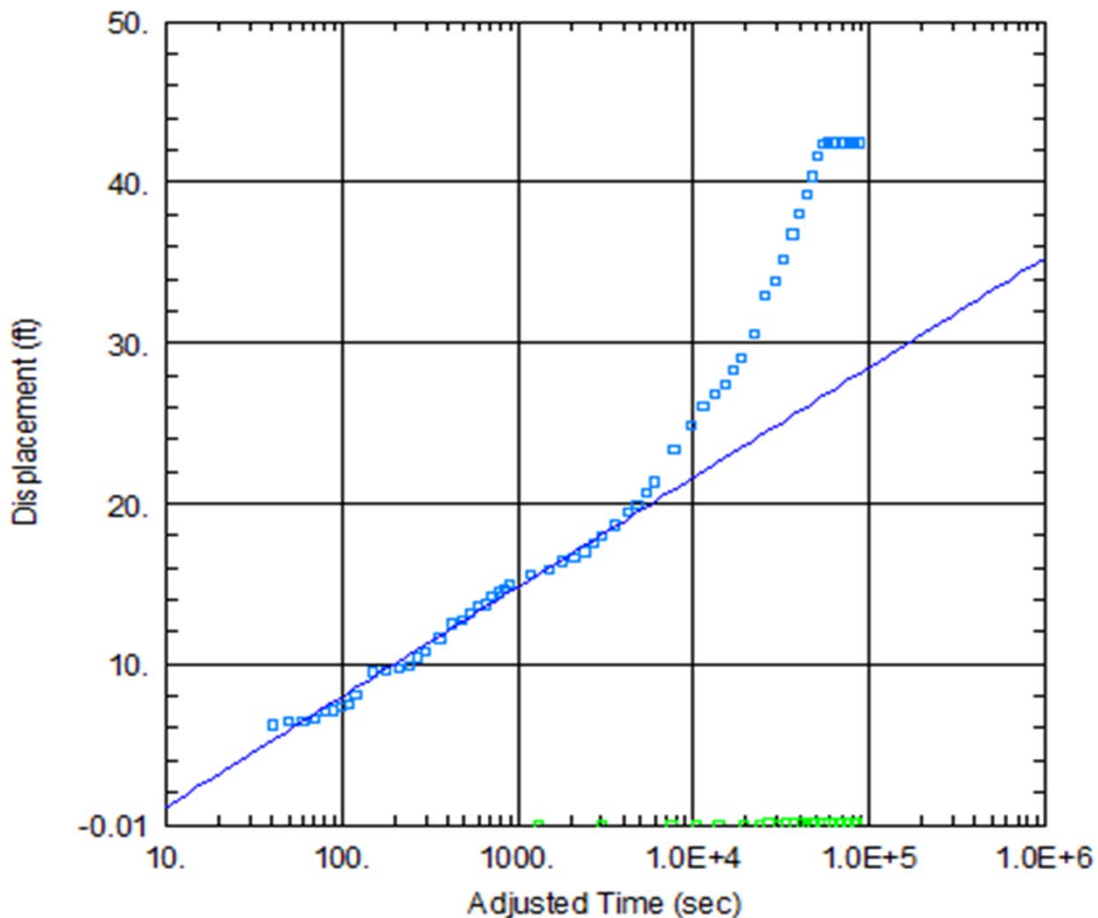
Test Type: Constant Rate Pumping Test  
Aquifer Model: Confined  
Solution Method: Cooper-Jacob

**ESTIMATED PARAMETERS**

T (high estimate) 9.65E-02  $\text{cm}^2/\text{s}$   
K (high estimate) 6.50E-05  $\text{cm/s}$

Note: This solution is fit to the pumping well and values of storativity estimated from these data are not necessarily representative and therefore not presented

---



Well ID: MW-4 (pumping well)

Test Type: Constant Rate Test

---

**PROJECT INFORMATION**

Company: Golder Associates Inc.  
Client: Marathon Oil Company  
Project: 130-0253  
Location: Colorado

**AQUIFER DATA**

Saturated Thickness: 48.67 feet  
Anisotropy Ratio ( $K_x/K_r$ ): 1

**SOLUTION**

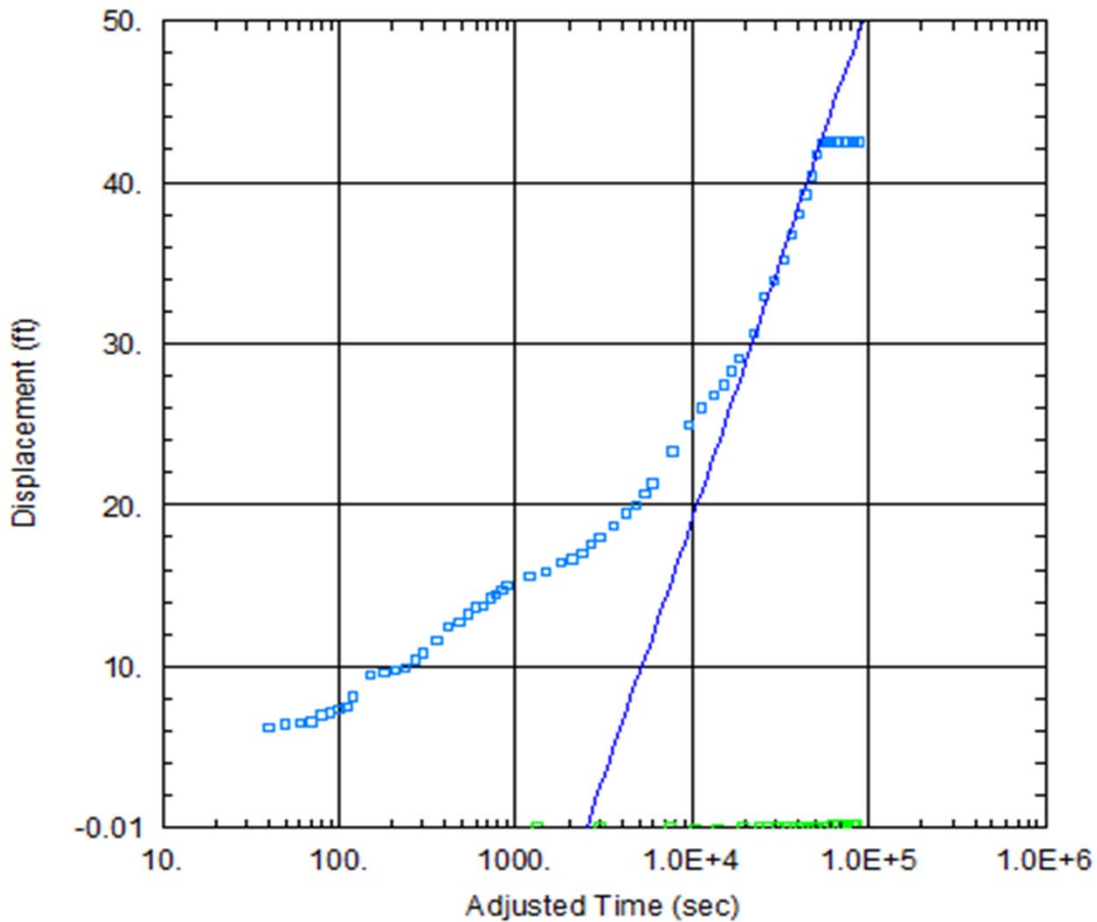
Test Type: Constant Rate Pumping Test  
Aquifer Model: Confined  
Solution Method: Cooper-Jacob

**ESTIMATED PARAMETERS**

T (low estimate) 2.06E-02  $\text{cm}^2/\text{s}$   
K (low estimate) 1.39E-05  $\text{cm/s}$

Note: This solution is fit to the pumping well and values of storativity estimated from these data are not necessarily representative and therefore not presented

---



**APPENDIX C**  
**GROUNDWATER QUALITY ANALYTICAL REPORTS**

**APPENDIX C-1**  
**JULY 9 SAMPLE RESULTS**





08/29/13

## Technical Report for

**Marathon Oil**

**MOC 32C/BWQ/MONITORING WELLS**

**WBS#TA.13.30788.EXP**

**Accutest Job Number: D48106**

**Sampling Date: 07/09/13**

**Report to:**

**Golder Associates**

**rmarch@golder.com**

**ATTN: Randy March**

**Total number of pages in report: 31**



Test results contained within this data package meet the requirements of the National Environmental Laboratory Accreditation Conference and/or state specific certification programs as applicable.

A handwritten signature in black ink, appearing to read 'Scott Heideman'.

**Scott Heideman**  
**Laboratory Director**

**Client Service contact: Ann Doerr 303-425-6021**

Certifications: CO (CO00049), ID, NE (CO00049), ND (R-027), NJ (CO 0007), OK (D9942), UT (NELAP CO00049), TX (T104704511)

This report shall not be reproduced, except in its entirety, without the written approval of Accutest Laboratories.  
Test results relate only to samples analyzed.

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## Sample Summary

Marathon Oil

Job No: D48106

MOC 32C/BWQ/MONITORING WELLS

Project No: WBS#TA.13.30788.EXP

Sample Number	Collected Date	Time By	Received	Matrix Code	Type	Client Sample ID
D48106-1	07/09/13	11:30 SD	07/11/13	AQ	Ground Water	MW-3
D48106-1A	07/09/13	11:30 SD	07/11/13	AQ	Ground Water	MW-3
D48106-1B	07/09/13	11:30 SD	07/11/13	AQ	Ground Water	MW-3
D48106-1F	07/09/13	11:30 SD	07/11/13	AQ	Groundwater Filtered	MW-3
D48106-2	07/09/13	14:30 SD	07/11/13	AQ	Ground Water	MW-1
D48106-2A	07/09/13	14:30 SD	07/11/13	AQ	Ground Water	MW-1
D48106-2B	07/09/13	14:30 SD	07/11/13	AQ	Ground Water	MW-1
D48106-2F	07/09/13	14:30 SD	07/11/13	AQ	Groundwater Filtered	MW-1
D48106-3	07/09/13	00:00 SD	07/11/13	AQ	Trip Blank Water	TRIP BLANK



## CASE NARRATIVE / CONFORMANCE SUMMARY

**Client:** Marathon Oil

**Job No** D48106

**Site:** MOC 32C/BWQ/MONITORING WELLS

**Report Date** 7/23/2013 10:05:33 AM

On 07/11/2013, 2 sample(s), 1 Trip Blank(s), and 0 Field Blank(s) were received at Accutest Mountain States (AMS) at a temperature of 5.2 °C. The samples were intact and properly preserved, unless noted below. An AMS Job Number of D48106 was assigned to the project. The lab sample ID, client sample ID, and date of sample collection are detailed in the report's Results Summary.

Specified quality control criteria were achieved for this job except as noted below. For more information, please refer to the analytical results and QC summary pages.

### Volatiles by GCMS By Method SW846 8260B

**Matrix** AQ

**Batch ID:** V3V1507

- All samples were analyzed within the recommended method holding time.
- All method blanks for this batch meet method specific criteria.
- Sample(s) D47878-1MS, D47878-1MSD were used as the QC samples indicated.
- D48106-2: The pH of the sample aliquot for VOA analysis was >2 at time of analysis.
- D47878-1MSD: Dilution required due to matrix interference (sample foamed).
- D47878-1MS: Dilution required due to matrix interference (sample foamed).

### Volatiles by GC By Method RSK175 MOD

**Matrix** AQ

**Batch ID:** GFB391

- All samples were analyzed within the recommended method holding time.
- Sample(s) D48007-3MS, D48007-3MSD were used as the QC samples indicated.
- All method blanks for this batch meet method specific criteria.

### Volatiles by GC By Method SW846 8015B

**Matrix** AQ

**Batch ID:** GGB1161

- All samples were analyzed within the recommended method holding time.
- Sample(s) D48026-1MS, D48026-1MSD were used as the QC samples indicated.
- All method blanks for this batch meet method specific criteria.

### Extractables by GC By Method SW846-8015B

**Matrix** AQ

**Batch ID:** OP8188

- All samples were extracted and analyzed within the recommended method holding time.
- All method blanks for this batch meet method specific criteria.
- Sample(s) D47726-37MS, D47726-37MSD were used as the QC samples indicated.



## Metals By Method SW846 6010C

**Matrix** AQ

**Batch ID:** MP10508

- All samples were digested and analyzed within the recommended method holding time.
- All method blanks for this batch meet method specific criteria.
- Sample(s) D48106-1MS, D48106-1MSD, D48106-1SDL were used as the QC samples for the metals analysis.
- The matrix spike (MS) recovery(s) of Potassium, Sodium are outside control limits. Spike recovery indicates possible matrix interference.
- The serial dilution RPD(s) for Boron are outside control limits for sample MP10508-SD1. Percent difference acceptable due to low initial sample concentration (< 50 times IDL).

## Metals By Method SW846 6020A

**Matrix** AQ

**Batch ID:** MP10509

- All samples were digested and analyzed within the recommended method holding time.
- All method blanks for this batch meet method specific criteria.
- Sample(s) D48106-1MS, D48106-1MSD, D48106-1SDL were used as the QC samples for the metals analysis.
- The serial dilution RPD(s) for Selenium are outside control limits for sample MP10509-SD1. Percent difference acceptable due to low initial sample concentration (< 50 times IDL).

## Wet Chemistry By Method EPA 300.0/SW846 9056

**Matrix** AQ

**Batch ID:** GP10396

- All samples were prepared and analyzed within the recommended method holding time.
- All method blanks for this batch meet method specific criteria.
- Sample(s) D48035-2MS, D48035-2MSD were used as the QC samples for the Bromide, Chloride, Fluoride, Nitrogen, Nitrate, Nitrogen, Nitrite, Sulfate, Bromide analysis.

**Matrix** AQ

**Batch ID:** R17959

- The data for EPA 300.0/SW846 9056 meets quality control requirements.
- D48106-2 for Nitrogen, Nitrate + Nitrite: Calculated as: (Nitrogen, Nitrate) + (Nitrogen, Nitrite)

**Matrix** AQ

**Batch ID:** R17960

- The data for EPA 300.0/SW846 9056 meets quality control requirements.
- D48106-1 for Nitrogen, Nitrate + Nitrite: Calculated as: (Nitrogen, Nitrate) + (Nitrogen, Nitrite)

## Wet Chemistry By Method HACH IRB-BART

**Matrix** AQ

**Batch ID:** MB218

- All samples were analyzed within the recommended method holding time.
- All method blanks for this batch meet method specific criteria.

## Wet Chemistry By Method HACH SLYM-BART

**Matrix** AQ

**Batch ID:** MB219

- All samples were analyzed within the recommended method holding time.
- All method blanks for this batch meet method specific criteria.

## Wet Chemistry By Method HACH SRB-BART

**Matrix** AQ

**Batch ID:** MB220

- All samples were analyzed within the recommended method holding time.
- All method blanks for this batch meet method specific criteria.

### Wet Chemistry By Method HACH8190/SM4500P-B/E

**Matrix** AQ

**Batch ID:** GP10412

- All samples were prepared and analyzed within the recommended method holding time.
- All method blanks for this batch meet method specific criteria.
- Sample(s) D48027-1DUP, D48027-1MS, D48027-1MSD were used as the QC samples for the Phosphorus, Total analysis.

### Wet Chemistry By Method SM 2320B-2011

**Matrix** AQ

**Batch ID:** GN20958

- All samples were analyzed within the recommended method holding time.
- All method blanks for this batch meet method specific criteria.
- Sample(s) D47951-2DUP, D47951-2MS, D47951-2MSD were used as the QC samples for the Alkalinity, Total as CaCO<sub>3</sub> analysis.

**Matrix** AQ

**Batch ID:** GN20959

- All samples were analyzed within the recommended method holding time.
- All method blanks for this batch meet method specific criteria.

**Matrix** AQ

**Batch ID:** GN20960

- All samples were analyzed within the recommended method holding time.
- All method blanks for this batch meet method specific criteria.

### Wet Chemistry By Method SM 2510B-2011

**Matrix** AQ

**Batch ID:** GP10422

- Sample(s) D47990-4DUP were used as the QC samples for the Specific Conductivity analysis.

### Wet Chemistry By Method SM 2540C-2011

**Matrix** AQ

**Batch ID:** GN20952

- All samples were analyzed within the recommended method holding time.
- All method blanks for this batch meet method specific criteria.
- Sample(s) D47990-2DUP were used as the QC samples for the Solids, Total Dissolved analysis.

### Wet Chemistry By Method SM4500HB+-2011/9040C

**Matrix** AQ

**Batch ID:** GN21010

- The following samples were run outside of holding time for method SM4500HB+-2011/9040C: D48106-1, D48106-2

AMS certifies that data reported for samples received, listed on the associated custody chain or analytical task order, were produced to specifications meeting AMS's Quality System precision, accuracy and completeness objectives except as noted.

Estimated non-standard method measurement uncertainty data is available on request, based on quality control bias and implicit for standard methods. Acceptable uncertainty requires tested parameter quality control data to meet method criteria.

AMS is not responsible for data quality assumptions if partial reports are used and recommends that this report be used in its entirety. This report is authorized by AMS indicated via signature on the report cover.

## Summary of Hits

**Job Number:** D48106  
**Account:** Marathon Oil  
**Project:** MOC 32C/BWQ/MONITORING WELLS  
**Collected:** 07/09/13



Lab Sample ID	Client Sample ID	Result/ Qual	RL	MDL	Units	Method
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### D48106-1 MW-3

Barium	0.15	0.010			mg/l	SW846 6020A
Calcium	73900	400			ug/l	SW846 6010C
Iron	7750	70			ug/l	SW846 6010C
Magnesium	31300	200			ug/l	SW846 6010C
Manganese	193	5.0			ug/l	SW846 6010C
Potassium	3160	1000			ug/l	SW846 6010C
Sodium	57000	400			ug/l	SW846 6010C
Alkalinity, Bicarbonate as CaCO <sub>3</sub>	323	5.0			mg/l	SM 2320B-2011
Alkalinity, Total as CaCO <sub>3</sub>	323	5.0			mg/l	SM 2320B-2011
Chloride	3.7	0.50			mg/l	EPA 300.0/SW846 9056
Fluoride	0.14	0.10			mg/l	EPA 300.0/SW846 9056
Nitrogen, Nitrate	0.015	0.010			mg/l	EPA 300.0/SW846 9056
Nitrogen, Nitrate + Nitrite <sup>a</sup>	0.015	0.014			mg/l	EPA 300.0/SW846 9056
Phosphorus, Total	0.29	0.010			mg/l	HACH8190/SM4500P-B/E
Solids, Total Dissolved	450	10			mg/l	SM 2540C-2011
Specific Conductivity	633	1.0			umhos/cm	SM 2510B-2011
Sulfate	50.7	2.5			mg/l	EPA 300.0/SW846 9056
pH	7.92				su	SM4500HB+ -2011/9040C

### D48106-1A MW-3

No hits reported in this sample.

### D48106-1B MW-3

Iron Reducing Bacteria	74500	25			CFU/ml	HACH IRB-BART
Slime Forming Bacteria	140000	500			CFU/ml	HACH SLYM-BART
Sulfate Reducing Bacteria	1200	200			CFU/ml	HACH SRB-BART

### D48106-1F MW-3

Barium	0.076	0.010			mg/l	SW846 6020A
Calcium	60000	400			ug/l	SW846 6010C
Magnesium	26900	200			ug/l	SW846 6010C
Manganese	48.2	5.0			ug/l	SW846 6010C
Potassium	1390	1000			ug/l	SW846 6010C
Sodium	49000	400			ug/l	SW846 6010C

### D48106-2 MW-1

Barium	0.084	0.010			mg/l	SW846 6020A
Boron	58.4	50			ug/l	SW846 6010C
Calcium	58900	400			ug/l	SW846 6010C

## Summary of Hits

**Job Number:** D48106  
**Account:** Marathon Oil  
**Project:** MOC 32C/BWQ/MONITORING WELLS  
**Collected:** 07/09/13

Lab Sample ID	Client Sample ID	Result/ Qual	RL	MDL	Units	Method
Analyte						
Iron		1120	70		ug/l	SW846 6010C
Magnesium		31900	200		ug/l	SW846 6010C
Manganese		71.8	5.0		ug/l	SW846 6010C
Potassium		1270	1000		ug/l	SW846 6010C
Sodium		46900	400		ug/l	SW846 6010C
Alkalinity, Bicarbonate as CaCO <sub>3</sub>		299	5.0		mg/l	SM 2320B-2011
Alkalinity, Total as CaCO <sub>3</sub>		299	5.0		mg/l	SM 2320B-2011
Bromide		0.14	0.050		mg/l	EPA 300.0/SW846 9056
Chloride		17.1	0.50		mg/l	EPA 300.0/SW846 9056
Fluoride		0.13	0.10		mg/l	EPA 300.0/SW846 9056
Nitrogen, Nitrate		0.45	0.050		mg/l	EPA 300.0/SW846 9056
Nitrogen, Nitrate + Nitrite <sup>a</sup>		0.45	0.054		mg/l	EPA 300.0/SW846 9056
Phosphorus, Total		0.036	0.010		mg/l	HACH8190/SM4500P-B/E
Solids, Total Dissolved		426	10		mg/l	SM 2540C-2011
Specific Conductivity		642	1.0		umhos/cm	SM 2510B-2011
Sulfate		47.1	2.5		mg/l	EPA 300.0/SW846 9056
pH		7.87			su	SM4500HB+ -2011/9040C

### D48106-2A MW-1

Methane	0.00041 J	0.00080	0.00040	mg/l	RSK175 MOD
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### D48106-2B MW-1

Iron Reducing Bacteria	9000	25	CFU/ml	HACH IRB-BART
Slime Forming Bacteria	140000	500	CFU/ml	HACH SLYM-BART
Sulfate Reducing Bacteria	5000	200	CFU/ml	HACH SRB-BART

### D48106-2F MW-1

Barium	0.069	0.010	mg/l	SW846 6020A
Calcium	58300	400	ug/l	SW846 6010C
Magnesium	31600	200	ug/l	SW846 6010C
Manganese	47.2	5.0	ug/l	SW846 6010C
Potassium	1080	1000	ug/l	SW846 6010C
Sodium	49400	400	ug/l	SW846 6010C

### D48106-3 TRIP BLANK

No hits reported in this sample.

(a) Calculated as: (Nitrogen, Nitrate) + (Nitrogen, Nitrite)



Sample Results

Report of Analysis

## Report of Analysis

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<b>Client Sample ID:</b>	MW-3	<b>Date Sampled:</b>	07/09/13
<b>Lab Sample ID:</b>	D48106-1	<b>Date Received:</b>	07/11/13
<b>Matrix:</b>	AQ - Ground Water	<b>Percent Solids:</b>	n/a
<b>Method:</b>	SW846 8260B		
<b>Project:</b>	MOC 32C/BWQ/MONITORING WELLS		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	3V25606.D	1	07/12/13	BR	n/a	n/a	V3V1507
Run #2							

	Purge Volume
Run #1	5.0 ml
Run #2	

## Purgeable Aromatics

CAS No.	Compound	Result	RL	MDL	Units	Q
71-43-2	Benzene	ND	0.0010	0.00025	mg/l	
108-88-3	Toluene	ND	0.0020	0.0010	mg/l	
100-41-4	Ethylbenzene	ND	0.0020	0.00025	mg/l	
1330-20-7	Xylene (total)	ND	0.0030	0.0020	mg/l	

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
17060-07-0	1,2-Dichloroethane-D4	104%		62-130%
2037-26-5	Toluene-D8	94%		70-130%
460-00-4	4-Bromofluorobenzene	89%		69-130%

ND = Not detected MDL - Method Detection Limit

RL = Reporting Limit

E = Indicates value exceeds calibration range

J = Indicates an estimated value

B = Indicates analyte found in associated method blank

N = Indicates presumptive evidence of a compound

## Report of Analysis

Page 1 of 1

<b>Client Sample ID:</b>	MW-3	<b>Date Sampled:</b>	07/09/13
<b>Lab Sample ID:</b>	D48106-1	<b>Date Received:</b>	07/11/13
<b>Matrix:</b>	AQ - Ground Water	<b>Percent Solids:</b>	n/a
<b>Method:</b>	SW846 8015B		
<b>Project:</b>	MOC 32C/BWQ/MONITORING WELLS		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	GB21145.D	1	07/13/13	BD	n/a	n/a	GGB1161
Run #2							

	Purge Volume
Run #1	5.0 ml
Run #2	

CAS No.	Compound	Result	RL	MDL	Units	Q
	TPH-GRO (C6-C10)	ND	0.20	0.10	mg/l	
CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits		
120-82-1	1,2,4-Trichlorobenzene	87%		60-140%		

ND = Not detected      MDL - Method Detection Limit  
 RL = Reporting Limit  
 E = Indicates value exceeds calibration range

J = Indicates an estimated value  
 B = Indicates analyte found in associated method blank  
 N = Indicates presumptive evidence of a compound

## Report of Analysis

Page 1 of 1

<b>Client Sample ID:</b>	MW-3	<b>Date Sampled:</b>	07/09/13
<b>Lab Sample ID:</b>	D48106-1	<b>Date Received:</b>	07/11/13
<b>Matrix:</b>	AQ - Ground Water	<b>Percent Solids:</b>	n/a
<b>Method:</b>	SW846-8015B SW846 3510C		
<b>Project:</b>	MOC 32C/BWQ/MONITORING WELLS		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	FD26471.D	1	07/14/13	TU	07/12/13	OP8188	GFD1299
Run #2							

	Initial Volume	Final Volume
Run #1	1050 ml	1.0 ml
Run #2		

CAS No.	Compound	Result	RL	MDL	Units	Q
	TPH-DRO (C10-C28)	ND	0.19	0.17	mg/l	
CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits		
84-15-1	o-Terphenyl	64%		20-140%		

ND = Not detected      MDL - Method Detection Limit  
 RL = Reporting Limit  
 E = Indicates value exceeds calibration range

J = Indicates an estimated value  
 B = Indicates analyte found in associated method blank  
 N = Indicates presumptive evidence of a compound



## Report of Analysis

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<b>Client Sample ID:</b> MW-3	<b>Date Sampled:</b> 07/09/13
<b>Lab Sample ID:</b> D48106-1	<b>Date Received:</b> 07/11/13
<b>Matrix:</b> AQ - Ground Water	<b>Percent Solids:</b> n/a
<b>Project:</b> MOC 32C/BWQ/MONITORING WELLS	

## Total Metals Analysis

Analyte	Result	RL	Units	DF	Prep	Analyzed By	Method	Prep Method
Barium	0.15	0.010	mg/l	5	07/12/13	07/13/13 JM	SW846 6020A <sup>2</sup>	SW846 3010A <sup>4</sup>
Boron	< 50	50	ug/l	1	07/12/13	07/12/13 JB	SW846 6010C <sup>1</sup>	SW846 3010A <sup>3</sup>
Calcium	73900	400	ug/l	1	07/12/13	07/12/13 JB	SW846 6010C <sup>1</sup>	SW846 3010A <sup>3</sup>
Iron	7750	70	ug/l	1	07/12/13	07/12/13 JB	SW846 6010C <sup>1</sup>	SW846 3010A <sup>3</sup>
Magnesium	31300	200	ug/l	1	07/12/13	07/12/13 JB	SW846 6010C <sup>1</sup>	SW846 3010A <sup>3</sup>
Manganese	193	5.0	ug/l	1	07/12/13	07/12/13 JB	SW846 6010C <sup>1</sup>	SW846 3010A <sup>3</sup>
Potassium	3160	1000	ug/l	1	07/12/13	07/12/13 JB	SW846 6010C <sup>1</sup>	SW846 3010A <sup>3</sup>
Selenium	< 0.0020	0.0020	mg/l	5	07/12/13	07/13/13 JM	SW846 6020A <sup>2</sup>	SW846 3010A <sup>4</sup>
Sodium	57000	400	ug/l	1	07/12/13	07/12/13 JB	SW846 6010C <sup>1</sup>	SW846 3010A <sup>3</sup>

(1) Instrument QC Batch: MA3753

(2) Instrument QC Batch: MA3754

(3) Prep QC Batch: MP10508

(4) Prep QC Batch: MP10509

RL = Reporting Limit

## Report of Analysis

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<b>Client Sample ID:</b>	MW-3	<b>Date Sampled:</b>	07/09/13
<b>Lab Sample ID:</b>	D48106-1	<b>Date Received:</b>	07/11/13
<b>Matrix:</b>	AQ - Ground Water	<b>Percent Solids:</b>	n/a
<b>Project:</b>	MOC 32C/BWQ/MONITORING WELLS		

## General Chemistry

Analyte	Result	RL	Units	DF	Analyzed	By	Method
Alkalinity, Bicarbonate as CaC	323	5.0	mg/l	1	07/11/13	KB	SM 2320B-2011
Alkalinity, Carbonate	< 5.0	5.0	mg/l	1	07/11/13	KB	SM 2320B-2011
Alkalinity, Total as CaCO <sub>3</sub>	323	5.0	mg/l	1	07/11/13	KB	SM 2320B-2011
Bromide	< 0.050	0.050	mg/l	1	07/11/13 15:53	GH	EPA 300.0/SW846 9056
Chloride	3.7	0.50	mg/l	1	07/11/13 15:53	GH	EPA 300.0/SW846 9056
Fluoride	0.14	0.10	mg/l	1	07/11/13 15:53	GH	EPA 300.0/SW846 9056
Nitrogen, Nitrate	0.015	0.010	mg/l	1	07/11/13 15:53	GH	EPA 300.0/SW846 9056
Nitrogen, Nitrate + Nitrite <sup>a</sup>	0.015	0.014	mg/l	1	07/11/13 15:53	GH	EPA 300.0/SW846 9056
Nitrogen, Nitrite	< 0.0040	0.0040	mg/l	1	07/11/13 15:53	GH	EPA 300.0/SW846 9056
Phosphorus, Total	0.29	0.010	mg/l	1	07/12/13	KB	HACH8190/SM4500P-B/E
Solids, Total Dissolved	450	10	mg/l	1	07/11/13	BF	SM 2540C-2011
Specific Conductivity	633	1.0	umhos/cm	1	07/15/13	RW	SM 2510B-2011
Sulfate	50.7	2.5	mg/l	5	07/11/13 18:07	GH	EPA 300.0/SW846 9056
pH	7.92		su	1	07/15/13 13:50	AK	SM4500HB+ -2011/9040C

(a) Calculated as: (Nitrogen, Nitrate) + (Nitrogen, Nitrite)

