REPSG
React Environmental
Professional Services Group, Inc.

March 31, 2021

Maryland Department of the Environment
1800 Washington Blvd.
Baltimore MD 21230
Attention: Ms. Lindley Campbell, Case Manager

RE: Response to MDE Notice of Violation
Calvert Citgo
2802 North East Road (Harrison Residence)
2794 North East Road (O'Brien Residence)
North East, Maryland 21901
Facility No. 5678
REPSG Project Reference No. 005977.130

Dear Ms. Campbell,

Country Stores, Inc. and the Patel's are in receipt of the MDE's Notice of Violation letter dated January 27, 2021 for the aforementioned Site. This response indicates Country Stores, Inc. and the Patels intent to comply with the requirements set forth in the letter. Specifically, this response addresses the following requirements indicated in the MDE Notice of Violation:

- The dual-phase extraction (DPE) system at the Site must be adjusted to ensure continuous year-round operation.

- Treatment system upgrades must be made for the potable water supplies at two off-site properties (2794 and 2802 North East Road) for the remediation of tertiary-butyl alcohol (TBA). Submission of proposed remedy for the drinking water treatment systems is due to MDE by March 31, 2021.

Ensuring Continuous Operation of On-Site DPE System

During the third quarter 2020 reporting period, updates were completed to the DPE system to allow discharging to the surface in accordance with the approved NPDES permit. A liquid-phase carbon filtration system as well as a vapor-phase carbon filtration

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system were installed to treat extracted media prior to discharge. Prior to these upgrades, extracted groundwater was collected in an aboveground frac tank pending disposal. The freezing of this above-ground component has historically been the most significant cause of winter downtime of the system. As the recent system upgrades have eliminated the need for frac tank storage, REPSG does not foresee similar winter downtime issues in the future. The inactive frac tank was removed from the Site on January 19, 2021.

DPE system downtime during the fourth quarter 2020 and first quarter 2021 reporting periods has primarily been due to faulty/damaged system components requiring replacement. Most recently, in January 2020, during regular system maintenance it was observed that the knockout tank had become worn through and needed replacing. A replacement tank was installed on March 11, 2021 and the system has been fully operational since this time.

Lastly, in the past the DPE system has been more intermittently shut down due to power outages which required a manual restart of the system. REPSG is currently in the process of installing a new remote monitoring system which will allow greater functionality from a remote location, including restarting the system as needed.

Proposal for Increased TBA Remediation at Off-Site Residences

Objectives

The goal of the proposed measures is to resolve the issue of elevated TBA contamination in the potable water wells at the two adjacent residential properties to the east of the Site. The approved Corrective Action Plan (CAP) shares this objective; however, under the approved CAP relief to the residents of these properties via a combination of source area remediation and natural attenuation resulting in a viable water source returning to these two (2) existing wells may still be several years away.

The measures proposed below acknowledge that the current remediation of off-Site drinking water has not sufficiently affected TBA concentrations. While there is not an established maximum contaminant level (MCL) for TBA, REPSG acknowledges that the persistent elevated concentrations of TBA in the post-filtration samples at the off-Site residences is an issue of primary importance and that additional, immediate action is warranted. As such, initial remedial action will consist of increased changeout of carbon filtration units. Additional details on the efficacy of the carbon filtration systems are provided below. Concurrent to the initial remedial action, REPSG is exploring three additional proposed remedial activities presented below in order to achieve this objective.

Initial Response (Option 1). Increased Carbon Filtration Unit Changeout Frequency

The current remedial strategy in effect at the off-Site residences includes a Granular Carbon Filtration (GAC) system. At each residence, withdrawn groundwater is filtered through four (4) tanks of granular carbon. REPSG collects a total of four (4) drinking water samples from each system, as follows:

- Off-Site, 2794 North East Road (O'Brien Residence)
  - DW-004C: Pre-Carbon Filtration
  - DW-004I: Mid-Carbon Filtration 1
  - DW-004J: Mid-Carbon Filtration 2
  - DW-004K: Post-Carbon Filtration

- Off-Site, 2802 North East Road (Harrison Residence)
  - DW-005A: Pre-Carbon Filtration
  - DW-005I: Mid-Carbon Filtration 1
  - DW-005J: Mid-Carbon Filtration 2
  - DW-005K: Post-Carbon Filtration

Recent analytical results, those from the last eight rounds of monthly drinking water sampling for these off-Site residences, show a moderate reduction of mean TBA concentrations between the pre-carbon filtration samples and the post-carbon filtration samples, as displayed in **Table 1**.

