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HYDROGEOLOGY • ENGINEERING

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VIA ELECTRONIC AND REGULAR MAIL

March 12, 2012

Ms. Shannon Harbour, P.E.
Supervisor, Special Projects Branch
Bureau of Corrective Actions
NEVADA DIVISION OF ENVIRONMENTAL PROTECTION
901 South Stewart Street
Carson City, NV 89701

Re: Special Groundwater Sampling Event - Boulder Highway Transect, Downgradient of the Companies and NERT Sites, Henderson, Nevada

Dear Ms. Harbour:

This letter was prepared by Hargis + Associates, Inc. (H+A) on behalf of the Olin Corporation, Stauffer Management Company, LLC, and Montrose Chemical Corporation of California (referred to herein as "the Companies") to summarize the findings of a special groundwater sampling event (the sampling event) conducted downgradient of groundwater extraction and treatment systems operated by the Companies and the Nevada Environmental Response Trust (NERT, formerly Tronox, LLC) in Henderson, Nevada.

Background and Purpose

Previous reports published by the Companies and NERT have identified the presence of chloroform in shallow zone groundwater in the vicinity of the former Montrose, Stauffer, and Tronox plant operations areas and separately in areas north of Boulder Highway. The area north of Boulder Highway is generally referred to as the "downgradient area". However, the interpretation that suggested the existence of separate chloroform-impacted areas suffered due to the sparse availability of data between the two areas generally along the alignment of the Boulder Highway.

The Nevada Division of Environmental Protection (NDEP) commented on the uncertainty of this interpretation during technical meetings and requested that the Companies collect additional data to determine chloroform concentrations between the former plant and downgradient areas.

These additional data, along with other recent data, would be used to provide a better area wide depiction of shallow zone chloroform concentrations.

Scope of Work

To address NDEP's request, the Companies reviewed the area along Boulder Highway and downgradient of the Olin-NERT property line to identify existing wells that might be used for sampling. This review identified a series of four useful shallow zone monitoring wells; PC-040, M-096, PC-054, and PC-021A arrayed along a northwest-southeast trending transect south of Boulder Highway as shown on **Figure 1**. For the proposes of this letter, this transect is referred to as the "Boulder Highway transect". The Boulder Highway transect is approximately 3,000 feet long and extends from an area downgradient of the Companies' GWTS to an area downgradient of the NERT site.

Converse Consultants, Inc. was subsequently retained to sample the wells on November 8, 2011. All groundwater samples were collected using low-flow procedures in accordance with the Companies' Field Sampling and Standard Operating Procedures. The groundwater samples were analyzed by TestAmerica Inc. for volatile organic compounds (VOCs) using Environmental Protection Agency (EPA) method 8260B.

Analytical Results

The analytical results of the groundwater samples are presented in **Table 1** and the chloroform concentrations are plotted on **Figure 2** relative to chlorofrom data compiled from available sources for the time period 2009 through 2011. From northwest to southeast, chloroform was detected at concentrations of:

- 1.1(J) ug/l at well PC-040;
- 4.6 ug/l at well M-096;
- 66 ug/l at well PC-054; and
- 540 ug/l at well PC-021A.

Also as shown on **Table 1**, trichloroethene (TCE) and tetrachloroethene (PCE) were the only other VOCs detected at concentrations greater than their respective MCLs. These exceedences occurred only in the groundwater sample collected from well PC-021A, located at the southeast end of the Boulder Highway transect.

Detectable concentrations of 1,1-dichloroethane, 1,2,3-trichlorobenzene, 1,2,4-trichlorobenzene, 1,2-dichlorobenzene, 1,3-dichlorobenzene, 1,4-dichlorobenzene, bromoform, carbon tetrachloride, chlorobenzene, n-butylbenzene, and n-propylbenzene, p-isopropyl toluene, sec-butylbenzene, and tert-butylbenzene were also present in the groundwater samples. However, many of these VOCs were reported at estimated (J-flagged) values and the concentrations of these VOCs were either less than their respective MCL, or had no established MCL.