RL = Reporting Limit

## Report of Analysis

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<b>Client Sample ID:</b>	MW-3	<b>Date Sampled:</b>	07/09/13
<b>Lab Sample ID:</b>	D48106-1A	<b>Date Received:</b>	07/11/13
<b>Matrix:</b>	AQ - Ground Water	<b>Percent Solids:</b>	n/a
<b>Method:</b>	RSK175 MOD		
<b>Project:</b>	MOC 32C/BWQ/MONITORING WELLS		

Run #	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	FB08924.D	1	07/11/13	AV	n/a	n/a	GFB391
Run #2							

## Methane, Ethane and Propane

CAS No.	Compound	Result	RL	MDL	Units	Q
74-82-8	Methane	ND	0.00080	0.00040	mg/l	
74-84-0	Ethane	ND	0.0016	0.00080	mg/l	
74-98-6	Propane	ND	0.018	0.0090	mg/l	

ND = Not detected      MDL - Method Detection Limit  
 RL = Reporting Limit  
 E = Indicates value exceeds calibration range

J = Indicates an estimated value  
 B = Indicates analyte found in associated method blank  
 N = Indicates presumptive evidence of a compound

**Report of Analysis**

Page 1 of 1

<b>Client Sample ID:</b>	MW-3	<b>Date Sampled:</b>	07/09/13
<b>Lab Sample ID:</b>	D48106-1B	<b>Date Received:</b>	07/11/13
<b>Matrix:</b>	AQ - Ground Water	<b>Percent Solids:</b>	n/a
<b>Project:</b>	MOC 32C/BWQ/MONITORING WELLS		

**General Chemistry**

Analyte	Result	RL	Units	DF	Analyzed	By	Method
Iron Reducing Bacteria	74500	25	CFU/ml	1	07/15/13	MM	HACH IRB-BART
Slime Forming Bacteria	140000	500	CFU/ml	1	07/15/13	MM	HACH SLYM-BART
Sulfate Reducing Bacteria	1200	200	CFU/ml	1	07/15/13	MM	HACH SRB-BART

RL = Reporting Limit



## Report of Analysis

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<b>Client Sample ID:</b> MW-3	<b>Date Sampled:</b> 07/09/13
<b>Lab Sample ID:</b> D48106-1F	<b>Date Received:</b> 07/11/13
<b>Matrix:</b> AQ - Groundwater Filtered	<b>Percent Solids:</b> n/a
<b>Project:</b> MOC 32C/BWQ/MONITORING WELLS	

## Dissolved Metals Analysis

Analyte	Result	RL	Units	DF	Prep	Analyzed By	Method	Prep Method
Barium	0.076	0.010	mg/l	5	07/12/13	07/13/13 JM	SW846 6020A <sup>2</sup>	SW846 3010A <sup>4</sup>
Boron	< 50	50	ug/l	1	07/12/13	07/12/13 JB	SW846 6010C <sup>1</sup>	SW846 3010A <sup>3</sup>
Calcium	60000	400	ug/l	1	07/12/13	07/12/13 JB	SW846 6010C <sup>1</sup>	SW846 3010A <sup>3</sup>
Iron	< 70	70	ug/l	1	07/12/13	07/12/13 JB	SW846 6010C <sup>1</sup>	SW846 3010A <sup>3</sup>
Magnesium	26900	200	ug/l	1	07/12/13	07/12/13 JB	SW846 6010C <sup>1</sup>	SW846 3010A <sup>3</sup>
Manganese	48.2	5.0	ug/l	1	07/12/13	07/12/13 JB	SW846 6010C <sup>1</sup>	SW846 3010A <sup>3</sup>
Potassium	1390	1000	ug/l	1	07/12/13	07/12/13 JB	SW846 6010C <sup>1</sup>	SW846 3010A <sup>3</sup>
Selenium	< 0.0020	0.0020	mg/l	5	07/12/13	07/13/13 JM	SW846 6020A <sup>2</sup>	SW846 3010A <sup>4</sup>
Sodium	49000	400	ug/l	1	07/12/13	07/12/13 JB	SW846 6010C <sup>1</sup>	SW846 3010A <sup>3</sup>

(1) Instrument QC Batch: MA3753

(2) Instrument QC Batch: MA3754

(3) Prep QC Batch: MP10508

(4) Prep QC Batch: MP10509

RL = Reporting Limit

## Report of Analysis

Page 1 of 1

<b>Client Sample ID:</b>	MW-1	
<b>Lab Sample ID:</b>	D48106-2	<b>Date Sampled:</b> 07/09/13
<b>Matrix:</b>	AQ - Ground Water	<b>Date Received:</b> 07/11/13
<b>Method:</b>	SW846 8260B	<b>Percent Solids:</b> n/a
<b>Project:</b>	MOC 32C/BWQ/MONITORING WELLS	

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1 <sup>a</sup>	3V25607.D	1	07/12/13	BR	n/a	n/a	V3V1507
Run #2							

	Purge Volume
Run #1	5.0 ml
Run #2	

## Purgeable Aromatics

CAS No.	Compound	Result	RL	MDL	Units	Q
71-43-2	Benzene	ND	0.0010	0.00025	mg/l	
108-88-3	Toluene	ND	0.0020	0.0010	mg/l	
100-41-4	Ethylbenzene	ND	0.0020	0.00025	mg/l	
1330-20-7	Xylene (total)	ND	0.0030	0.0020	mg/l	

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
17060-07-0	1,2-Dichloroethane-D4	100%		62-130%
2037-26-5	Toluene-D8	96%		70-130%
460-00-4	4-Bromofluorobenzene	91%		69-130%

(a) The pH of the sample aliquot for VOA analysis was > 2 at time of analysis.

ND = Not detected      MDL - Method Detection Limit  
 RL = Reporting Limit  
 E = Indicates value exceeds calibration range

J = Indicates an estimated value  
 B = Indicates analyte found in associated method blank  
 N = Indicates presumptive evidence of a compound

## Report of Analysis

Page 1 of 1

<b>Client Sample ID:</b>	MW-1	<b>Date Sampled:</b>	07/09/13
<b>Lab Sample ID:</b>	D48106-2	<b>Date Received:</b>	07/11/13
<b>Matrix:</b>	AQ - Ground Water	<b>Percent Solids:</b>	n/a
<b>Method:</b>	SW846 8015B		
<b>Project:</b>	MOC 32C/BWQ/MONITORING WELLS		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	GB21146.D	1	07/13/13	BD	n/a	n/a	GGB1161
Run #2							

	Purge Volume
Run #1	5.0 ml
Run #2	

CAS No.	Compound	Result	RL	MDL	Units	Q
	TPH-GRO (C6-C10)	ND	0.20	0.10	mg/l	
CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits		
120-82-1	1,2,4-Trichlorobenzene	89%		60-140%		

ND = Not detected      MDL - Method Detection Limit  
 RL = Reporting Limit  
 E = Indicates value exceeds calibration range

J = Indicates an estimated value  
 B = Indicates analyte found in associated method blank  
 N = Indicates presumptive evidence of a compound

## Report of Analysis

Page 1 of 1

<b>Client Sample ID:</b>	MW-1	<b>Date Sampled:</b>	07/09/13
<b>Lab Sample ID:</b>	D48106-2	<b>Date Received:</b>	07/11/13
<b>Matrix:</b>	AQ - Ground Water	<b>Percent Solids:</b>	n/a
<b>Method:</b>	SW846-8015B SW846 3510C		
<b>Project:</b>	MOC 32C/BWQ/MONITORING WELLS		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	FD26401.D	1	07/13/13	TU	07/12/13	OP8188	GFD1299
Run #2							

	Initial Volume	Final Volume
Run #1	1060 ml	1.0 ml
Run #2		

CAS No.	Compound	Result	RL	MDL	Units	Q
	TPH-DRO (C10-C28)	ND	0.19	0.17	mg/l	
CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits		
84-15-1	o-Terphenyl	75%		20-140%		

ND = Not detected      MDL - Method Detection Limit  
 RL = Reporting Limit  
 E = Indicates value exceeds calibration range

J = Indicates an estimated value  
 B = Indicates analyte found in associated method blank  
 N = Indicates presumptive evidence of a compound



## Report of Analysis

Page 1 of 1

<b>Client Sample ID:</b> MW-1	<b>Date Sampled:</b> 07/09/13
<b>Lab Sample ID:</b> D48106-2	<b>Date Received:</b> 07/11/13
<b>Matrix:</b> AQ - Ground Water	<b>Percent Solids:</b> n/a
<b>Project:</b> MOC 32C/BWQ/MONITORING WELLS	

## Total Metals Analysis

Analyte	Result	RL	Units	DF	Prep	Analyzed By	Method	Prep Method
Barium	0.084	0.010	mg/l	5	07/12/13	07/13/13 JM	SW846 6020A <sup>2</sup>	SW846 3010A <sup>4</sup>
Boron	58.4	50	ug/l	1	07/12/13	07/12/13 JB	SW846 6010C <sup>1</sup>	SW846 3010A <sup>3</sup>
Calcium	58900	400	ug/l	1	07/12/13	07/12/13 JB	SW846 6010C <sup>1</sup>	SW846 3010A <sup>3</sup>
Iron	1120	70	ug/l	1	07/12/13	07/12/13 JB	SW846 6010C <sup>1</sup>	SW846 3010A <sup>3</sup>
Magnesium	31900	200	ug/l	1	07/12/13	07/12/13 JB	SW846 6010C <sup>1</sup>	SW846 3010A <sup>3</sup>
Manganese	71.8	5.0	ug/l	1	07/12/13	07/12/13 JB	SW846 6010C <sup>1</sup>	SW846 3010A <sup>3</sup>
Potassium	1270	1000	ug/l	1	07/12/13	07/12/13 JB	SW846 6010C <sup>1</sup>	SW846 3010A <sup>3</sup>
Selenium	< 0.0020	0.0020	mg/l	5	07/12/13	07/13/13 JM	SW846 6020A <sup>2</sup>	SW846 3010A <sup>4</sup>
Sodium	46900	400	ug/l	1	07/12/13	07/12/13 JB	SW846 6010C <sup>1</sup>	SW846 3010A <sup>3</sup>

(1) Instrument QC Batch: MA3753

(2) Instrument QC Batch: MA3754

(3) Prep QC Batch: MP10508

(4) Prep QC Batch: MP10509

RL = Reporting Limit

## Report of Analysis

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<b>Client Sample ID:</b> MW-1	<b>Date Sampled:</b> 07/09/13
<b>Lab Sample ID:</b> D48106-2	<b>Date Received:</b> 07/11/13
<b>Matrix:</b> AQ - Ground Water	<b>Percent Solids:</b> n/a
<b>Project:</b> MOC 32C/BWQ/MONITORING WELLS	

## General Chemistry

Analyte	Result	RL	Units	DF	Analyzed	By	Method
Alkalinity, Bicarbonate as CaC	299	5.0	mg/l	1	07/11/13	KB	SM 2320B-2011
Alkalinity, Carbonate	< 5.0	5.0	mg/l	1	07/11/13	KB	SM 2320B-2011
Alkalinity, Total as CaCO <sub>3</sub>	299	5.0	mg/l	1	07/11/13	KB	SM 2320B-2011
Bromide	0.14	0.050	mg/l	1	07/11/13 16:04	GH	EPA 300.0/SW846 9056
Chloride	17.1	0.50	mg/l	1	07/11/13 16:04	GH	EPA 300.0/SW846 9056
Fluoride	0.13	0.10	mg/l	1	07/11/13 16:04	GH	EPA 300.0/SW846 9056
Nitrogen, Nitrate	0.45	0.050	mg/l	5	07/11/13 18:18	GH	EPA 300.0/SW846 9056
Nitrogen, Nitrate + Nitrite <sup>a</sup>	0.45	0.054	mg/l	1	07/11/13 18:18	GH	EPA 300.0/SW846 9056
Nitrogen, Nitrite	< 0.0040	0.0040	mg/l	1	07/11/13 16:04	GH	EPA 300.0/SW846 9056
Phosphorus, Total	0.036	0.010	mg/l	1	07/12/13	KB	HACH8190/SM4500P-B/E
Solids, Total Dissolved	426	10	mg/l	1	07/11/13	BF	SM 2540C-2011
Specific Conductivity	642	1.0	umhos/cm	1	07/15/13	RW	SM 2510B-2011
Sulfate	47.1	2.5	mg/l	5	07/11/13 18:18	GH	EPA 300.0/SW846 9056
pH	7.87		su	1	07/15/13 13:50	AK	SM4500HB+ -2011/9040C

(a) Calculated as: (Nitrogen, Nitrate) + (Nitrogen, Nitrite)

RL = Reporting Limit

## Report of Analysis

Page 1 of 1

<b>Client Sample ID:</b>	MW-1						
<b>Lab Sample ID:</b>	D48106-2A					<b>Date Sampled:</b>	07/09/13
<b>Matrix:</b>	AQ - Ground Water					<b>Date Received:</b>	07/11/13
<b>Method:</b>	RSK175 MOD					<b>Percent Solids:</b>	n/a
<b>Project:</b>	MOC 32C/BWQ/MONITORING WELLS						

Run #	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	FB08925.D	1	07/11/13	AV	n/a	n/a	GFB391
Run #2							

## Methane, Ethane and Propane

CAS No.	Compound	Result	RL	MDL	Units	Q
74-82-8	Methane	0.00041	0.00080	0.00040	mg/l	J
74-84-0	Ethane	ND	0.0016	0.00080	mg/l	
74-98-6	Propane	ND	0.018	0.0090	mg/l	

ND = Not detected MDL - Method Detection Limit

RL = Reporting Limit

E = Indicates value exceeds calibration range

J = Indicates an estimated value

B = Indicates analyte found in associated method blank

N = Indicates presumptive evidence of a compound

Report of Analysis

<b>Client Sample ID:</b>	MW-1	<b>Date Sampled:</b>	07/09/13
<b>Lab Sample ID:</b>	D48106-2B	<b>Date Received:</b>	07/11/13
<b>Matrix:</b>	AQ - Ground Water	<b>Percent Solids:</b>	n/a
<b>Project:</b>	MOC 32C/BWQ/MONITORING WELLS		

General Chemistry

Analyte	Result	RL	Units	DF	Analyzed	By	Method
Iron Reducing Bacteria	9000	25	CFU/ml	1	07/15/13	MM	HACH IRB-BART
Slime Forming Bacteria	140000	500	CFU/ml	1	07/15/13	MM	HACH SLYM-BART
Sulfate Reducing Bacteria	5000	200	CFU/ml	1	07/15/13	MM	HACH SRB-BART

RL = Reporting Limit



## Report of Analysis

Page 1 of 1

<b>Client Sample ID:</b> MW-1	<b>Date Sampled:</b> 07/09/13
<b>Lab Sample ID:</b> D48106-2F	<b>Date Received:</b> 07/11/13
<b>Matrix:</b> AQ - Groundwater Filtered	<b>Percent Solids:</b> n/a
<b>Project:</b> MOC 32C/BWQ/MONITORING WELLS	

## Dissolved Metals Analysis

Analyte	Result	RL	Units	DF	Prep	Analyzed By	Method	Prep Method
Barium	0.069	0.010	mg/l	5	07/12/13	07/13/13 JM	SW846 6020A <sup>2</sup>	SW846 3010A <sup>4</sup>
Boron	< 50	50	ug/l	1	07/12/13	07/12/13 JB	SW846 6010C <sup>1</sup>	SW846 3010A <sup>3</sup>
Calcium	58300	400	ug/l	1	07/12/13	07/12/13 JB	SW846 6010C <sup>1</sup>	SW846 3010A <sup>3</sup>
Iron	< 70	70	ug/l	1	07/12/13	07/12/13 JB	SW846 6010C <sup>1</sup>	SW846 3010A <sup>3</sup>
Magnesium	31600	200	ug/l	1	07/12/13	07/12/13 JB	SW846 6010C <sup>1</sup>	SW846 3010A <sup>3</sup>
Manganese	47.2	5.0	ug/l	1	07/12/13	07/12/13 JB	SW846 6010C <sup>1</sup>	SW846 3010A <sup>3</sup>
Potassium	1080	1000	ug/l	1	07/12/13	07/12/13 JB	SW846 6010C <sup>1</sup>	SW846 3010A <sup>3</sup>
Selenium	< 0.0020	0.0020	mg/l	5	07/12/13	07/13/13 JM	SW846 6020A <sup>2</sup>	SW846 3010A <sup>4</sup>
Sodium	49400	400	ug/l	1	07/12/13	07/12/13 JB	SW846 6010C <sup>1</sup>	SW846 3010A <sup>3</sup>

(1) Instrument QC Batch: MA3753

(2) Instrument QC Batch: MA3754

(3) Prep QC Batch: MP10508

(4) Prep QC Batch: MP10509

RL = Reporting Limit

## Report of Analysis

Page 1 of 1

<b>Client Sample ID:</b>	TRIP BLANK	<b>Date Sampled:</b>	07/09/13
<b>Lab Sample ID:</b>	D48106-3	<b>Date Received:</b>	07/11/13
<b>Matrix:</b>	AQ - Trip Blank Water	<b>Percent Solids:</b>	n/a
<b>Method:</b>	SW846 8260B		
<b>Project:</b>	MOC 32C/BWQ/MONITORING WELLS		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	3V25608.D	1	07/12/13	BR	n/a	n/a	V3V1507
Run #2							

	Purge Volume
Run #1	5.0 ml
Run #2	

## Purgeable Aromatics

CAS No.	Compound	Result	RL	MDL	Units	Q
71-43-2	Benzene	ND	0.0010	0.00025	mg/l	
108-88-3	Toluene	ND	0.0020	0.0010	mg/l	
100-41-4	Ethylbenzene	ND	0.0020	0.00025	mg/l	
1330-20-7	Xylene (total)	ND	0.0030	0.0020	mg/l	

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
17060-07-0	1,2-Dichloroethane-D4	113%		62-130%
2037-26-5	Toluene-D8	93%		70-130%
460-00-4	4-Bromofluorobenzene	91%		69-130%

ND = Not detected MDL - Method Detection Limit

RL = Reporting Limit

E = Indicates value exceeds calibration range

J = Indicates an estimated value

B = Indicates analyte found in associated method blank

N = Indicates presumptive evidence of a compound

## Misc. Forms

5

### Custody Documents and Other Forms

---

Includes the following where applicable:

- Chain of Custody

Accutest Laboratories Mountain States  
4036 Youngfield Street Wheat Ridge, Co 80033  
TEL: 303-425-6021 877-737-4521  
FAX: 303-425-6021

FED-EX Tracking #	Bottle Order Control #
Accutest Quote #	Accutest Job # <b>D48106</b>

Client / Reporting Information		Project Information		Requested Analysis (see TEST CODE sheet)												Matrix Codes
Company Name <b>Marathon Oil</b>		Project Name <b>MOC 32C/BWQ/Monitoring Wells</b>		<div style="writing-mode: vertical-rl; transform: rotate(180deg);">See Attached</div>												DW - Drinking Water GW - Ground Water WW - Water SW - Surface Water SO - Soil SL - Sludge SED - Sediment OL - Oil LIQ - Other Liquid AIR - Air SOL - Other Solid WP - Wipe FB - Field Blank EB - Equipment Blank RB - Rinse Blank TB - Trip Blank
Street Address <b>743 Horizon Ct, Suite 220</b>		Street:														
City, State, Zip <b>Grand Junction CO 81506</b>		Billing Information (If different from Report to)														
Project Contact <b>Zach Toellner</b>		Company Name														
E-mail		Street Address														
Phone # <b>970-260-0772</b>		Client PO#		City		State		Zip		Project#		Attention:		PO#		
Samples (Name(s)) <b>Scott Distel 307-399-2329</b>		Project Manager		Date		Time		Sampled by		Matrix		# of bottles		Number of preserved bottles		
Field ID / Point of Collection		MECHD/ Viol #		Date		Time		Sampled by		Matrix		# of bottles		Number of preserved bottles		
1 MW-3				7/9/13		11:30		SD GW		22 9		1 1 10		1 1 10		
2 MW-1				7/9/13		14:30		SD GW		22 9		1 1 10		1 1 10		
3 Lab-Provided Trip Blank										2 2						

Turnaround Time (Business days)		Approved By (Accutest PM) / Date:		Data Deliverable Information		Comments / Special Instructions	
<input type="checkbox"/> Std. 10 Business Days <input type="checkbox"/> Std. 5 Business Days (By Contract only) <input type="checkbox"/> 5 Day H/SH <input type="checkbox"/> 3 Day EMERGENCY <input checked="" type="checkbox"/> 2 Day EMERGENCY <input checked="" type="checkbox"/> 1 Day EMERGENCY <small>Emergency &amp; Rush T/A data available VIA LabLink</small>		<input type="checkbox"/> Commercial "A" (Level 1) <input type="checkbox"/> Commercial "B" (Level 2) <input type="checkbox"/> Commercial "B" + Narrative <input checked="" type="checkbox"/> FULLT1 (Level 3+4)		<input checked="" type="checkbox"/> State Forms <input checked="" type="checkbox"/> EDD Format <input checked="" type="checkbox"/> PDF		<b>Trip Blank "Made 5/22/12 SK"</b> <b>Analyze Trip Blank as required by QA/QC protocols.</b>	
		Commercial "A" = Results Only Commercial "B" = Results + QC Summary					

Sample Custody must be documented below each time samples change possession, including courier delivery.			
Relinquished by Sampler:	Date Time:	Received By:	Date Time:
1 <b>Scott Distel</b>	7/13 17:30	<b>[Signature]</b>	
Relinquished by Sampler:	Date Time:	Received By:	Date Time:
3		3	
Relinquished by:	Date Time:	Received By:	Date Time:
5		5	
Custody Seal #		<input type="checkbox"/> Intact <input type="checkbox"/> Not Intact	
		<input type="checkbox"/> Preserved where applicable <input checked="" type="checkbox"/> On Ice <input type="checkbox"/> Cooler Temp. <b>5.2</b>	

**D48106: Chain of Custody**

**Page 1 of 4**

Marathon BWQ Analytical Parameters

Analyte	Method(s)	Lower Limit of Quantification
pH	SM-4500-H+ 150.1 SW-846 9040C	NA
Specific Conductance	SM-2510 SW-846 9050A	NA
Total Dissolved Solids	SM-2540C	10mg/l
Total Alkalinity as CaCO <sub>3</sub>	SM 2320	10mg/l
Bicarbonate Alkalinity as CaCO <sub>3</sub>		10mg/l
Carbonate Alkalinity as CaCO <sub>3</sub>		10mg/l
Bromide	300.0 SW-846	0.2mg/l
Chloride	9056	0.1mg/l
Fluoride		0.2mg/l
Sulfate		5mg/l
Nitrate (as individual analyte instead of combined analysis)		0.1mg/l
Nitrite (as individual analyte instead of combined analysis)		0.1mg/l
Nitrate and Nitrite as N	353.3	0.1mg/l
Phosphorous	SM-4500-P 365.3	0.05mg/l
<b>Dissolved Gases</b>		
Methane	RSK SOP 175	0.005mg/l
Ethane	and	0.005mg/l
Propane	modifications	0.005mg/l
<b>Well Bore Bacterial Indicators</b>		
Iron-related bacteria	BART Manuals	1 day to reaction or 100 cfu/100 ml
Sulfur-related bacteria		
Slime-forming bacteria		
<b>Metals and Other Elements (Filtered in Lab or in Field)</b>		
Calcium	200.7/200.8 or	1mg/l
Iron	SW-846	0.1mg/l
Magnesium	6010C/SW-846	1mg/l
Manganese	6020A	0.01mg/l
Potassium		1mg/l
Sodium		1mg/l
Barium		0.001mg/l
Boron		0.1mg/l
Selenium		0.001mg/l

D48106: Chain of Custody

Page 2 of 4



Strontium		0.01mg/l
Dissolved fraction metals (filtered and acidified at lab or filtered and acidified in field)		
Organic Compounds and Indicators (Unfiltered in Field)		
Benzene	SW-846 8260B	1µg/l
Toluene	Or SW-846	1µg/l
Ethylbenzene	8260C	1µg/l
o-Xylene		1µg/l
m-Xylene and p-Xylene		1µg/l
Total Xylenes		1µg/l
Total Petroleum Hydrocarbons (see fraction description below)		
TPH-volatile hydrocarbons (from 2-methylpentane-1,2,4-trimethylbenzene)	SW-846 8015C and modifications	0.05mg/l
TPH-extractable hydrocarbons (from C10-C28 alkanes)	SW-846 8015C and modifications	0.5mg/l
Gas Composition and Isotopic Analyses (Unfiltered in Field)		
Hydrogen	GC/TCD*	0.0001mol%
Argon	GC/TCD*	0.0001mol%
Oxygen	GC/TCD*	0.0001mol%
Nitrogen	GC/TCD*	0.0001mol%
Carbon Dioxide	GC/TCD*	0.0001mol%
Methane	GC/FID**	0.0001mol%
Ethane	GC/FID**	0.0001mol%
Ethene	GC/FID**	0.0001mol%
Propane	GC/FID**	0.0001mol%
Propene	GC/FID**	0.0001mol%
iso-Butane	GC/FID**	0.0001mol%
n-Butane	GC/FID**	0.0001mol%
iso-Pentane	GC/FID**	0.0001mol%
n-Pentane	GC/FID**	0.0001mol%
Hexanes +	GC/FID**	0.0001mol%
δ13C CH4 (VPDB)	IRMS***	NA
δD CH4 (VSMOW)	IRMS***	NA

D48106: Chain of Custody

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\*GC/TCD - Gas Chromatography/Thermal Conductivity Detector  
\*\*GC/FID - Gas Chromatography/Flame Ionization Detector  
\*\*\*IRMS - Isotope-Ratio Mass Spectrometry

**D48106: Chain of Custody**  
**Page 4 of 4**

**APPENDIX C-2**  
**JULY 10 SAMPLE RESULTS**



08/29/13

## Technical Report for

Marathon Oil

MOC 32C/BWQ/MONITORING WELLS

WBS#TA.13.30788.EXP

Accutest Job Number: D48107

Sampling Date: 07/10/13

Report to:

Golder Associates

rmarch@golder.com

ATTN: Randy March

Total number of pages in report: **24**



Test results contained within this data package meet the requirements of the National Environmental Laboratory Accreditation Conference and/or state specific certification programs as applicable.

A handwritten signature in black ink, appearing to read 'Scott Heideman'.

Scott Heideman  
Laboratory Director

Client Service contact: Ann Doerr 303-425-6021

Certifications: CO (CO00049), ID, NE (CO00049), ND (R-027), NJ (CO 0007), OK (D9942), UT (NELAP CO00049), TX (T104704511)

This report shall not be reproduced, except in its entirety, without the written approval of Accutest Laboratories.  
Test results relate only to samples analyzed.

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## Sample Summary

Marathon Oil

Job No: D48107

MOC 32C/BWQ/MONITORING WELLS

Project No: WBS#TA.13.30788.EXP

Sample Number	Collected		Received	Matrix		Client Sample ID
	Date	Time By		Code	Type	
D48107-1	07/10/13	15:00 BT	07/11/13	AQ	Ground Water	MW-4
D48107-1A	07/10/13	15:00 BT	07/11/13	AQ	Ground Water	MW-4
D48107-1B	07/10/13	15:00 BT	07/11/13	AQ	Ground Water	MW-4
D48107-1F	07/10/13	15:00 BT	07/11/13	AQ	Groundwater Filtered	MW-4
D48107-2	07/10/13	00:00 BT	07/11/13	AQ	Trip Blank Water	TRIP BLANK



## CASE NARRATIVE / CONFORMANCE SUMMARY

**Client:** Marathon Oil

**Job No** D48107

**Site:** MOC 32C/BWQ/MONITORING WELLS

**Report Date** 7/23/2013 10:06:50 AM

On 07/11/2013, 1 sample(s), 1 Trip Blank(s), and 0 Field Blank(s) were received at Accutest Mountain States (AMS) at a temperature of 5.8 °C. The samples were intact and properly preserved, unless noted below. An AMS Job Number of D48107 was assigned to the project. The lab sample ID, client sample ID, and date of sample collection are detailed in the report's Results Summary.

Specified quality control criteria were achieved for this job except as noted below. For more information, please refer to the analytical results and QC summary pages.

### Volatiles by GCMS By Method SW846 8260B

**Matrix** AQ

**Batch ID:** V3V1507

- All samples were analyzed within the recommended method holding time.
- All method blanks for this batch meet method specific criteria.
- Sample(s) D47878-1MS, D47878-1MSD were used as the QC samples indicated.
- D47878-1MSD: Dilution required due to matrix interference (sample foamed).
- D47878-1MS: Dilution required due to matrix interference (sample foamed).

### Volatiles by GC By Method RSK175 MOD

**Matrix** AQ

**Batch ID:** GFB391

- All samples were analyzed within the recommended method holding time.
- All method blanks for this batch meet method specific criteria.
- Sample(s) D48007-3MS, D48007-3MSD were used as the QC samples indicated.

### Volatiles by GC By Method SW846 8015B

**Matrix** AQ

**Batch ID:** GGB1161

- All samples were analyzed within the recommended method holding time.
- All method blanks for this batch meet method specific criteria.
- Sample(s) D48026-1MS, D48026-1MSD were used as the QC samples indicated.

### Extractables by GC By Method SW846-8015B

**Matrix** AQ

**Batch ID:** OP8188

- All samples were extracted and analyzed within the recommended method holding time.
- All method blanks for this batch meet method specific criteria.
- Sample(s) D47726-37MS, D47726-37MSD were used as the QC samples indicated.

## Metals By Method SW846 6010C

**Matrix** AQ

**Batch ID:** MP10508

- All samples were digested and analyzed within the recommended method holding time.
- All method blanks for this batch meet method specific criteria.
- Sample(s) D48106-1MS, D48106-1MSD, D48106-1SDL were used as the QC samples for the metals analysis.
- The matrix spike (MS) recovery(s) of Potassium, Sodium are outside control limits. Spike recovery indicates possible matrix interference.
- The serial dilution RPD(s) for Boron are outside control limits for sample MP10508-SD1. Percent difference acceptable due to low initial sample concentration (< 50 times IDL).

## Metals By Method SW846 6020A

**Matrix** AQ

**Batch ID:** MP10509

- All samples were digested and analyzed within the recommended method holding time.
- All method blanks for this batch meet method specific criteria.
- Sample(s) D48106-1MS, D48106-1MSD, D48106-1SDL were used as the QC samples for the metals analysis.
- The serial dilution RPD(s) for Selenium are outside control limits for sample MP10509-SD1. Percent difference acceptable due to low initial sample concentration (< 50 times IDL).

