

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

Region 1 5 Post Office Square, Suite 100 BOSTON, MA 02109-3912

CERTIFIED MAIL RETURN RECEIPT REQUESTED JUN 1 5 2011

Marcella Albanese, President Albanese Brothers, Inc. 28 Loon Hill Road Dracut, MA01826

Re: Authorization to discharge under the Remediation General Permit (RGP) – MAG910000. Lynnfield/Saugus Pipeline Project: MWRA Contract 6584 site located at Broadway (Route 1) from Walnut Street in Saugus North to Lynnfield Town line, Saugus, MA 01906, Essex County; Authorization # MAG910488

Dear Ms. Albanese:

Based on the review of a Notice of Intent (NOI) submitted on behalf of Massachusetts Water Resources Authority (MWRA) by the firm SAK Environmental, for the site referenced above, the U.S. Environmental Protection Agency (EPA) hereby authorizes you, as the named Operator, to discharge in accordance with the provisions of the RGP at that site. Your authorization number is listed above.

The checklist enclosed with this RGP authorization indicates the pollutants which you are required to monitor. Also indicated on the checklist are the effluent limits, test methods and minimum levels (MLs) for each pollutant. Please note that the checklist does not represent the complete requirements of the RGP. Operators must comply with all of the applicable requirements of this permit, including influent and effluent monitoring, narrative water quality standards, record keeping, and reporting requirements, found in Parts I and II, and Appendices I – VIII of the RGP. See EPA's website for the complete RGP and other information at: http://www.epa.gov/region1/npdes/mass.html#dgp.

Please note the enclosed checklist includes parameters that you have marked "Believed Present". The checklist also includes other parameters for which your laboratory reports indicated there was insufficient sensitivity to detect these parameters at the minimum levels established in Appendix VI of the RGP.

Also, please note that the metals included on the checklist are dilution dependent pollutants and subject to limitations based on selected dilution ranges and technology-based ceiling limitations. For each parameter the dilution factor 72.7 for this site is within a dilution range greater than fifty to one hundred (>50-100), established in the RGP. (See

the RGP Appendix IV for Massachusetts facilities). Therefore, the limits for arsenic of 500ug/L, copper of 260ug/L, lead of 66ug/L, selenium of 250ug/L, zinc of 1480ug/L and iron of 5,000ug/L, are required to achieve permit compliance at your site.

Finally, please note the checklist of pollutants attached to this authorization is subject to a recertification if the operations at the site result in a discharge lasting longer than six months. A recertification can be submitted to EPA within six (6) to twelve (12) months of operations in accordance with the 2010 RGP regulations.

This general permit and authorization to discharge will expire on September 9, 2015. You have reported that this project will terminate on 10/31/2012. If for any reason the discharge terminates sooner you are required to submit a Notice of Termination (NOT) to the attention of the contact person indicated below within 30 days of project completion.

Thank you in advance for your cooperation in this matter. Please contact Victor Alvarez at 617-918-1572 or Alvarez. Victor@epa.gov, if you have any questions.

required to a smitter. Also undirested on the elucidist are the efficient limits, test at

Sincerely,

David M. Webster, Chief
Industrial Permits Branch

Jans M. Walnet

Enclosure

cc:

Kathleen Keohane, MassDEP

Eleanor Duffy, MWRA

Mark P. Grady Jr. SAK Environmental, Inc.

2010 Remediation General Permit Summary of Monitoring Parameters [1]

NPDES Authorization Number:) (him	MAG910488
Authorization Issued:	June,	2011
Facility/Site Name:	Lynnf	ield/Saugus Pipeline Project: MWRA Contract 6584
Facility/Site Address:	Broa	dway (Route 1) from Walnut Street in Saugus North to Lynnfield line, Saugus, MA 01906, Essex County
	Email	address of owner: eleonor.duffy@mwra.state.ma.us
Legal Name of Operate	or:	Albanese Brothers, Inc.
Operator contact name and Address:	, title,	Marcella Albanese, President, 28 Loon Hill Road Dracut, MA01826
and Address.		Email: GLabonte@albanesebros.com
Estimated Date of Com	pletion	: 10/31/2012
Category and Sub-Cate	egory:	Category I. Petroleum Related Site Remediation. Sub-category A. Gasoline Only Sites and Category III. Contaminated Construction Dewatering. Sub-category A. General Urban Fill Sites.
Receiving Water:		Hawkes Brook and Saugus River

Monitoring & Limits are applicable if checked. All samples are to be collected as grab samples