Table 1. Mean Pre- and Post-Filtration TBA Concentrations (3Q20-1Q21)

	2794 North East Road			2802 North East Road		
Dataset Period	DW-004C Mean TBA (µg /L)	DW-004K Mean TBA (µg /L)	TBA Concentration Reduction	DW-005A Mean TBA (µg /L)	DW-005K Mean TBA (µg /L)	TBA Concentration Reduction
3Q20-1Q21	3,526.25	2,663.67	25.3%	754.25	680.00	9.8%

The effective reduction of TBA concentrations by the GAC system is significantly greater immediately following the rotation/replacement of the granular carbon units. **Table 2** below shows the TBA results in the post-filtration samples at each residence as collected during monthly sampling events immediately preceding and succeeding the carbon unit changeout. REPSG currently replaces and rotates the granular carbon units on an annual basis. Effective immediately the GAC units will be replaced quarterly. The most recent change out was July 2020. The next changeout is scheduled for April 22-23, 2021.

REPSG is reviewing upgrades to the GAC system which would allow for less frequent changeouts while maintaining efficacy.

Table 2. TBA Concentrations Relative to Carbon Changeouts (2015-2020)

	2794 North East Road			2802 North East Road		
Carbon Changeout Date	DW-004K TBA Pre-Changeout (µg /L)	DW-004K TBA Post-Changeout (µg /L)	TBA Concentration Reduction	DW-005K TBA Pre-Changeout (µg /L)	DW-005K TBA Post-Changeout (µg /L)	TBA Concentration Reduction
Sept 2015	4,830	5,220	-8.1 %	43.6	10.8	75.2 %
Sept 2016	5,420	10.9	99.8 %	2,020	707	65.0 %
May 2017	4,590	13.5	99.7 %	422	372	11.8 %
June 2018	3,590	257	92.8 %	152	5.6	96.3 %
April 2019	4,230	19	99.6 %	395	483	-22.3 %
July 2020	2,300	122	94.7 %	907	70.6	92.2 %

Option 2. Ozone/Ultraviolet Light Treatment

TBA has been documented to oxidize rapidly when subjected to ozone gas dosage and incident ultraviolet (UV) light intensity[1]. For gasoline constituents like TBA, the remediation efficiency for a combined ozone/UV process has been demonstrated to be significantly higher than the efficiency for ozonation-only treatment[2].

REPSG has previously proposed a combined ozone/UV process for treatment of the off-Site residences drinking water wells. On August 23, 2016, REPSG conducted an ozone treatability in-lab bench-scale study at the 2794 North East Road residence. As per email correspondence between REPSG and the MDE on August 1, 2016, this in-lab bench scale study was conducted in order to make sure that the planned field-based pilot-test ozone treatment study would be appropriately calibrated, allowing for a more effective pilot-test and subsequent full-scale system installation. The results of this in-lab treatability study indicated that a combination of ozone and ultraviolet oxidation would be a viable remedial method for addressing ongoing TBA concentrations.

Based on the results of this bench-scale study, an in-field pilot test for this system was conducted at the 2794 North East Road residence by REPSG and contractor Remediation Equipment & Services ('RES,' Royersford, PA) on May 29-31, 2018. As documented in MDE correspondence, the results of this pilot test were not encouraging enough to justify enacting this remedial strategy at the residences at this time.

[1] Garoma, Temesgen, and Gurol, Mirat D., 'Degradation of tert-Butyl Alcohol in Dilute Aqueous Solution by an O3/UV Process," Eviron. Sci. Technol., 38 (19), pp 5246-52152, DOI: 10.1021/es0353210, 2004.
[2] Garoma, Temesgen, Gurol, Mirat D., et al., 'Treatment of Groundwater Contaminated with Gasoline Components by an Ozone/UV Process,' Chemosphere vol. 73 (5), pp. 825-831, October 2008.

As the combination of ozone and UV light remediation of site-specific TBA conditions has proven successful in the previous laboratory bench-scale study, REPSG is evaluating the value in revisiting this remedial strategy and conducting new field pilot tests at both residences to re-evaluate the applicability of this methodology to either one or both of the residences. Any new field pilot test to be conducted would use updated, proprietary test methodologies. These methodology improvements would distinguish any new field pilot test and its results from the one conducted in May 2018.