## Wet Chemistry By Method EPA 300.0/SW846 9056

**Matrix** AQ

**Batch ID:** GP10400

- All samples were prepared and analyzed within the recommended method holding time.
- All method blanks for this batch meet method specific criteria.
- Sample(s) D48029-4MS, D48029-4MSD were used as the QC samples for the Bromide, Chloride, Fluoride, Nitrogen, Nitrate, Nitrogen, Nitrite, Sulfate, Bromide analysis.
- D48107-1 for Fluoride: Elevated detection limit due to matrix interference.
- D48107-1 for Nitrogen, Nitrite: Elevated detection limit due to matrix interference.

**Matrix** AQ

**Batch ID:** R17957

- The data for EPA 300.0/SW846 9056 meets quality control requirements.
- D48107-1 for Nitrogen, Nitrate + Nitrite: Calculated as: (Nitrogen, Nitrate) + (Nitrogen, Nitrite)

## Wet Chemistry By Method HACH IRB-BART

**Matrix** AQ

**Batch ID:** MB218

- All samples were analyzed within the recommended method holding time.
- All method blanks for this batch meet method specific criteria.

## Wet Chemistry By Method HACH SLYM-BART

**Matrix** AQ

**Batch ID:** MB219

- All samples were analyzed within the recommended method holding time.
- All method blanks for this batch meet method specific criteria.

## Wet Chemistry By Method HACH SRB-BART

**Matrix** AQ

**Batch ID:** MB220

- All samples were analyzed within the recommended method holding time.
- All method blanks for this batch meet method specific criteria.

### Wet Chemistry By Method HACH8190/SM4500P-B/E

**Matrix** AQ

**Batch ID:** GP10412

- All samples were prepared and analyzed within the recommended method holding time.
- All method blanks for this batch meet method specific criteria.
- Sample(s) D48027-1DUP, D48027-1MS, D48027-1MSD were used as the QC samples for the Phosphorus, Total analysis.

### Wet Chemistry By Method SM 2320B-2011

**Matrix** AQ

**Batch ID:** GN20958

- All samples were analyzed within the recommended method holding time.
- All method blanks for this batch meet method specific criteria.
- Sample(s) D47951-2DUP, D47951-2MS, D47951-2MSD were used as the QC samples for the Alkalinity, Total as CaCO<sub>3</sub> analysis.

**Matrix** AQ

**Batch ID:** GN20959

- All samples were analyzed within the recommended method holding time.
- All method blanks for this batch meet method specific criteria.

**Matrix** AQ

**Batch ID:** GN20960

- All samples were analyzed within the recommended method holding time.
- All method blanks for this batch meet method specific criteria.

### Wet Chemistry By Method SM 2510B-2011

**Matrix** AQ

**Batch ID:** GP10422

- Sample(s) D47990-4DUP were used as the QC samples for the Specific Conductivity analysis.

### Wet Chemistry By Method SM 2540C-2011

**Matrix** AQ

**Batch ID:** GN20952

- All samples were analyzed within the recommended method holding time.
- All method blanks for this batch meet method specific criteria.
- Sample(s) D47990-2DUP were used as the QC samples for the Solids, Total Dissolved analysis.

### Wet Chemistry By Method SM4500HB+-2011/9040C

**Matrix** AQ

**Batch ID:** GN21010

- The following samples were run outside of holding time for method SM4500HB+-2011/9040C: D48107-1

AMS certifies that data reported for samples received, listed on the associated custody chain or analytical task order, were produced to specifications meeting AMS's Quality System precision, accuracy and completeness objectives except as noted.

Estimated non-standard method measurement uncertainty data is available on request, based on quality control bias and implicit for standard methods. Acceptable uncertainty requires tested parameter quality control data to meet method criteria.

AMS is not responsible for data quality assumptions if partial reports are used and recommends that this report be used in its entirety. This report is authorized by AMS indicated via signature on the report cover.

## Summary of Hits

Page 1 of 2

**Job Number:** D48107  
**Account:** Marathon Oil  
**Project:** MOC 32C/BWQ/MONITORING WELLS  
**Collected:** 07/10/13

Lab Sample ID	Client Sample ID	Result/ Qual	RL	MDL	Units	Method
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### D48107-1 MW-4

Benzene	0.0947	0.0010	0.00025	mg/l	SW846 8260B
Ethylbenzene	0.0021	0.0020	0.00025	mg/l	SW846 8260B
Xylene (total)	0.0138	0.0030	0.0020	mg/l	SW846 8260B
TPH-GRO (C6-C10)	0.270	0.20	0.10	mg/l	SW846 8015B
TPH-DRO (C10-C28)	0.242	0.19	0.17	mg/l	SW846-8015B
Barium	0.16	0.010		mg/l	SW846 6020A
Boron	475	50		ug/l	SW846 6010C
Calcium	149000	400		ug/l	SW846 6010C
Iron	629	70		ug/l	SW846 6010C
Magnesium	66400	200		ug/l	SW846 6010C
Manganese	1210	5.0		ug/l	SW846 6010C
Potassium	1590	1000		ug/l	SW846 6010C
Sodium	230000	400		ug/l	SW846 6010C
Alkalinity, Bicarbonate as CaCO <sub>3</sub>	385	5.0		mg/l	SM 2320B-2011
Alkalinity, Total as CaCO <sub>3</sub>	385	5.0		mg/l	SM 2320B-2011
Bromide	4.2	0.25		mg/l	EPA 300.0/SW846 9056
Chloride	462	10		mg/l	EPA 300.0/SW846 9056
Nitrogen, Nitrate	0.13	0.050		mg/l	EPA 300.0/SW846 9056
Nitrogen, Nitrate + Nitrite <sup>a</sup>	0.15	0.070		mg/l	EPA 300.0/SW846 9056
Phosphorus, Total	0.047	0.010		mg/l	HACH8190/SM4500P-B/E
Solids, Total Dissolved	1550	10		mg/l	SM 2540C-2011
Specific Conductivity	2310	1.0		umhos/cm	SM 2510B-2011
Sulfate	118	2.5		mg/l	EPA 300.0/SW846 9056
pH	7.67			su	SM4500HB+ -2011/9040C

### D48107-1A MW-4

Methane	0.0811	0.00080	0.00040	mg/l	RSK175 MOD
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### D48107-1B MW-4

Iron Reducing Bacteria	9000	25		CFU/ml	HACH IRB-BART
Slime Forming Bacteria	140000	500		CFU/ml	HACH SLYM-BART
Sulfate Reducing Bacteria	18000	200		CFU/ml	HACH SRB-BART

### D48107-1F MW-4

Barium	0.17	0.010		mg/l	SW846 6020A
Boron	518	50		ug/l	SW846 6010C
Calcium	160000	400		ug/l	SW846 6010C
Magnesium	68200	200		ug/l	SW846 6010C
Manganese	1260	5.0		ug/l	SW846 6010C
Potassium	1460	1000		ug/l	SW846 6010C



## Summary of Hits

Page 2 of 2

**Job Number:** D48107  
**Account:** Marathon Oil  
**Project:** MOC 32C/BWQ/MONITORING WELLS  
**Collected:** 07/10/13



Lab Sample ID	Client Sample ID	Result/ Qual	RL	MDL	Units	Method
Analyte						

Sodium		224000	400		ug/l	SW846 6010C
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**D48107-2**      **TRIP BLANK**

No hits reported in this sample.

(a) Calculated as: (Nitrogen, Nitrate) + (Nitrogen, Nitrite)

Sample Results

Report of Analysis

## Report of Analysis

Page 1 of 1

<b>Client Sample ID:</b>	MW-4	<b>Date Sampled:</b>	07/10/13
<b>Lab Sample ID:</b>	D48107-1	<b>Date Received:</b>	07/11/13
<b>Matrix:</b>	AQ - Ground Water	<b>Percent Solids:</b>	n/a
<b>Method:</b>	SW846 8260B		
<b>Project:</b>	MOC 32C/BWQ/MONITORING WELLS		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	3V25609.D	1	07/12/13	BR	n/a	n/a	V3V1507
Run #2							

	Purge Volume
Run #1	5.0 ml
Run #2	

## Purgeable Aromatics

CAS No.	Compound	Result	RL	MDL	Units	Q
71-43-2	Benzene	0.0947	0.0010	0.00025	mg/l	
108-88-3	Toluene	ND	0.0020	0.0010	mg/l	
100-41-4	Ethylbenzene	0.0021	0.0020	0.00025	mg/l	
1330-20-7	Xylene (total)	0.0138	0.0030	0.0020	mg/l	

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
17060-07-0	1,2-Dichloroethane-D4	102%		62-130%
2037-26-5	Toluene-D8	94%		70-130%
460-00-4	4-Bromofluorobenzene	90%		69-130%

ND = Not detected      MDL - Method Detection Limit  
 RL = Reporting Limit  
 E = Indicates value exceeds calibration range

J = Indicates an estimated value  
 B = Indicates analyte found in associated method blank  
 N = Indicates presumptive evidence of a compound

## Report of Analysis

Page 1 of 1

<b>Client Sample ID:</b>	MW-4	<b>Date Sampled:</b>	07/10/13
<b>Lab Sample ID:</b>	D48107-1	<b>Date Received:</b>	07/11/13
<b>Matrix:</b>	AQ - Ground Water	<b>Percent Solids:</b>	n/a
<b>Method:</b>	SW846 8015B		
<b>Project:</b>	MOC 32C/BWQ/MONITORING WELLS		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	GB21147.D	1	07/13/13	BD	n/a	n/a	GGB1161
Run #2							

	Purge Volume
Run #1	5.0 ml
Run #2	

CAS No.	Compound	Result	RL	MDL	Units	Q
	TPH-GRO (C6-C10)	0.270	0.20	0.10	mg/l	
CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits		
120-82-1	1,2,4-Trichlorobenzene	90%		60-140%		

ND = Not detected      MDL - Method Detection Limit  
 RL = Reporting Limit  
 E = Indicates value exceeds calibration range

J = Indicates an estimated value  
 B = Indicates analyte found in associated method blank  
 N = Indicates presumptive evidence of a compound

## Report of Analysis

Page 1 of 1

<b>Client Sample ID:</b>	MW-4	<b>Date Sampled:</b>	07/10/13
<b>Lab Sample ID:</b>	D48107-1	<b>Date Received:</b>	07/11/13
<b>Matrix:</b>	AQ - Ground Water	<b>Percent Solids:</b>	n/a
<b>Method:</b>	SW846-8015B SW846 3510C		
<b>Project:</b>	MOC 32C/BWQ/MONITORING WELLS		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	FD26473.D	1	07/14/13	TU	07/12/13	OP8188	GFD1299
Run #2							

	Initial Volume	Final Volume
Run #1	1060 ml	1.0 ml
Run #2		

CAS No.	Compound	Result	RL	MDL	Units	Q
	TPH-DRO (C10-C28)	0.242	0.19	0.17	mg/l	
CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits		
84-15-1	o-Terphenyl	57%		20-140%		

ND = Not detected      MDL - Method Detection Limit  
 RL = Reporting Limit  
 E = Indicates value exceeds calibration range

J = Indicates an estimated value  
 B = Indicates analyte found in associated method blank  
 N = Indicates presumptive evidence of a compound



## Report of Analysis

Page 1 of 1

<b>Client Sample ID:</b>	MW-4	<b>Date Sampled:</b>	07/10/13
<b>Lab Sample ID:</b>	D48107-1	<b>Date Received:</b>	07/11/13
<b>Matrix:</b>	AQ - Ground Water	<b>Percent Solids:</b>	n/a
<b>Project:</b>	MOC 32C/BWQ/MONITORING WELLS		

## Total Metals Analysis

Analyte	Result	RL	Units	DF	Prep	Analyzed By	Method	Prep Method
Barium	0.16	0.010	mg/l	5	07/12/13	07/13/13 JM	SW846 6020A <sup>2</sup>	SW846 3010A <sup>5</sup>
Boron	475	50	ug/l	1	07/12/13	07/15/13 JB	SW846 6010C <sup>3</sup>	SW846 3010A <sup>4</sup>
Calcium	149000	400	ug/l	1	07/12/13	07/15/13 JB	SW846 6010C <sup>3</sup>	SW846 3010A <sup>4</sup>
Iron	629	70	ug/l	1	07/12/13	07/12/13 JB	SW846 6010C <sup>1</sup>	SW846 3010A <sup>4</sup>
Magnesium	66400	200	ug/l	1	07/12/13	07/12/13 JB	SW846 6010C <sup>1</sup>	SW846 3010A <sup>4</sup>
Manganese	1210	5.0	ug/l	1	07/12/13	07/15/13 JB	SW846 6010C <sup>3</sup>	SW846 3010A <sup>4</sup>
Potassium	1590	1000	ug/l	1	07/12/13	07/12/13 JB	SW846 6010C <sup>1</sup>	SW846 3010A <sup>4</sup>
Selenium	< 0.0020	0.0020	mg/l	5	07/12/13	07/13/13 JM	SW846 6020A <sup>2</sup>	SW846 3010A <sup>5</sup>
Sodium	230000	400	ug/l	1	07/12/13	07/12/13 JB	SW846 6010C <sup>1</sup>	SW846 3010A <sup>4</sup>

(1) Instrument QC Batch: MA3753

(2) Instrument QC Batch: MA3754

(3) Instrument QC Batch: MA3759

(4) Prep QC Batch: MP10508

(5) Prep QC Batch: MP10509

RL = Reporting Limit

## Report of Analysis

Page 1 of 1

<b>Client Sample ID:</b> MW-4	<b>Date Sampled:</b> 07/10/13
<b>Lab Sample ID:</b> D48107-1	<b>Date Received:</b> 07/11/13
<b>Matrix:</b> AQ - Ground Water	<b>Percent Solids:</b> n/a
<b>Project:</b> MOC 32C/BWQ/MONITORING WELLS	

## General Chemistry

Analyte	Result	RL	Units	DF	Analyzed	By	Method
Alkalinity, Bicarbonate as CaC	385	5.0	mg/l	1	07/11/13	KB	SM 2320B-2011
Alkalinity, Carbonate	< 5.0	5.0	mg/l	1	07/11/13	KB	SM 2320B-2011
Alkalinity, Total as CaCO3	385	5.0	mg/l	1	07/11/13	KB	SM 2320B-2011
Bromide	4.2	0.25	mg/l	5	07/11/13 16:02	SK	EPA 300.0/SW846 9056
Chloride	462	10	mg/l	20	07/11/13 19:08	SK	EPA 300.0/SW846 9056
Fluoride <sup>a</sup>	< 0.50	0.50	mg/l	5	07/11/13 16:02	SK	EPA 300.0/SW846 9056
Nitrogen, Nitrate	0.13	0.050	mg/l	5	07/11/13 16:02	SK	EPA 300.0/SW846 9056
Nitrogen, Nitrate + Nitrite <sup>b</sup>	0.15	0.070	mg/l	1	07/11/13 16:02	SK	EPA 300.0/SW846 9056
Nitrogen, Nitrite <sup>a</sup>	< 0.020	0.020	mg/l	5	07/11/13 16:02	SK	EPA 300.0/SW846 9056
Phosphorus, Total	0.047	0.010	mg/l	1	07/12/13	KB	HACH8190/SM4500P-B/E
Solids, Total Dissolved	1550	10	mg/l	1	07/11/13	BF	SM 2540C-2011
Specific Conductivity	2310	1.0	umhos/cm	1	07/15/13	RW	SM 2510B-2011
Sulfate	118	2.5	mg/l	5	07/11/13 16:02	SK	EPA 300.0/SW846 9056
pH	7.67		su	1	07/15/13 13:50	AK	SM4500HB+ -2011/9040C

(a) Elevated detection limit due to matrix interference.

(b) Calculated as: (Nitrogen, Nitrate) + (Nitrogen, Nitrite)

RL = Reporting Limit

## Report of Analysis

Page 1 of 1

<b>Client Sample ID:</b>	MW-4	<b>Date Sampled:</b>	07/10/13
<b>Lab Sample ID:</b>	D48107-1A	<b>Date Received:</b>	07/11/13
<b>Matrix:</b>	AQ - Ground Water	<b>Percent Solids:</b>	n/a
<b>Method:</b>	RSK175 MOD		
<b>Project:</b>	MOC 32C/BWQ/MONITORING WELLS		

Run #	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	FB08926.D	1	07/11/13	AV	n/a	n/a	GFB391
Run #2							

## Methane, Ethane and Propane

CAS No.	Compound	Result	RL	MDL	Units	Q
74-82-8	Methane	0.0811	0.00080	0.00040	mg/l	
74-84-0	Ethane	ND	0.0016	0.00080	mg/l	
74-98-6	Propane	ND	0.018	0.0090	mg/l	

ND = Not detected MDL - Method Detection Limit

RL = Reporting Limit

E = Indicates value exceeds calibration range

J = Indicates an estimated value

B = Indicates analyte found in associated method blank

N = Indicates presumptive evidence of a compound

Report of Analysis

<b>Client Sample ID:</b>	MW-4	<b>Date Sampled:</b>	07/10/13
<b>Lab Sample ID:</b>	D48107-1B	<b>Date Received:</b>	07/11/13
<b>Matrix:</b>	AQ - Ground Water	<b>Percent Solids:</b>	n/a
<b>Project:</b>	MOC 32C/BWQ/MONITORING WELLS		

General Chemistry

Analyte	Result	RL	Units	DF	Analyzed	By	Method
Iron Reducing Bacteria	9000	25	CFU/ml	1	07/15/13	MM	HACH IRB-BART
Slime Forming Bacteria	140000	500	CFU/ml	1	07/15/13	MM	HACH SLYM-BART
Sulfate Reducing Bacteria	18000	200	CFU/ml	1	07/15/13	MM	HACH SRB-BART

RL = Reporting Limit

## Report of Analysis

Page 1 of 1

<b>Client Sample ID:</b> MW-4	<b>Date Sampled:</b> 07/10/13
<b>Lab Sample ID:</b> D48107-1F	<b>Date Received:</b> 07/11/13
<b>Matrix:</b> AQ - Groundwater Filtered	<b>Percent Solids:</b> n/a
<b>Project:</b> MOC 32C/BWQ/MONITORING WELLS	

## Dissolved Metals Analysis

Analyte	Result	RL	Units	DF	Prep	Analyzed By	Method	Prep Method
Barium	0.17	0.010	mg/l	5	07/12/13	07/13/13 JM	SW846 6020A <sup>2</sup>	SW846 3010A <sup>4</sup>
Boron	518	50	ug/l	1	07/12/13	07/12/13 JB	SW846 6010C <sup>1</sup>	SW846 3010A <sup>3</sup>
Calcium	160000	400	ug/l	1	07/12/13	07/12/13 JB	SW846 6010C <sup>1</sup>	SW846 3010A <sup>3</sup>
Iron	< 70	70	ug/l	1	07/12/13	07/12/13 JB	SW846 6010C <sup>1</sup>	SW846 3010A <sup>3</sup>
Magnesium	68200	200	ug/l	1	07/12/13	07/12/13 JB	SW846 6010C <sup>1</sup>	SW846 3010A <sup>3</sup>
Manganese	1260	5.0	ug/l	1	07/12/13	07/12/13 JB	SW846 6010C <sup>1</sup>	SW846 3010A <sup>3</sup>
Potassium	1460	1000	ug/l	1	07/12/13	07/12/13 JB	SW846 6010C <sup>1</sup>	SW846 3010A <sup>3</sup>
Selenium	< 0.0020	0.0020	mg/l	5	07/12/13	07/13/13 JM	SW846 6020A <sup>2</sup>	SW846 3010A <sup>4</sup>
Sodium	224000	400	ug/l	1	07/12/13	07/12/13 JB	SW846 6010C <sup>1</sup>	SW846 3010A <sup>3</sup>

(1) Instrument QC Batch: MA3753

(2) Instrument QC Batch: MA3754

(3) Prep QC Batch: MP10508

(4) Prep QC Batch: MP10509

RL = Reporting Limit



## Report of Analysis

Page 1 of 1

<b>Client Sample ID:</b>	TRIP BLANK	<b>Date Sampled:</b>	07/10/13
<b>Lab Sample ID:</b>	D48107-2	<b>Date Received:</b>	07/11/13
<b>Matrix:</b>	AQ - Trip Blank Water	<b>Percent Solids:</b>	n/a
<b>Method:</b>	SW846 8260B		
<b>Project:</b>	MOC 32C/BWQ/MONITORING WELLS		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	3V25610.D	1	07/12/13	BR	n/a	n/a	V3V1507
Run #2							

	Purge Volume
Run #1	5.0 ml
Run #2	

## Purgeable Aromatics

CAS No.	Compound	Result	RL	MDL	Units	Q
71-43-2	Benzene	ND	0.0010	0.00025	mg/l	
108-88-3	Toluene	ND	0.0020	0.0010	mg/l	
100-41-4	Ethylbenzene	ND	0.0020	0.00025	mg/l	
1330-20-7	Xylene (total)	ND	0.0030	0.0020	mg/l	

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
17060-07-0	1,2-Dichloroethane-D4	106%		62-130%
2037-26-5	Toluene-D8	93%		70-130%
460-00-4	4-Bromofluorobenzene	93%		69-130%

ND = Not detected MDL - Method Detection Limit

RL = Reporting Limit

E = Indicates value exceeds calibration range

J = Indicates an estimated value

B = Indicates analyte found in associated method blank

N = Indicates presumptive evidence of a compound

## Misc. Forms

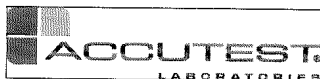
5

### Custody Documents and Other Forms

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Includes the following where applicable:

- Chain of Custody



## CHAIN OF CUSTODY

PAGE \_\_\_\_ OF \_\_\_\_

4036 Youngfield Street, Wheat Ridge, CO 80033  
TEL: 303-425-6021 FAX: 303-425-6854  
www.accutest.com

FED-EX Tracking #		Bottle Order Control #	
Accutest Quote #		Accutest Job # <b>D48107</b>	
Client / Reporting Information		Project Information	
Company Name <b>Marathon Oil Company</b>		Project Name: <b>MOC 32C / BWQ / MONITORING WELLS</b>	
Street Address <b>743 Horizon Court Suite 220</b>		Street	
City <b>Grand Junction, Colorado</b>		City State	
Project Contact <b>Zach Toellner</b>		Billing Information (If different from Report to) Company Name	
Phone # <b>970-260-0772</b>		Project #	
Sampler(s) Name(s) <b>Ben Talancon, Marathon Oil Company</b>		Client Purchase Order #	
Project Manager		Street Address	
Attention:		City	
Collection		Number of preserved Bottles	
Accutest Sample #	Field ID / Point of Collection	MECH/ID Vial #	Date
			Time
			Sampled by
			Matrix
			# of bottles
			H2O
			NO3
			HNO3
			H2SO4
			NONE
			DI Water
			MEOH
			ENGLURE
			BISULFAT
			1 X
Turnaround Time (Business days)		Data Deliverable Information	
<input type="checkbox"/> Std. 15 Business Days <input type="checkbox"/> Std. 10 Business Days <input type="checkbox"/> 5 Day RUSH <input type="checkbox"/> 3 Day Emergency <input type="checkbox"/> 2 Day Emergency <input checked="" type="checkbox"/> 1 Day Emergency		<input type="checkbox"/> Commercial "A" (Level 1) <input type="checkbox"/> Commercial "B" (Level 2) <input type="checkbox"/> COMMBN <input type="checkbox"/> COMMBN+ <input checked="" type="checkbox"/> FULL I1 (level 3+4) <input type="checkbox"/> State Forms Required <input type="checkbox"/> Send Forms to State <input type="checkbox"/> Report by Fax <input checked="" type="checkbox"/> Report by PDF <input checked="" type="checkbox"/> EDD Format	
Approved By (Accutest PM): / Date:		Comments / Special Instructions	
		Trip blank "Made 5/22/12 SK" analyze Trip Blank as required by QA/QC	
Emergency & Rush T/A data available VIA Lablink			
Sample Custody must be documented below each time samples change possession, including courier delivery.			
Relinquished by Sampler: <b>1 Ben Talancon</b>	Date Time: <b>4:45 7/10/13</b>	Received By: <b>2</b>	Date Time:
Relinquished by Sampler:	Date Time:	Received By:	Date Time:
Relinquished by:	Date Time:	Received By:	Date Time:
Custody Seal #	<input type="checkbox"/> Intact <input type="checkbox"/> Not Intact	Preserved where applicable <input type="checkbox"/>	On Ice <input checked="" type="checkbox"/>
			Cooler Temp. <b>5.2</b>

D48107: Chain of Custody

Page 1 of 5

Marathon BWQ Analytical Parameters

Anions and General Water Quality Parameters (Unfiltered in Field)		
Analyte	Method(s)	Lower Limit of Quantification
pH	SM-4500-H+ 150.1 SW-846 9040C	NA
Specific Conductance	SM-2510 SW-846 9050A	NA
Total Dissolved Solids	SM-2540C	10mg/l
Total Alkalinity as CaCO <sub>3</sub>	SM 2320	10mg/l
Bicarbonate Alkalinity as CaCO <sub>3</sub>		10mg/l
Carbonate Alkalinity as CaCO <sub>3</sub>		10mg/l
Bromide	300.0 SW-846 9056	0.2mg/l
Chloride		0.1mg/l
Fluoride		0.2mg/l
Sulfate		5mg/l
Nitrate (as individual analyte instead of combined analysis)		0.1mg/l
Nitrite (as individual analyte instead of combined analysis)		0.1mg/l
Nitrate and Nitrite as N	353.3	0.1mg/l
Phosphorous	SM-4500-P 365.3	0.05mg/l
Dissolved Gases		
Methane	RSK SOP 175	0.005mg/l
Ethane	and modifications	0.005mg/l
Propane		0.005mg/l
Well Bore Bacterial Indicators		
Iron-related bacteria	BART Manuals	1 day to reaction or 100 cfu/100 ml
Sulfur-related bacteria		
Slime-forming bacteria		
Metals and Other Elements (Filtered in Lab or in Field)		
Calcium	200.7/200.8 or SW-846	1mg/l
Iron		0.1mg/l
Magnesium	6010C/SW-846	1mg/l
Manganese	6020A	0.01mg/l
Potassium		1mg/l
Sodium		1mg/l
Barium		0.001mg/l
Boron		0.1mg/l
Selenium		0.001mg/l

D48107: Chain of Custody

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Strontium		0.01mg/l
Dissolved fraction metals (filtered and acidified at lab or filtered and acidified in field)		
Organic Compounds and Indicators (Unfiltered in Field)		
Benzene	SW-846 8260B	1µg/l
Toluene	Or SW-846	1µg/l
Ethylbenzene	8260C	1µg/l
o-Xylene		1µg/l
m-Xylene and p-Xylene		1µg/l
Total Xylenes		1µg/l
Total Petroleum Hydrocarbons (see fraction description below)		
TPH-volatile hydrocarbons (from 2-methylpentane-1,2,4-trimethylbenzene)	SW-846 8015C and modifications	0.05mg/l
TPH-extractable hydrocarbons (from C10-C28 alkanes)	SW-846 8015C and modifications	0.5mg/l
Gas Composition and Isotopic Analyses (Unfiltered in Field)		
Hydrogen	GC/TCD*	0.0001mol%
Argon	GC/TCD*	0.0001mol%
Oxygen	GC/TCD*	0.0001mol%
Nitrogen	GC/TCD*	0.0001mol%
Carbon Dioxide	GC/TCD*	0.0001mol%
Methane	GC/FID**	0.0001mol%
Ethane	GC/FID**	0.0001mol%
Ethene	GC/FID**	0.0001mol%
Propane	GC/FID**	0.0001mol%
Propene	GC/FID**	0.0001mol%
iso-Butane	GC/FID**	0.0001mol%
n-Butane	GC/FID**	0.0001mol%
iso-Pentane	GC/FID**	0.0001mol%
n-Pentane	GC/FID**	0.0001mol%
Hexanes +	GC/FID**	0.0001mol%
δ13C CH4 (VPDB)	IRMS***	NA
δD CH4 (VSMOW)	IRMS***	NA

D48107: Chain of Custody

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\*GC/TCD - Gas Chromatography/Thermal Conductivity Detector  
\*\*GC/FID - Gas Chromatography/Flame Ionization Detector  
\*\*\*IRMS - Isotope-Ratio Mass Spectrometry

**D48107: Chain of Custody**  
**Page 4 of 5**

# Accutest Laboratories Sample Receipt Summary

Accutest Job Number: D48107

Client: MARATHON

Immediate Client Services Action Required: No

Date / Time Received: 7/11/2013 2:00:00 PM

No. Coolers: 1

Client Service Action Required at Login: No

Project: MOC 32C

Airbill #'s: CO

Cooler Security	Y	or	N		Y	or	N
1. Custody Seals Present:	<input checked="" type="checkbox"/>		<input type="checkbox"/>	3. COC Present:	<input checked="" type="checkbox"/>		<input type="checkbox"/>
2. Custody Seals Intact:	<input checked="" type="checkbox"/>		<input type="checkbox"/>	4. Smpl Dates/Time OK	<input checked="" type="checkbox"/>		<input type="checkbox"/>

Cooler Temperature	Y	or	N
1. Temp criteria achieved:	<input checked="" type="checkbox"/>		<input type="checkbox"/>
2. Cooler temp verification:			Infrared gun
3. Cooler media:			Ice (bag)

Quality Control Preservation	Y	or	N	N/A
1. Trip Blank present / cooler:	<input checked="" type="checkbox"/>		<input type="checkbox"/>	
2. Trip Blank listed on COC:	<input checked="" type="checkbox"/>		<input type="checkbox"/>	
3. Samples preserved properly:	<input checked="" type="checkbox"/>		<input type="checkbox"/>	
4. VOCs headspace free:	<input checked="" type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>

Sample Integrity - Documentation	Y	or	N
1. Sample labels present on bottles:	<input checked="" type="checkbox"/>		<input type="checkbox"/>
2. Container labeling complete:	<input checked="" type="checkbox"/>		<input type="checkbox"/>
3. Sample container label / COC agree:	<input checked="" type="checkbox"/>		<input type="checkbox"/>

Sample Integrity - Condition	Y	or	N
1. Sample recvd within HT:	<input checked="" type="checkbox"/>		<input type="checkbox"/>
2. All containers accounted for:	<input checked="" type="checkbox"/>		<input type="checkbox"/>
3. Condition of sample:			Intact

Sample Integrity - Instructions	Y	or	N	N/A
1. Analysis requested is clear:	<input checked="" type="checkbox"/>		<input type="checkbox"/>	
2. Bottles received for unspecified tests	<input type="checkbox"/>		<input checked="" type="checkbox"/>	
3. Sufficient volume rec'd for analysis:	<input checked="" type="checkbox"/>		<input type="checkbox"/>	
4. Compositing instructions clear:	<input type="checkbox"/>		<input type="checkbox"/>	<input checked="" type="checkbox"/>
5. Filtering instructions clear:	<input type="checkbox"/>		<input type="checkbox"/>	<input checked="" type="checkbox"/>

Comments

Accutest Laboratories  
V:(303) 425-6021

4036 Youngfield Street  
F: (303) 425-6854

Wheat Ridge, CO  
www.accutest.com

**APPENDIX C-3**  
**JULY 12 SAMPLE RESULTS**



08/29/13

Technical Report for

Marathon Oil

MOC 32C/BWQ/MONITORING WELLS

WBS#TA.13.30788.EXP

Accutest Job Number: D48174

Sampling Date: 07/12/13

Report to:

Golder Associates

rmarch@golder.com

ATTN: Randy March

Total number of pages in report: **18**



Test results contained within this data package meet the requirements of the National Environmental Laboratory Accreditation Conference and/or state specific certification programs as applicable.