	Vans TW Coase Premi	Effluent Limit/Method#/ML (All Effluent Limits are shown as Daily
	<u>Parameter</u>	Maximum Limit, unless denoted by a **, in that case it will be a Monthly Average Limit)
√	Total Suspended Solids (TSS)	30 milligrams/liter (mg/L) **, 50 mg/L for hydrostatic testing **, Me#60.2/ML5ug/L
√	Total Residual Chlorine (TRC) 1	Freshwater = 11 ug/L ** Saltwater = 7.5 ug/L **/ Me#330.5/ML 20ug/L
√	3. Total Petroleum Hydrocarbons (TPH)	5.0 mg/L/ Me# 1664A/ML 5.0mg/L
	4. Cyanide (CN) 2,3	Freshwater = 5.2 ug/l ** Saltwater = 1.0 ug/L **/ Me#335.4/ML 10ug/L
√	5. Benzene (B)	5ug/L /50.0 ug/L for hydrostatic testing only/ Me#8260C/ML 2 ug/L
	6. Toluene (T)	(limited as ug/L total BTEX)/ Me#8260C/ ML 2ug/L
√	7. Ethylbenzene (E)	(limited as ug/L total BTEX) Me#8260C/ ML 2ug/L
✓	8. (m,p,o) Xylenes (X)	(limited as ug/L total BTEX) Me#8260C/ ML 2ug/L
√	9. Total Benzene, Toluene, Ethyl Benzene, and Xylenes (BTEX) ⁴	100 ug/L/ Me#8260C/ ML 2ug/L

	<u>Parameter</u>	Effluent Limit/Method#/ML (All Effluent Limits are shown as Daily Maximum Limit, unless denoted by a **, in that case it will be a Monthly Average Limit)
	10. Ethylene Dibromide (EDB) (1,2- Dibromoethane)	0.05 ug/l/ Me#8260C/ ML 10ug/L
√	11. Methyl-tert-Butyl Ether (MtBE)	70.0 ug/l/Me#8260C/ML 10ug/L
	12.tert-Butyl Alcohol (TBA) (TertiaryButanol)	Monitor Only(ug/L)/Me#8260C/ML 10ug/L
	13. tert-Amyl Methyl Ether (TAME)	Monitor Only(ug/L)/Me#8260C/ML 10ug/L
√	14. Naphthalene ⁵	20 ug/L /Me#8260C/ML 2ug/L
	15. Carbon Tetrachloride	4.4 ug/L /Me#8260C/ ML 5ug/L
	16. 1,2 Dichlorobenzene (o-DCB)	600 ug/L /Me#8260C/ ML 5ug/L
NO HOND	17. 1,3 Dichlorobenzene (m-DCB)	320 ug/L /Me#8260C/ ML 5ug/L
	18. 1,4 Dichlorobenzene (p-DCB)	5.0 ug/L /Me#8260C/ ML 5ug/L
	18a. Total dichlorobenzene	763 ug/L - NH only /Me#8260C/ ML 5ug/L
	19. 1,1 Dichloroethane (DCA)	70 ug/L /Me#8260C/ ML 5ug/L
	20. 1,2 Dichloroethane (DCA)	5.0 ug/L /Me#8260C/ ML 5ug/L
uni un	21. 1,1 Dichloroethene (DCE)	3.2 ug/L/Me#8260C/ ML 5ug/L
	22. cis-1,2 Dichloroethene (DCE)	70 ug/L/Me#8260C/ ML 5ug/L
	23. Methylene Chloride	4.6 ug/L/Me#8260C/ ML 5ug/L
	24. Tetrachloroethene (PCE)	5.0 ug/L/Me#8260C/ ML 5ug/L
9.0	25. 1,1,1 Trichloro-ethane (TCA)	200 ug/L/Me#8260C/ ML 5ug/L
red	26. 1,1,2 Trichloro-ethane (TCA)	5.0 ug/L /Me#8260C/ ML 5ug/L
Jvo	27. Trichloroethene (TCE)	5.0 ug/L /Me#8260C/ ML 5ug/L
	28. Vinyl Chloride (Chloroethene)	2.0 ug/L /Me#8260C/ ML 5ug/L
	29. Acetone	Monitor Only(ug/L)/Me#8260C/ML 50ug/L
	30. 1,4 Dioxane	Monitor Only /Me#1624C/ML 50ug/L
g:i	31. Total Phenols	300 ug/L Me#420.1&420.2/ML 2 ug/L/ Me# 420.4 /ML 50ug/L
Û	32. Pentachlorophenol (PCP)	1.0 ug/L /Me#8270D/ML 5ug/L,Me#604 &625/ML 10ug/L
1,5	33. Total Phthalates (Phthalate esters) ⁶	3.0 ug/L ** /Me#8270D/ML 5ug/L, Me#606/ML 10ug/L& Me#625/ML 5ug/L
√	34. Bis (2-Ethylhexyl) Phthalate [Di- (ethylhexyl) Phthalate]	6.0 ug/L /Me#8270D/ML 5ug/L,Me#606/ML 10ug/L & Me#625/ML 5ug/L
√	35. Total Group I Polycyclic Aromatic Hydrocarbons (PAH)	10.0 ug/L
	a. Benzo(a) Anthracene ⁷	0.0038 ug/L /Me#8270D/ ML 5ug/L, Me#610/ML 5ug/L& Me#625/ML 5ug/L