Discussion of Findings

As shown on **Figure 2**, the results of the sampling event indicate that the two areas of shallow zone chloroform present south and north of Boulder Highway are connected. Review of this figure indicates that chloroform concentrations along the Boulder Highway transect are also consistent with concentrations present to the south and the north. In most cases, the chloroform concentrations along the Boulder Highway transect are less than those concentrations upgradient, and slightly greater than those downgradient. A generally decreasing trend in chloroform concentration from south to north is expected for this area as distance from the source areas increases.

Further review indicates that chloroform concentrations increase along the Boulder Highway transect from the northwest to the southeast as illustrated in **Figure 2**. This pattern of increasing chloroform concentrations from west to east in the downgradient areas is also consistent with previous data. Review of the April 2011 chloroform data, presented in the 2011 Comprehensive Groundwater Data Evaluation Report, indicates that concentrations were either low or non-detectable in the area immediately downgradient of the Companies' GWTS as shown in **Figure 2**. This condition is also present further downgradient of the GWTS (north of Boulder Highway) near monitor wells PC-064 and PC-031. However, east of these monitor wells, near monitor wells PC-067 and PC-028, chloroform concentrations increased to 120 ug/l and 880 ug/l, respectively.

Summary

The VOC data generated by the sampling event indicates that chloroform is present in the shallow zone along Boulder Highway at concentrations ranging from an estimated value of 1.1(J) ug/l to 540 ug/l. This additional chloroform data indicates that chloroform is consistently present in groundwater from the former plant areas into the downgradient area. The data also demonstrate that chloroform concentrations along Boulder Highway increases from northwest to southeast.

Sincerely,
HARGIS + ASSOCIATES, INC.

Brian R. Waggle, RG, CHG, CEM
Senior Hydrogeologist

BRW:keh

cc w/encl: Paul Sundberg, Montrose Chemical Corporation
George Crouse, Syngenta Crop Protection, LLC
Charles Elmendorf, Stauffer Management Company, LLC
Curt Richards, Olin Corporation
Mike Bellotti, Consultant to Olin Corporation
Ed Modiano, de maximis, inc.
Brian Rakvica, McGinley and Associates, Inc.

TABLES

TABLE 1
BOULDER HIGHWAY TRANSECT WELL SAMPLING
Analyitical Results

(Wells arranged from West to East)