The benefits of this remedial option, which would consist of installation of small-footprint equipment in the basements of the off-Site residences, include its limited visual and auditory invasiveness to the residents, less power consumption when compared to Option 3, and its potential to entirely replace the existing GAC system depending on its efficacy. REPSG recognizes this option has a potentially viable alternative to the currently enacted measures, but it requires additional research to determine its efficacy for TBA remediation.

Option 3. Air Stripper Treatment

Stacked tray air strippers can be used in groundwater treatment to remove volatile organic compounds (VOCs). Impacted groundwater is fed into the top of the system and flows downward through a set of trays. VOC removal occurs as forced air draft flows counter-current with water in each tray, forming a froth with a large mass transfer surface area where the contaminants are volatilized.

Air stripper water treatment efficiency depends on contact time and air/water ratio. REPSG is working with RES to run modelling software to preliminarily assess the expected efficacy of this option on the current concentrations of TBA at the 2794 North East Road residence[3]. Assuming a stripper air flow of 140 cfm and an air to water ratio of 104.7, a four-tray out air stripper system may reasonably be expected to remediate influent exhibiting MTBE at 500 µg/L and TBA at 4,000 µg/L to produce effluent exhibiting MTBE at 73 µg/L and TBA at 3,885.8 µg/L. The modeled efficacy of the air stripper system suggests significant results for MTBE remediation but only marginal improvements over current levels of TBA at the 2794 North East Road residence. These modeled results are corroborated by studies which have shown air stripping to be less effective in remediating TBA than BTEX compounds[4].

Additionally, the air stripping system would occupy a significant footprint at the subject properties, as the proposed system would consist of an approximately 30-inch diameter, 4-

[3] QED Environmental Systems, "QED Air Stripper Model API," Version 1.0.
[4] The Interstate Technology & Regulatory Council, MTBE and Other Fuel Oxygenates Team, 'Overview of Groundwater Remediation Technologies for MTBE and TBA,' February 2005.

foot high tray stripper system, a blower unit, a power supply, and a shed to house these features, all installed at the current drinking water well location. While the air stripper treatment system may outperform its preliminary modelling with proper site-specific specifications and may have the potential to replace the existing GAC system depending on its efficacy, the additional system would incur additional visual and auditory invasiveness to the residents. REPSG recognizes this option has a potentially viable alternative to the currently enacted measures, but it requires additional research to determine its efficacy for TBA remediation at these locations.

Option 4. Installation of Replacement Drinking Water Wells

In the February 2014 Proposed Interim Remedial Measures (PIRM) letter and the November 2014 Revised Scope of Work submitted by REPSG to the MDE, REPSG recommended that if the results of the evaluation of drinking water well DW-005 indicated that viable drinking water wells with alternate open depth ranges from those currently in use could be installed to replace those same wells at the two off-Site residents of concern, that a deep zone monitoring well be installed within the front yard of the residence located at 2794 North East Road, and assessed for viability prior to conversion to a new drinking water well.

In April 2015, REPSG conducted packer testing and discrete interval sampling on the residential water well located at 2802 North East Road (DW-005) which was installed by others in March 2006 to a total depth of 250 fbg, with an open borehole between 87-250 fbg. The discrete intervals upon which pumping yield tests were run and analytical samples were collected during this event were: 186-196 fbg, 209-219 fbg, 115-247 fbg, 0-115 fbg. The analytical results of the packer zone testing, when combined with the results of the concurrent downhole geophysical evaluation results indicate that it is not clear there existed a distinct water bearing zone within the 0-250 foot depth range which would provide the combination of water quality and water yield to serve as a replacement drinking water supply well. Therefore, the installation of a new deep zone replacement drinking water well at the residence with a more limited open depth system was determined at the time to likely not be sufficient in providing immediate relief to the residents via the supply of a clean, viable drinking water source.

It should be noted that while the March 2015 packer testing identified MTBE impacts at all of the tested intervals, the concentrations of MTBE and TBA were lower in the 115-247 fbg interval than in the 0-115 fbg interval, as shown in **Table 3** below. Furthermore, both of these intervals exhibited a similar sustainable yield (approximately 4 gpm) during the pumping test which purged at least one full well volume. As shown in the enclosed cross-section, the 115-247 fbg interval does not bisect the shallow moderate-yield water-bearing zones in the unconsolidated aquifer located at 18-25 fbg and 90-115 fbg; rather the 115-247 fbg interval bisects a fractured zone of the schist bedrock aquifer at 120-134 fbg as well as a low-yield water-bearing zone at 200-230 fbg.