ag ag	<u>Parameter</u>	Effluent Limit/Method#/ML (All Effluent Limits are shown as Daily Maximum Limit, unless denoted by a **, in that case it will be a Monthly Average Limit)
	10. Ethylene Dibromide (EDB) (1,2- Dibromoethane)	0.05 ug/l/ Me#8260C/ ML 10ug/L
√	11. Methyl-tert-Butyl Ether (MtBE)	70.0 ug/l/Me#8260C/ML 10ug/L
	12.tert-Butyl Alcohol (TBA) (TertiaryButanol)	Monitor Only(ug/L)/Me#8260C/ML 10ug/L
	13. tert-Amyl Methyl Ether (TAME)	Monitor Only(ug/L)/Me#8260C/ML 10ug/L
\checkmark	14. Naphthalene ⁵	20 ug/L /Me#8260C/ML 2ug/L
	15. Carbon Tetrachloride	4.4 ug/L /Me#8260C/ ML 5ug/L
	16. 1,2 Dichlorobenzene (o-DCB)	600 ug/L /Me#8260C/ ML 5ug/L
_	17. 1,3 Dichlorobenzene (m-DCB)	320 ug/L /Me#8260C/ ML 5ug/L
	18. 1,4 Dichlorobenzene (p-DCB)	5.0 ug/L /Me#8260C/ ML 5ug/L
	18a. Total dichlorobenzene	763 ug/L - NH only /Me#8260C/ ML 5ug/L
	19. 1,1 Dichloroethane (DCA)	70 ug/L /Me#8260C/ ML 5ug/L
	20. 1,2 Dichloroethane (DCA)	5.0 ug/L /Me#8260C/ ML 5ug/L
	21. 1,1 Dichloroethene (DCE)	3.2 ug/L/Me#8260C/ ML 5ug/L
	22. cis-1,2 Dichloroethene (DCE)	70 ug/L/Me#8260C/ ML 5ug/L
	23. Methylene Chloride	4.6 ug/L/Me#8260C/ ML 5ug/L
	24. Tetrachloroethene (PCE)	5.0 ug/L/Me#8260C/ ML 5ug/L
	25. 1,1,1 Trichloro-ethane (TCA)	200 ug/L/Me#8260C/ ML 5ug/L
	26. 1,1,2 Trichloro-ethane (TCA)	5.0 ug/L /Me#8260C/ ML 5ug/L
	27. Trichloroethene (TCE)	5.0 ug/L /Me#8260C/ ML 5ug/L
Ap	28. Vinyl Chloride (Chloroethene)	2.0 ug/L /Me#8260C/ ML 5ug/L
	29. Acetone	Monitor Only(ug/L)/Me#8260C/ML 50ug/L
	30. 1,4 Dioxane	Monitor Only /Me#1624C/ML 50ug/L
	31. Total Phenols	300 ug/L Me#420.1&420.2/ML 2 ug/L/ Me# 420.4 /ML 50ug/L
	32. Pentachlorophenol (PCP)	1.0 ug/L /Me#8270D/ML 5ug/L,Me#604 &625/ML 10ug/L
	33. Total Phthalates (Phthalate esters) ⁶	3.0 ug/L ** /Me#8270D/ML 5ug/L, Me#606/ML 10ug/L& Me#625/ML 5ug/L
√	34. Bis (2-Ethylhexyl) Phthalate [Di- (ethylhexyl) Phthalate]	6.0 ug/L /Me#8270D/ML 5ug/L,Me#606/ML 10ug/L & Me#625/ML 5ug/L
√	35. Total Group I Polycyclic Aromatic Hydrocarbons (PAH)	10.0 ug/L
	a. Benzo(a) Anthracene ⁷	0.0038 ug/L /Me#8270D/ ML 5ug/L, Me#610/ML 5ug/L& Me#625/ML 5ug/L