Parameter	NDEP Basic Comparison Levels for Residential Water (1/2011)	EPA Maximum Contaminant Level	Units	**PC-040**	**M-096**	**PC-054**	**PC-021A**
				Date Sampled			
				11/8/2011	11/8/2011	11/8/2011	11/8/2011
VOLATILE ORGANIC COMPOUNDS (EPA 8260B)							
1,1,1,2-TETRACHLOROETHANE	2.29	--	ug/L	<5	<5	<5	<25
1,1,1-TRICHLOROETHANE	200	200	ug/L	<2	<2	<2	<10
1,1,2,2-TETRACHLOROETHANE	0.297	--	ug/L	<2	<2	<2	<10
1,1,2-TRICHLOROETHANE	5	5	ug/L	<2	<2	<2	<10
1,1-DICHLOROETHANE	11.8	--	ug/L	**8.4**	<2	<2	<10
1,1-DICHLOROETHENE	7	7	ug/L	<5	<5	<5	<25
1,1-DICHLOROPROPENE	--	--	ug/L	<2	<2	<2	<10
1,2,3-TRICHLOROBENZENE	--	--	ug/L	**2.1 J**	<5	<5	<25
1,2,3-TRICHLOROPROPANE	0.00224	--	ug/L	<10	<10	<10	<50
1,2,4-TRICHLOROBENZENE	70	70	ug/L	**8.9**	<5	<5	<25
1,2,4-TRIMETHYLBENZENE	51.1	--	ug/L	<2	<2	<2	<10
1,2-DIBROMO-3-CHLOROPROPANE	0.2	0.2	ug/L	<5	<5	<5	<25
1,2-DIBROMOETHANE	0.05	0.05	ug/L	<2	<2	<2	<10
1,2-DICHLOROBENZENE	600	600	ug/L	**9.5**	**1.6 J**	<2	<10
1,2-DICHLOROETHANE	5	5	ug/L	<2	<2	<2	<10
1,2-DICHLOROPROPANE	5	5	ug/L	<2	<2	<2	<10
1,3,5-TRIMETHYLBENZENE	655	--	ug/L	<2	<2	<2	<10
1,3-DICHLOROBENZENE	109	--	ug/L	**1.1 J**	**3.6**	**1.4 J**	<10
1,3-DICHLOROPROPANE	324	--	ug/L	<2	<2	<2	<10
1,4-DICHLOROBENZENE	75	75	ug/L	**8.3**	**0.96 J**	**0.91 J**	<10
2,2-DICHLOROPROPANE	--	--	ug/L	<2	<2	<2	<10
2-CHLOROTOLUENE	664	--	ug/L	<5	<5	<5	<25
4-CHLOROTOLUENE	--	--	ug/L	<5	<5	<5	<25
BENZENE	5	5	ug/L	<2	<2	<2	<10
BROMOBENZENE	283	--	ug/L	<5	<5	<5	<25
BROMOCHLOROMETHANE	--	--	ug/L	<5	<5	<5	<25
BROMODICHLOROMETHANE	1.08	80	ug/L	<2	<2	<2	<10
BROMOFORM	8.51	80	ug/L	<5	<5	<5	**9.3 J**
BROMOMETHANE	47.8	--	ug/L	<5	<5	<5	<25
CARBON TETRACHLORIDE	5	5	ug/L	<1	<1	**0.44 J**	**2.8 J**
CHLOROBENZENE	100	100	ug/L	**0.65 J**	<2	<2	<10
CHLOROETHANE	23.2	--	ug/L	<5	<5	<5	<25
CHLOROFORM	1.62	80	ug/L	**1.1 J**	**4.6**	**66**	**540**
CHLOROMETHANE	81.1	--	ug/L	<5	<5	<5	<25

TABLE 1
BOULDER HIGHWAY TRANSECT WELL SAMPLING
Analyitical Results

(Wells arranged from West to East)

Parameter	NDEP Basic Comparison Levels for Residential Water (1/2011)	EPA Maximum Contaminant Level	Units	PC-040	M-096	PC-054	PC-021A
				Date Sampled			
				11/8/2011	11/8/2011	11/8/2011	11/8/2011
VOLATILE ORGANIC COMPOUNDS (EPA 8260B) cont.							
CIS-1,2-DICHLOROETHENE	70	70	ug/L	<2	<2	<2	<10
CIS-1,3-DICHLOROPROPENE	--	--	ug/L	<2	<2	<2	<10
DIBROMOCHLOROMETHANE	0.697	80	ug/L	<2	<2	<2	<10
DIBROMOMETHANE	225	--	ug/L	<2	<2	<2	<10
DICHLORODIFLUOROMETHANE	5840	--	ug/L	<5	<5	<5	<25
DIMETHYL DISULFIDE	--	--	ug/L	<2	<2	<2	<10
ETHYLBENZENE	700	700	ug/L	<2	<2	<2	<10
HEXACHLOROBUTADIENE	0.862	--	ug/L	<5	<5	<5	<25
ISOPROPYLBENZENE	3440	--	ug/L	<2	<2	<2	<10
M,P-XYLENE	--	10000	ug/L	<2	<2	<2	<10
METHYLENE CHLORIDE	5	5	ug/L	<2	<2	<2	<10
NAPHTHALENE	4.29	--	ug/L	<5	<5	<5	<25
N-BUTYLBENZENE	363	--	ug/L	<5	**0.41 J**	<5	<25
N-PROPYLBENZENE	363	--	ug/L	<2	**0.27 J**	<2	<10
O-XYLENE	6810	10000	ug/L	<2	<2	<2	<10
P-ISOPROPYL TOLUENE	2920	--	ug/L	<2	**0.31 J**	<2	<10
SEC-BUTYLBENZENE	363	--	ug/L	<5	**0.32 J**	<5	<25
STYRENE	100	100	ug/L	<2 M2R-3	<2	<2	<10
TERT- BUTYLBENZENE	363	--	ug/L	<5	**0.26 J**	<5	<25
TETRACHLOROETHENE	5	5	ug/L	**2**	**0.78 J**	**0.69 J**	**78**
TOLUENE	1000	1000	ug/L	<2	<2	<2	<10
TRANS-1,2-DICHLOROETHENE	100	100	ug/L	<2	<2	<2	<10
TRANS-1,3-DICHLOROPROPENE	--	--	ug/L	<2	<2	<2	<10
TRICHLOROETHENE	5	5	ug/L	**3.2**	**0.31 J**	<2	**6.8 J**
TRICHLOROFLUOROMETHANE	9890	--	ug/L	<5	<5	<5	<25
VINYL CHLORIDE	2	2	ug/L	<5	<5	<5	<25

