Groundwater
& Environmental Services, Inc.

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May 22, 2013

Mr. Jim Richmond
Oil Control Program
Maryland Department of the Environment
1800 Washington Blvd, Suite 620
Baltimore, Maryland 21230

RE: **REQUEST TO REVISE THE MONITORING WELL SAMPLING PLAN**
Monrovia BP/Former Green Valley Citgo
11791 Fingerboard Road
Monrovia, Maryland
OCP Case #2005-0834-FR

Dear Mr. Richmond:

Groundwater & Environmental Services, Inc. (GES) is writing on behalf of the Carroll Independent Fuel Company (Carroll) relative to the referenced case. This letter provides an assessment of the dissolved sampling program at the Monrovia BP/Former Green Valley Citgo station (Site) referenced above.

GES applied the Monitoring and Remediation Optimization System (MAROS) software to evaluate the efficacy of the current monitoring well sampling program. The MAROS software was developed in 1998 by GSI Environmental Inc. in conjunction with the University of Houston (UH), with funding from the Air Force Center for Engineering and the Environment (AFCEE) (GSI, 2012). MAROS provides a statistical review of groundwater monitoring data with the goal of improving the efficiency of monitoring networks. Statistical modules exist for individual well analyses, plume analyses, spatial optimization, and sampling frequency optimization.

The objective of this analysis was to determine which monitoring wells should remain in the sampling program. This was achieved by determining if the mean contaminant concentration at a given monitoring well is below the cleanup goal with statistical significance. Based on the enclosed MAROS evaluation report, GES recommends that the sampling frequency of monitoring wells MW-1, MW-2, MW-4, MW-5, MW-6, MW-11, and MW-12 be reduced to an annual frequency. Statistically, the mean dissolved methyl tert-butyl ether (MTBE) concentration in these wells is less than the MDE Action Level for MTBE of 20 ug/L.

In addition to the MAROS evaluation of the monitoring well sampling program, GES requests the MDE's approval to discontinue the Total Petroleum Hydrocarbons – Diesel Range Organics (TPH-DRO) groundwater analysis of the monitoring wells at the above referenced Site. GES included this request to change to the groundwater analysis requirements in the quarterly monitoring reports beginning with the Second Quarter 2011 and in the *Request to Discontinue TPH-DRO Analysis on Monitoring Well Samples* letter dated February 27, 2012.

Groundwater samples collected from the monitoring wells are currently analyzed for full-suite volatile organic compounds, total petroleum hydrocarbons-gasoline range organics (TPH-GRO) and total petroleum hydrocarbons-diesel range organics (TPH-DRO). Per the MDE's November 18, 2010 *Work*

Plan Approval, the discontinuation of TPH-DRO analysis from monitoring wells would be considered pending the evaluation of low-flow sampling data and pilot test activities.

GES has reviewed the historical groundwater analytical data for TPH-DRO which includes data obtained from both groundwater sampling methodologies employed at the site (traditional purge and grab sampling and low flow sampling methodology). With MDE approval, GES changed monitoring well sampling techniques from purge and grab to low-flow sampling starting in the Fourth Quarter 2010. Historical groundwater analytical data at this site indicates that changing sampling techniques has had no influence on the concentrations of TPH-DRO detected in the groundwater. It should be noted that historical TPH-DRO concentrations in monitoring wells are typically below method detection limits. Monitoring wells where TPH-DRO concentrations have been detected are at low levels and have shown decreasing TPH-DRO concentrations trends.

GES, on behalf of Carroll, respectfully requests MDE approval to discontinue analysis of TPH-DRO on samples collected from the groundwater monitoring wells at this site. GES would also appreciate your review of the attached MAROS evaluation report and consideration of GES' request to reduce the sampling frequency of select monitoring wells MW-1, MW-2, MW-4, MW-5, MW-6, MW-11, and MW-12 from quarterly to annually.

GES appreciates the continued guidance of the MDE on this project. If you have any questions or would like additional information, please contact the undersigned at 800-220-3606, extension 3717 or 3706, respectively, or Herb Meade at 410-261-5450.