Table 3: Compounds with Detectable Concentrations in Packer Testing Sample Zones (March 2015)

	Sample Name	*DW-005:0-115*	*DW-005:115-247*	*DW-005:186-196*	*DW-005:209-219*
	Depth Range (fbg)	*0-115*	*115-247*	*186-196*	*209-219*
Compound	**EPA Drinking Water Standard (ug/L)**	***Results Concentration (ug/L)***			
1,2-Dichloroethane	5	1.2	ND	0.79J	0.5J
Acetone	**	ND	ND	4.3J	ND
Bromodichloromethane	**	ND	0.36J	0.52J	1.1
Chloroform	**	ND	4	1.5	5.1
Diesel Range Organics (DRO)	**	37J	44J	830	330
Gasoline Range Organics (GRO)	**	142	39.4J	77.5J	51.1J
Isopropyl Ether	**	1.4	ND	0.26J	ND
Methyl bromide	**	0.44J	ND	0.43J	0.51J
Methyl tert-butyl ether	20	**195**	**26.7**	**28.1**	**38.6**
Tert-Amyl alcohol	**	19.9	ND	ND	ND
Tert-Amyl Methyl Ether	**	2	0.33J	0.32J	0.38J
tert-Butylalcohol	**	165	20.7	30.9	91.2
Toluene	1000	0.75J	1.8	1.7	1.2

Exceedances of the regulatory standard are printed in **bold**; "J" values denote an estimated value between the MDL and the practical quantitation limit (PQL). "ND" denotes compounds not detectable above the MDL.

If the water wells at both off-Site residences could be successfully and permanently replaced such that extracted groundwater exhibits no impacts above the applicable MDE MCLs, additional remediation at these residences would not be necessary. While the results of the March 2015 packer testing do not suggest that new water wells installed within the currently screened depth could permanently resolve the issue of these contaminated drinking water wells, the results do suggest that installing a bedrock aquifer well which completely cases off the unconsolidated aquifer may result in lower concentrations of contaminants of concern in withdrawn groundwater, which may negate the need for additional TBA remediation at these residences. REPSG recognizes this option has a potentially viable alternative to the currently enacted measures, but it requires additional research to determine its efficacy for TBA remediation.

If this option were enacted and during the installation of these wells, a new, deeper, water-bearing zone were encountered, packer testing should again be conducted to determine its productivity and suitability as a clean, viable drinking water source. In the case that such a source is identified, REPSG would suggest the remediating parties and

MDE meet to re-evaluate the objectives, scope, and requirements of the on-Site remediation activities defined by the approved CAP.

Conclusions

Upgrades to the on-Site dual phase extraction system undertaken in the winter of 2020-2021 are anticipated to eliminate unauthorized system down time as requested by MDE. Future reporting will document the results of the continued remediation of on-Site groundwater.

As of the date of this letter, REPSG will initiate immediate remedial action in the form of increased frequency of GAC changeout at the off-Site residences. REPSG is in the process exploring the costs and benefits of the above-presented TBA remediation options with its remediation and drilling contractors.

It is REPSG's professional opinion that any option be enacted on its own initially and that the success rate of the additional remediation measure should be evaluated prior to incorporating other options. Evaluation metrics for the success rate of the selected option(s) will include continued drinking water sampling and analysis for contaminants of concern on a monthly basis. This remedial strategy will allow for the system to be adjusted in a more effective and cost-efficient manner. This will ensure that the clean-up strategy at the off-Site residences will be the most effective for the protection of human health and will optimize remedial design, making any adjustments, based on real time data. It will also ensure that the available project funds are not exhausted on an ineffective method.

If you have any questions or concerns, please do not hesitate to contact our offices at 215-729-3220.