ACT A CHARGE OF THE PARTY OF THE PARTY OF	Effluent Limit/Method#/ML
to an investment surpline of the property in	(All Effluent Limits are shown as Daily
<u>Parameter</u>	Maximum Limit, unless denoted by a **,
Charle (Starle)	in that case it will be a Monthly Average Limit)
b. Benzo(a) Pyrene ⁷	0.0038 ug/L /Me#8270D/ ML 5ug/L, Me#610/ML 5ug/L& Me#625/ML 5ug/L
c. Benzo(b)Fluoranthene 7	0.0038 ug/L /Me#8270D/ ML 5ug/L, Me#610/ML 5ug/L& Me#625/ML 5ug/L
d. Benzo(k)Fluoranthene ⁷	0.0038 ug/L /Me#8270D/ ML 5ug/L, Me#610/ML 5ug/L& Me#625/ML 5ug/L
e. Chrysene ⁷	0.0038 ug/L /Me#8270D/ML 5ug/L, Me#610/ML 5ug/L& Me#625/ML 5ug/L
f. Dibenzo(a,h)anthracene ⁷	0.0038 ug/L /Me#8270D/ML 5ug/L, Me#610/ML 5ug/L& Me#625/ML 5ug/L
g. Indeno(1,2,3-cd) Pyrene ⁷	0.0038 ug/L /Me#8270D/ML 5ug/L, Me#610/ML 5ug/L& Me#625/ML5ug/L
36. Total Group II Polycyclic Aromatic Hydrocarbons (PAH)	100 ug/L
h. Acenaphthene	X/Me#8270D/ML 5ug/L,Me#610/ML 5ug/L & Me#625/ML 5ug/L
i. Acenaphthylene	X/Me#8270D/ML 5ug/L,Me#610/ML 5ug/L & Me#625/ML 5ug/L
j. Anthracene	X/Me#8270D/ML 5ug/L,Me#610/ML 5ug/L & Me#625/ML 5ug/L
k. Benzo(ghi) Perylene	X/Me#8270D/ML 5ug/L,Me#610/ML 5ug/L & Me#625/ML 5ug/L
I. Fluoranthene	X/Me#8270D/ML 5ug/L,Me#610/ML 5ug/L & Me#625/ML 5ug/L
m. Fluorene	X/Me#8270D/ML 5ug/L,Me#610/ML 5ug/L & Me#625/ML 5ug/L
n. Naphthalene ⁵	20 ug/l / Me#8270/ML 5ug/L, Me#610/Ml 5ug/L & Me#625/ML 5ug/L
o. Phenanthrene	X/Me#8270D/ML 5ug/L,Me#610/ML 5ug/L & Me#625/ML 5ug/L
p. Pyrene	X/Me#8270D/ML5ug/L,Me#610/ML 5ug/L & Me#625/ML 5ug/L
37. Total Polychlorinated Biphenyls (PCBs) ^{8, 9}	0.000064 ug/L/Me# 608/ ML 0.5 ug/L
38. Chloride	Monitor only/Me# 300.0/ ML 0.1ug/L
	c. Benzo(b)Fluoranthene ⁷ d. Benzo(k)Fluoranthene ⁷ e. Chrysene ⁷ f. Dibenzo(a,h)anthracene ⁷ g. Indeno(1,2,3-cd) Pyrene ⁷ 36. Total Group II Polycyclic Aromatic Hydrocarbons (PAH) h. Acenaphthene i. Acenaphthylene j. Anthracene k. Benzo(ghi) Perylene l. Fluoranthene m. Fluorene n. Naphthalene ⁵ o. Phenanthrene p. Pyrene 37. Total Polychlorinated Biphenyls (PCBs) ^{8, 9}

	QAL ** /Mee2270D/ML Sug/L QB/ML 1002/LB Me#625/ML Sug/L QAL /Me#8270D/MI .Me#606/ML 100g/L B Me#625/MI	Total Recoverable Metal Limit @ H ¹⁰ = 50 mg/l CaCO3 for discharges in Massachusetts (ug/l) ^{11/12}	Minimum level=ML
	Metal parameter	Freshwater	HART RETURNS
	39. Antimony	5.6/ML 10	A STATE OF THE STA
\checkmark	40. Arsenic **	500/L20	(L)asnas a

		Total Recoverable Metal Limit @ H 10= 50 mg/l CaCO3 for discharges in Massachusetts (ug/l) 11/12	<u>Minimum</u> level=ML
	Metal parameter	Freshwater	
	41. Cadmium **	0.2/ML10	
	42. Chromium III (trivalent) **	48.8/ML15	
	43. Chromium VI (hexavalent) **	11.4/ML10	
√	44. Copper **	260/ML15	
√	45. Lead **	66/ML20	
	46. Mercury **	0.9/ML0.2	
	47. Nickel **	1,451/ML20	
\checkmark	48. Selenium **	250/ML20	
	49. Silver	1.2/ML10	
√	50. Zinc **	1,480/ML15	
\checkmark	51. Iron	5,000/ML 20	