Sincerely,

Greg Reichart
Project Manager

Steven M. Slatnick
Sr. Project Manager
Site Operations Manager

Attachments:
MAROS Evaluation Report
Figure 1 - Site Map

c: Jim Richmond – MDE (additional copy & CD)
Susan Bull – MDE
Andrew Miller – MDE
Herb Meade – Carroll Independent Fuels Company
George Keller – Frederick County Health Department
Samir Andrawos – Timbercrest Limited Partnership
Jennifer Andrawos – Timbercrest Limited Partnership
Dwight W. Stone – Whiteford Taylor Preston
Robert S. Bassman – Bassman, Mitchell & Alfano, Chtd.
M. Albert Figinski – Law Offices of Peter Angelos
Craig Silverman – Law Offices of Peter Angelos (copy & CD)
Heather Deane – Bonner Kiernan
File – GES, MD (PSID 443899)

MAROS Evaluation Report

Monrovia BP/Former Green Valley Citgo
MDE Case #2005-0834-FR
MDE Facility ID #11836
11791 Fingerboard Road
Monrovia, Maryland

Prepared for:

Carroll Independent Fuel Company
2700 Loch Raven Road
Baltimore, Maryland 21218

Prepared by:

GROUNDWATER & ENVIRONMENTAL SERVICES, INC.
1350 Blair Drive, Suite A
Odenton, Maryland 21113

May 2013

Introduction

This evaluation report provides an assessment of the dissolved sampling program at the Monrovia BP/Former Green Valley Citgo station (Site) located at 11791 Fingerboard Road, Monrovia, Maryland. Groundwater & Environmental Services, Inc. (GES) applied the Monitoring and Remediation Optimization System (MAROS) software to evaluate the efficacy of the current sampling program. The MAROS software was developed in 1998 by GSI Environmental Inc. in conjunction with the University of Houston (UH), with funding from the Air Force Center for Engineering and the Environment (AFCEE) (GSI, 2012). MAROS provides a statistical review of groundwater monitoring data with the goal of improving the efficiency of monitoring networks. Statistical modules exist for individual well analyses, plume analyses, spatial optimization, and sampling frequency optimization.

Specifically, statistical modules providing summary statistics using the Kaplan-Meier Method, trend analysis using the Mann-Kendall Test for Trend, and Data Sufficiency were applied to dissolved methyl tert-butyl ether (MTBE) data collected at monitoring wells and area private drinking water wells. The objective of this analysis is to determine which monitoring wells should remain in the sampling program. This was achieved by determining if the mean contaminant concentration at a given monitoring well is below the cleanup goal with statistical significance.

Approach

Dissolved MTBE data were collected from 74 discrete monitoring locations (monitoring wells and private drinking water wells) divided into 31 sampling events between February 2006 and January 2013. Once uploaded into the program, data were consolidated: half of the reported detection limit was applied in the model for non-detect results, results reported below the detection limit were applied in the model as the actual value, and the maximum concentration was used when duplicate values were reported for a given monitoring location for the same sampling event.

Site-specific input parameters as defined in the ISCO System Comprehensive Summary & Update to the Conceptual Site Model (September 2012) were applied in the model.

Hydraulic Conductivity: The maximum hydraulic conductivity determined during a rising head slug test conducted on August 31, 2012 at MW-10 was applied in the MAROS model.

Hydraulic Gradient: Calculations from the September 5, 2012 shallow groundwater elevation dataset demonstrate a hydraulic gradient of 0.02 feet per foot (ft/ft) from MW-2 to MW-9 and a hydraulic gradient of 0.05 ft/ft from MW-8 to MW-9. The average gradient of 0.035 ft/ft was applied in the model.

Porosity: The porosity was set at 0.10 to represent the saprolite/weathered bedrock silt matrix.

Groundwater Flow Direction: Due to the existence of active water supply wells both onsite and offsite, the effects of large volume pumping may influence the direction of groundwater flow, however, the effects of localized pumping are generally not evident (GES, 2012). Groundwater flow through saprolite or in crystalline rock aquifers is strongly influenced by the structural attributes of the parent rock and is further driven by groundwater elevation or head. As such the groundwater flow direction in the model (NW to SE) was set to mimic the anisotropy of the formation.

Source Location: The **s**ource of the dissolved MTBE plume was identified in the model as the center of the tank field.

Aquifer Thickness: A uniform aquifer thickness was set at 30 feet which was based on the average depth to water in the formation and the top of rock defined at IW-4.

Plume Delineation: During plume delineation monitoring wells and private drinking water wells were divided into 3 categories: source, tail, and delineation. Source wells are located in areas where the original source occurred or where aqueous-phase releases have occurred, and generally have high detected concentrations. Tail wells are located downgradient of the contaminant source zone. Delineation wells are unaffected locations. They can be upgradient, downgradient, or cross-gradient from the source. Delineation wells are used to assist with defining the plume; statistics are not performed on these wells.

All site monitoring wells were delineated as source wells, while four private drinking water wells located within the maximum dissolved MTBE plume footprint were delineated as tail wells. All other potable wells were designated as delineation wells. All potable wells will remain in the sampling program regardless of the outcome of these analyses, and therefore, will not be discussed in the Results or Recommendations sections. Only monitoring wells will be considered for removal.