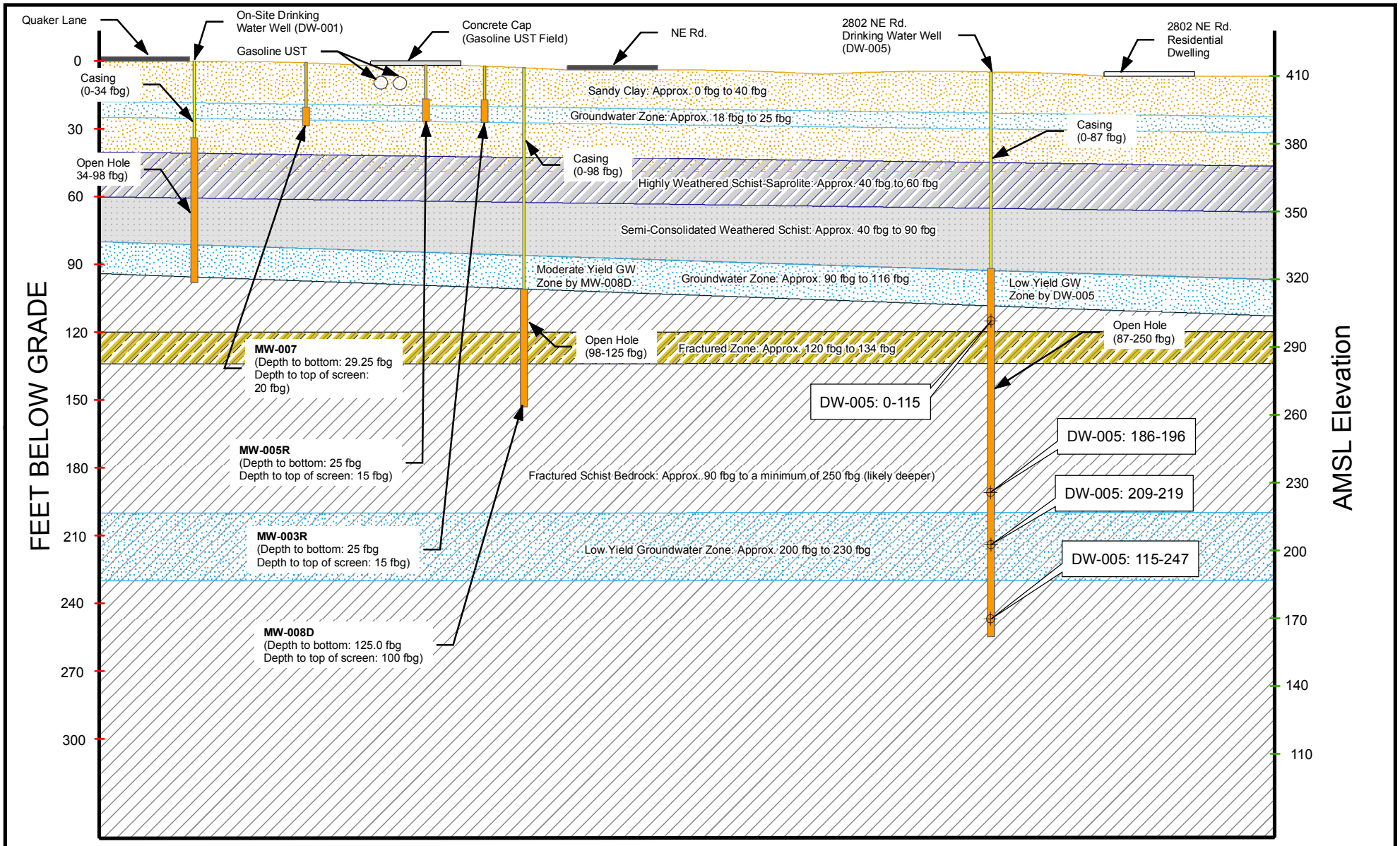
Sincerely,

John Filoon
Project Manager

James Manuel
Senior Project Manager

React Environmental Professional Services Group, Inc.

Cc: Susan Bull, Eastern Region Supervisor, MDE
Andrew Miller, Chief, MDE
Christopher H. Ralston, Program Administrator, MDE
Prag Patel, Calvert Citgo
Country Stores, Inc.
John O'Brien, Property Owner, 2794 North East Road
Roudie Harrison, Property Owner, 2802 North East Road
Thomas V. McCarron, Esquire (Semmes, Bowen & Semmens)
Robert Valliant Jones, Esquire (Law Offices of Robert Valliant Jones)
Ed Arellano, Acting Director of Env. Health, Cecil County Health Dept.



Soil and Groundwater Cross-Sectional Diagram

⌖ Packer Test Samples April 2015

REPSG
React Environmental Professional Services Group, Inc.

MAP SCALE: 1 inch = 60 feet

0 12.5 25 50 75 100 Feet

PROJECT NAME: ***CALVERT CITGO***
PROJECT ADDRESS: ***2815 NORTH EAST ROAD, NORTH EAST, MD***
PROJECT NUMBER: ***005977***
DATE: ***June 2015***

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