A handwritten signature in black ink, appearing to read 'Scott Heideman'.

Scott Heideman  
Laboratory Director

Client Service contact: Ann Doerr 303-425-6021

Certifications: CO (CO00049), ID, NE (CO00049), ND (R-027), NJ (CO 0007), OK (D9942), UT (NELAP CO00049), TX (T104704511)

This report shall not be reproduced, except in its entirety, without the written approval of Accutest Laboratories.  
Test results relate only to samples analyzed.

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## Sample Summary

Marathon Oil

**Job No:** D48174

MOC 32C/BWQ/MONITORING WELLS

Project No: WBS#TA.13.30788.EXP

Sample Number	Collected		Received	Matrix		Client Sample ID
	Date	Time By		Code	Type	
D48174-1	07/12/13	12:50 SD	07/13/13	AQ	Ground Water	MW-2
D48174-1B	07/12/13	12:50 SD	07/13/13	AQ	Ground Water	MW-2
D48174-1F	07/12/13	12:50 SD	07/13/13	AQ	Groundwater Filtered	MW-2

## CASE NARRATIVE / CONFORMANCE SUMMARY

**Client:** Marathon Oil**Job No** D48174**Site:** MOC 32C/BWQ/MONITORING WELLS**Report Date** 7/29/2013 6:58:28 PM

On 07/13/2013, 1 sample(s), 0 Trip Blank(s), and 0 Field Blank(s) were received at Accutest Mountain States (AMS) at a temperature of 3 °C. The samples were intact and properly preserved, unless noted below. An AMS Job Number of D48174 was assigned to the project. The lab sample ID, client sample ID, and date of sample collection are detailed in the report's Results Summary.

Specified quality control criteria were achieved for this job except as noted below. For more information, please refer to the analytical results and QC summary pages.

### Volatiles by GCMS By Method SW846 8260B

**Matrix:** AQ**Batch ID:** V7V1169

- All samples were analyzed within the recommended method holding time.
- All method blanks for this batch meet method specific criteria.
- Sample(s) D47726-49MS, D47726-49MSD were used as the QC samples indicated.
- D47726-49MS, -49MSD: The pH of the sample aliquot for VOA analysis was >2 at time of analysis.

### Volatiles by GC By Method RSK175 MOD

**Matrix:** AQ**Batch ID:** GFB392

- All samples were analyzed within the recommended method holding time.
- All method blanks for this batch meet method specific criteria.
- Sample(s) D48174-1MS, D48174-1MSD were used as the QC samples indicated.

### Volatiles by GC By Method SW846 8015B

**Matrix:** AQ**Batch ID:** GGB1161

- All samples were analyzed within the recommended method holding time.
- Sample(s) D48026-1MS, D48026-1MSD were used as the QC samples indicated.
- All method blanks for this batch meet method specific criteria.

### Extractables by GC By Method SW846-8015B

**Matrix:** AQ**Batch ID:** OP8194

- All samples were extracted and analyzed within the recommended method holding time.
- All method blanks for this batch meet method specific criteria.
- Sample(s) D47726-44MS, D47726-44MSD were used as the QC samples indicated.

### Metals By Method SW846 6010C

**Matrix:** AQ**Batch ID:** MP10531

- All samples were digested and analyzed within the recommended method holding time.
- All method blanks for this batch meet method specific criteria.
- Sample(s) D48174-1MS, D48174-1MSD, D48174-1SDL were used as the QC samples for the metals analysis.

## Metals By Method SW846 6020A

**Matrix:** AQ

**Batch ID:** MP10532

- All samples were digested and analyzed within the recommended method holding time.
- All method blanks for this batch meet method specific criteria.
- Sample(s) D48174-1MS, D48174-1MSD, D48174-1SDL were used as the QC samples for the metals analysis.
- The serial dilution RPD(s) for Selenium are outside control limits for sample MP10532-SD1. Percent difference acceptable due to low initial sample concentration (< 50 times IDL).

## Wet Chemistry By Method EPA 300.0/SW846 9056

**Matrix:** AQ

**Batch ID:** GP10425

- All samples were prepared and analyzed within the recommended method holding time.
- All method blanks for this batch meet method specific criteria.
- Sample(s) D48174-1MS, D48174-1MSD were used as the QC samples for the Bromide, Chloride, Fluoride, Nitrogen, Nitrate, Nitrogen, Nitrite, Sulfate analysis.
- D48174-1 for Fluoride: Elevated detection limit due to matrix interference.

**Matrix:** AQ

**Batch ID:** R17996

- The data for EPA 300.0/SW846 9056 meets quality control requirements.
- The following samples were run outside of holding time for method EPA 300.0/SW846 9056: D48174-1
- D48174-1 for Nitrogen, Nitrate + Nitrite: Calculated as: (Nitrogen, Nitrate) + (Nitrogen, Nitrite)

## Wet Chemistry By Method HACH IRB-BART

**Matrix:** AQ

**Batch ID:** MB218

- All samples were analyzed within the recommended method holding time.
- All method blanks for this batch meet method specific criteria.

## Wet Chemistry By Method HACH SLYM-BART

**Matrix:** AQ

**Batch ID:** MB219

- All samples were analyzed within the recommended method holding time.
- All method blanks for this batch meet method specific criteria.

## Wet Chemistry By Method HACH SRB-BART

**Matrix:** AQ

**Batch ID:** MB220

- All samples were analyzed within the recommended method holding time.
- All method blanks for this batch meet method specific criteria.

## Wet Chemistry By Method HACH8190/SM4500P-B/E

**Matrix:** AQ

**Batch ID:** GP10431

- All samples were prepared and analyzed within the recommended method holding time.
- All method blanks for this batch meet method specific criteria.
- Sample(s) D48099-1DUP, D48099-1MS, D48099-1MSD were used as the QC samples for the Phosphorus, Total analysis.

## Wet Chemistry By Method SM 2320B-2011

**Matrix:** AQ

**Batch ID:** GN20996

- All samples were analyzed within the recommended method holding time.
- All method blanks for this batch meet method specific criteria.
- Sample(s) D48133-1DUP, D48133-1MS, D48133-1MSD were used as the QC samples for the Alkalinity, Total as CaCO<sub>3</sub> analysis.

**Matrix:** AQ

**Batch ID:** GN20997

- All samples were analyzed within the recommended method holding time.
- All method blanks for this batch meet method specific criteria.

**Matrix:** AQ

**Batch ID:** GN20998

- All samples were analyzed within the recommended method holding time.
- All method blanks for this batch meet method specific criteria.

## Wet Chemistry By Method SM 2510B-2011

**Matrix:** AQ

**Batch ID:** GP10422

- Sample(s) D47990-4DUP were used as the QC samples for the Specific Conductivity analysis.

## Wet Chemistry By Method SM 2540C-2011

**Matrix:** AQ

**Batch ID:** GN20991

- All samples were analyzed within the recommended method holding time.
- All method blanks for this batch meet method specific criteria.
- Sample(s) D48174-1DUP were used as the QC samples for the Solids, Total Dissolved analysis.

## Wet Chemistry By Method SM4500HB+-2011/9040C

**Matrix:** AQ

**Batch ID:** GN21010

- The following samples were run outside of holding time for method SM4500HB+-2011/9040C: D48174-1

AMS certifies that data reported for samples received, listed on the associated custody chain or analytical task order, were produced to specifications meeting AMS's Quality System precision, accuracy and completeness objectives except as noted.

Estimated non-standard method measurement uncertainty data is available on request, based on quality control bias and implicit for standard methods. Acceptable uncertainty requires tested parameter quality control data to meet method criteria.

AMS is not responsible for data quality assumptions if partial reports are used and recommends that this report be used in its entirety. This report is authorized by AMS indicated via signature on the report cover.

## Summary of Hits

Page 1 of 1

**Job Number:** D48174  
**Account:** Marathon Oil  
**Project:** MOC 32C/BWQ/MONITORING WELLS  
**Collected:** 07/12/13

Lab Sample ID	Client Sample ID	Result/ Qual	RL	MDL	Units	Method
---------------	------------------	-----------------	----	-----	-------	--------

### D48174-1 MW-2

Benzene	0.0392	0.0010	0.00025	mg/l	SW846 8260B
Ethylbenzene	0.00041 J	0.0020	0.00025	mg/l	SW846 8260B
Xylene (total)	0.0045	0.0030	0.0020	mg/l	SW846 8260B
Methane	0.0235	0.00080	0.00040	mg/l	RSK175 MOD
TPH-GRO (C6-C10)	0.121 J	0.20	0.10	mg/l	SW846 8015B
Barium	0.16	0.010		mg/l	SW846 6020A
Boron	168	50		ug/l	SW846 6010C
Calcium	82300	400		ug/l	SW846 6010C
Iron	517	70		ug/l	SW846 6010C
Magnesium	34200	200		ug/l	SW846 6010C
Manganese	275	5.0		ug/l	SW846 6010C
Potassium	1050	1000		ug/l	SW846 6010C
Sodium	97700	400		ug/l	SW846 6010C
Alkalinity, Bicarbonate as CaCO <sub>3</sub>	312	5.0		mg/l	SM 2320B-2011
Alkalinity, Total as CaCO <sub>3</sub>	312	5.0		mg/l	SM 2320B-2011
Bromide	0.85	0.10		mg/l	EPA 300.0/SW846 9056
Chloride	95.1	2.5		mg/l	EPA 300.0/SW846 9056
Nitrogen, Nitrate	0.36	0.020		mg/l	EPA 300.0/SW846 9056
Nitrogen, Nitrate + Nitrite <sup>a</sup>	0.39	0.028		mg/l	EPA 300.0/SW846 9056
Nitrogen, Nitrite	0.028	0.0080		mg/l	EPA 300.0/SW846 9056
Solids, Total Dissolved	596	10		mg/l	SM 2540C-2011
Specific Conductivity	938	1.0		umhos/cm	SM 2510B-2011
Sulfate	68.3	2.5		mg/l	EPA 300.0/SW846 9056
pH	7.52			su	SM4500HB+ -2011/9040C

### D48174-1B MW-2

Iron Reducing Bacteria	74500	25	CFU/ml	HACH IRB-BART
Slime Forming Bacteria	350000	500	CFU/ml	HACH SLYM-BART
Sulfate Reducing Bacteria	18000	200	CFU/ml	HACH SRB-BART

### D48174-1F MW-2

Barium	0.13	0.010	mg/l	SW846 6020A
Boron	153	50	ug/l	SW846 6010C
Calcium	75200	400	ug/l	SW846 6010C
Magnesium	31500	200	ug/l	SW846 6010C
Manganese	292	5.0	ug/l	SW846 6010C
Potassium	1130	1000	ug/l	SW846 6010C
Sodium	90900	400	ug/l	SW846 6010C

(a) Calculated as: (Nitrogen, Nitrate) + (Nitrogen, Nitrite)



Sample Results

Report of Analysis

## Report of Analysis

Page 1 of 1

<b>Client Sample ID:</b>	MW-2	<b>Date Sampled:</b>	07/12/13
<b>Lab Sample ID:</b>	D48174-1	<b>Date Received:</b>	07/13/13
<b>Matrix:</b>	AQ - Ground Water	<b>Percent Solids:</b>	n/a
<b>Method:</b>	SW846 8260B		
<b>Project:</b>	MOC 32C/BWQ/MONITORING WELLS		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	7V21368.D	1	07/15/13	JL	n/a	n/a	V7V1169
Run #2							

	Purge Volume
Run #1	5.0 ml
Run #2	

## Purgeable Aromatics

CAS No.	Compound	Result	RL	MDL	Units	Q
71-43-2	Benzene	0.0392	0.0010	0.00025	mg/l	
108-88-3	Toluene	ND	0.0020	0.0010	mg/l	
100-41-4	Ethylbenzene	0.00041	0.0020	0.00025	mg/l	J
1330-20-7	Xylene (total)	0.0045	0.0030	0.0020	mg/l	

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
17060-07-0	1,2-Dichloroethane-D4	96%		62-130%
2037-26-5	Toluene-D8	93%		70-130%
460-00-4	4-Bromofluorobenzene	85%		69-130%

ND = Not detected MDL - Method Detection Limit

RL = Reporting Limit

E = Indicates value exceeds calibration range

J = Indicates an estimated value

B = Indicates analyte found in associated method blank

N = Indicates presumptive evidence of a compound

## Report of Analysis

Page 1 of 1

<b>Client Sample ID:</b>	MW-2	<b>Date Sampled:</b>	07/12/13
<b>Lab Sample ID:</b>	D48174-1	<b>Date Received:</b>	07/13/13
<b>Matrix:</b>	AQ - Ground Water	<b>Percent Solids:</b>	n/a
<b>Method:</b>	SW846 8015B		
<b>Project:</b>	MOC 32C/BWQ/MONITORING WELLS		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	GB21157.D	1	07/13/13	BD	n/a	n/a	GGB1161
Run #2							

	Purge Volume
Run #1	5.0 ml
Run #2	

CAS No.	Compound	Result	RL	MDL	Units	Q
	TPH-GRO (C6-C10)	0.121	0.20	0.10	mg/l	J
CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits		
120-82-1	1,2,4-Trichlorobenzene	103%		60-140%		

ND = Not detected      MDL - Method Detection Limit  
 RL = Reporting Limit  
 E = Indicates value exceeds calibration range

J = Indicates an estimated value  
 B = Indicates analyte found in associated method blank  
 N = Indicates presumptive evidence of a compound

## Report of Analysis

Page 1 of 1

<b>Client Sample ID:</b>	MW-2	<b>Date Sampled:</b>	07/12/13
<b>Lab Sample ID:</b>	D48174-1	<b>Date Received:</b>	07/13/13
<b>Matrix:</b>	AQ - Ground Water	<b>Percent Solids:</b>	n/a
<b>Method:</b>	RSK175 MOD		
<b>Project:</b>	MOC 32C/BWQ/MONITORING WELLS		

Run #	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	FB08933.D	1	07/15/13	SM	n/a	n/a	GFB392
Run #2							

## Methane, Ethane and Propane

CAS No.	Compound	Result	RL	MDL	Units	Q
74-82-8	Methane	0.0235	0.00080	0.00040	mg/l	
74-84-0	Ethane	ND	0.0016	0.00080	mg/l	
74-98-6	Propane	ND	0.018	0.0090	mg/l	

ND = Not detected MDL - Method Detection Limit

RL = Reporting Limit

E = Indicates value exceeds calibration range

J = Indicates an estimated value

B = Indicates analyte found in associated method blank

N = Indicates presumptive evidence of a compound

## Report of Analysis

Page 1 of 1

<b>Client Sample ID:</b>	MW-2	<b>Date Sampled:</b>	07/12/13
<b>Lab Sample ID:</b>	D48174-1	<b>Date Received:</b>	07/13/13
<b>Matrix:</b>	AQ - Ground Water	<b>Percent Solids:</b>	n/a
<b>Method:</b>	SW846-8015B SW846 3510C		
<b>Project:</b>	MOC 32C/BWQ/MONITORING WELLS		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	FD26554.D	1	07/16/13	TU	07/15/13	OP8194	GFD1304
Run #2							

	Initial Volume	Final Volume
Run #1	1060 ml	1.0 ml
Run #2		

CAS No.	Compound	Result	RL	MDL	Units	Q
	TPH-DRO (C10-C28)	ND	0.19	0.17	mg/l	
CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits		
84-15-1	o-Terphenyl	65%		20-140%		

ND = Not detected      MDL - Method Detection Limit  
 RL = Reporting Limit  
 E = Indicates value exceeds calibration range

J = Indicates an estimated value  
 B = Indicates analyte found in associated method blank  
 N = Indicates presumptive evidence of a compound



## Report of Analysis

Page 1 of 1

<b>Client Sample ID:</b> MW-2	<b>Date Sampled:</b> 07/12/13
<b>Lab Sample ID:</b> D48174-1	<b>Date Received:</b> 07/13/13
<b>Matrix:</b> AQ - Ground Water	<b>Percent Solids:</b> n/a
<b>Project:</b> MOC 32C/BWQ/MONITORING WELLS	

## Total Metals Analysis

Analyte	Result	RL	Units	DF	Prep	Analyzed By	Method	Prep Method
Barium	0.16	0.010	mg/l	5	07/15/13	07/16/13 JM	SW846 6020A <sup>2</sup>	SW846 3010A <sup>5</sup>
Boron	168	50	ug/l	1	07/15/13	07/15/13 JB	SW846 6010C <sup>1</sup>	SW846 3010A <sup>4</sup>
Calcium	82300	400	ug/l	1	07/15/13	07/15/13 JB	SW846 6010C <sup>1</sup>	SW846 3010A <sup>4</sup>
Iron	517	70	ug/l	1	07/15/13	07/15/13 JB	SW846 6010C <sup>1</sup>	SW846 3010A <sup>4</sup>
Magnesium	34200	200	ug/l	1	07/15/13	07/15/13 JB	SW846 6010C <sup>1</sup>	SW846 3010A <sup>4</sup>
Manganese	275	5.0	ug/l	1	07/15/13	07/15/13 JB	SW846 6010C <sup>1</sup>	SW846 3010A <sup>4</sup>
Potassium	1050	1000	ug/l	1	07/15/13	07/15/13 JB	SW846 6010C <sup>1</sup>	SW846 3010A <sup>4</sup>
Selenium	< 0.0020	0.0020	mg/l	5	07/15/13	07/17/13 JB	SW846 6020A <sup>3</sup>	SW846 3010A <sup>5</sup>
Sodium	97700	400	ug/l	1	07/15/13	07/15/13 JB	SW846 6010C <sup>1</sup>	SW846 3010A <sup>4</sup>

- (1) Instrument QC Batch: MA3759  
 (2) Instrument QC Batch: MA3761  
 (3) Instrument QC Batch: MA3766  
 (4) Prep QC Batch: MP10531  
 (5) Prep QC Batch: MP10532

---

 RL = Reporting Limit

## Report of Analysis

Page 1 of 1

<b>Client Sample ID:</b> MW-2	<b>Date Sampled:</b> 07/12/13
<b>Lab Sample ID:</b> D48174-1	<b>Date Received:</b> 07/13/13
<b>Matrix:</b> AQ - Ground Water	<b>Percent Solids:</b> n/a
<b>Project:</b> MOC 32C/BWQ/MONITORING WELLS	

## General Chemistry

Analyte	Result	RL	Units	DF	Analyzed	By	Method
Alkalinity, Bicarbonate as CaC	312	5.0	mg/l	1	07/15/13	KB	SM 2320B-2011
Alkalinity, Carbonate	< 5.0	5.0	mg/l	1	07/15/13	KB	SM 2320B-2011
Alkalinity, Total as CaCO <sub>3</sub>	312	5.0	mg/l	1	07/15/13	KB	SM 2320B-2011
Bromide	0.85	0.10	mg/l	2	07/16/13 10:36	SK	EPA 300.0/SW846 9056
Chloride	95.1	2.5	mg/l	5	07/16/13 10:48	SK	EPA 300.0/SW846 9056
Fluoride <sup>a</sup>	< 0.20	0.20	mg/l	2	07/16/13 10:36	SK	EPA 300.0/SW846 9056
Nitrogen, Nitrate	0.36	0.020	mg/l	2	07/16/13 10:36	SK	EPA 300.0/SW846 9056
Nitrogen, Nitrate + Nitrite <sup>b</sup>	0.39	0.028	mg/l	1	07/16/13 10:36	SK	EPA 300.0/SW846 9056
Nitrogen, Nitrite	0.028	0.0080	mg/l	2	07/16/13 10:36	SK	EPA 300.0/SW846 9056
Phosphorus, Total	< 0.010	0.010	mg/l	1	07/16/13	KB	HACH8190/SM4500P-B/E
Solids, Total Dissolved	596	10	mg/l	1	07/15/13	RW	SM 2540C-2011
Specific Conductivity	938	1.0	umhos/cm	1	07/15/13	RW	SM 2510B-2011
Sulfate	68.3	2.5	mg/l	5	07/16/13 10:48	SK	EPA 300.0/SW846 9056
pH	7.52		su	1	07/15/13 13:50	AK	SM4500HB+ -2011/9040C

(a) Elevated detection limit due to matrix interference.

(b) Calculated as: (Nitrogen, Nitrate) + (Nitrogen, Nitrite)

RL = Reporting Limit

Report of Analysis

<b>Client Sample ID:</b>	MW-2	<b>Date Sampled:</b>	07/12/13
<b>Lab Sample ID:</b>	D48174-1B	<b>Date Received:</b>	07/13/13
<b>Matrix:</b>	AQ - Ground Water	<b>Percent Solids:</b>	n/a
<b>Project:</b>	MOC 32C/BWQ/MONITORING WELLS		

General Chemistry

Analyte	Result	RL	Units	DF	Analyzed	By	Method
Iron Reducing Bacteria	74500	25	CFU/ml	1	07/15/13	MM	HACH IRB-BART
Slime Forming Bacteria	350000	500	CFU/ml	1	07/15/13	MM	HACH SLYM-BART
Sulfate Reducing Bacteria	18000	200	CFU/ml	1	07/15/13	MM	HACH SRB-BART

RL = Reporting Limit

## Report of Analysis

Page 1 of 1

<b>Client Sample ID:</b> MW-2	<b>Date Sampled:</b> 07/12/13
<b>Lab Sample ID:</b> D48174-1F	<b>Date Received:</b> 07/13/13
<b>Matrix:</b> AQ - Groundwater Filtered	<b>Percent Solids:</b> n/a
<b>Project:</b> MOC 32C/BWQ/MONITORING WELLS	

## Dissolved Metals Analysis

Analyte	Result	RL	Units	DF	Prep	Analyzed By	Method	Prep Method
Barium	0.13	0.010	mg/l	5	07/15/13	07/16/13 JM	SW846 6020A <sup>2</sup>	SW846 3010A <sup>5</sup>
Boron	153	50	ug/l	1	07/15/13	07/15/13 JB	SW846 6010C <sup>1</sup>	SW846 3010A <sup>4</sup>
Calcium	75200	400	ug/l	1	07/15/13	07/15/13 JB	SW846 6010C <sup>1</sup>	SW846 3010A <sup>4</sup>
Iron	< 70	70	ug/l	1	07/15/13	07/15/13 JB	SW846 6010C <sup>1</sup>	SW846 3010A <sup>4</sup>
Magnesium	31500	200	ug/l	1	07/15/13	07/15/13 JB	SW846 6010C <sup>1</sup>	SW846 3010A <sup>4</sup>
Manganese	292	5.0	ug/l	1	07/15/13	07/15/13 JB	SW846 6010C <sup>1</sup>	SW846 3010A <sup>4</sup>
Potassium	1130	1000	ug/l	1	07/15/13	07/15/13 JB	SW846 6010C <sup>1</sup>	SW846 3010A <sup>4</sup>
Selenium	< 0.0020	0.0020	mg/l	5	07/15/13	07/17/13 JB	SW846 6020A <sup>3</sup>	SW846 3010A <sup>5</sup>
Sodium	90900	400	ug/l	1	07/15/13	07/15/13 JB	SW846 6010C <sup>1</sup>	SW846 3010A <sup>4</sup>

- (1) Instrument QC Batch: MA3759  
 (2) Instrument QC Batch: MA3761  
 (3) Instrument QC Batch: MA3769  
 (4) Prep QC Batch: MP10531  
 (5) Prep QC Batch: MP10532

---

 RL = Reporting Limit

## Misc. Forms

5

### Custody Documents and Other Forms

---

Includes the following where applicable:

- Chain of Custody

[illegible]

## D48174: Chain of Custody

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**APPENDIX C-4**  
**JULY 18 SAMPLE RESULTS**



08/29/13

## Technical Report for

Marathon Oil

MOC 32C Monitoring Wells

WBS#TA.13.30788.EXP

Accutest Job Number: D48389

Sampling Date: 07/18/13

Report to:

Golder Associates

rmarch@golder.com

ATTN: Randy March

Total number of pages in report: **17**



Test results contained within this data package meet the requirements of the National Environmental Laboratory Accreditation Conference and/or state specific certification programs as applicable.

A handwritten signature in black ink, appearing to read 'Scott Heideman'.

Scott Heideman  
Laboratory Director

Client Service contact: Ann Doerr 303-425-6021

Certifications: CO (CO00049), ID, NE (CO00049), ND (R-027), NJ (CO 0007), OK (D9942), UT (NELAP CO00049), TX (T104704511)

This report shall not be reproduced, except in its entirety, without the written approval of Accutest Laboratories.  
Test results relate only to samples analyzed.

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**5.1:** Chain of Custody ..... 15



Sample Summary

Marathon Oil

Job No: D48389

MOC 32C Monitoring Wells  
Project No: WBS#TA.13.30788.EXP

Sample Number	Collected		Received	Matrix		Client Sample ID
	Date	Time By		Code	Type	
D48389-1	07/18/13	14:00 SD	07/19/13	AQ	Ground Water	MW-4
D48389-1A	07/18/13	14:00 SD	07/19/13	AQ	Ground Water	MW-4

## CASE NARRATIVE / CONFORMANCE SUMMARY

**Client:** Marathon Oil

**Job No** D48389

**Site:** MOC 32C Monitoring Wells

**Report Date** 7/23/2013 6:38:27 PM

On 07/19/2013, 1 sample(s), 0 Trip Blank(s), and 0 Field Blank(s) were received at Accutest Mountain States (AMS) at a temperature of 4.1 °C. The samples were intact and properly preserved, unless noted below. An AMS Job Number of D48389 was assigned to the project. The lab sample ID, client sample ID, and date of sample collection are detailed in the report's Results Summary.

Specified quality control criteria were achieved for this job except as noted below. For more information, please refer to the analytical results and QC summary pages.

### Volatiles by GCMS By Method SW846 8260B

**Matrix:** AQ

**Batch ID:** V7V1175

- All samples were analyzed within the recommended method holding time.
- All method blanks for this batch meet method specific criteria.
- Sample(s) D48347-1MS, D48347-2DUP were used as the QC samples indicated.
- D48347-1MS: The pH of the sample aliquot for VOA analysis was >2 at time of analysis.
- D48347-2DUP: The pH of the sample aliquot for VOA analysis was >2 at time of analysis.

### Volatiles by GC By Method SW846 8015B

**Matrix:** AQ

**Batch ID:** GFA746

- All samples were analyzed within the recommended method holding time.
- Sample(s) D48108-1MS, D48108-1MSD were used as the QC samples indicated.
- All method blanks for this batch meet method specific criteria.

**Matrix:** AQ

**Batch ID:** GGB1168

- All samples were analyzed within the recommended method holding time.
- Sample(s) D48389-1MS, D48389-1MSD were used as the QC samples indicated.
- All method blanks for this batch meet method specific criteria.

### Extractables by GC By Method SW846-8015B

**Matrix:** AQ

**Batch ID:** OP8230

- All samples were extracted and analyzed within the recommended method holding time.
- Sample(s) D48200-7MS, D48200-7MSD were used as the QC samples indicated.
- All method blanks for this batch meet method specific criteria.

### Wet Chemistry By Method EPA 300.0/SW846 9056

**Matrix:** AQ

**Batch ID:** GP10466

- All samples were prepared and analyzed within the recommended method holding time.
- All method blanks for this batch meet method specific criteria.
- Sample(s) D48389-1AMS, D48389-1AMSD were used as the QC samples for the Chloride, Sulfate, Chloride analysis.

**Wet Chemistry By Method SM 2540C-2011****Matrix:** AQ**Batch ID:** GN21112

- All samples were analyzed within the recommended method holding time.
- All method blanks for this batch meet method specific criteria.
- Sample(s) D48263-1DUP were used as the QC samples for the Solids, Total Dissolved analysis.

**Wet Chemistry By Method SM 2540D-2011****Matrix:** AQ**Batch ID:** GN21113

- All samples were analyzed within the recommended method holding time.
- All method blanks for this batch meet method specific criteria.
- Sample(s) D48321-2DUP were used as the QC samples for the Solids, Total Suspended analysis.

**Wet Chemistry By Method SM4500HB+-2011/9040C****Matrix:** AQ**Batch ID:** GN21105

- The following samples were run outside of holding time for method SM4500HB+-2011/9040C: D48389-1

AMS certifies that data reported for samples received, listed on the associated custody chain or analytical task order, were produced to specifications meeting AMS's Quality System precision, accuracy and completeness objectives except as noted.

Estimated non-standard method measurement uncertainty data is available on request, based on quality control bias and implicit for standard methods. Acceptable uncertainty requires tested parameter quality control data to meet method criteria.

AMS is not responsible for data quality assumptions if partial reports are used and recommends that this report be used in its entirety. This report is authorized by AMS indicated via signature on the report cover.