	Other Parameters	<u>Limit</u>
√	52. Instantaneous Flow	Site specific in CFS
$\sqrt{}$	53. Total Flow	Site specific in CFS
$\sqrt{}$	54. pH Range for Class A & Class B Waters in MA	6.5-8.3; 1/Month/Grab ¹³
	55. pH Range for Class SA & Class SB Waters in MA	6.5-8.3; 1/Month/Grab ¹³
	56. pH Range for Class B Waters in NH	6.5-8; 1/Month/Grab ¹³
	57. Daily maximum temperature - Warm water fisheries	83°F; 1/Month/Grab ¹⁴
	58. Daily maximum temperature - Cold water fisheries	68°F; 1/Month/Grab14
	59. Maximum Change in Temperature in MA - Any Class A water body	1.5°F; 1/Month/Grab ¹⁴
	60. Maximum Change in Temperature in MA - Any Class B water body- Warm Water	5°F; 1/Month/Grab ¹⁴
	61. Maximum Change in Temperature in MA – Any Class B water body - Cold water and Lakes/Ponds	3°F; 1/Month/Grab ¹⁴
	62. Maximum Change in Temperature in MA – Any Class SA water body - Coastal	1.5°F; 1/Month/Grab ¹⁴
	63. Maximum Change in Temperature in MA – Any Class SB water body - July to September	1.5°F; 1/Month/Grab ¹⁴
	64. Maximum Change in Temperature in MA –Any Class SB water body - October to June	4°F; 1/Month/Grab ¹⁴

Footnotes:

¹ Although the maximum values for TRC are 11ug/l and 7.5 ug/l for freshwater, and saltwater respectively, the compliance limits are equal to the minimum level (ML) of the test method used as listed in Appendix VI (i.e., Method 330.5, 20 ug/l).

E.S.B.3; I/Month/Grab"	

asilon huril

^{*} Ammongs the maximum values for TRC are I Light and 2.5 sign for frontwater and gathwater respectively, the compliance units are some to the minimum lever McC Light section attends of Appendix VI (Light Method 130.5, 20 sign).

² Limits for cyanide are based on EPA's water quality criteria expressed as micrograms per liter. There is currently no EPA approved test method for free cyanide. Therefore, total cyanide must be reported.

Although the maximum values for cyanide are 5.2 ug/l and 1.0 ug/l for freshwater and saltwater, respectively, the compliance limits are equal to the minimum level (ML) of the Method 335.4 as listed in Appendix VI (i.e., 10 ug/l).

BTEX = sum of Benzene, Toluene, Ethylbenzene, and total Xylenes.

⁵ Naphthalene can be reported as both a purgeable (VOC) and extractable (SVOC) organic compound. If both VOC and SVOC are analyzed, the highest value must be used unless the QC criteria for one of the analyses is not met. In such cases, the value from the analysis meeting the QC criteria must be used.

⁶ The sum of individual phthalate compounds(not including the #34, Bis (2-Ethylhexyl) Phthalate . The compliance limits are equal to the minimum level (ML) of

the test method used as listed in Appendix VI.

Total values calculated for reporting on NOIs and discharge monitoring reports shall be calculated by adding the measured concentration of each constituent. If the measurement of a constituent is less than the ML, the permittee shall use a value of zero for that constituent. For each test, the permittee shall also attach the raw data for each constituent to the discharge monitoring report, including the minimum level and minimum detection level for the analysis.

Although the maximum value for the individual PAH compounds is 0.0038 ug/l, the compliance limits are equal to the minimum level (ML) of the test method used as

listed in Appendix VI.

⁸ In the November 2002 WQC, EPA has revised the definition of Total PCBs for aquatic life as total PCBs is the sum of all homologue, all isomer, all congener, or all "Oroclor analyses."Total values calculated for reporting on NOIs and discharge monitoring reports shall be calculated by adding the measured concentration of each constituent. If the measure of a constituent is less than the ML, the permittee shall use a value of zero for that constituent. For each test, the permittee shall also attach the raw data for each constituent to the discharge monitoring report, including the minimum level and minimum detection level for the analysis.

9Although the maximum value for total PCBs is 0.000064 ug/l, the compliance limit is equal to the minimum level (ML) of the test method used as listed in Appendix VI (i.e., 0.5 ug/l for Method 608 or 0.00005 ug/l when Method 1668a is approved).

10 Hardness. Cadmium, Chromium III, Copper, Lead, Nickel, Silver, and Zinc are

Hardness Dependent.