It is also important to note that while MW-3 was designated as a source well in this analysis, the well has been abandoned, and therefore, it is no longer part of the sampling program. It was, however, important in delineating the plume at the beginning of the timeline.

Data Sufficiency Analysis: The MDE Action Level of 20 ug/L for MTBE, a target level of 16 ug/L MTBE, and an alpha of 0.05 was applied in the model.

Results

Summary statistics were performed identifying the sampling frequency, the detection frequency, minimum and maximum detected concentrations, and whether or not the maximum concentration is above the cleanup goal. The Shapiro-Wilk method was used to determine whether the data at each monitoring location followed a normal or lognormal distribution. The majority of the data follows a lognormal distribution.

Mann-Kendall Test for Trend

The Mann-Kendall Test for Trend was applied to all source and tail monitoring locations in the MAROS module. Due to the high percentage of censored, or non-detect, data, these locations were excluded from the analysis: MW-2, MW-4, MW-5, MW-6, MW-8, MW-9, MW-11, MW-12, and MW-16. Confidence of trend was determined using an alpha of 0.05, or a 95% confidence interval.

Results indicate that decreasing trends exist in dissolved MTBE concentrations detected in monitoring wells MW-1, MW-7, MW-10, MW-13, MW-14S, MW-15D, MW-17, and MW-18S. No trend was determined to be statistically significant in MW-14D, however, the MTBE concentrations are stable. No trend was determined to be statistically significant in MW-18D, either. MTBE concentrations in MW-18D are not stable, though.

Individual Well Cleanup Status

Data sufficiency, in the statistical sense, defines whether or not the observed data are adequate in quantity and quality. MAROS' Data Sufficiency module identifies monitoring locations that have statistically attained the cleanup goal. This module requires a minimum of six years of sampling data, and the analysis can only be applied to a plume that has reached or is reaching steady state. Applying the analysis to wells in an expanding plume may cause incorrect conclusions (GSI, 2012).

The Sequential T-test Method was applied to all source and tail monitoring locations in the MAROS module. Results indicate that monitoring wells MW-1, MW-2, MW-4, MW-5, MW-6, MW-11, and MW-12 may be eliminated from the sampling program. Statistically, the mean dissolved MTBE concentration in these wells is less than the MDE Action Level of 20 ug/L for MTBE. None the less, taking a conservation approach, GES recommends the continued sampling of these well, all be it on an annual basis rather than quarterly basis.

In addition sampling should continue at MW-7, MW-8, MW-9, MW-10, MW-13, MW-14S, MW-15D, MW-16, MW-18S, and MW-18D. The mean dissolved MTBE concentration in these wells is below the cleanup goal, although it is not statistically significant. The mean MTBE concentration in MW-14D and MW-17 is higher than the cleanup goal, and, therefore, sampling should continue.