## Summary of Hits

Page 1 of 1

**Job Number:** D48389  
**Account:** Marathon Oil  
**Project:** MOC 32C Monitoring Wells  
**Collected:** 07/18/13



Lab Sample ID	Client Sample ID	Result/ Qual	RL	MDL	Units	Method
---------------	------------------	-----------------	----	-----	-------	--------

### D48389-1 MW-4

Benzene	0.0799	0.0010	0.00025	mg/l	SW846 8260B
Ethylbenzene	0.0018 J	0.0020	0.00025	mg/l	SW846 8260B
Xylene (total)	0.0125	0.0030	0.0020	mg/l	SW846 8260B
TPH-GRO (C6-C10)	0.276	0.20	0.10	mg/l	SW846 8015B
TPH-DRO (C10-C28)	0.196	0.19	0.17	mg/l	SW846-8015B
Solids, Total Suspended	262	5.0		mg/l	SM 2540D-2011
pH	7.67			su	SM4500HB+ -2011/9040C

### D48389-1A MW-4

Chloride	426	25		mg/l	EPA 300.0/SW846 9056
Solids, Total Dissolved	1360	10		mg/l	SM 2540C-2011
Sulfate	125	25		mg/l	EPA 300.0/SW846 9056

Sample Results

Report of Analysis

## Report of Analysis

Page 1 of 1

<b>Client Sample ID:</b>	MW-4	<b>Date Sampled:</b>	07/18/13
<b>Lab Sample ID:</b>	D48389-1	<b>Date Received:</b>	07/19/13
<b>Matrix:</b>	AQ - Ground Water	<b>Percent Solids:</b>	n/a
<b>Method:</b>	SW846 8260B		
<b>Project:</b>	MOC 32C Monitoring Wells		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	7V21433.D	1	07/19/13	JL	n/a	n/a	V7V1175
Run #2							

	Purge Volume
Run #1	5.0 ml
Run #2	

## Purgeable Aromatics

CAS No.	Compound	Result	RL	MDL	Units	Q
71-43-2	Benzene	0.0799	0.0010	0.00025	mg/l	
108-88-3	Toluene	ND	0.0020	0.0010	mg/l	
100-41-4	Ethylbenzene	0.0018	0.0020	0.00025	mg/l	J
1330-20-7	Xylene (total)	0.0125	0.0030	0.0020	mg/l	

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
17060-07-0	1,2-Dichloroethane-D4	94%		62-130%
2037-26-5	Toluene-D8	92%		70-130%
460-00-4	4-Bromofluorobenzene	92%		69-130%

ND = Not detected      MDL - Method Detection Limit  
 RL = Reporting Limit  
 E = Indicates value exceeds calibration range

J = Indicates an estimated value  
 B = Indicates analyte found in associated method blank  
 N = Indicates presumptive evidence of a compound

## Report of Analysis

Page 1 of 1

<b>Client Sample ID:</b>	MW-4	<b>Date Sampled:</b>	07/18/13
<b>Lab Sample ID:</b>	D48389-1	<b>Date Received:</b>	07/19/13
<b>Matrix:</b>	AQ - Ground Water	<b>Percent Solids:</b>	n/a
<b>Method:</b>	SW846 8015B		
<b>Project:</b>	MOC 32C Monitoring Wells		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	FA12482.D	1	07/19/13	AV	n/a	n/a	GFA746
Run #2							

	Initial Volume	Final Volume
Run #1	1.0 ml	1.0 ml
Run #2		

CAS No.	Compound	Result	RL	MDL	Units	Q
67-56-1	Methanol	ND	0.50	0.40	mg/l	

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
71-36-3	n-Butyl Alcohol	91%		25-169%

ND = Not detected      MDL - Method Detection Limit  
 RL = Reporting Limit  
 E = Indicates value exceeds calibration range

J = Indicates an estimated value  
 B = Indicates analyte found in associated method blank  
 N = Indicates presumptive evidence of a compound

## Report of Analysis

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<b>Client Sample ID:</b>	MW-4	<b>Date Sampled:</b>	07/18/13
<b>Lab Sample ID:</b>	D48389-1	<b>Date Received:</b>	07/19/13
<b>Matrix:</b>	AQ - Ground Water	<b>Percent Solids:</b>	n/a
<b>Method:</b>	SW846 8015B		
<b>Project:</b>	MOC 32C Monitoring Wells		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	GB21282.D	1	07/22/13	BR	n/a	n/a	GGB1168
Run #2							

	Purge Volume
Run #1	5.0 ml
Run #2	

CAS No.	Compound	Result	RL	MDL	Units	Q
	TPH-GRO (C6-C10)	0.276	0.20	0.10	mg/l	
CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits		
120-82-1	1,2,4-Trichlorobenzene	70%		60-140%		

ND = Not detected      MDL - Method Detection Limit  
 RL = Reporting Limit  
 E = Indicates value exceeds calibration range

J = Indicates an estimated value  
 B = Indicates analyte found in associated method blank  
 N = Indicates presumptive evidence of a compound

## Report of Analysis

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<b>Client Sample ID:</b>	MW-4	<b>Date Sampled:</b>	07/18/13
<b>Lab Sample ID:</b>	D48389-1	<b>Date Received:</b>	07/19/13
<b>Matrix:</b>	AQ - Ground Water	<b>Percent Solids:</b>	n/a
<b>Method:</b>	SW846-8015B SW846 3510C		
<b>Project:</b>	MOC 32C Monitoring Wells		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	FD26706.D	1	07/22/13	TU	07/19/13	OP8230	GFD1312
Run #2							

	Initial Volume	Final Volume
Run #1	1060 ml	1.0 ml
Run #2		

CAS No.	Compound	Result	RL	MDL	Units	Q
	TPH-DRO (C10-C28)	0.196	0.19	0.17	mg/l	
CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits		
84-15-1	o-Terphenyl	59%		20-140%		

ND = Not detected      MDL - Method Detection Limit  
 RL = Reporting Limit  
 E = Indicates value exceeds calibration range

J = Indicates an estimated value  
 B = Indicates analyte found in associated method blank  
 N = Indicates presumptive evidence of a compound



**Report of Analysis**

Page 1 of 1

**Client Sample ID:** MW-4  
**Lab Sample ID:** D48389-1  
**Matrix:** AQ - Ground Water  
**Project:** MOC 32C Monitoring Wells

**Date Sampled:** 07/18/13  
**Date Received:** 07/19/13  
**Percent Solids:** n/a

**General Chemistry**

Analyte	Result	RL	Units	DF	Analyzed	By	Method
Solids, Total Suspended	262	5.0	mg/l	1	07/22/13	BF	SM 2540D-2011
pH	7.67		su	1	07/21/13 14:15	KB	SM4500HB+ -2011/9040C

---

RL = Reporting Limit

Report of Analysis

<b>Client Sample ID:</b>	MW-4	<b>Date Sampled:</b>	07/18/13
<b>Lab Sample ID:</b>	D48389-1A	<b>Date Received:</b>	07/19/13
<b>Matrix:</b>	AQ - Ground Water	<b>Percent Solids:</b>	n/a
<b>Project:</b>	MOC 32C Monitoring Wells		

General Chemistry

Analyte	Result	RL	Units	DF	Analyzed	By	Method
Chloride	426	25	mg/l	50	07/19/13 18:18	SK	EPA 300.0/SW846 9056
Solids, Total Dissolved	1360	10	mg/l	1	07/22/13	JD	SM 2540C-2011
Sulfate	125	25	mg/l	50	07/19/13 18:18	SK	EPA 300.0/SW846 9056

RL = Reporting Limit

## Misc. Forms

5

### Custody Documents and Other Forms

---

Includes the following where applicable:

- Chain of Custody



w/coc

Marathon Oil Company  
Permit No. 09GA0337  
Issuance 1

Colorado Department of Public Health and Environment  
Air Pollution Control Division

the self-certification process to demonstrate compliance with emission limits.  
(Reference: Regulation No. 3, Part B, Section III.E.)

#### Periodic Testing Requirements

18. **AIRS Point 001:** The operator shall sample the wastewater inlet to the pond system (or the gun barrel separator tank wastewater outlet) to determine volatile organic compounds (VOC) and hazardous air pollutant (HAP) concentrations, including total hydrocarbons (including gasoline range and diesel range), benzene, toluene, ethylbenzene, xylene, and methanol. These samples shall be analyzed using EPA Method 8260 for benzene, toluene, ethylbenzene, and xylene, and EPA Method 8015 for methanol, gasoline range organics (total volatile hydrocarbons), and diesel range organics (total extractable hydrocarbons).

A sample of the wastewater inlet to the pond system (or the gun barrel separator tank wastewater outlet) shall be collected and analyzed at a minimum frequency of once per calendar month. Sample results shall be used to calculate emissions as required by Condition 12. If more frequent sampling is conducted, then all samples of the wastewater inlet to the pond collected during the calendar month will be averaged and then used to calculate emissions as specified in Condition 12. Samples shall be collected no less than at least seven (7) days apart. The operator shall maintain records of all sampling events and the records shall be made available to the Division for inspection upon request. The operator shall flag monthly records if any sampling results are noted by the laboratory as beyond QA/QC criteria limits.

#### ADDITIONAL REQUIREMENTS

19. A revised Air Pollutant Emission Notice (APEN) shall be filed: (Reference: Regulation No. 3, Part A, II.C)
- Annually whenever a significant increase in emissions occurs as follows:

**For any criteria pollutant:**

For sources emitting less than 100 tons per year, a change in actual emissions of five (5) tons per year or more, above the level reported on the last APEN; or

**For any non-criteria reportable pollutant:**

If the emissions increase by 50% or five (5) tons per year, whichever is less, above the level reported on the last APEN submitted to the Division.

Whenever there is a change in the owner or operator of any facility, process, or activity; or

Whenever new control equipment is installed, or whenever a different type of control equipment replaces an existing type of control equipment; or

Whenever a permit limitation must be modified; or

No later than 30 days before the existing APEN expires.

20. Federal regulatory program requirements (i.e. PSD, NANSR or Title V Operating Permit) shall apply to this source at any such time that this source becomes major solely by virtue of a relaxation in any permit condition. Any relaxation that increases the potential to emit above the applicable Federal program threshold will require a full review of the

AIRS ID: 045/1741/001

Page 5 of 9

\*Please analyze in accordance with the highlighted section.  
Thank you Scott B. B. B.

D48389: Chain of Custody

Page 2 of 3

# Accutest Laboratories Sample Receipt Summary

Accutest Job Number: D48389

Client: MARATHON OIL

Immediate Client Services Action Required: No

Date / Time Received: 7/19/2013 12:30:00 PM

No. Coolers: 1

Client Service Action Required at Login: No

Project: MOC 32C MONITORING WELLS

Airbill #'s: HD-CO

Cooler Security	Y	or	N		Y	or	N
1. Custody Seals Present:	<input checked="" type="checkbox"/>		<input type="checkbox"/>	3. COC Present:	<input checked="" type="checkbox"/>		<input type="checkbox"/>
2. Custody Seals Intact:	<input checked="" type="checkbox"/>		<input type="checkbox"/>	4. Smpl Dates/Time OK	<input checked="" type="checkbox"/>		<input type="checkbox"/>

Cooler Temperature	Y	or	N
1. Temp criteria achieved:	<input checked="" type="checkbox"/>		<input type="checkbox"/>
2. Cooler temp verification:			Infrared gun
3. Cooler media:			Ice (bag)

Quality Control Preservation	Y	or	N	N/A
1. Trip Blank present / cooler:	<input type="checkbox"/>		<input type="checkbox"/>	
2. Trip Blank listed on COC:	<input type="checkbox"/>		<input type="checkbox"/>	
3. Samples preserved properly:	<input checked="" type="checkbox"/>		<input type="checkbox"/>	
4. VOCs headspace free:	<input checked="" type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>

Sample Integrity - Documentation	Y	or	N
1. Sample labels present on bottles:	<input checked="" type="checkbox"/>		<input type="checkbox"/>
2. Container labeling complete:	<input checked="" type="checkbox"/>		<input type="checkbox"/>
3. Sample container label / COC agree:	<input checked="" type="checkbox"/>		<input type="checkbox"/>

Sample Integrity - Condition	Y	or	N
1. Sample recvd within HT:	<input checked="" type="checkbox"/>		<input type="checkbox"/>
2. All containers accounted for:	<input checked="" type="checkbox"/>		<input type="checkbox"/>
3. Condition of sample:			Intact

Sample Integrity - Instructions	Y	or	N	N/A
1. Analysis requested is clear:	<input checked="" type="checkbox"/>		<input type="checkbox"/>	
2. Bottles received for unspecified tests	<input type="checkbox"/>		<input checked="" type="checkbox"/>	
3. Sufficient volume rec'd for analysis:	<input checked="" type="checkbox"/>		<input type="checkbox"/>	
4. Compositing instructions clear:	<input type="checkbox"/>		<input type="checkbox"/>	<input checked="" type="checkbox"/>
5. Filtering instructions clear:	<input type="checkbox"/>		<input type="checkbox"/>	<input checked="" type="checkbox"/>

Comments

Accutest Laboratories  
V:(303) 425-6021

4036 Youngfield Street  
F: (303) 425-6854

Wheat Ridge, CO  
www.accutest.com



**APPENDIX C-5**  
**JULY 25 SAMPLE RESULTS**



08/29/13

## Technical Report for

Marathon Oil

32C Monitoring Wells

WBS#TA.13.30788.EXP

Accutest Job Number: D48642

Sampling Date: 07/25/13

Report to:

Golder Associates

rmarch@golder.com

ATTN: Randy March

Total number of pages in report: **23**



Test results contained within this data package meet the requirements of the National Environmental Laboratory Accreditation Conference and/or state specific certification programs as applicable.

A handwritten signature in black ink, appearing to read 'Scott Heideman'.

Scott Heideman  
Laboratory Director

Client Service contact: Ann Doerr 303-425-6021

Certifications: CO (CO00049), ID, NE (CO00049), ND (R-027), NJ (CO 0007), OK (D9942), UT (NELAP CO00049), TX (T104704511)

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Test results relate only to samples analyzed.

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Sample Summary

Marathon Oil

Job No: D48642

32C Monitoring Wells  
Project No: WBS#TA.13.30788.EXP

Sample Number	Collected		Received	Matrix		Client Sample ID
	Date	Time By		Code	Type	
D48642-1	07/25/13	11:10 SD	07/26/13	AQ	Ground Water	MW-4
D48642-2	07/25/13	13:30 SD	07/26/13	AQ	Ground Water	MW-2



## CASE NARRATIVE / CONFORMANCE SUMMARY

**Client:** Marathon Oil

**Job No** D48642

**Site:** 32C Monitoring Wells

**Report Date** 7/30/2013 2:17:36 PM

On 07/26/2013, 2 sample(s), 0 Trip Blank(s), and 0 Field Blank(s) were received at Accutest Mountain States (AMS) at a temperature of 4.4 °C. The samples were intact and properly preserved, unless noted below. An AMS Job Number of D48642 was assigned to the project. The lab sample ID, client sample ID, and date of sample collection are detailed in the report's Results Summary.

Specified quality control criteria were achieved for this job except as noted below. For more information, please refer to the analytical results and QC summary pages.

### Volatiles by GCMS By Method SW846 8260B

**Matrix** AQ

**Batch ID:** V3V1524

- All samples were analyzed within the recommended method holding time.
- Sample(s) D48602-8MS, D48602-8MSD were used as the QC samples indicated.
- All method blanks for this batch meet method specific criteria.

### Volatiles by GC By Method SW846 8015B

**Matrix** AQ

**Batch ID:** GFA752

- All samples were analyzed within the recommended method holding time.
- Sample(s) D48600-1MS, D48600-1MSD were used as the QC samples indicated.
- All method blanks for this batch meet method specific criteria.

**Matrix** AQ

**Batch ID:** GGB1174

- All samples were analyzed within the recommended method holding time.
- Sample(s) D48641-1MS, D48641-1MSD were used as the QC samples indicated.
- All method blanks for this batch meet method specific criteria.

### Extractables by GC By Method SW846-8015B

**Matrix** AQ

**Batch ID:** OP8272

- All samples were extracted and analyzed within the recommended method holding time.
- Sample(s) D48200-31MS, D48200-31MSD were used as the QC samples indicated.
- All method blanks for this batch meet method specific criteria.

### Wet Chemistry By Method EPA 300.0/SW846 9056

**Matrix** AQ

**Batch ID:** GP10529

- All samples were prepared and analyzed within the recommended method holding time.
- All method blanks for this batch meet method specific criteria.
- Sample(s) D48602-3MS, D48602-3MSD were used as the QC samples for the Chloride, Sulfate, Chloride analysis.

**Wet Chemistry By Method SM 2540C-2011****Matrix** AQ**Batch ID:** GN21210

- All samples were analyzed within the recommended method holding time.
- All method blanks for this batch meet method specific criteria.
- Sample(s) D48547-1DUP were used as the QC samples for the Solids, Total Dissolved analysis.

**Wet Chemistry By Method SM 2540D-2011****Matrix** AQ**Batch ID:** GN21208

- All samples were analyzed within the recommended method holding time.
- All method blanks for this batch meet method specific criteria.
- Sample(s) D48628-1DUP were used as the QC samples for the Solids, Total Suspended analysis.

AMS certifies that data reported for samples received, listed on the associated custody chain or analytical task order, were produced to specifications meeting AMS's Quality System precision, accuracy and completeness objectives except as noted.

Estimated non-standard method measurement uncertainty data is available on request, based on quality control bias and implicit for standard methods. Acceptable uncertainty requires tested parameter quality control data to meet method criteria.

AMS is not responsible for data quality assumptions if partial reports are used and recommends that this report be used in its entirety. This report is authorized by AMS indicated via signature on the report cover.



## Summary of Hits

Page 1 of 1

**Job Number:** D48642  
**Account:** Marathon Oil  
**Project:** 32C Monitoring Wells  
**Collected:** 07/25/13



Lab Sample ID	Client Sample ID	Result/ Qual	RL	MDL	Units	Method
---------------	------------------	-----------------	----	-----	-------	--------

### D48642-1 MW-4

Benzene	0.0340	0.0010	0.00025	mg/l	SW846 8260B
Ethylbenzene	0.0012 J	0.0020	0.00025	mg/l	SW846 8260B
Xylene (total)	0.0040	0.0030	0.0020	mg/l	SW846 8260B
TPH-GRO (C6-C10)	0.107 J	0.20	0.10	mg/l	SW846 8015B
TPH-DRO (C10-C28)	0.211	0.19	0.17	mg/l	SW846-8015B
Chloride	369	10		mg/l	EPA 300.0/SW846 9056
Solids, Total Dissolved	1330	10		mg/l	SM 2540C-2011
Solids, Total Suspended	134	5.0		mg/l	SM 2540D-2011
Sulfate	123	2.5		mg/l	EPA 300.0/SW846 9056
pH	7.69			su	SM4500HB+ -2011/9040C

### D48642-2 MW-2

Benzene	0.0312	0.0010	0.00025	mg/l	SW846 8260B
Ethylbenzene	0.00075 J	0.0020	0.00025	mg/l	SW846 8260B
Xylene (total)	0.0041	0.0030	0.0020	mg/l	SW846 8260B
TPH-DRO (C10-C28)	0.201	0.19	0.17	mg/l	SW846-8015B
Chloride	121	2.5		mg/l	EPA 300.0/SW846 9056
Solids, Total Dissolved	658	10		mg/l	SM 2540C-2011
Solids, Total Suspended	159	5.0		mg/l	SM 2540D-2011
Sulfate	70.6	2.5		mg/l	EPA 300.0/SW846 9056
pH	7.55			su	SM4500HB+ -2011/9040C

Sample Results

Report of Analysis

## Report of Analysis

Page 1 of 1

<b>Client Sample ID:</b>	MW-4	
<b>Lab Sample ID:</b>	D48642-1	<b>Date Sampled:</b> 07/25/13
<b>Matrix:</b>	AQ - Ground Water	<b>Date Received:</b> 07/26/13
<b>Method:</b>	SW846 8260B	<b>Percent Solids:</b> n/a
<b>Project:</b>	32C Monitoring Wells	

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	3V25932.D	1	07/27/13	BR	n/a	n/a	V3V1524
Run #2							

	Purge Volume
Run #1	5.0 ml
Run #2	

## Purgeable Aromatics

CAS No.	Compound	Result	RL	MDL	Units	Q
71-43-2	Benzene	0.0340	0.0010	0.00025	mg/l	
108-88-3	Toluene	ND	0.0020	0.0010	mg/l	
100-41-4	Ethylbenzene	0.0012	0.0020	0.00025	mg/l	J
1330-20-7	Xylene (total)	0.0040	0.0030	0.0020	mg/l	

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
17060-07-0	1,2-Dichloroethane-D4	110%		62-130%
2037-26-5	Toluene-D8	108%		70-130%
460-00-4	4-Bromofluorobenzene	95%		69-130%

ND = Not detected MDL - Method Detection Limit

RL = Reporting Limit

E = Indicates value exceeds calibration range

J = Indicates an estimated value

B = Indicates analyte found in associated method blank

N = Indicates presumptive evidence of a compound

## Report of Analysis

Page 1 of 1

<b>Client Sample ID:</b>	MW-4	<b>Date Sampled:</b>	07/25/13
<b>Lab Sample ID:</b>	D48642-1	<b>Date Received:</b>	07/26/13
<b>Matrix:</b>	AQ - Ground Water	<b>Percent Solids:</b>	n/a
<b>Method:</b>	SW846 8015B		
<b>Project:</b>	32C Monitoring Wells		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	FA12629.D	1	07/26/13	AV	n/a	n/a	GFA752
Run #2							

	Initial Volume	Final Volume
Run #1	1.0 ml	1.0 ml
Run #2		

CAS No.	Compound	Result	RL	MDL	Units	Q
67-56-1	Methanol	ND	0.50	0.40	mg/l	

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
71-36-3	n-Butyl Alcohol	110%		25-169%

ND = Not detected      MDL - Method Detection Limit  
 RL = Reporting Limit  
 E = Indicates value exceeds calibration range

J = Indicates an estimated value  
 B = Indicates analyte found in associated method blank  
 N = Indicates presumptive evidence of a compound

## Report of Analysis

Page 1 of 1

<b>Client Sample ID:</b>	MW-4	<b>Date Sampled:</b>	07/25/13
<b>Lab Sample ID:</b>	D48642-1	<b>Date Received:</b>	07/26/13
<b>Matrix:</b>	AQ - Ground Water	<b>Percent Solids:</b>	n/a
<b>Method:</b>	SW846 8015B		
<b>Project:</b>	32C Monitoring Wells		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	GB21377.D	1	07/26/13	EV	n/a	n/a	GGB1174
Run #2							

	Purge Volume
Run #1	5.0 ml
Run #2	

CAS No.	Compound	Result	RL	MDL	Units	Q
	TPH-GRO (C6-C10)	0.107	0.20	0.10	mg/l	J
CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits		
120-82-1	1,2,4-Trichlorobenzene	86%		60-140%		

ND = Not detected      MDL - Method Detection Limit  
 RL = Reporting Limit  
 E = Indicates value exceeds calibration range

J = Indicates an estimated value  
 B = Indicates analyte found in associated method blank  
 N = Indicates presumptive evidence of a compound

## Report of Analysis

Page 1 of 1

<b>Client Sample ID:</b>	MW-4	
<b>Lab Sample ID:</b>	D48642-1	<b>Date Sampled:</b> 07/25/13
<b>Matrix:</b>	AQ - Ground Water	<b>Date Received:</b> 07/26/13
<b>Method:</b>	SW846-8015B SW846 3510C	<b>Percent Solids:</b> n/a
<b>Project:</b>	32C Monitoring Wells	

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	FD26922.D	1	07/27/13	TU	07/26/13	OP8272	GFD1317
Run #2							

	Initial Volume	Final Volume
Run #1	1060 ml	1.0 ml
Run #2		

CAS No.	Compound	Result	RL	MDL	Units	Q
	TPH-DRO (C10-C28)	0.211	0.19	0.17	mg/l	
CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits		
84-15-1	o-Terphenyl	64%		20-140%		

ND = Not detected      MDL - Method Detection Limit  
 RL = Reporting Limit  
 E = Indicates value exceeds calibration range

J = Indicates an estimated value  
 B = Indicates analyte found in associated method blank  
 N = Indicates presumptive evidence of a compound



## Report of Analysis

Page 1 of 1

**Client Sample ID:** MW-4  
**Lab Sample ID:** D48642-1  
**Matrix:** AQ - Ground Water  
**Project:** 32C Monitoring Wells

**Date Sampled:** 07/25/13  
**Date Received:** 07/26/13  
**Percent Solids:** n/a

## General Chemistry

Analyte	Result	RL	Units	DF	Analyzed	By	Method
Chloride	369	10	mg/l	20	07/26/13 18:44	SK	EPA 300.0/SW846 9056
Solids, Total Dissolved	1330	10	mg/l	1	07/29/13	AK	SM 2540C-2011
Solids, Total Suspended	134	5.0	mg/l	1	07/29/13	BF	SM 2540D-2011
Sulfate	123	2.5	mg/l	5	07/26/13 14:04	SK	EPA 300.0/SW846 9056
pH	7.69		su	1	07/26/13 16:00	AK	SM4500HB+ -2011/9040C

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RL = Reporting Limit

## Report of Analysis

Page 1 of 1

<b>Client Sample ID:</b>	MW-2	<b>Date Sampled:</b>	07/25/13
<b>Lab Sample ID:</b>	D48642-2	<b>Date Received:</b>	07/26/13
<b>Matrix:</b>	AQ - Ground Water	<b>Percent Solids:</b>	n/a
<b>Method:</b>	SW846 8260B		
<b>Project:</b>	32C Monitoring Wells		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	3V25933.D	1	07/27/13	BR	n/a	n/a	V3V1524
Run #2							

	Purge Volume
Run #1	5.0 ml
Run #2	

## Purgeable Aromatics

CAS No.	Compound	Result	RL	MDL	Units	Q
71-43-2	Benzene	0.0312	0.0010	0.00025	mg/l	
108-88-3	Toluene	ND	0.0020	0.0010	mg/l	
100-41-4	Ethylbenzene	0.00075	0.0020	0.00025	mg/l	J
1330-20-7	Xylene (total)	0.0041	0.0030	0.0020	mg/l	

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
17060-07-0	1,2-Dichloroethane-D4	109%		62-130%
2037-26-5	Toluene-D8	112%		70-130%
460-00-4	4-Bromofluorobenzene	97%		69-130%

ND = Not detected MDL - Method Detection Limit

RL = Reporting Limit

E = Indicates value exceeds calibration range

J = Indicates an estimated value

B = Indicates analyte found in associated method blank

N = Indicates presumptive evidence of a compound

## Report of Analysis

Page 1 of 1

<b>Client Sample ID:</b>	MW-2	<b>Date Sampled:</b>	07/25/13
<b>Lab Sample ID:</b>	D48642-2	<b>Date Received:</b>	07/26/13
<b>Matrix:</b>	AQ - Ground Water	<b>Percent Solids:</b>	n/a
<b>Method:</b>	SW846 8015B		
<b>Project:</b>	32C Monitoring Wells		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	FA12630.D	1	07/26/13	AV	n/a	n/a	GFA752
Run #2							

	Initial Volume	Final Volume
Run #1	1.0 ml	1.0 ml
Run #2		

CAS No.	Compound	Result	RL	MDL	Units	Q
67-56-1	Methanol	ND	0.50	0.40	mg/l	
CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits		
71-36-3	n-Butyl Alcohol	116%		25-169%		

ND = Not detected      MDL - Method Detection Limit  
 RL = Reporting Limit  
 E = Indicates value exceeds calibration range

J = Indicates an estimated value  
 B = Indicates analyte found in associated method blank  
 N = Indicates presumptive evidence of a compound

## Report of Analysis

Page 1 of 1

<b>Client Sample ID:</b>	MW-2	<b>Date Sampled:</b>	07/25/13
<b>Lab Sample ID:</b>	D48642-2	<b>Date Received:</b>	07/26/13
<b>Matrix:</b>	AQ - Ground Water	<b>Percent Solids:</b>	n/a
<b>Method:</b>	SW846 8015B		
<b>Project:</b>	32C Monitoring Wells		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	GB21378.D	1	07/26/13	EV	n/a	n/a	GGB1174
Run #2							

	Purge Volume
Run #1	5.0 ml
Run #2	

CAS No.	Compound	Result	RL	MDL	Units	Q
	TPH-GRO (C6-C10)	ND	0.20	0.10	mg/l	
CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits		
120-82-1	1,2,4-Trichlorobenzene	86%		60-140%		

ND = Not detected      MDL - Method Detection Limit  
 RL = Reporting Limit  
 E = Indicates value exceeds calibration range

J = Indicates an estimated value  
 B = Indicates analyte found in associated method blank  
 N = Indicates presumptive evidence of a compound

## Report of Analysis

Page 1 of 1

<b>Client Sample ID:</b>	MW-2	<b>Date Sampled:</b>	07/25/13
<b>Lab Sample ID:</b>	D48642-2	<b>Date Received:</b>	07/26/13
<b>Matrix:</b>	AQ - Ground Water	<b>Percent Solids:</b>	n/a
<b>Method:</b>	SW846-8015B SW846 3510C		
<b>Project:</b>	32C Monitoring Wells		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	FH011530.D	1	07/29/13	TU	07/26/13	OP8272	GFH637
Run #2							

	Initial Volume	Final Volume
Run #1	1060 ml	1.0 ml
Run #2		

CAS No.	Compound	Result	RL	MDL	Units	Q
	TPH-DRO (C10-C28)	0.201	0.19	0.17	mg/l	
CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits		
84-15-1	o-Terphenyl	76%		20-140%		

ND = Not detected      MDL - Method Detection Limit  
 RL = Reporting Limit  
 E = Indicates value exceeds calibration range

J = Indicates an estimated value  
 B = Indicates analyte found in associated method blank  
 N = Indicates presumptive evidence of a compound

Report of Analysis

<b>Client Sample ID:</b>	MW-2	<b>Date Sampled:</b>	07/25/13
<b>Lab Sample ID:</b>	D48642-2	<b>Date Received:</b>	07/26/13
<b>Matrix:</b>	AQ - Ground Water	<b>Percent Solids:</b>	n/a
<b>Project:</b>	32C Monitoring Wells		

General Chemistry

Analyte	Result	RL	Units	DF	Analyzed	By	Method
Chloride	121	2.5	mg/l	5	07/26/13 14:16	SK	EPA 300.0/SW846 9056
Solids, Total Dissolved	658	10	mg/l	1	07/29/13	AK	SM 2540C-2011
Solids, Total Suspended	159	5.0	mg/l	1	07/29/13	BF	SM 2540D-2011
Sulfate	70.6	2.5	mg/l	5	07/26/13 14:16	SK	EPA 300.0/SW846 9056
pH	7.55		su	1	07/26/13 16:00	AK	SM4500HB+ -2011/9040C

RL = Reporting Limit



## Misc. Forms

5

### Custody Documents and Other Forms

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Includes the following where applicable:

- Chain of Custody



the self-certification process to demonstrate compliance with emission limits.  
(Reference: Regulation No. 3, Part B, Section III.E.)

**Periodic Testing Requirements**

18. **AIRS Point 001:** The operator shall sample the wastewater inlet to the pond system (or the gun barrel separator tank wastewater outlet) to determine volatile organic compounds (VOC) and hazardous air pollutant (HAP) concentrations, including total hydrocarbons (including gasoline range and diesel range), benzene, toluene, ethylbenzene, xylene, and methanol. These samples shall be analyzed using EPA Method 8260 for benzene, toluene, ethylbenzene, and xylene, and EPA Method 8015 for methanol, gasoline range organics (total volatile hydrocarbons), and diesel range organics (total extractable hydrocarbons).