¹¹ For a Dilution Factor (DF) from 1 to 5, metals limits are calculated using DF times the base limit for the metal. See Appendix IV. For example, iron limits are calculated using DF x 1,000ug/L (the iron base limit). Therefore DF is 1.5, the iron limit will be 1,500 ug/L; DF 2, then iron limit =1,000 x 2 =2,000 ug/L., etc. not to exceed the DF=5.

Minimum Level (ML) is the lowest level at which the analytical system gives a recognizable signal and acceptable calibration point for the analyte. The ML represents the lowest concentration at which an analyte can be measured with a known level of confidence. The ML is calculated by multiplying the laboratorydetermined method detection limit by 3.18 (see 40 CFR Part 136, Appendix B).

pH sampling for compliance with permit limits may be performed using field

methods as provided for in EPA test Method 150.1.

Temperature sampling per Method 170.1

advise • remediate • sustain

May 25, 2011

US Environmental Protection Agency RGP – NOC Processing Municipal Assistance Unit One Congress Street, Suite 1100 Boston, Massachusetts 02114

Re: Lynnfield/Saugus Pipelines Project: MWRA Contract No. 6584

US Route 1 (Broadway) Saugus, Massachusetts 01906

Construction Dewatering Remediation General Permit Application

Under Massachusetts General Permit No. MAG910000

To Whom It May Concern:

1. Introduction

This Remediation General Permit (RGP) was prepared for the Massachusetts Water Resources Authority (MWRA) Contract No. 6584 - Saugus/Lynnfield Pipeline Project ("Project"). The Project is located in Saugus, Massachusetts along Route 1 (a.k.a Broadway) extending approximately 6,400 feet south from the Lynnfield town line (See Figure 1). The Project consists of the installation of approximately 1,815 ft. of 36-inch diameter and 4,585 ft. of 24-inch diameter water mains. In addition, 6,000 ft of 12-inch water main will be installed for the Town of Saugus which will run parallel to the MWRA water main for most of the length. The water mains are located at depths which will require approximately 8 to 12 foot excavations and near continuous dewatering. A National Pollution Discharge Elimination System (NPDES) Remediation General Permit (RGP) is required for this project due to contaminants in groundwater above RGP thresholds, and is attached. The Project is expected to generate water that will be discharged to local storm drains via catch basins. Proposed groundwater treatment will consist of a fractionation tank(s) for particulate settling throughout the Project. Bag filters may be used for removal of suspended solids and granular activated carbon may be added to remove petroleum at locations where groundwater concentrations are potentially elevated. It is anticipated that the proposed dewatering will commence in April of 2011 and be completed on or before November 2012. There will be a winter shutdown period required by the MassDOT permit from 11/14/2011 to 4/15/2012 where no work related to this permit (RGP) will be completed. Project information listed below:

Permit Applicant: Albanese Brothers Inc.

P.O. Box 518 28 Loon Hill Road Dracut, MA 01826

Permit Preparer: SAK Environmental LLC

231 Sutton Street, Suite 2G North Andover, MA 01845

Project Owner: Massachusetts Water Resources Authority (MWRA)

Charlestown Navy Yard

100 First Street

Charlestown, MA 02129

According to Albanese's dewatering consultant, GSI, the average rate of rate of dewatering rate is estimated at 50 gallons per minute (gpm) and the maximum rate is 90 gpm. Storm drains along the Project route discharge to various water bodies that include Hawkes Brook, Saugus River and Camp Nihan Pond.

2. Site Conditions

Information in this section was, in part, taken from reports prepared by the Owner's engineer, Fay Spofford and Thorndike (FST) of Burlington, MA. During a combined geotechnical/environmental investigation, gasoline-related volatile organic compounds (VOCs) and lead were detected in groundwater at several locations above applicable reportable concentrations under the Massachusetts Contingency Plan (MCP), 310 CMR 40.0000.

2.1. Site Setting

The proposed construction route is shown on Figure 1 – Site Location. At the southern end, the proposed route will follow the eastern shoulder of the northbound lane, cross Route 1 to the western shoulder of the southbound lane near the Walnut Street bridge, and extend to the Lynnfield town line. As described above, the water mains will be installed along Route 1 in Saugus where the highway is a major three-lane thoroughfare with commercial and industrial businesses located just off the shoulders. Uncontrolled access and egress to commercial and industrial properties is prevalent on Route 1.

U.S. Geological Survey (USGS) topographic maps of the Boston Quadrangle (USGS 1903) and Lawrence Quadrangle (USGS 1893) show a road in similar location and geometry as the present-day road. The interchange of Route 1 and Route 129 (Walnut Street) is located near MWRA Station 15+50NB, where the Walnut Street Bridge crosses over and connects with Route 1 via on- and off-ramps. Hawkes Pond, retained by Hawkes Pond Dam, is located immediately west of Route 1 between Stations 51+50NB and 60+00NB. According to the National Inventory of Dams database (NID, 2008), Hawkes Pond Dam (NID ID No. MA00245) is owned by the Lynn Water and Sewer Department and was constructed in 1895. The Lynnfield Water District Pump Station is the Site northern terminus, on the eastern side of Rte. 1 near Sta. 64+00NB.