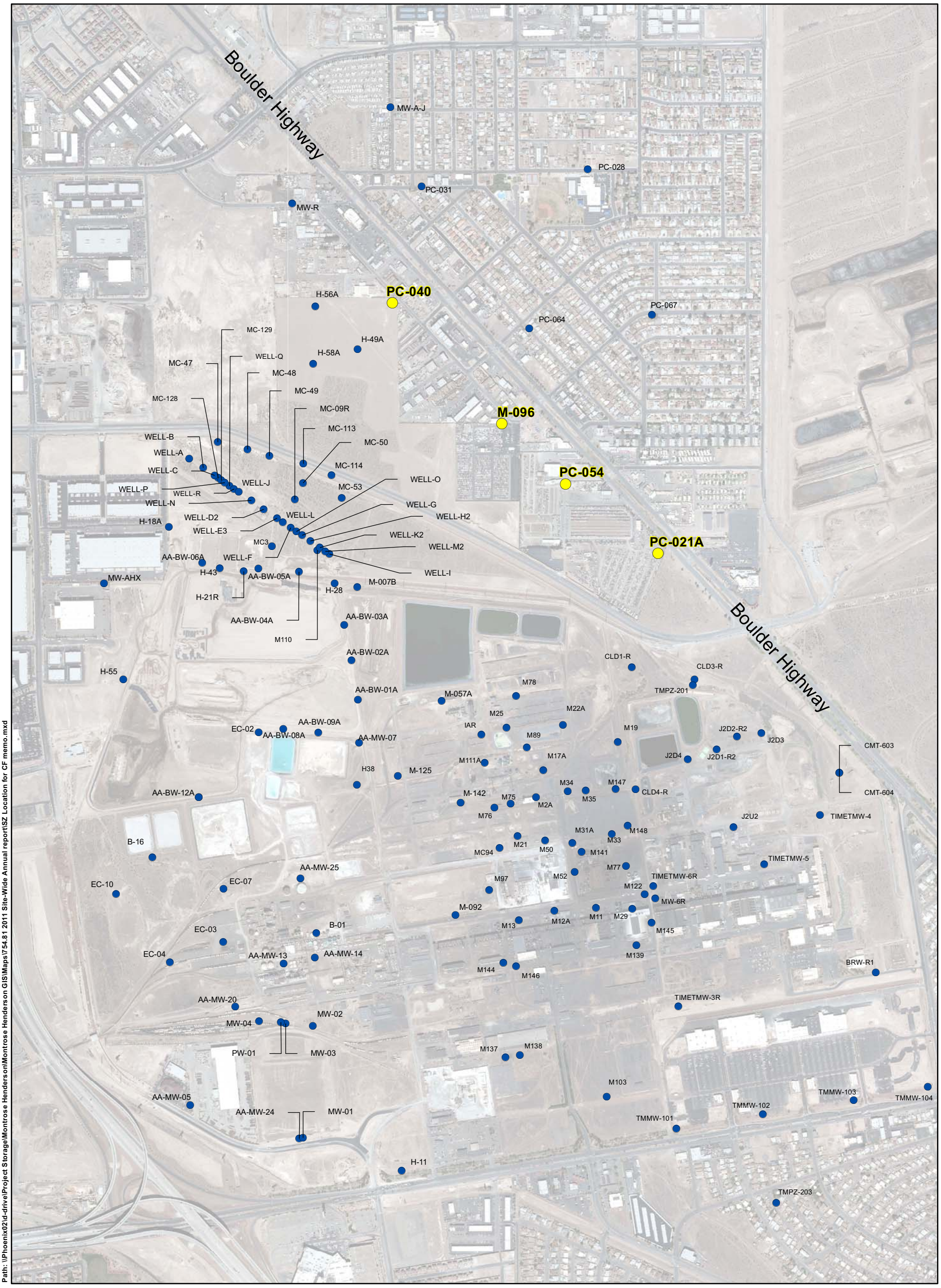
NOTES:

J = The associated value is an estimated quantity.
M2 = The MS and/or MSD were below the acceptance limits due to sample matrix interference. See Blank Spike (LCS).
R-3 = The RPD exceeded the acceptance limit due to sample matrix effects.
-- = A guidance level has not been establish

Bolded entries indicate detected concentrations greater than detection limits.

Exceeds NDEP Basic Comparison Level (BCL)
Exceeds EPA Maximum Contaminant Level (MCL)

FIGURES



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EXPLANATION

- SHALLOW ZONE MONITOR WELL LOCATION
- SPECIAL GROUNDWATER SAMPLING EVENT (BOULDER HIGHWAY TRANSECT) MONITOR WELL LOCATION

N

0 500 1,000
Feet

MONTROSE, STAUFFER AND OLIN SITES
HENDERSON, NEVADA

BOULDER HIGHWAY TRANSECT MONITOR WELL LOCATIONS

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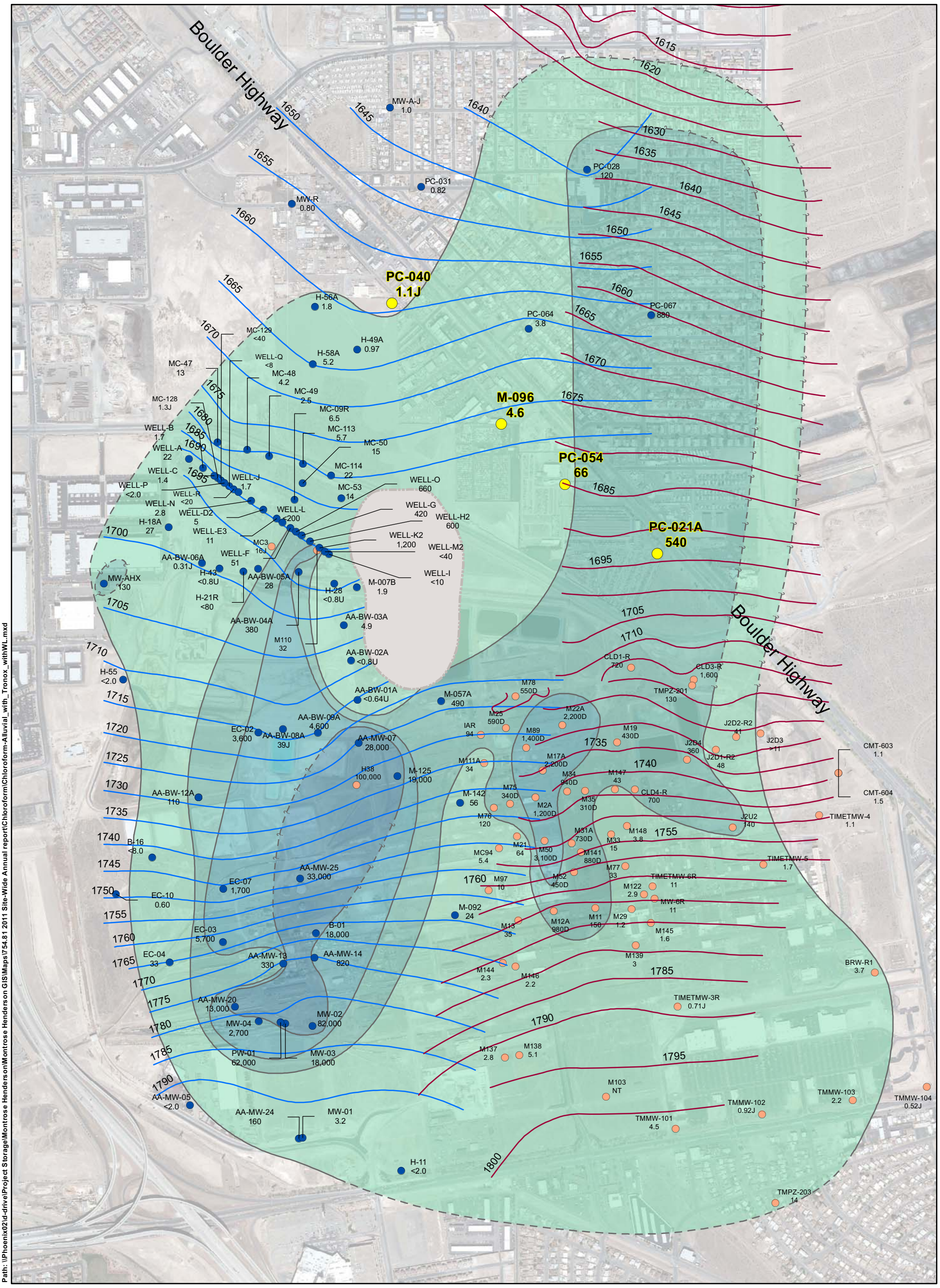
3/6/2012