A sample of the wastewater inlet to the pond system (or the gun barrel separator tank wastewater outlet) shall be collected and analyzed at a minimum frequency of once per calendar month. Sample results shall be used to calculate emissions as required by Condition 12. If more frequent sampling is conducted, then all samples of the wastewater inlet to the pond collected during the calendar month will be averaged and then used to calculate emissions as specified in Condition 12. Samples shall be collected no less than at least seven (7) days apart. The operator shall maintain records of all sampling events and the records shall be made available to the Division for inspection upon request. The operator shall flag monthly records if any sampling results are noted by the laboratory as beyond QA/QC criteria limits.

**ADDITIONAL REQUIREMENTS**

19. A revised Air Pollutant Emission Notice (APEN) shall be filed: (Reference: Regulation No. 3, Part A, II.C)
- a. Annually whenever a significant increase in emissions occurs as follows:

**For any criteria pollutant:**

For sources emitting less than 100 tons per year, a change in actual emissions of five (5) tons per year or more, above the level reported on the last APEN, or

**For any non-criteria reportable pollutant:**

If the emissions increase by 50% or five (5) tons per year, whichever is less, above the level reported on the last APEN submitted to the Division.

- b. Whenever there is a change in the owner or operator of any facility, process, or activity; or
- c. Whenever new control equipment is installed, or whenever a different type of control equipment replaces an existing type of control equipment; or
- d. Whenever a permit limitation must be modified; or
- e. No later than 30 days before the existing APEN expires.

20. Federal regulatory program requirements (i.e. PSD, NANSR or Title V Operating Permit) shall apply to this source at any such time that this source becomes major solely by virtue of a relaxation in any permit condition. Any relaxation that increases the potential to emit above the applicable Federal program threshold will require a full review of the

AIRS ID: 045/1741/001

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Please analyze in accordance with the highlighted sections on this, and the following, pages:  
Thanks, *Justin*

D48642: Chain of Custody

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Form 4, within thirty (30) days of December 30, 1997. The Sundry Notice, Form 4 shall include a copy of the existing pit permit, if a permit was obtained, and a description of the closure process.

(2) Pits closed prior to December 30, 1997 were required to be reclaimed in accordance with the 1000 Series rules. Pits closed after December 30, 1997 shall be closed in accordance with the 900 Series rules and reclaimed in accordance with the 1000 Series rules.

(3) Operators of steel, fiberglass, concrete or other similar produced water vessels buried or partially buried and located in sensitive areas were required to repair or replace vessels and tanks found to be leaking. Operators shall repair or replace vessels and tanks found to be leaking. Operators shall submit to the Director a Sundry Notice, Form 4, describing the integrity testing results and action taken within thirty (30) days of December 30, 1997.

(4) Closure of pits and steel, fiberglass, concrete or other similar produced water vessels, and associated remediation operations conducted prior to December 30, 1997 are not subject to Rules 905., 906., 907., 909. and 910.

#### 912. VENTING OR FLARING NATURAL GAS

a. The unnecessary or excessive venting or flaring of natural gas produced from a well is prohibited.

b. Except for gas flared or vented during an upset condition, well maintenance, well stimulation flowback, purging operations, or a productivity test, gas from a well shall be flared or vented only after notice has been given and approval obtained from the Director on a Sundry Notice, Form 4, stating the estimated volume and content of the gas. The notice shall indicate whether the gas contains more than one (1) ppm of hydrogen sulfide. If necessary to protect the public health, safety or welfare, the Director may require the flaring of gas.

c. Gas flared, vented or used on the lease shall be estimated based on a gas-oil ratio test or other equivalent test approved by the Director, and reported on Operator's Monthly Production Report, Form 7.

d. Flared gas that is subject to Sundry Notice, Form 4, shall be directed to a controlled flare in accordance with Rule 903.b.(2) or other combustion device operated as efficiently as possible to provide maximum reduction of air contaminants where practicable and without endangering the safety of the well site personnel and the public.

e. Operators shall notify the local emergency dispatch or the local governmental designee of any natural gas flaring. Notice shall be given prior to flaring when flaring can be reasonably anticipated, or as soon as possible, but in no event more than two (2) hours after the flaring occurs.

Table 910-1  
CONCENTRATION LEVELS<sup>1</sup>

Contaminant of Concern	Concentrations
Organic Compounds in Soil	
TPH (total volatile and extractable petroleum hydrocarbons)	500 mg/kg
Benzene	0.17 mg/kg <sup>2</sup>

900.21

As of May 30, 2011

Toluene	85 mg/kg <sup>2</sup>
Ethylbenzene	100 mg/kg <sup>2</sup>
Xylenes (total)	175 mg/kg <sup>2</sup>
Acenaphthene	1,000 mg/kg <sup>2</sup>
Anthracene	1,000 mg/kg <sup>2</sup>
Benzo(A)anthracene	0.22 mg/kg <sup>2</sup>
Benzo(B)fluoranthene	0.22 mg/kg <sup>2</sup>
Benzo(K)fluoranthene	2.2 mg/kg <sup>2</sup>
Benzo(A)pyrene	0.022 mg/kg <sup>2</sup>
Chrysene	22 mg/kg <sup>2</sup>
Dibenzo(A,H)anthracene	0.022 mg/kg <sup>2</sup>
Fluoranthene	1,000 mg/kg <sup>2</sup>
Fluorene	1,000 mg/kg <sup>2</sup>
Indeno(1,2,3-C,D)pyrene	0.22 mg/kg <sup>2</sup>
Naphthalene	23 mg/kg <sup>2</sup>
Pyrene	1,000 mg/kg <sup>2</sup>
Organic Compounds in Ground Water	
Benzene	5 µg/l <sup>3</sup>
Toluene	560 to 1,000 µg/l <sup>3</sup>
Ethylbenzene	700 µg/l <sup>3</sup>
Xylenes (Total)	1,400 to 10,000 µg/l <sup>3,4</sup>
Inorganics in Soils	
Electrical Conductivity (EC)	<4 mmhos/cm or 2x background
Sodium Adsorption Ratio (SAR)	<12 <sup>5</sup>
pH	6-9
Inorganics in Ground Water	
Total Dissolved Solids (TDS)	<1.25 x background <sup>3</sup>
Chlorides	<1.25 x background <sup>3</sup>
Sulfates	<1.25 x background <sup>3</sup>
Metals in Soils	
Arsenic	0.39 mg/kg <sup>2</sup>
Barium (LDNR True Total Barium)	15,000 mg/kg <sup>2</sup>
Boron (Hot Water Soluble)	2 mg/l <sup>3</sup>
Cadmium	70 mg/kg <sup>3,5</sup>
Chromium (III)	120,000 mg/kg <sup>2</sup>
Chromium (VI)	23 mg/kg <sup>2,6</sup>
Copper	3,100 mg/kg <sup>2</sup>
Lead (inorganic)	400 mg/kg <sup>2</sup>
Mercury	23 mg/kg <sup>2</sup>
Nickel (soluble salts)	1,600 mg/kg <sup>2,6</sup>
Selenium	390 mg/kg <sup>2,6</sup>
Silver	390 mg/kg <sup>2</sup>
Zinc	23,000 mg/kg <sup>3,5</sup>
Liquid Hydrocarbons in Soils and Ground Water	
Liquid hydrocarbons including condensate and oil	Below detection level

COGCC recommends that the latest version of EPA SW 846 analytical methods be used where possible and that analyses of samples be performed by laboratories that maintain state or national accreditation programs.

- <sup>1</sup> Consideration shall be given to background levels in native soils and ground water.
- <sup>2</sup> Concentrations taken from CDPHE-HMMWD Table 1 Colorado Soil Evaluation Values (December 2007).
- <sup>3</sup> Concentrations taken from CDPHE-WQCC Regulation 41 - The Basic Standards for Ground Water.
- <sup>4</sup> For this range of standards, the first number in the range is a strictly health-based value, based on the WQCC's established methodology for human health-based standards. The second number in the range is a maximum contaminant level (MCL), established under the Federal Safe Drinking Water Act which has been

900-22

As of May 30, 2011

D48642: Chain of Custody

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## Accutest Laboratories Sample Receipt Summary

**Accutest Job Number:** D48642

**Client:** MARATHON OIL

**Immediate Client Services Action Required:** No

**Date / Time Received:** 7/26/2013 1:00:00 PM

**No. Coolers:** 1

**Client Service Action Required at Login:** No

**Project:** MOC 32C MONITORING WELLS

**Airbill #'s:** HD-CO

<b>Cooler Security</b>	<b>Y</b>	<b>or</b>	<b>N</b>		<b>Y</b>	<b>or</b>	<b>N</b>
1. Custody Seals Present:	<input checked="" type="checkbox"/>		<input type="checkbox"/>	3. COC Present:	<input checked="" type="checkbox"/>		<input type="checkbox"/>
2. Custody Seals Intact:	<input checked="" type="checkbox"/>		<input type="checkbox"/>	4. Smpl Dates/Time OK	<input checked="" type="checkbox"/>		<input type="checkbox"/>

<b>Cooler Temperature</b>	<b>Y</b>	<b>or</b>	<b>N</b>
1. Temp criteria achieved:	<input checked="" type="checkbox"/>		<input type="checkbox"/>
2. Cooler temp verification:			Infrared gun
3. Cooler media:			Ice (bag)

<b>Quality Control Preservation</b>	<b>Y</b>	<b>or</b>	<b>N</b>	<b>N/A</b>
1. Trip Blank present / cooler:	<input type="checkbox"/>		<input type="checkbox"/>	
2. Trip Blank listed on COC:	<input type="checkbox"/>		<input type="checkbox"/>	
3. Samples preserved properly:	<input checked="" type="checkbox"/>		<input type="checkbox"/>	
4. VOCs headspace free:	<input checked="" type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>

<b>Sample Integrity - Documentation</b>	<b>Y</b>	<b>or</b>	<b>N</b>
1. Sample labels present on bottles:	<input checked="" type="checkbox"/>		<input type="checkbox"/>
2. Container labeling complete:	<input checked="" type="checkbox"/>		<input type="checkbox"/>
3. Sample container label / COC agree:	<input checked="" type="checkbox"/>		<input type="checkbox"/>

<b>Sample Integrity - Condition</b>	<b>Y</b>	<b>or</b>	<b>N</b>
1. Sample recvd within HT:	<input checked="" type="checkbox"/>		<input type="checkbox"/>
2. All containers accounted for:	<input checked="" type="checkbox"/>		<input type="checkbox"/>
3. Condition of sample:			Intact

<b>Sample Integrity - Instructions</b>	<b>Y</b>	<b>or</b>	<b>N</b>	<b>N/A</b>
1. Analysis requested is clear:	<input checked="" type="checkbox"/>		<input type="checkbox"/>	
2. Bottles received for unspecified tests	<input type="checkbox"/>		<input checked="" type="checkbox"/>	
3. Sufficient volume rec'd for analysis:	<input checked="" type="checkbox"/>		<input type="checkbox"/>	
4. Compositing instructions clear:	<input type="checkbox"/>		<input type="checkbox"/>	<input checked="" type="checkbox"/>
5. Filtering instructions clear:	<input type="checkbox"/>		<input type="checkbox"/>	<input checked="" type="checkbox"/>

Comments

 Accutest Laboratories  
 V: (303) 425-6021

 4036 Youngfield Street  
 F: (303) 425-6854

 Wheat Ridge, CO  
 www.accutest.com



**APPENDIX C-6**  
**AUGUST 1 SAMPLE RESULTS**



08/29/13

Technical Report for

Marathon Oil

MOC 32C Monitoring Wells

WBS#TA.13.30788.EXP

Accutest Job Number: D48844

Sampling Date: 08/01/13

Report to:

Golder Associates

rmarch@golder.com

ATTN: Randy March

Total number of pages in report: **18**



Test results contained within this data package meet the requirements of the National Environmental Laboratory Accreditation Conference and/or state specific certification programs as applicable.

A handwritten signature in black ink, appearing to read 'Scott Heideman'.

Scott Heideman  
Laboratory Director

Client Service contact: Ann Doerr 303-425-6021

Certifications: CO (CO00049), ID, NE (CO00049), ND (R-027), NJ (CO 0007), OK (D9942), UT (NELAP CO00049), TX (T104704511)

This report shall not be reproduced, except in its entirety, without the written approval of Accutest Laboratories.  
Test results relate only to samples analyzed.

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Sample Summary

Marathon Oil

Job No: D48844

MOC 32C Monitoring Wells  
Project No: WBS#TA.13.30788.EXP

Sample Number	Collected		Received	Matrix		Client Sample ID
	Date	Time By		Code	Type	
D48844-1	08/01/13	14:15 SD	08/02/13	AQ	Ground Water	MW-2



## CASE NARRATIVE / CONFORMANCE SUMMARY

**Client:** Marathon Oil

**Job No** D48844

**Site:** MOC 32C Monitoring Wells

**Report Date** 8/6/2013 4:46:03 PM

On 08/02/2013, 1 sample(s), 0 Trip Blank(s), and 0 Field Blank(s) were received at Accutest Mountain States (AMS) at a temperature of 3.5 °C. The samples were intact and properly preserved, unless noted below. An AMS Job Number of D48844 was assigned to the project. The lab sample ID, client sample ID, and date of sample collection are detailed in the report's Results Summary.

Specified quality control criteria were achieved for this job except as noted below. For more information, please refer to the analytical results and QC summary pages.

### Volatiles by GCMS By Method SW846 8260B

**Matrix** AQ

**Batch ID:** V6V1110

- All samples were analyzed within the recommended method holding time.
- Sample(s) D48781-1MS, D48781-2DUP were used as the QC samples indicated.
- All method blanks for this batch meet method specific criteria.

### Volatiles by GC By Method SW846 8015B

**Matrix** AQ

**Batch ID:** GFA754

- All samples were analyzed within the recommended method holding time.
- All method blanks for this batch meet method specific criteria.
- Sample(s) D48844-1MS, D48844-1MSD were used as the QC samples indicated.

**Matrix** AQ

**Batch ID:** GGB1180

- All samples were analyzed within the recommended method holding time.
- All method blanks for this batch meet method specific criteria.
- Sample(s) D48773-1MS, D48773-1MSD were used as the QC samples indicated.

### Extractables by GC By Method SW846-8015B

**Matrix** AQ

**Batch ID:** OP8316

- All samples were extracted and analyzed within the recommended method holding time.
- Sample(s) D48557-5MS, D48557-5MSD were used as the QC samples indicated.
- All method blanks for this batch meet method specific criteria.

### Wet Chemistry By Method EPA 300.0/SW846 9056

**Matrix** AQ

**Batch ID:** GP10591

- All samples were prepared and analyzed within the recommended method holding time.
- All method blanks for this batch meet method specific criteria.
- Sample(s) D48849-2MS, D48849-2MSD were used as the QC samples for the Chloride, Sulfate, Chloride analysis.

## Wet Chemistry By Method SM 2540C-2011

**Matrix** AQ

**Batch ID:** GN21306

- All samples were analyzed within the recommended method holding time.
- All method blanks for this batch meet method specific criteria.
- Sample(s) D48844-1DUP were used as the QC samples for the Solids, Total Dissolved analysis.

## Wet Chemistry By Method SM 2540D-2011

**Matrix** AQ

**Batch ID:** GN21305

- All samples were analyzed within the recommended method holding time.
- All method blanks for this batch meet method specific criteria.
- Sample(s) D48778-1DUP were used as the QC samples for the Solids, Total Suspended analysis.
- The duplicate RPD(s) for Solids, Total Suspended are outside control limits for sample GN21305-D1. High RPD due to possible sample nonhomogeneity.

## Wet Chemistry By Method SM4500HB+-2011/9040C

**Matrix** AQ

**Batch ID:** GN21318

- The following samples were run outside of holding time for method SM4500HB+-2011/9040C: D48844-1

AMS certifies that data reported for samples received, listed on the associated custody chain or analytical task order, were produced to specifications meeting AMS's Quality System precision, accuracy and completeness objectives except as noted.

Estimated non-standard method measurement uncertainty data is available on request, based on quality control bias and implicit for standard methods. Acceptable uncertainty requires tested parameter quality control data to meet method criteria.

AMS is not responsible for data quality assumptions if partial reports are used and recommends that this report be used in its entirety. This report is authorized by AMS indicated via signature on the report cover.



## Summary of Hits

Page 1 of 1

**Job Number:** D48844  
**Account:** Marathon Oil  
**Project:** MOC 32C Monitoring Wells  
**Collected:** 08/01/13



Lab Sample ID	Client Sample ID	Result/ Qual	RL	MDL	Units	Method
D48844-1	MW-2					
Benzene		0.0436	0.0010	0.00025	mg/l	SW846 8260B
Xylene (total)		0.0041	0.0030	0.0020	mg/l	SW846 8260B
TPH-GRO (C6-C10)		0.116 J	0.20	0.10	mg/l	SW846 8015B
TPH-DRO (C10-C28)		0.272	0.19	0.17	mg/l	SW846-8015B
Chloride		123	10		mg/l	EPA 300.0/SW846 9056
Solids, Total Dissolved		632	10		mg/l	SM 2540C-2011
Solids, Total Suspended		93.0	5.0		mg/l	SM 2540D-2011
Sulfate		78.1	10		mg/l	EPA 300.0/SW846 9056
pH		7.76			su	SM4500HB+ -2011/9040C

Sample Results

Report of Analysis

## Report of Analysis

Page 1 of 1

<b>Client Sample ID:</b>	MW-2	<b>Date Sampled:</b>	08/01/13
<b>Lab Sample ID:</b>	D48844-1	<b>Date Received:</b>	08/02/13
<b>Matrix:</b>	AQ - Ground Water	<b>Percent Solids:</b>	n/a
<b>Method:</b>	SW846 8260B		
<b>Project:</b>	MOC 32C Monitoring Wells		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	6V20088.D	1	08/02/13	JL	n/a	n/a	V6V1110
Run #2							

	Purge Volume
Run #1	5.0 ml
Run #2	

## Purgeable Aromatics

CAS No.	Compound	Result	RL	MDL	Units	Q
71-43-2	Benzene	0.0436	0.0010	0.00025	mg/l	
108-88-3	Toluene	ND	0.0020	0.0010	mg/l	
100-41-4	Ethylbenzene	ND	0.0020	0.00025	mg/l	
1330-20-7	Xylene (total)	0.0041	0.0030	0.0020	mg/l	

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
17060-07-0	1,2-Dichloroethane-D4	120%		62-130%
2037-26-5	Toluene-D8	93%		70-130%
460-00-4	4-Bromofluorobenzene	94%		69-130%

ND = Not detected MDL - Method Detection Limit

RL = Reporting Limit

E = Indicates value exceeds calibration range

J = Indicates an estimated value

B = Indicates analyte found in associated method blank

N = Indicates presumptive evidence of a compound

## Report of Analysis

Page 1 of 1

<b>Client Sample ID:</b>	MW-2	<b>Date Sampled:</b>	08/01/13
<b>Lab Sample ID:</b>	D48844-1	<b>Date Received:</b>	08/02/13
<b>Matrix:</b>	AQ - Ground Water	<b>Percent Solids:</b>	n/a
<b>Method:</b>	SW846 8015B		
<b>Project:</b>	MOC 32C Monitoring Wells		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	FA12661.D	1	08/06/13	AV	n/a	n/a	GFA754
Run #2							

	Initial Volume	Final Volume
Run #1	1.0 ml	1.0 ml
Run #2		

CAS No.	Compound	Result	RL	MDL	Units	Q
67-56-1	Methanol	ND	0.50	0.40	mg/l	
CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits		
71-36-3	n-Butyl Alcohol	107%		25-169%		

ND = Not detected      MDL - Method Detection Limit  
 RL = Reporting Limit  
 E = Indicates value exceeds calibration range

J = Indicates an estimated value  
 B = Indicates analyte found in associated method blank  
 N = Indicates presumptive evidence of a compound

## Report of Analysis

Page 1 of 1

<b>Client Sample ID:</b>	MW-2	<b>Date Sampled:</b>	08/01/13
<b>Lab Sample ID:</b>	D48844-1	<b>Date Received:</b>	08/02/13
<b>Matrix:</b>	AQ - Ground Water	<b>Percent Solids:</b>	n/a
<b>Method:</b>	SW846 8015B		
<b>Project:</b>	MOC 32C Monitoring Wells		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	GB21483.D	1	08/03/13	EV	n/a	n/a	GGB1180
Run #2							

	Purge Volume
Run #1	5.0 ml
Run #2	

CAS No.	Compound	Result	RL	MDL	Units	Q
	TPH-GRO (C6-C10)	0.116	0.20	0.10	mg/l	J
CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits		
120-82-1	1,2,4-Trichlorobenzene	84%		60-140%		

ND = Not detected      MDL - Method Detection Limit  
 RL = Reporting Limit  
 E = Indicates value exceeds calibration range

J = Indicates an estimated value  
 B = Indicates analyte found in associated method blank  
 N = Indicates presumptive evidence of a compound

## Report of Analysis

Page 1 of 1

<b>Client Sample ID:</b>	MW-2	
<b>Lab Sample ID:</b>	D48844-1	<b>Date Sampled:</b> 08/01/13
<b>Matrix:</b>	AQ - Ground Water	<b>Date Received:</b> 08/02/13
<b>Method:</b>	SW846-8015B SW846 3510C	<b>Percent Solids:</b> n/a
<b>Project:</b>	MOC 32C Monitoring Wells	

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	FD27333.D	1	08/05/13	TU	08/03/13	OP8316	GFD1333
Run #2							

	Initial Volume	Final Volume
Run #1	1060 ml	1.0 ml
Run #2		

CAS No.	Compound	Result	RL	MDL	Units	Q
	TPH-DRO (C10-C28)	0.272	0.19	0.17	mg/l	
CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits		
84-15-1	o-Terphenyl	67%		20-140%		

ND = Not detected      MDL - Method Detection Limit  
 RL = Reporting Limit  
 E = Indicates value exceeds calibration range

J = Indicates an estimated value  
 B = Indicates analyte found in associated method blank  
 N = Indicates presumptive evidence of a compound



## Report of Analysis

Page 1 of 1

**Client Sample ID:** MW-2  
**Lab Sample ID:** D48844-1  
**Matrix:** AQ - Ground Water  
**Project:** MOC 32C Monitoring Wells

**Date Sampled:** 08/01/13  
**Date Received:** 08/02/13  
**Percent Solids:** n/a

## General Chemistry

Analyte	Result	RL	Units	DF	Analyzed	By	Method
Chloride	123	10	mg/l	20	08/02/13 18:24	GH	EPA 300.0/SW846 9056
Solids, Total Dissolved	632	10	mg/l	1	08/05/13	BF	SM 2540C-2011
Solids, Total Suspended	93.0	5.0	mg/l	1	08/05/13	JD	SM 2540D-2011
Sulfate	78.1	10	mg/l	20	08/02/13 18:24	GH	EPA 300.0/SW846 9056
pH	7.76		su	1	08/05/13 16:30	AK	SM4500HB+ -2011/9040C

---

RL = Reporting Limit

## Misc. Forms

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### Custody Documents and Other Forms

---

Includes the following where applicable:

- Chain of Custody



the self-certification process to demonstrate compliance with emission limits.  
(Reference: Regulation No. 3, Part B, Section III.E.)

#### Periodic Testing Requirements

18. **AIRS Point 001:** The operator shall sample the wastewater inlet to the pond system (or the gun barrel separator tank wastewater outlet) to determine volatile organic compounds (VOC) and hazardous air pollutant (HAP) concentrations, including total hydrocarbons (including gasoline range and diesel range), benzene, toluene, ethylbenzene, xylene, and methanol. These samples shall be analyzed using EPA Method 8260 for benzene, toluene, ethylbenzene, and xylene, and EPA Method 8015 for methanol, gasoline range organics (total volatile hydrocarbons), and diesel range organics (total extractable hydrocarbons).

A sample of the wastewater inlet to the pond system (or the gun barrel separator tank wastewater outlet) shall be collected and analyzed at a minimum frequency of once per calendar month. Sample results shall be used to calculate emissions as required by Condition 12. If more frequent sampling is conducted, then all samples of the wastewater inlet to the pond collected during the calendar month will be averaged and then used to calculate emissions as specified in Condition 12. Samples shall be collected no less than at least seven (7) days apart. The operator shall maintain records of all sampling events and the records shall be made available to the Division for inspection upon request. The operator shall flag monthly records if any sampling results are noted by the laboratory as beyond QA/QC criteria limits.

#### ADDITIONAL REQUIREMENTS

19. A revised Air Pollutant Emission Notice (APEN) shall be filed: (Reference: Regulation No. 3, Part A, II.C)
- Annually whenever a significant increase in emissions occurs as follows:

##### **For any criteria pollutant:**

For sources emitting less than 100 tons per year, a change in actual emissions of five (5) tons per year or more, above the level reported on the last APEN; or

##### **For any non-criteria reportable pollutant:**

If the emissions increase by 50% or five (5) tons per year, whichever is less, above the level reported on the last APEN submitted to the Division.

- Whenever there is a change in the owner or operator of any facility, process, or activity; or
- Whenever new control equipment is installed, or whenever a different type of control equipment replaces an existing type of control equipment; or
- Whenever a permit limitation must be modified; or
- No later than 30 days before the existing APEN expires.

20. Federal regulatory program requirements (i.e. PSD, NANSR or Title V Operating Permit) shall apply to this source at any such time that this source becomes major solely by virtue of a relaxation in any permit condition. Any relaxation that increases the potential to emit above the applicable Federal program threshold will require a full review of the

AIRS ID: 045/1741/001

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Please analyze in accordance with this, and the following pages, as highlighted. Thank you, *Just Datta*

D48844: Chain of Custody

Page 2 of 5

Form 4, within thirty (30) days of December 30, 1997. The Sundry Notice, Form 4 shall include a copy of the existing pit permit, if a permit was obtained, and a description of the closure process.

(2) Pits closed prior to December 30, 1997 were required to be reclaimed in accordance with the 1000 Series rules. Pits closed after December 30, 1997 shall be closed in accordance with the 900 Series rules and reclaimed in accordance with the 1000 Series rules.

(3) Operators of steel, fiberglass, concrete or other similar produced water vessels buried or partially buried and located in sensitive areas were required to repair or replace vessels and tanks found to be leaking. Operators shall repair or replace vessels and tanks found to be leaking. Operators shall submit to the Director a Sundry Notice, Form 4, describing the integrity testing results and action taken within thirty (30) days of December 30, 1997.

(4) Closure of pits and steel, fiberglass, concrete or other similar produced water vessels, and associated remediation operations conducted prior to December 30, 1997 are not subject to Rules 905, 906, 907, 909, and 910.

#### 912. VENTING OR FLARING NATURAL GAS

a. The unnecessary or excessive venting or flaring of natural gas produced from a well is prohibited.

b. Except for gas flared or vented during an upset condition, well maintenance, well stimulation flowback, purging operations, or a productivity test, gas from a well shall be flared or vented only after notice has been given and approval obtained from the Director on a Sundry Notice, Form 4, stating the estimated volume and content of the gas. The notice shall indicate whether the gas contains more than one (1) ppm of hydrogen sulfide. If necessary to protect the public health, safety or welfare, the Director may require the flaring of gas.

c. Gas flared, vented or used on the lease shall be estimated based on a gas-oil ratio test or other equivalent test approved by the Director, and reported on Operator's Monthly Production Report, Form 7.

d. Flared gas that is subject to Sundry Notice, Form 4, shall be directed to a controlled flare in accordance with Rule 903.b.(2) or other combustion device operated as efficiently as possible to provide maximum reduction of air contaminants where practicable and without endangering the safety of the well site personnel and the public.

e. Operators shall notify the local emergency dispatch or the local governmental designee of any natural gas flaring. Notice shall be given prior to flaring when flaring can be reasonably anticipated, or as soon as possible, but in no event more than two (2) hours after the flaring occurs.

Table 910-1  
CONCENTRATION LEVELS<sup>1</sup>

Contaminant of Concern	Concentrations
Organic Compounds in Soil	
TPH (total volatile and extractable petroleum hydrocarbons)	500 mg/kg
Benzene	0.17 mg/kg <sup>2</sup>

900-21

As of May 30, 2011

Toluene	85 mg/kg <sup>1</sup>
Ethylbenzene	100 mg/kg <sup>2</sup>
Xylenes (total)	175 mg/kg <sup>2</sup>
Acenaphthene	1,000 mg/kg <sup>2</sup>
Anthracene	1,000 mg/kg <sup>2</sup>
Benzo(A)anthracene	0.22 mg/kg <sup>2</sup>
Benzo(B)fluoranthene	0.22 mg/kg <sup>2</sup>
Benzo(K)fluoranthene	2.2 mg/kg <sup>2</sup>
Benzo(A)pyrene	0.022 mg/kg <sup>2</sup>
Chrysene	22 mg/kg <sup>2</sup>
Dibenzol(A,H)anthracene	0.022 mg/kg <sup>2</sup>
Fluoranthene	1,000 mg/kg <sup>2</sup>
Fluorene	1,000 mg/kg <sup>2</sup>
Indeno(1,2,3-C,D)pyrene	0.22 mg/kg <sup>2</sup>
Naphthalene	23 mg/kg <sup>2</sup>
Pyrene	1,000 mg/kg <sup>2</sup>
<b>Organic Compounds in Ground Water</b>	
Benzene	5 µg/l <sup>3</sup>
Toluene	560 to 1,000 µg/l <sup>3</sup>
Ethylbenzene	700 µg/l <sup>3</sup>
Xylenes (Total)	1,400 to 10,000 µg/l <sup>3,4</sup>
<b>Inorganics in Soils</b>	
Electrical Conductivity (EC)	<4 mmhos/cm or 2x background
Sodium Adsorption Ratio (SAR)	<12 <sup>5</sup>
pH	6-9
<b>Inorganics in Ground Water</b>	
Total Dissolved Solids (TDS)	<1.25 x background <sup>3</sup>
Chlorides	<1.25 x background <sup>3</sup>
Sulfates	<1.25 x background <sup>3</sup>
<b>Metals in Soils</b>	
Arsenic	0.39 mg/kg <sup>2</sup>
Barium (LDNR True Total Barium)	15,000 mg/kg <sup>2</sup>
Boron (Hot Water Soluble)	2 mg/l <sup>2</sup>
Cadmium	70 mg/kg <sup>3,5</sup>
Chromium (III)	120,000 mg/kg <sup>2</sup>
Chromium (VI)	23 mg/kg <sup>2</sup>
Copper	3,100 mg/kg <sup>2</sup>
Lead (inorganic)	400 mg/kg <sup>2</sup>
Mercury	23 mg/kg <sup>2</sup>
Nickel (soluble salts)	1,600 mg/kg <sup>2,6</sup>
Selenium	390 mg/kg <sup>3,6</sup>
Silver	390 mg/kg <sup>2</sup>
Zinc	23,000 mg/kg <sup>2,6</sup>
<b>Liquid Hydrocarbons in Soils and Ground Water</b>	
Liquid hydrocarbons including condensate and oil	Below detection level

COGCC recommends that the latest version of EPA SW 846 analytical methods be used where possible and that analyses of samples be performed by laboratories that maintain state or national accreditation programs.