Ground surface elevations generally increase from south to north along Route 1. Based on the Existing Conditions Plan, the topography slopes gently upward south of the Walnut St. Bridge (approx. Stations 0+00 to 15+50NB) from about El. 48 to El 53. North of the Walnut St. Bridge, topography slopes moderately upward to a peak of about El. 69.7 near Sta. 28+00NB, and then slopes gently downward to a relatively level section of about El. 63 to 66 between Stations 31+00NB and 45+00NB. From Sta. 45+00, the Site slopes to about El. 115 ft. near Sta. 63+00NB, and then gently downward to about El. 113 near the Pump Station. (1)

A review of the Massachusetts Department of Environmental Protection (MADEP) Priority Resource Map (Figure 5) indicates Saugus River passes through the southern extent of the Project. Hawkes Brook is a sub-basin which drains to the Saugus River. The watershed is approximately 47 square miles and passes through Wakefield, Lynnfield, Saugus, and Lynn as it meanders east and south from its source in Lake Quannapowitt in Wakefield to its mouth at Boston Broad Sound. It has at least eight tributaries including: Hawkes Brooks; the Mill River; Bennets Pond Brook; the Pines River; Crystal Pond Brook; Beaver Dam Brook; Strawberry Brook; and Shute Brook. The northern extent of the project passes through two (2) Zone A Public Water Supplies (Hawkes Pond and Walden Pond). Zone A designation indicates the area is located within 400 feet laterally from the bank of a Class A surface drinking water source (as identified in 314 CMR 4.00) and 200 feet laterally from the banks of its tributaries. Though the project passes between these water bodies, no catch basins discharge to them. The Priority Resource Map did not identify any other environmentally pertinent settings.

2.2. Subsurface Investigation

Fay, Spofford & Thorndike (FST) prepared a Hazardous Materials Assessment Memorandum dated September 28, 2008 (Appendix A) that identified locations along the pipeline route where oil and/or hazardous materials (OHM) could potentially be encountered in soil or groundwater during the Project. FST advanced 27 borings and installed 9 monitoring wells along the proposed pipeline alignment between March 30 and April 25, 2008 during a combined geotechnical/environmental investigation to evaluate soil structural properties and to obtain samples for environmental assessment. The boring and monitoring well locations are shown on Figure 2 and included sites identified as current or former "Disposal Sites" under the Massachusetts Contingency Plan (MCP), 310 CMR 40.0000, as well as sites likely to have known or suspected underground storage tanks (USTs) such as gas stations. These locations are listed in Table 1 of the FST memorandum (9/2008). Boring locations not listed in this table were advanced for geotechnical purposes only. Boring logs are included in Stephen's Associate's Inc. Geotechnical Report (Appendix B).

The subsurface conditions encountered during drilling consisted of asphalt and sub-base overlying fill consisting of mostly dense to very dense fine to coarse sand with varying proportions of silt and gravel extending about 3 to 12 ft. below ground surface. The fill unit was underlain by medium dense to very dense sand with varying proportions of silt and gravel or bedrock consisting of granitic, dioritic, or granodioritic rock. Where encountered, bedrock depths ranged from about 3 to 15 feet below ground surface.

Stephens Associates performed various geotechnical testing of soil samples collected from the borings with results summarized in Table 2 of their report (See Appendix B). The estimated vertical permeability using the Kozeny-Carmen Formula ranged from 3.6×10^{-2} to 5.9×10^{-7} cm/s. FST performed field permeability tests ("slug tests") in the observation wells and the estimated permeability ranged from 1×10^{-2} and 4.7×10^{-4} cm/s. These values are presented in Table 3 of the Stephens Associates report.