Recommendations

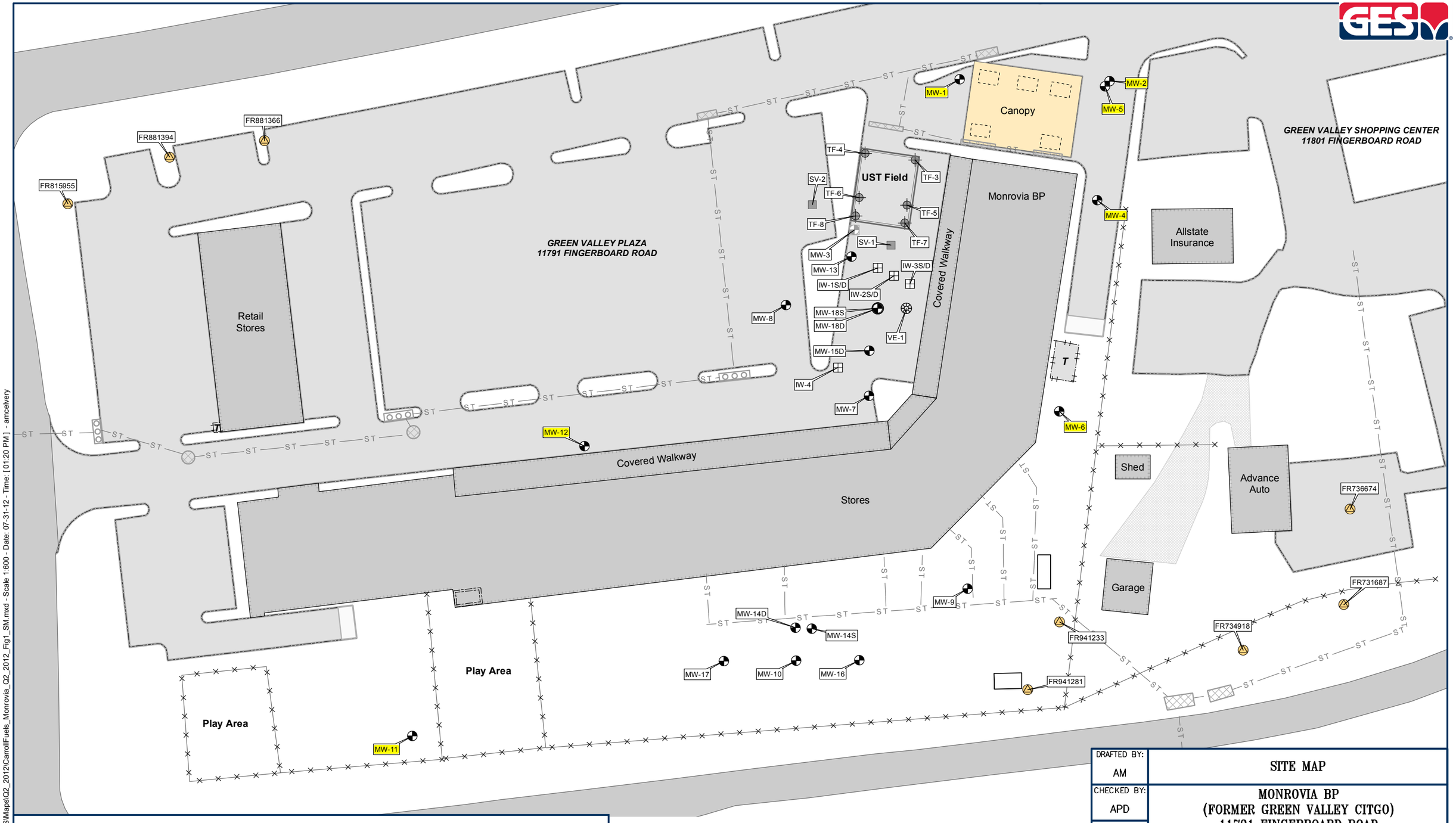
The Mann-Kendall Test for Trend and the Data Sufficiency modules in MAROS were applied to dissolved MTBE data that were collected from 74 discrete monitoring locations (monitoring wells and private drinking water wells) divided into 31 sampling events between February 2006 and January 2013. Based on the results of these statistical analyses GES recommends that sampling should continue at MW-7, MW-8, MW-9, MW-10, MW-13, MW-14S, MW-15D, MW-16, MW-18S, and MW-18D. The mean MTBE concentration in these wells is below the cleanup goal, although it is not statistically significant. Additionally, the mean MTBE concentration in MW-14D and MW-17 is higher than the cleanup goal, and, therefore, sampling should continue.

Finally, GES recommends that the sampling frequency of monitoring wells MW-1, MW-2, MW-4, MW-5, MW-6, MW-11, and MW-12 be reduced to annually. Statistically, the mean dissolved MTBE concentration in these wells is less than the MDE Action Level of 20 ug/L for MTBE.

References

GES. 2012. ISCO System Comprehensive Summary Report and Update to CSM, Monrovia BP/Former Green Valley CITGO, MDE Case #2005-0834-FR, MDE Facility ID #11836, 11791 Fingerboard Road, Monrovia, Maryland. Groundwater & Environmental Services, Inc., Odenton, Maryland, September 2012.

GSI. 2012. Monitoring and Remediation Optimization System (MAROS), Software Version 3.0, User's Guide and Technical Manual. GSI Environmental, Inc., Houston, Texas, September 2012.



Legend

Abandoned Well	Abandoned Soil Vapor Point	Fence	Building	Propane AST
Monitoring Well	Injection Well	ST Storm Sewer	Canopy	Pump Room
Potable Well	Nested Obs Well	Curb Catch Basin	Dispenser	T Transformer
Tank Field Well	Vapor Extraction Well	Catch Basin	Tank Field	Dumpster

Source:
NAIP aerial photograph for Frederick Co. Based on GIS data provided by Environmental Alliance, Inc.

DRAFTED BY: AM	SITE MAP
CHECKED BY: APD	MONROVIA BP (FORMER GREEN VALLEY CITGO) 11791 FINGERBOARD ROAD MONROVIA, MARYLAND
REVIEWED BY: GR	Groundwater & Environmental Services, Inc. 2142 PRIEST BRIDGE COURT, SUITE 1, CROFTON, MD 21114
NORTH	SCALE IN FEET: 0 50 / DATE: 7-31-12 / FIGURE: 1

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