- <sup>1</sup> Consideration shall be given to background levels in native soils and ground water.
- <sup>2</sup> Concentrations taken from CDPHE-HMMWD Table 1. Colorado Soil Evaluation Values (December 2007).
- <sup>3</sup> Concentrations taken from CDPHE-WQCC Regulation 41 - The Basic Standards for Ground Water.
- <sup>4</sup> For this range of standards, the first number in the range is a strictly health-based value, based on the WQCC's established methodology for human health-based standards. The second number in the range is a maximum contaminant level (MCL), established under the Federal Safe Drinking Water Act which has been

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As of May 30, 2011

D48844: Chain of Custody

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# Accutest Laboratories Sample Receipt Summary

Accutest Job Number: D48844

Client: MARATHON

Immediate Client Services Action Required: No

Date / Time Received: 8/2/2013 12:30:00 PM

No. Coolers: 1

Client Service Action Required at Login: No

Project: MOC

Airbill #'s: CO

## Cooler Security

Y or N

Y or N

- |                           |                                     |                          |                       |                                     |                          |
|---------------------------|-------------------------------------|--------------------------|-----------------------|-------------------------------------|--------------------------|
| 1. Custody Seals Present: | <input checked="" type="checkbox"/> | <input type="checkbox"/> | 3. COC Present:       | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| 2. Custody Seals Intact:  | <input checked="" type="checkbox"/> | <input type="checkbox"/> | 4. Smpl Dates/Time OK | <input checked="" type="checkbox"/> | <input type="checkbox"/> |

## Cooler Temperature

Y or N

- |                              |                                     |                          |
|------------------------------|-------------------------------------|--------------------------|
| 1. Temp criteria achieved:   | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| 2. Cooler temp verification: | Infrared gun                        |                          |
| 3. Cooler media:             | Ice (bag)                           |                          |

## Quality Control Preservation

Y or N

N/A

- |                                 |                                     |                          |                          |
|---------------------------------|-------------------------------------|--------------------------|--------------------------|
| 1. Trip Blank present / cooler: | <input type="checkbox"/>            | <input type="checkbox"/> |                          |
| 2. Trip Blank listed on COC:    | <input type="checkbox"/>            | <input type="checkbox"/> |                          |
| 3. Samples preserved properly:  | <input checked="" type="checkbox"/> | <input type="checkbox"/> |                          |
| 4. VOCs headspace free:         | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

## Sample Integrity - Documentation

Y or N

- |  |                                     |                          |
|--|-------------------------------------|--------------------------|
| 1. Sample labels present on bottles:   | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| 2. Container labeling complete:        | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| 3. Sample container label / COC agree: | <input checked="" type="checkbox"/> | <input type="checkbox"/> |

## Sample Integrity - Condition

Y or N

- |                                  |                                     |                          |
|----------------------------------|-------------------------------------|--------------------------|
| 1. Sample recvd within HT:       | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| 2. All containers accounted for: | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| 3. Condition of sample:          | Intact                              |                          |

## Sample Integrity - Instructions

Y or N N/A

- |   |                                     |                                     |                                     |
|---|-------------------------------------|-------------------------------------|-------------------------------------|
| 1. Analysis requested is clear:           | <input checked="" type="checkbox"/> | <input type="checkbox"/>            |                                     |
| 2. Bottles received for unspecified tests | <input type="checkbox"/>            | <input checked="" type="checkbox"/> |                                     |
| 3. Sufficient volume rec'd for analysis:  | <input checked="" type="checkbox"/> | <input type="checkbox"/>            |                                     |
| 4. Compositing instructions clear:        | <input type="checkbox"/>            | <input type="checkbox"/>            | <input checked="" type="checkbox"/> |
| 5. Filtering instructions clear:          | <input type="checkbox"/>            | <input type="checkbox"/>            | <input checked="" type="checkbox"/> |

Comments

Accutest Laboratories  
V: (303) 425-6021

4036 Youngfield Street  
F: (303) 425-6854

Wheat Ridge, CO  
www.accutest.com



**APPENDIX C-7**  
**AUGUST 9 SAMPLE RESULTS**



08/29/13

## Technical Report for

Marathon Oil

MOC 32C Monitoring Wells

WBS#TA.13.30788.EXP

Accutest Job Number: D49205

Sampling Date: 08/09/13

Report to:

Golder Associates

rmarch@golder.com

ATTN: Randy March

Total number of pages in report: **18**



Test results contained within this data package meet the requirements of the National Environmental Laboratory Accreditation Conference and/or state specific certification programs as applicable.

A handwritten signature in black ink, appearing to read 'Scott Heideman'.

Scott Heideman  
Laboratory Director

Client Service contact: Ann Doerr 303-425-6021

Certifications: CO (CO00049), ID, NE (CO00049), ND (R-027), NJ (CO 0007), OK (D9942), UT (NELAP CO00049), TX (T104704511)

This report shall not be reproduced, except in its entirety, without the written approval of Accutest Laboratories.  
Test results relate only to samples analyzed.

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Sample Summary

Marathon Oil

Job No: D49205

MOC 32C Monitoring Wells  
Project No: WBS#TA.13.30788.EXP

Sample Number	Collected		Matrix Code	Type	Client Sample ID
	Date	Time By			
D49205-1	08/09/13	12:35 SD	08/10/13	AQ Ground Water	MW-4



## CASE NARRATIVE / CONFORMANCE SUMMARY

**Client:** Marathon Oil

**Job No** D49205

**Site:** MOC 32C Monitoring Wells

**Report Date** 8/14/2013 3:55:31 PM

On 08/10/2013, 1 sample(s), 0 Trip Blank(s), and 0 Field Blank(s) were received at Accutest Mountain States (AMS) at a temperature of 2.6 °C. The samples were intact and properly preserved, unless noted below. An AMS Job Number of D49205 was assigned to the project. The lab sample ID, client sample ID, and date of sample collection are detailed in the report's Results Summary.

Specified quality control criteria were achieved for this job except as noted below. For more information, please refer to the analytical results and QC summary pages.

### Volatiles by GCMS By Method SW846 8260B

**Matrix** AQ

**Batch ID:** V7V1207

- All samples were analyzed within the recommended method holding time.
- All method blanks for this batch meet method specific criteria.
- Sample(s) D49157-2DUP, D49157-4MS were used as the QC samples indicated.
- D49157-4MS: The pH of the sample aliquot for VOA analysis was >2 at time of analysis.
- D49157-4MS: The pH of the sample aliquot for VOA analysis was >2 at time of analysis.
- D49157-2DUP: The pH of the sample aliquot for VOA analysis was >2 at time of analysis.

### Volatiles by GC By Method SW846 8015B

**Matrix** AQ

**Batch ID:** GFA758

- All samples were analyzed within the recommended method holding time.
- All method blanks for this batch meet method specific criteria.
- Sample(s) D49205-1MS, D49205-1MSD were used as the QC samples indicated.

**Matrix** AQ

**Batch ID:** GGA1089

- All samples were analyzed within the recommended method holding time.
- All method blanks for this batch meet method specific criteria.
- Sample(s) D49041-2MS, D49041-2MSD were used as the QC samples indicated.

### Extractables by GC By Method SW846-8015B

**Matrix** AQ

**Batch ID:** OP8356

- All samples were extracted and analyzed within the recommended method holding time.
- Sample(s) D48558-2MS, D48558-2MSD were used as the QC samples indicated.
- All method blanks for this batch meet method specific criteria.

### Wet Chemistry By Method EPA 300.0/SW846 9056

**Matrix** AQ

**Batch ID:** GP10662

- All samples were prepared and analyzed within the recommended method holding time.
- All method blanks for this batch meet method specific criteria.
- Sample(s) D49030-1MSD, D49030-1MS were used as the QC samples for the Chloride, Sulfate, Chloride analysis.
- The matrix spike / matrix spike duplicate (MS/MSD) recovery(s) of Chloride, Sulfate are outside control limits. Outside control limits due to matrix interference.

**Wet Chemistry By Method SM 2540C-2011****Matrix** AQ**Batch ID:** GN21427

- All samples were analyzed within the recommended method holding time.
- All method blanks for this batch meet method specific criteria.
- Sample(s) D49123-2DUP were used as the QC samples for the Solids, Total Dissolved analysis.

**Wet Chemistry By Method SM 2540D-2011****Matrix** AQ**Batch ID:** GN21402

- All samples were analyzed within the recommended method holding time.
- All method blanks for this batch meet method specific criteria.
- Sample(s) D48988-1DUP were used as the QC samples for the Solids, Total Suspended analysis.

AMS certifies that data reported for samples received, listed on the associated custody chain or analytical task order, were produced to specifications meeting AMS's Quality System precision, accuracy and completeness objectives except as noted.

Estimated non-standard method measurement uncertainty data is available on request, based on quality control bias and implicit for standard methods. Acceptable uncertainty requires tested parameter quality control data to meet method criteria.

AMS is not responsible for data quality assumptions if partial reports are used and recommends that this report be used in its entirety. This report is authorized by AMS indicated via signature on the report cover.

## Summary of Hits

Page 1 of 1

**Job Number:** D49205  
**Account:** Marathon Oil  
**Project:** MOC 32C Monitoring Wells  
**Collected:** 08/09/13



Lab Sample ID	Client Sample ID	Result/ Qual	RL	MDL	Units	Method
D49205-1	MW-4					
Benzene		0.0888	0.0010	0.00025	mg/l	SW846 8260B
Ethylbenzene		0.0019 J	0.0020	0.00025	mg/l	SW846 8260B
Xylene (total)		0.0159	0.0030	0.0020	mg/l	SW846 8260B
TPH-GRO (C6-C10)		0.260	0.20	0.10	mg/l	SW846 8015B
Chloride		393	10		mg/l	EPA 300.0/SW846 9056
Solids, Total Dissolved		1250	10		mg/l	SM 2540C-2011
Sulfate		118	2.5		mg/l	EPA 300.0/SW846 9056
pH		7.55			su	SM4500HB+ -2011/9040C



Sample Results

Report of Analysis

## Report of Analysis

Page 1 of 1

<b>Client Sample ID:</b>	MW-4	<b>Date Sampled:</b>	08/09/13
<b>Lab Sample ID:</b>	D49205-1	<b>Date Received:</b>	08/10/13
<b>Matrix:</b>	AQ - Ground Water	<b>Percent Solids:</b>	n/a
<b>Method:</b>	SW846 8260B		
<b>Project:</b>	MOC 32C Monitoring Wells		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	7V21962.D	1	08/13/13	JL	n/a	n/a	V7V1207
Run #2							

	Purge Volume
Run #1	5.0 ml
Run #2	

## Purgeable Aromatics

CAS No.	Compound	Result	RL	MDL	Units	Q
71-43-2	Benzene	0.0888	0.0010	0.00025	mg/l	
108-88-3	Toluene	ND	0.0020	0.0010	mg/l	
100-41-4	Ethylbenzene	0.0019	0.0020	0.00025	mg/l	J
1330-20-7	Xylene (total)	0.0159	0.0030	0.0020	mg/l	

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
17060-07-0	1,2-Dichloroethane-D4	114%		62-130%
2037-26-5	Toluene-D8	106%		70-130%
460-00-4	4-Bromofluorobenzene	91%		69-130%

ND = Not detected MDL - Method Detection Limit

RL = Reporting Limit

E = Indicates value exceeds calibration range

J = Indicates an estimated value

B = Indicates analyte found in associated method blank

N = Indicates presumptive evidence of a compound

## Report of Analysis

Page 1 of 1

<b>Client Sample ID:</b>	MW-4						
<b>Lab Sample ID:</b>	D49205-1					<b>Date Sampled:</b>	08/09/13
<b>Matrix:</b>	AQ - Ground Water					<b>Date Received:</b>	08/10/13
<b>Method:</b>	SW846 8015B					<b>Percent Solids:</b>	n/a
<b>Project:</b>	MOC 32C Monitoring Wells						

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	FA12725.D	1	08/13/13	AV	n/a	n/a	GFA758
Run #2							

	Initial Volume	Final Volume
Run #1	1.0 ml	1.0 ml
Run #2		

CAS No.	Compound	Result	RL	MDL	Units	Q
67-56-1	Methanol	ND	0.50	0.40	mg/l	
CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits		
71-36-3	n-Butyl Alcohol	100%		25-169%		

ND = Not detected      MDL - Method Detection Limit  
 RL = Reporting Limit  
 E = Indicates value exceeds calibration range

J = Indicates an estimated value  
 B = Indicates analyte found in associated method blank  
 N = Indicates presumptive evidence of a compound

## Report of Analysis

Page 1 of 1

<b>Client Sample ID:</b>	MW-4	<b>Date Sampled:</b>	08/09/13
<b>Lab Sample ID:</b>	D49205-1	<b>Date Received:</b>	08/10/13
<b>Matrix:</b>	AQ - Ground Water	<b>Percent Solids:</b>	n/a
<b>Method:</b>	SW846 8015B		
<b>Project:</b>	MOC 32C Monitoring Wells		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	GA19364.D	1	08/12/13	BR	n/a	n/a	GGA1089
Run #2							

	Purge Volume
Run #1	5.0 ml
Run #2	

CAS No.	Compound	Result	RL	MDL	Units	Q
	TPH-GRO (C6-C10)	0.260	0.20	0.10	mg/l	
CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits		
120-82-1	1,2,4-Trichlorobenzene	96%		60-140%		

ND = Not detected      MDL - Method Detection Limit  
 RL = Reporting Limit  
 E = Indicates value exceeds calibration range

J = Indicates an estimated value  
 B = Indicates analyte found in associated method blank  
 N = Indicates presumptive evidence of a compound

## Report of Analysis

Page 1 of 1

<b>Client Sample ID:</b>	MW-4	<b>Date Sampled:</b>	08/09/13
<b>Lab Sample ID:</b>	D49205-1	<b>Date Received:</b>	08/10/13
<b>Matrix:</b>	AQ - Ground Water	<b>Percent Solids:</b>	n/a
<b>Method:</b>	SW846-8015B SW846 3546		
<b>Project:</b>	MOC 32C Monitoring Wells		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	FH011963.D	1	08/14/13	TU	08/12/13	OP8356	GFH659
Run #2							

	Initial Volume	Final Volume
Run #1	1050 ml	1.0 ml
Run #2		

CAS No.	Compound	Result	RL	MDL	Units	Q
	TPH-DRO (C10-C28)	ND	0.19	0.17	mg/l	
CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits		
84-15-1	o-Terphenyl	75%		20-140%		

ND = Not detected      MDL - Method Detection Limit  
 RL = Reporting Limit  
 E = Indicates value exceeds calibration range

J = Indicates an estimated value  
 B = Indicates analyte found in associated method blank  
 N = Indicates presumptive evidence of a compound

## Report of Analysis

Page 1 of 1

**Client Sample ID:** MW-4  
**Lab Sample ID:** D49205-1  
**Matrix:** AQ - Ground Water  
**Project:** MOC 32C Monitoring Wells

**Date Sampled:** 08/09/13  
**Date Received:** 08/10/13  
**Percent Solids:** n/a

## General Chemistry

Analyte	Result	RL	Units	DF	Analyzed	By	Method
Chloride	393	10	mg/l	20	08/12/13 14:24	SK	EPA 300.0/SW846 9056
Solids, Total Dissolved	1250	10	mg/l	1	08/12/13	AK	SM 2540C-2011
Solids, Total Suspended	< 5.0	5.0	mg/l	1	08/10/13	BF	SM 2540D-2011
Sulfate	118	2.5	mg/l	5	08/12/13 11:37	SK	EPA 300.0/SW846 9056
pH	7.55		su	1	08/10/13 10:30	BF	SM4500HB+ -2011/9040C

---

RL = Reporting Limit

## Misc. Forms

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### Custody Documents and Other Forms

---

Includes the following where applicable:

- Chain of Custody





the self-certification process to demonstrate compliance with emission limits.  
(Reference: Regulation No. 3, Part B, Section III.E.)

#### Periodic Testing Requirements

18. **AIRS Point 001:** The operator shall sample the wastewater inlet to the pond system (or the gun barrel separator tank wastewater outlet) to determine volatile organic compounds (VOC) and hazardous air pollutant (HAP) concentrations, including total hydrocarbons (including gasoline range and diesel range), benzene, toluene, ethylbenzene, xylene, and methanol. These samples shall be analyzed using EPA Method 8260 for benzene, toluene, ethylbenzene, and xylene, and EPA Method 8015 for methanol, gasoline range organics (total volatile hydrocarbons), and diesel range organics (total extractable hydrocarbons).

A sample of the wastewater inlet to the pond system (or the gun barrel separator tank wastewater outlet) shall be collected and analyzed at a minimum frequency of once per calendar month. Sample results shall be used to calculate emissions as required by Condition 12. If more frequent sampling is conducted, then all samples of the wastewater inlet to the pond collected during the calendar month will be averaged and then used to calculate emissions as specified in Condition 12. Samples shall be collected no less than at least seven (7) days apart. The operator shall maintain records of all sampling events and the records shall be made available to the Division for inspection upon request. The operator shall flag monthly records if any sampling results are noted by the laboratory as beyond QA/QC criteria limits.

#### ADDITIONAL REQUIREMENTS

19. A revised Air Pollutant Emission Notice (APEN) shall be filed: (Reference: Regulation No. 3, Part A, II.C)
- Annually whenever a significant increase in emissions occurs as follows:

**For any criteria pollutant:**

For sources emitting less than 100 tons per year, a change in actual emissions of five (5) tons per year or more, above the level reported on the last APEN; or

**For any non-criteria reportable pollutant:**

If the emissions increase by 50% or five (5) tons per year, whichever is less, above the level reported on the last APEN submitted to the Division.

- Whenever there is a change in the owner or operator of any facility, process, or activity, or
- Whenever new control equipment is installed, or whenever a different type of control equipment replaces an existing type of control equipment; or
- Whenever a permit limitation must be modified; or
- No later than 30 days before the existing APEN expires.

20. Federal regulatory program requirements (i.e. PSD, NANSR or Title V Operating Permit) shall apply to this source at any such time that this source becomes major solely by virtue of a relaxation in any permit condition. Any relaxation that increases the potential to emit above the applicable Federal program threshold will require a full review of the

AIRS ID: 045/1741/001

Page 5 of 9

Please analyze in accordance with the highlighted sections on this and the following pages.  
Thanks, Kristin

D49205: Chain of Custody

Page 2 of 5

Form 4, within thirty (30) days of December 30, 1997. The Sundry Notice, Form 4 shall include a copy of the existing pit permit, if a permit was obtained, and a description of the closure process.

(2) Pits closed prior to December 30, 1997 were required to be reclaimed in accordance with the 1000 Series rules. Pits closed after December 30, 1997 shall be closed in accordance with the 900 Series rules and reclaimed in accordance with the 1000 Series rules.

(3) Operators of steel, fiberglass, concrete or other similar produced water vessels buried or partially buried and located in sensitive areas were required to repair or replace vessels and tanks found to be leaking. Operators shall repair or replace vessels and tanks found to be leaking. Operators shall submit to the Director a Sundry Notice, Form 4, describing the integrity testing results and action taken within thirty (30) days of December 30, 1997.

(4) Closure of pits and steel, fiberglass, concrete or other similar produced water vessels, and associated remediation operations conducted prior to December 30, 1997 are not subject to Rules 905., 906., 907., 909. and 910.

#### 912. VENTING OR FLARING NATURAL GAS

a. The unnecessary or excessive venting or flaring of natural gas produced from a well is prohibited.

b. Except for gas flared or vented during an upset condition, well maintenance, well stimulation flowback, purging operations, or a productivity test, gas from a well shall be flared or vented only after notice has been given and approval obtained from the Director on a Sundry Notice, Form 4, stating the estimated volume and content of the gas. The notice shall indicate whether the gas contains more than one (1) ppm of hydrogen sulfide. If necessary to protect the public health, safety or welfare, the Director may require the flaring of gas.

c. Gas flared, vented or used on the lease shall be estimated based on a gas-oil ratio test or other equivalent test approved by the Director, and reported on Operator's Monthly Production Report, Form 7.

d. Flared gas that is subject to Sundry Notice, Form 4, shall be directed to a controlled flare in accordance with Rule 903.b.(2) or other combustion device operated as efficiently as possible to provide maximum reduction of air contaminants where practicable and without endangering the safety of the well site personnel and the public.

e. Operators shall notify the local emergency dispatch or the local governmental designee of any natural gas flaring. Notice shall be given prior to flaring when flaring can be reasonably anticipated, or as soon as possible, but in no event more than two (2) hours after the flaring occurs.

Table 910-1  
CONCENTRATION LEVELS<sup>1</sup>

Contaminant of Concern	Concentrations
Organic Compounds in Soil	
TPH (total volatile and extractable petroleum hydrocarbons)	500 mg/kg
Benzene	0.17 mg/kg <sup>2</sup>

900-21

As of May 30, 2011

Toluene	85 mg/kg <sup>2</sup>
Ethylbenzene	100 mg/kg <sup>2</sup>
Xylenes (total)	175 mg/kg <sup>2</sup>
Acenaphthene	1,000 mg/kg <sup>2</sup>
Anthracene	1,000 mg/kg <sup>2</sup>
Benzo(A)anthracene	0.22 mg/kg <sup>2</sup>
Benzo(B)fluoranthene	0.22 mg/kg <sup>2</sup>
Benzo(K)fluoranthene	2.2 mg/kg <sup>2</sup>
Benzo(A)pyrene	0.022 mg/kg <sup>2</sup>
Chrysene	22 mg/kg <sup>2</sup>
Dibenzo(A,H)anthracene	0.022 mg/kg <sup>2</sup>
Fluoranthene	1,000 mg/kg <sup>2</sup>
Fluorene	1,000 mg/kg <sup>2</sup>
Indeno(1,2,3,C,D)pyrene	0.22 mg/kg <sup>2</sup>
Naphthalene	23 mg/kg <sup>2</sup>
Pyrene	1,000 mg/kg <sup>2</sup>
<b>Organic Compounds in Ground Water</b>	
Benzene	5 µg/l <sup>3</sup>
Toluene	560 to 1,000 µg/l <sup>3</sup>
Ethylbenzene	700 µg/l <sup>3</sup>
Xylenes (Total)	1,400 to 10,000 µg/l <sup>3,4</sup>
<b>Inorganics in Soils</b>	
Electrical Conductivity (EC)	<4 mmhos/cm or 2x background
Sodium Adsorption Ratio (SAR)	<12 <sup>5</sup>
pH	6-9
<b>Inorganics in Ground Water</b>	
Total Dissolved Solids (TDS)	<1.25 x background <sup>2</sup>
Chlorides	<1.25 x background <sup>2</sup>
Sulfates	<1.25 x background <sup>2</sup>
<b>Metals in Soils</b>	
Arsenic	0.39 mg/kg <sup>2</sup>
Barium (LDNR True Total Barium)	15,000 mg/kg <sup>2</sup>
Boron (Hot Water Soluble)	2 mg/l <sup>3</sup>
Cadmium	70 mg/kg <sup>2,6</sup>
Chromium (III)	120,000 mg/kg <sup>2</sup>
Chromium (VI)	23 mg/kg <sup>2,6</sup>
Copper	3,100 mg/kg <sup>2</sup>
Lead (inorganic)	400 mg/kg <sup>2</sup>
Mercury	23 mg/kg <sup>2</sup>
Nickel (soluble salts)	1,600 mg/kg <sup>2,8</sup>
Selenium	390 mg/kg <sup>2,9</sup>
Silver	390 mg/kg <sup>2</sup>
Zinc	23,000 mg/kg <sup>2,6</sup>
<b>Liquid Hydrocarbons in Soils and Ground Water</b>	
Liquid hydrocarbons including condensate and oil	Below detection level

COGCC recommends that the latest version of EPA SW 846 analytical methods be used where possible and that analyses of samples be performed by laboratories that maintain state or national accreditation programs.

- <sup>1</sup> Consideration shall be given to background levels in native soils and ground water.
- <sup>2</sup> Concentrations taken from CDPHE-HMWMD Table 1 Colorado Soil Evaluation Values (December 2007).
- <sup>3</sup> Concentrations taken from CDPHE-WQCC Regulation 41 - The Basic Standards for Ground Water.
- <sup>4</sup> For this range of standards, the first number in the range is a strictly health-based value, based on the WQCC's established methodology for human health-based standards. The second number in the range is a maximum contaminant level (MCL), established under the Federal Safe Drinking Water Act which has been

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As of May 30, 2011

D49205: Chain of Custody

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## Accutest Laboratories Sample Receipt Summary

**Accutest Job Number:** D49205

**Client:** MARATHON OIL

**Immediate Client Services Action Required:** No

**Date / Time Received:** 8/9/2013 9:30:00 AM

**No. Coolers:** 1

**Client Service Action Required at Login:** No

**Project:** MOC 32C MONITORING

**Airbill #'s:** FX

<b>Cooler Security</b>	<b>Y</b>	<b>or</b>	<b>N</b>		<b>Y</b>	<b>or</b>	<b>N</b>
1. Custody Seals Present:	<input checked="" type="checkbox"/>		<input type="checkbox"/>	3. COC Present:	<input checked="" type="checkbox"/>		<input type="checkbox"/>
2. Custody Seals Intact:	<input checked="" type="checkbox"/>		<input type="checkbox"/>	4. Smpl Dates/Time OK	<input checked="" type="checkbox"/>		<input type="checkbox"/>

<b>Cooler Temperature</b>	<b>Y</b>	<b>or</b>	<b>N</b>
1. Temp criteria achieved:	<input checked="" type="checkbox"/>		<input type="checkbox"/>
2. Cooler temp verification:			Infrared gun
3. Cooler media:			Ice (bag)

<b>Quality Control Preservation</b>	<b>Y</b>	<b>or</b>	<b>N</b>	<b>N/A</b>
1. Trip Blank present / cooler:	<input type="checkbox"/>		<input type="checkbox"/>	
2. Trip Blank listed on COC:	<input type="checkbox"/>		<input type="checkbox"/>	
3. Samples preserved properly:	<input checked="" type="checkbox"/>		<input type="checkbox"/>	
4. VOCs headspace free:	<input type="checkbox"/>		<input type="checkbox"/>	<input checked="" type="checkbox"/>

<b>Sample Integrity - Documentation</b>	<b>Y</b>	<b>or</b>	<b>N</b>
1. Sample labels present on bottles:	<input checked="" type="checkbox"/>		<input type="checkbox"/>
2. Container labeling complete:	<input checked="" type="checkbox"/>		<input type="checkbox"/>
3. Sample container label / COC agree:	<input checked="" type="checkbox"/>		<input type="checkbox"/>

<b>Sample Integrity - Condition</b>	<b>Y</b>	<b>or</b>	<b>N</b>
1. Sample recvd within HT:	<input checked="" type="checkbox"/>		<input type="checkbox"/>
2. All containers accounted for:	<input checked="" type="checkbox"/>		<input type="checkbox"/>
3. Condition of sample:			Intact

<b>Sample Integrity - Instructions</b>	<b>Y</b>	<b>or</b>	<b>N</b>	<b>N/A</b>
1. Analysis requested is clear:	<input checked="" type="checkbox"/>		<input type="checkbox"/>	
2. Bottles received for unspecified tests	<input type="checkbox"/>		<input checked="" type="checkbox"/>	
3. Sufficient volume rec'd for analysis:	<input checked="" type="checkbox"/>		<input type="checkbox"/>	
4. Compositing instructions clear:	<input type="checkbox"/>		<input type="checkbox"/>	<input checked="" type="checkbox"/>
5. Filtering instructions clear:	<input type="checkbox"/>		<input type="checkbox"/>	<input checked="" type="checkbox"/>

Comments

 Accutest Laboratories  
 V: (303) 425-6021

 4036 Youngfield Street  
 F: (303) 425-6854

 Wheat Ridge, CO  
 www.accutest.com

**APPENDIX C-8**  
**AUGUST 16 SAMPLE RESULTS**



09/10/13

## Technical Report for

Marathon Oil

MOC 32C Monitoring Wells

WBS#TA.13.30788.EXP

Accutest Job Number: D49509

Sampling Date: 08/16/13

Report to:

Golder Associates

rmarch@golder.com

ATTN: Randy March

Total number of pages in report: **18**



Test results contained within this data package meet the requirements of the National Environmental Laboratory Accreditation Conference and/or state specific certification programs as applicable.

A handwritten signature in black ink, appearing to read 'Scott Heideman'.

Scott Heideman  
Laboratory Director

Client Service contact: Ann Doerr 303-425-6021

Certifications: CO (CO00049), ID, NE (CO00049), ND (R-027), NJ (CO 0007), OK (D9942), UT (NELAP CO00049), TX (T104704511)

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Test results relate only to samples analyzed.



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**5.1: Chain of Custody** ..... 14



Sample Summary

Marathon Oil

Job No: D49509

MOC 32C Monitoring Wells  
Project No: WBS#TA.13.30788.EXP

Sample Number	Collected		Matrix Code	Type	Client Sample ID
	Date	Time By			
D49509-1	08/16/13	06:50 SD	08/16/13	AQ Ground Water	MW-4



## CASE NARRATIVE / CONFORMANCE SUMMARY

**Client:** Marathon Oil

**Job No** D49509

**Site:** MOC 32C Monitoring Wells

**Report Date** 8/3/2013 3:23:33 PM

On 08/16/2013, 1 sample(s), 0 Trip Blank(s), and 0 Field Blank(s) were received at Accutest Mountain States (AMS) at a temperature of 2.3 °C. The samples were intact and properly preserved, unless noted below. An AMS Job Number of D49509 was assigned to the project. The lab sample ID, client sample ID, and date of sample collection are detailed in the report's Results Summary.

Specified quality control criteria were achieved for this job except as noted below. For more information, please refer to the analytical results and QC summary pages.

### Volatiles by GCMS By Method SW846 8260B

**Matrix** AQ

**Batch ID:** V7V1218

- All samples were analyzed within the recommended method holding time.
- All method blanks for this batch meet method specific criteria.
- Sample(s) D49509-1DUP, D48562-1MS were used as the QC samples indicated.
- D48562-1MS: The pH of the sample aliquot for VOA analysis was >2 at time of analysis.
- D48562-1MS: The pH of the sample aliquot for VOA analysis was >2 at time of analysis.

### Volatiles by GC By Method SW846 8015B

**Matrix** AQ

**Batch ID:** GFA764

- All samples were analyzed within the recommended method holding time.
- Sample(s) D49509-1MS, D49509-1MSD were used as the QC samples indicated.
- All method blanks for this batch meet method specific criteria.