FIGURE 1

PREP BY DAT REV BY BRW RPT NO 754.81



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2009 AERIAL PHOTO

EXPLANATION

CHLOROFORM CONCENTRATION (ug/l)
EPA METHOD: 8260B

- 1.62 (BCL) - 79
- 80 (TTHM MCL) - 999
- 1,000 - 9,999
- 10,000 - 99,999

Boundary of concentration zone is dashed where inferred, queried where uncertain.

- **H-11** MONITOR WELL IDENTIFIER
- **<2.0** CONCENTRATION IN MICROGRAMS PER LITER **SECOND QUARTER 2011**
- TIMET AND TRONOX DATA SAMPLED IN **FIRST, SECOND OR THIRD QUARTER 2009**
- SPECIAL GROUNDWATER SAMPLING EVENT (BOULDER HIGHWAY TRANSECT) MONITOR WELL LOCATION

< LESS THAN; COMPOUND WAS NOT DETECTED AT OR ABOVE THE REPORTED DETECTION LIMIT

ug/l MICROGRAMS PER LITER

NT SAMPLES COLLECTED FROM WELL NOT TESTED FOR THIS PARAMETER

TTHM TOTAL TRIHALOMETHANES (BROMODICHLOROMETHANE + BROMOFORM + CHLOROFORM + DIBROMOCHLOROMETHANE)

J- THE ASSOCIATED VALUE IS AN ESTIMATED QUANTITY WITH A NEGATIVE BIAS.

AREA OF LIMITED SHALLOW ZONE SATURATION

SECOND QUARTER 2011 NERT WATER LEVEL CONTOURS

SECOND QUARTER 2011 SITE-WIDE WATER LEVEL CONTOURS

N

0 500 1,000
Feet

MONTROSE, STAUFFER AND OLIN SITES
HENDERSON, NEVADA

COMPILATION OF RECENT CHLOROFORM CONCENTRATIONS AND WATER LEVELS SHALLOW ZONE 2009 - 2011

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FIGURE 2

PREP BY DAT REV BY BRW RPT NO 754.81