**Matrix** AQ

**Batch ID:** GGA1095

- All samples were analyzed within the recommended method holding time.
- Sample(s) D49715-1MS, D49715-1MSD were used as the QC samples indicated.
- All method blanks for this batch meet method specific criteria.

### Extractables by GC By Method SW846-8015B

**Matrix** AQ

**Batch ID:** OP8407

- All samples were extracted and analyzed within the recommended method holding time.
- Sample(s) D48559-17MS, D48559-17MSD were used as the QC samples indicated.
- All method blanks for this batch meet method specific criteria.

### Wet Chemistry By Method EPA 300.0/SW846 9056

**Matrix** AQ

**Batch ID:** GP10776

- All samples were prepared and analyzed within the recommended method holding time.
- All method blanks for this batch meet method specific criteria.
- Sample(s) D49345-1MS, D49345-1MSD were used as the QC samples for the Chloride, Sulfate, Chloride analysis.

### Wet Chemistry By Method SM 2540C-2011

**Matrix** AQ

**Batch ID:** GN21535

- All samples were analyzed within the recommended method holding time.
- All method blanks for this batch meet method specific criteria.
- Sample(s) D49385-1DUP were used as the QC samples for the Solids, Total Dissolved analysis.

### Wet Chemistry By Method SM 2540D-2011

**Matrix** AQ

**Batch ID:** GN21534

- All samples were analyzed within the recommended method holding time.
- All method blanks for this batch meet method specific criteria.
- Sample(s) D49309-1DUP were used as the QC samples for the Solids, Total Suspended analysis.

### Wet Chemistry By Method SM4500HB+-2011/9040C

**Matrix** AQ

**Batch ID:** GN21550

- The following samples were run outside of holding time for method SM4500HB+-2011/9040C: D49509-1

AMS certifies that data reported for samples received, listed on the associated custody chain or analytical task order, were produced to specifications meeting AMS's Quality System precision, accuracy and completeness objectives except as noted.

Estimated non-standard method measurement uncertainty data is available on request, based on quality control bias and implicit for standard methods. Acceptable uncertainty requires tested parameter quality control data to meet method criteria.

AMS is not responsible for data quality assumptions if partial reports are used and recommends that this report be used in its entirety. This report is authorized by AMS indicated via signature on the report cover.

## Summary of Hits

Page 1 of 1

**Job Number:** D49509  
**Account:** Marathon Oil  
**Project:** MOC 32C Monitoring Wells  
**Collected:** 08/16/13



Lab Sample ID	Client Sample ID	Result/ Qual	RL	MDL	Units	Method
---------------	------------------	-----------------	----	-----	-------	--------

**D49509-1**      **MW-4**

Benzene	0.0737	0.0010	0.00025	mg/l	SW846 8260B
Ethylbenzene	0.0017 J	0.0020	0.00025	mg/l	SW846 8260B
Xylene (total)	0.0139	0.0030	0.0020	mg/l	SW846 8260B
TPH-GRO (C6-C10)	0.246	0.20	0.10	mg/l	SW846 8015B
Chloride	367	10		mg/l	EPA 300.0/SW846 9056
Solids, Total Dissolved	1200	10		mg/l	SM 2540C-2011
Sulfate	110	2.5		mg/l	EPA 300.0/SW846 9056
pH	7.62			su	SM4500HB+ -2011/9040C

Sample Results

Report of Analysis

## Report of Analysis

Page 1 of 1

<b>Client Sample ID:</b>	MW-4		
<b>Lab Sample ID:</b>	D49509-1	<b>Date Sampled:</b>	08/16/13
<b>Matrix:</b>	AQ - Ground Water	<b>Date Received:</b>	08/16/13
<b>Method:</b>	SW846 8260B	<b>Percent Solids:</b>	n/a
<b>Project:</b>	MOC 32C Monitoring Wells		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	7V22135.D	1	08/20/13	JL	n/a	n/a	V7V1218
Run #2							

	Purge Volume
Run #1	5.0 ml
Run #2	

## Purgeable Aromatics

CAS No.	Compound	Result	RL	MDL	Units	Q
71-43-2	Benzene	0.0737	0.0010	0.00025	mg/l	
108-88-3	Toluene	ND	0.0020	0.0010	mg/l	
100-41-4	Ethylbenzene	0.0017	0.0020	0.00025	mg/l	J
1330-20-7	Xylene (total)	0.0139	0.0030	0.0020	mg/l	

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
17060-07-0	1,2-Dichloroethane-D4	116%		62-130%
2037-26-5	Toluene-D8	104%		70-130%
460-00-4	4-Bromofluorobenzene	95%		69-130%

ND = Not detected      MDL - Method Detection Limit  
 RL = Reporting Limit  
 E = Indicates value exceeds calibration range

J = Indicates an estimated value  
 B = Indicates analyte found in associated method blank  
 N = Indicates presumptive evidence of a compound



## Report of Analysis

Page 1 of 1

<b>Client Sample ID:</b>	MW-4	<b>Date Sampled:</b>	08/16/13
<b>Lab Sample ID:</b>	D49509-1	<b>Date Received:</b>	08/16/13
<b>Matrix:</b>	AQ - Ground Water	<b>Percent Solids:</b>	n/a
<b>Method:</b>	SW846 8015B		
<b>Project:</b>	MOC 32C Monitoring Wells		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	FA12821.D	1	08/19/13	JS	n/a	n/a	GFA764
Run #2							

	Initial Volume	Final Volume
Run #1	1.0 ml	1.0 ml
Run #2		

CAS No.	Compound	Result	RL	MDL	Units	Q
67-56-1	Methanol	ND	0.50	0.40	mg/l	

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
71-36-3	n-Butyl Alcohol	112%		25-169%

ND = Not detected      MDL - Method Detection Limit  
 RL = Reporting Limit  
 E = Indicates value exceeds calibration range

J = Indicates an estimated value  
 B = Indicates analyte found in associated method blank  
 N = Indicates presumptive evidence of a compound

## Report of Analysis

Page 1 of 1

<b>Client Sample ID:</b>	MW-4	<b>Date Sampled:</b>	08/16/13
<b>Lab Sample ID:</b>	D49509-1	<b>Date Received:</b>	08/16/13
<b>Matrix:</b>	AQ - Ground Water	<b>Percent Solids:</b>	n/a
<b>Method:</b>	SW846 8015B		
<b>Project:</b>	MOC 32C Monitoring Wells		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	GA19484.D	1	08/26/13	EV	n/a	n/a	GGA1095
Run #2							

	Purge Volume
Run #1	5.0 ml
Run #2	

CAS No.	Compound	Result	RL	MDL	Units	Q
	TPH-GRO (C6-C10)	0.246	0.20	0.10	mg/l	
CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits		
120-82-1	1,2,4-Trichlorobenzene	101%		60-140%		

ND = Not detected      MDL - Method Detection Limit  
 RL = Reporting Limit  
 E = Indicates value exceeds calibration range

J = Indicates an estimated value  
 B = Indicates analyte found in associated method blank  
 N = Indicates presumptive evidence of a compound

## Report of Analysis

Page 1 of 1

<b>Client Sample ID:</b>	MW-4	
<b>Lab Sample ID:</b>	D49509-1	<b>Date Sampled:</b> 08/16/13
<b>Matrix:</b>	AQ - Ground Water	<b>Date Received:</b> 08/16/13
<b>Method:</b>	SW846-8015B SW846 3510C	<b>Percent Solids:</b> n/a
<b>Project:</b>	MOC 32C Monitoring Wells	

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	FD27914.D	1	08/21/13	TU	08/20/13	OP8407	GFD1354
Run #2							

	Initial Volume	Final Volume
Run #1	1060 ml	1.0 ml
Run #2		

CAS No.	Compound	Result	RL	MDL	Units	Q
	TPH-DRO (C10-C28)	ND	0.19	0.17	mg/l	
CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits		
84-15-1	o-Terphenyl	86%		20-140%		

ND = Not detected      MDL - Method Detection Limit  
 RL = Reporting Limit  
 E = Indicates value exceeds calibration range

J = Indicates an estimated value  
 B = Indicates analyte found in associated method blank  
 N = Indicates presumptive evidence of a compound

## Report of Analysis

Page 1 of 1

**Client Sample ID:** MW-4  
**Lab Sample ID:** D49509-1  
**Matrix:** AQ - Ground Water  
**Project:** MOC 32C Monitoring Wells

**Date Sampled:** 08/16/13  
**Date Received:** 08/16/13  
**Percent Solids:** n/a

## General Chemistry

Analyte	Result	RL	Units	DF	Analyzed	By	Method
Chloride	367	10	mg/l	20	08/26/13 18:04	SK	EPA 300.0/SW846 9056
Solids, Total Dissolved	1200	10	mg/l	1	08/19/13	BF	SM 2540C-2011
Solids, Total Suspended	< 5.0	5.0	mg/l	1	08/19/13	JD	SM 2540D-2011
Sulfate	110	2.5	mg/l	5	08/26/13 13:25	SK	EPA 300.0/SW846 9056
pH	7.62		su	1	08/19/13 14:10	BF	SM4500HB+ -2011/9040C

---

RL = Reporting Limit

## Misc. Forms

5

### Custody Documents and Other Forms

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Includes the following where applicable:

- Chain of Custody



## CHAIN OF CUSTODY

4036 Youngfield Street, Wheat Ridge, CO 80033  
TEL: 303-425-6021 FAX: 303-425-6854  
www.accutest.com

D49509

PAGE 1 OF 1

Client / Reporting Information		Project Information										Requested Analysis (see TEST CODE sheet)										Matrix Codes									
Company Name <b>Marathon Oil</b>		Project Name: <b>MOC 32C Monitoring Wells</b>										<div>TSS TDS pH See Attached</div>										<div>DW - Drinking Water GW - Ground Water WW - Water SW - Surface Water SO - Soil SL - Sludge SED - Sediment OI - Oil LIQ - Other Liquid AIR - Air SOL - Other Solid WP - Wipe FB - Field Blank EB - Equipment Blank RB - Rinse Blank TB - Trip Blank</div>									
Street Address <b>743 Horizon Ct Suite 220</b>		Street																													
City <b>Grand Junction Co</b>		City State																													
Project Contact <b>Zach Toellner</b>		Project #																													
Phone # <b>970-260-0772</b>		Client Purchase Order #																													
Sampler(s) Name(s) <b>Scott Distel</b>		Project Manager										Attention:																			
Field ID / Point of Collection <b>MW-4</b>		MECH/DI Val #		Date <b>8/16/13</b>		Time <b>6:50</b>		SD		GW		# of bottles <b>9</b>		HCl		NaOH		HNO3		H2SO4		NONE		DI Water		MEOH		ENCODE		LAB USE ONLY	
Turnaround Time (Business days) <input checked="" type="checkbox"/> Std. 16 Business Days <input type="checkbox"/> Std. 10 Business Days <input type="checkbox"/> 8 Day RUSH <input type="checkbox"/> 3 Day Emergency <input type="checkbox"/> 2 Day Emergency <input type="checkbox"/> 1 Day Emergency		Approved By (Accutest PM): / Date:										Data Deliverable Information <input type="checkbox"/> Commercial "A" (Level 1) <input type="checkbox"/> Commercial "B" (Level 2) <input type="checkbox"/> COMMBN <input type="checkbox"/> COMMBN+ <input type="checkbox"/> State Forms Required <input type="checkbox"/> Send Forms to State <input type="checkbox"/> Report by Fax <input type="checkbox"/> Report by PDF <input checked="" type="checkbox"/> EDD Format										Comments / Special Instructions <b>Only received (1) 1L Amber</b>									
Emergency & Rush T/A data available VIA Lablink		Sample Custody must be documented below each time samples change possession, including courier delivery.																													
Relinquished by Sampler <b>Scott Distel</b>		Date/Time <b>8/16/13 8:30</b>		Received By: <b>1 Jacob Brown</b>		Date/Time <b>8/17/13 11:00</b>		Relinquished By: <b>2</b>		Date/Time:		Received By: <b>2</b>																			
Relinquished by Sampler:		Date/Time:		Received By: <b>3</b>		Date/Time:		Relinquished By: <b>4</b>		Date/Time:		Received By: <b>4</b>																			
Relinquished by:		Date/Time:		Received By: <b>5</b>		Date/Time:		Custody Seal # <b>FX</b>		<input checked="" type="checkbox"/> Intact <input type="checkbox"/> Not Intact		Preserved where applicable <b>8</b>		On Ice <input type="checkbox"/>		Cooler Temp. <b>2.3</b>															

D49509: Chain of Custody

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Scan with

the self-certification process to demonstrate compliance with emission limits.  
(Reference: Regulation No. 3, Part B, Section III.E.)

#### Periodic Testing Requirements

18. **AIRS Point 001:** The operator shall sample the wastewater inlet to the pond system (or the gun barrel separator tank wastewater outlet) to determine volatile organic compounds (VOC) and hazardous air pollutant (HAP) concentrations, including total hydrocarbons (including gasoline range and diesel range), benzene, toluene, ethylbenzene, xylene, and methanol. These samples shall be analyzed using EPA Method 8260 for benzene, toluene, ethylbenzene, and xylene, and EPA Method 8015 for methanol, gasoline range organics (total volatile hydrocarbons), and diesel range organics (total extractable hydrocarbons).

A sample of the wastewater inlet to the pond system (or the gun barrel separator tank wastewater outlet) shall be collected and analyzed at a minimum frequency of once per calendar month. Sample results shall be used to calculate emissions as required by Condition 12. If more frequent sampling is conducted, then all samples of the wastewater inlet to the pond collected during the calendar month will be averaged and then used to calculate emissions as specified in Condition 12. Samples shall be collected no less than at least seven (7) days apart. The operator shall maintain records of all sampling events and the records shall be made available to the Division for inspection upon request. The operator shall flag monthly records if any sampling results are noted by the laboratory as beyond QA/QC criteria limits.

#### ADDITIONAL REQUIREMENTS

19. A revised Air Pollutant Emission Notice (APEN) shall be filed: (Reference: Regulation No. 3, Part A, II.C)
- Annually whenever a significant increase in emissions occurs as follows:

##### **For any criteria pollutant:**

For sources emitting less than 100 tons per year, a change in actual emissions of five (5) tons per year or more, above the level reported on the last APEN; or

##### **For any non-criteria reportable pollutant:**

If the emissions increase by 50% or five (5) tons per year, whichever is less, above the level reported on the last APEN submitted to the Division.

- Whenever there is a change in the owner or operator of any facility, process, or activity, or
- Whenever new control equipment is installed, or whenever a different type of control equipment replaces an existing type of control equipment; or
- Whenever a permit limitation must be modified; or
- No later than 30 days before the existing APEN expires.

20. Federal regulatory program requirements (i.e. PSD, NANSR or Title V Operating Permit) shall apply to this source at any such time that this source becomes major solely by virtue of a relaxation in any permit condition. Any relaxation that increases the potential to emit above the applicable Federal program threshold will require a full review of the

Please analyze in accordance with the highlighted sections on this and the following pages.  
Thank you, *John Deere*

AIRS ID: 045/1741/001

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D49509: Chain of Custody

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Form 4, within thirty (30) days of December 30, 1997. The Sundry Notice, Form 4 shall include a copy of the existing pit permit, if a permit was obtained, and a description of the closure process.

(2) Pits closed prior to December 30, 1997 were required to be reclaimed in accordance with the 1000 Series rules. Pits closed after December 30, 1997 shall be closed in accordance with the 900 Series rules and reclaimed in accordance with the 1000 Series rules.

(3) Operators of steel, fiberglass, concrete or other similar produced water vessels buried or partially buried and located in sensitive areas were required to repair or replace vessels and tanks found to be leaking. Operators shall repair or replace vessels and tanks found to be leaking. Operators shall submit to the Director a Sundry Notice, Form 4, describing the integrity testing results and action taken within thirty (30) days of December 30, 1997.

(4) Closure of pits and steel, fiberglass, concrete or other similar produced water vessels, and associated remediation operations conducted prior to December 30, 1997 are not subject to Rules 905., 906., 907., 909. and 910.

#### 912. VENTING OR FLARING NATURAL GAS

a. The unnecessary or excessive venting or flaring of natural gas produced from a well is prohibited.

b. Except for gas flared or vented during an upset condition, well maintenance, well stimulation flowback, purging operations, or a productivity test, gas from a well shall be flared or vented only after notice has been given and approval obtained from the Director on a Sundry Notice, Form 4, stating the estimated volume and content of the gas. The notice shall indicate whether the gas contains more than one (1) ppm of hydrogen sulfide. If necessary to protect the public health, safety or welfare, the Director may require the flaring of gas.

c. Gas flared, vented or used on the lease shall be estimated based on a gas-oil ratio test or other equivalent test approved by the Director, and reported on Operator's Monthly Production Report, Form 7.

d. Flared gas that is subject to Sundry Notice, Form 4, shall be directed to a controlled flare in accordance with Rule 903.b.(2) or other combustion device operated as efficiently as possible to provide maximum reduction of air contaminants where practicable and without endangering the safety of the well site personnel and the public.

e. Operators shall notify the local emergency dispatch or the local governmental designee of any natural gas flaring. Notice shall be given prior to flaring when flaring can be reasonably anticipated, or as soon as possible, but in no event more than two (2) hours after the flaring occurs.

Table 910-1  
CONCENTRATION LEVELS<sup>1</sup>

Contaminant of Concern	Concentrations
Organic Compounds in Soil	
TPH (total volatile and extractable petroleum hydrocarbons)	500 mg/kg
Benzene	0.17 mg/kg <sup>2</sup>

900-21

As of May 30, 2011

Toluene	85 mg/kg <sup>2</sup>
Ethylbenzene	100 mg/kg <sup>2</sup>
Xylenes (total)	175 mg/kg <sup>2</sup>
Acenaphthene	1,000 mg/kg <sup>2</sup>
Anthracene	1,000 mg/kg <sup>2</sup>
Benzo(A)anthracene	0.22 mg/kg <sup>2</sup>
Benzo(B)fluoranthene	0.22 mg/kg <sup>2</sup>
Benzo(K)fluoranthene	2.2 mg/kg <sup>2</sup>
Benzo(A)pyrene	0.022 mg/kg <sup>2</sup>
Chrysene	22 mg/kg <sup>2</sup>
Dibenzo(A,H)anthracene	0.022 mg/kg <sup>2</sup>
Fluoranthene	1,000 mg/kg <sup>2</sup>
Fluorene	1,000 mg/kg <sup>2</sup>
Indeno(1,2,3-C,D)pyrene	0.22 mg/kg <sup>2</sup>
Naphthalene	23 mg/kg <sup>2</sup>
Pyrene	1,000 mg/kg <sup>2</sup>
<b>Organic Compounds in Ground Water</b>	
Benzene	5 µg/l <sup>3</sup>
Toluene	560 to 1,000 µg/l <sup>3</sup>
Ethylbenzene	700 µg/l <sup>3</sup>
Xylenes (Total)	1,400 to 10,000 µg/l <sup>3,4</sup>
<b>Inorganics in Soils</b>	
Electrical Conductivity (EC)	<4 mmhos/cm or 2x background
Sodium Adsorption Ratio (SAR)	<12 <sup>5</sup>
pH	6-9
<b>Inorganics in Ground Water</b>	
Total Dissolved Solids (TDS)	<1.25 x background <sup>3</sup>
Chlorides	<1.25 x background <sup>3</sup>
Sulfates	<1.25 x background <sup>3</sup>
<b>Metals in Soils</b>	
Arsenic	0.39 mg/kg <sup>2</sup>
Barium (LDNR True Total Barium)	15,000 mg/kg <sup>2</sup>
Boron (Hot Water Soluble)	2 mg/l <sup>3</sup>
Cadmium	70 mg/kg <sup>3,5</sup>
Chromium (III)	120,000 mg/kg <sup>2</sup>
Chromium (VI)	23 mg/kg <sup>2</sup>
Copper	3,100 mg/kg <sup>2</sup>
Lead (inorganic)	400 mg/kg <sup>2</sup>
Mercury	23 mg/kg <sup>2</sup>
Nickel (soluble salts)	1,600 mg/kg <sup>2,6</sup>
Selenium	390 mg/kg <sup>2,6</sup>
Silver	390 mg/kg <sup>2</sup>
Zinc	23,000 mg/kg <sup>2,6</sup>
<b>Liquid Hydrocarbons in Soils and Ground Water</b>	
Liquid hydrocarbons including condensate and oil	Below detection level

COGCC recommends that the latest version of EPA SW 846 analytical methods be used where possible and that analyses of samples be performed by laboratories that maintain state or national accreditation programs.

- <sup>1</sup> Consideration shall be given to background levels in native soils and ground water
- <sup>2</sup> Concentrations taken from CDPHE-HMMMD Table 1 Colorado Soil Evaluation Values (December 2007).
- <sup>3</sup> Concentrations taken from CDPHE-WQCC Regulation 41 - The Basic Standards for Ground Water.
- <sup>4</sup> For this range of standards, the first number in the range is a strictly health-based value, based on the WQCC's established methodology for human health-based standards. The second number in the range is a maximum contaminant level (MCL), established under the Federal Safe Drinking Water Act which has been

# Accutest Laboratories Sample Receipt Summary

Accutest Job Number: D49509

Client: MARATHON OIL

Immediate Client Services Action Required: No

Date / Time Received: 8/16/2013 11:00:00 AM

No. Coolers: 1

Client Service Action Required at Login: No

Project: MOC 32C MONITORING WELLS

Airbill #'s: Fedex

Cooler Security	Y	or	N		Y	or	N
1. Custody Seals Present:	<input checked="" type="checkbox"/>		<input type="checkbox"/>	3. COC Present:	<input checked="" type="checkbox"/>		<input type="checkbox"/>
2. Custody Seals Intact:	<input checked="" type="checkbox"/>		<input type="checkbox"/>	4. Smpl Dates/Time OK	<input checked="" type="checkbox"/>		<input type="checkbox"/>

Cooler Temperature	Y	or	N
1. Temp criteria achieved:	<input checked="" type="checkbox"/>		<input type="checkbox"/>
2. Cooler temp verification:			Infrared gun
3. Cooler media:			Ice (bag)

Quality Control Preservation	Y	or	N	N/A
1. Trip Blank present / cooler:	<input type="checkbox"/>		<input type="checkbox"/>	
2. Trip Blank listed on COC:	<input type="checkbox"/>		<input type="checkbox"/>	
3. Samples preserved properly:	<input checked="" type="checkbox"/>		<input type="checkbox"/>	
4. VOCs headspace free:	<input checked="" type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>

Sample Integrity - Documentation	Y	or	N
1. Sample labels present on bottles:	<input checked="" type="checkbox"/>		<input type="checkbox"/>
2. Container labeling complete:	<input checked="" type="checkbox"/>		<input type="checkbox"/>
3. Sample container label / COC agree:	<input checked="" type="checkbox"/>		<input type="checkbox"/>

Sample Integrity - Condition	Y	or	N
1. Sample recvd within HT:	<input checked="" type="checkbox"/>		<input type="checkbox"/>
2. All containers accounted for:	<input checked="" type="checkbox"/>		<input type="checkbox"/>
3. Condition of sample:			Intact

Sample Integrity - Instructions	Y	or	N	N/A
1. Analysis requested is clear:	<input checked="" type="checkbox"/>		<input type="checkbox"/>	
2. Bottles received for unspecified tests	<input type="checkbox"/>		<input checked="" type="checkbox"/>	
3. Sufficient volume rec'd for analysis:	<input checked="" type="checkbox"/>		<input type="checkbox"/>	
4. Compositing instructions clear:	<input type="checkbox"/>		<input type="checkbox"/>	<input checked="" type="checkbox"/>
5. Filtering instructions clear:	<input type="checkbox"/>		<input type="checkbox"/>	<input checked="" type="checkbox"/>

Comments

Accutest Laboratories  
V:(303) 425-6021

4036 Youngfield Street  
F: (303) 425-6854

Wheat Ridge, CO  
www.accutest.com

**APPENDIX D**  
**CONTAMINANT TRANSPORT EVALUATIONS**

## CONTAMINANT TRANSPORT EVALUATIONS

Contaminant transport evaluations were performed using the American Petroleum Institute (API) AMIGO online decision support tool<sup>1</sup>. AMIGO allows users to estimate the concentrations in groundwater and soil resulting from a produced water (brine) release. The produced water impacts on groundwater are simulated as one-dimensional vertical flow through the unsaturated zone (vadose zone) and one-dimensional mixing in the saturated zone beneath the water table.

A simplified schematic of the produced water migration pathway from the 32C pond subgrade to monitoring well MW-4 is provided as Figure D-1. Although the migration pathway is shown as vertical in the vadose zone and horizontal in the saturated zone, it is understood that produced water migration through the fractured bedrock is largely controlled by the fracture systems present and not by primary porosity, and that these fractures influence the actual groundwater flow directions. Basic assumptions inherent in the model<sup>2</sup> are:

- Flow in the vadose zone is one-dimensional downward and flow in the aquifer is one-dimensional and horizontal;
- Attenuation in the vadose zone is neglected because a conservative analyte (chloride or TDS) is being modeled;
- Groundwater flow is steady and the aquifer thickness and hydraulic properties are uniform;
- Density effects on brine flow are neglected; and
- Mixing throughout the aquifer depth is uniform and immediate.

The currently-available version of AMIGO uses a library of HYDRUS-1D unsaturated flow model results from southeastern New Mexico and a simple groundwater mixing model to estimate chloride concentrations in the vadose zone and in an underlying aquifer below the water table. Also, a complementary Microsoft Excel™ spreadsheet for AMIGO, known as MASSLOAD, was used to calculate the chloride loading rate per unit area. Since total dissolved solids (TDS) data are available for the site, and because TDS and chloride would behave similarly, TDS data were used in the place of chloride data for these contaminant transport evaluations.

Contaminant transport evaluations summarized in Section 3.2.2 are based on the following assumptions about TDS concentrations and hydraulic characteristics at the site.

- Produced water release TDS concentration of 10,800 milligrams per liter (mg/L) based on April 12, 2013 analytical results for the 32C leak detection system;

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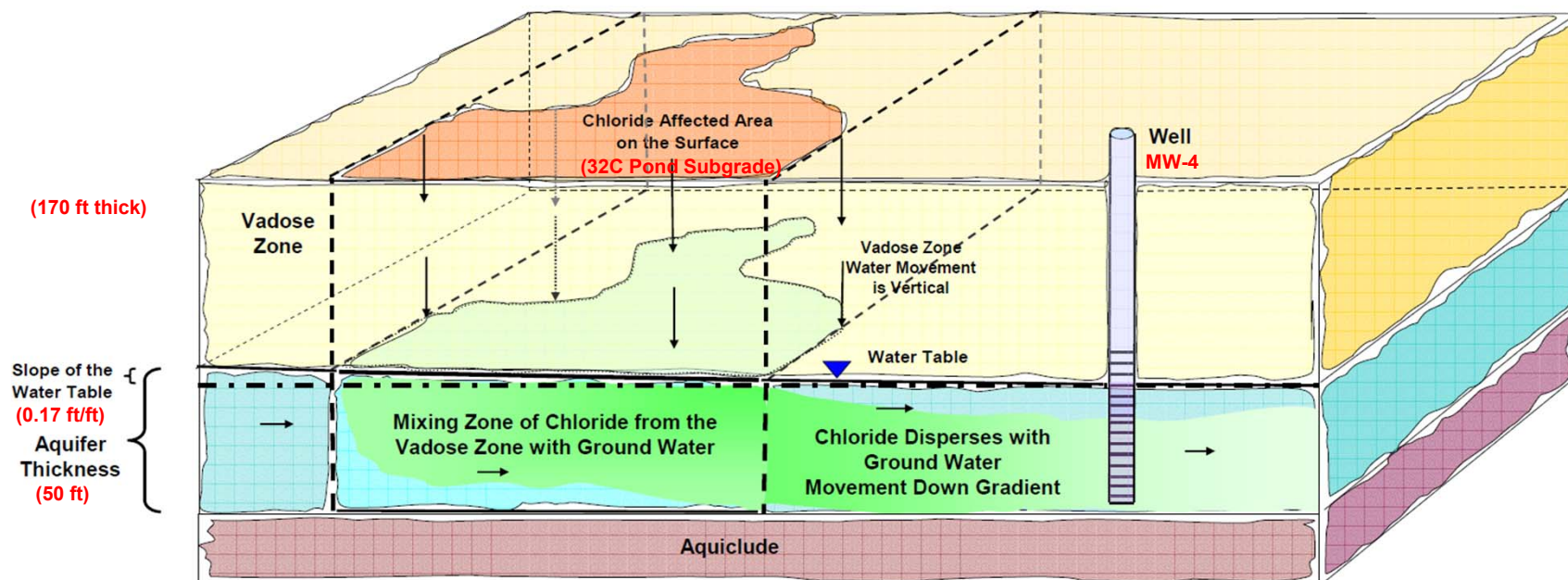
<sup>1</sup> <http://www.api.org/environment-health-and-safety/clean-water/surface-water-quality/api-amigo-online-decision-support-tool>

<sup>2</sup> API, 2005. *Modeling Study of Produced Water Release Scenarios*, API Publication Number 4734, January 2005.

- Background TDS concentration of 426 mg/L at up-gradient well MW-1 (July 9, 2013 sample);
- TDS concentration of 1,550 mg/L at down-gradient well MW-4 (July 10, 2013 sample);
- Site-vicinity hydraulic gradient of 0.17;
- Fractured bedrock hydraulic conductivity of 0.2 feet/day;
- Fractured bedrock porosity of 0.01;
- The 170-foot thick fractured bedrock unsaturated zone was represented by an equivalent porous medium (sand) vadose zone thickness of 20 feet; and
- The saturated thickness in the fractured bedrock aquifer affected by the produced water release was assumed to be 50 feet.

**FIGURE**





**Chloride Mass Entering Ground Water Depends Upon:**

- 1) Chloride Concentration within the Affected Area
- 2) Size of the Affected Area
- 3) Flux Through the Vadose Zone

**Chloride Concentration in a Well Depends Upon:**

- 1) Chloride Flux from the Vadose Zone to Ground Water
- 2) Ground Water Flux
- 3) Aquifer Thickness
- 4) Aquifer Dispersion Properties
- 5) Distance of the Well from the Down Gradient Edge of the Affected Area

reference: <http://amigo-app.api.org/amigo.pdf>

**(Site-specific values are noted in red)**

**Figure D-1**  
**Simplified Schematic of Contaminant Transport**

Marathon Oil Company  
596-32C Produced Water Pond

Denver, Colorado, USA

9/20/2013

**Golder Associates**