2.3. Soil and Groundwater Sample Collection and Analyses

2.3.1. Soil

Soil samples collected during the field program were screened for total volatile organic compounds (TVOCs) using a photoionization detector (PID) and submitted for laboratory analyses for the following:

- Volatile organic compounds (VOCs) by EPA Method 8260
- Semi-volatile organic compounds (SVOCs) by EPA Method 8270
- Total petroleum hydrocarbon (TPH) by EPA Method modifed 8100
- Volatile/extractable petroleum hydrocarbon (VPH/EPH) parameters with target VOCs and polycyclic aromatic hydrocarbons (PAHs) by MADEP method
- RCRA 8 metals by EPA Methods 6010, E200.7
- Polychlorinated biphenyls (PCBs) by EPA Method 8082
- RCRA hazardous waste characteristics: conductivity, pH, ignitablity, reactive cyanide and sulfide, and toxicity characteristic leaching procedure (TCLP)

All TVOC concentrations were below 5 parts per million by volume air (ppmv) except for B-3 at a 3-ft depth (265 ppmv) and B-25 at 5-ft depth (49 ppmv). Soil analytical results are summarized in the FST memorandum as Table 3. In general detected petroleum concentrations were below the MCP reportable concentrations for S-1 soil (RCS-1) and/or were consistent with MADEP's concentrations for PAHs and metals in urban fill containing coal and/or wood ash.

2.3.2. Groundwater

Groundwater was analyzed for the following using the RGP Appendix VI Methods which included the same parameters as soil (excluding RCRA hazardous waste characteristics) plus: cyanide, iron, copper, antimony, nickel, hexavalent chromium, total suspended solids, and total residual chlorine.

Groundwater analytical results are shown in Table 4 of the FST memorandum (Appendix B). Lead, copper and arsenic were detected in groundwater at concentrations that exceed RGP (no dilution) limits, but are below RGP limits when the dilution factor for the project is applied. Iron was detected in groundwater at concentrations that exceed RGP (no dilution) limits and RGP limits with the dilution factor; consequently, treatment to remove iron is necessary under the permit conditions.

The maximum detected concentrations of benzene and MTBE were 69.2 and 371 micrograms per liter (" μ g/L"), respectively and exceeded the RGP limits of 5μ g/L for benzene and 70 μ g/L for MTBE. In areas where VOC concentrations do not exceed the RCs, dewatering could potentially draw in contaminants resulting in concentrations that do exceed the RCs. Treatment under the RGP will be site-specific and monitored, as contaminant levels and chemical compounds detected in preconstruction studies are not consistent at all monitoring well locations.

3. Dilution Factor for Metals (Calculations)

A Dilution Factor (DF) was calculated (Appendix C) in order to identify the RGP limits for total metals. The DF calculation was performed in accordance with the procedure contained in MAG 910000, Appendix V "Calculation of Dilution Factor for Applications in Massachusetts." The purpose of the DF calculation is to establish the Total Recoverable Limits for metals, taking into consideration the anticipated dilution of the detected analytes upon discharge of effluent to the discharge waters.

The calculated DF was then used to find the appropriate Dilution Range Concentrations (DRCs) contained in MAG91000, Appendix IV.

The Project DF was calculated using the following equation:

$$DF = (Qd + Qs)/Qd$$

Where: Qd is the maximum discharge flow rate, cubic feet per second

Qs is the receiving water flow rate (minimum for 7 consecutive days with a recurrence

interval of 10 years – 7Q10), cubic feet per second

The value for Qs used for identifying the DRCs contained in MAG91000 Appendix IV is based on information provided by the US Geological Survey (USGS) – Massachusetts Stream Flow Data for the Saugus River. The Saugus River is the closest river with stream flow data that will receive discharges from the Project. The average flow rate reported for the Saugus Iron Works gauge station was 33.6 cubic feet per second (cfs) over a 16-year period. This value was used for the Qs to calculate the DF. Saugus River flow data is provided in Appendix C. The resulting DF equals 72.75. The applicable DRCs are those shown for a DF between 50 and 100. A summary of the metals Total Recoverable Limits (TRL) is presented in Table 1.

4. Dewatering and Groundwater Treatment System

The new water mains will be installed generally at 8 to 9 feet below grade and the trench excavations will extend up to 12 feet in depth. Measured groundwater levels were 4.1 to 13.7 feet below grade. Stephens Associates recommended water levels be maintained a minimum of 1 foot below the trench bottom at all times while the trench is open. According to Albanese's dewatering consultant, GSI, the volume of water pumped during dewatering will range from 10 to 90 gpm.

The treatment system will consist of the following components – a fractank to remove readily settable sediment (and Iron). FlocLogs which are non-hazardous polymer blocks may be placed in the tank to aid in sediment deposition. This will be followed by bag filters to remove suspended solids (and Iron) not captured by the fractank, followed by granular activated carbon to remove petroleum and related volatile organic compounds. Final treated effluent will be discharged to storm water catch basins along the length of the Project. An oil/water separator will be added to the beginning of the treatment system, in areas where unexpected gross petroleum contamination (i.e. separate phase petroleum product) is of concern.

Treatment components, excluding the fractank, may be removed from the system, subject to EPA approval, if monitoring results demonstrate reliable compliance with RGP effluent discharge limits.

5. Monitoring

Sampling and chemical testing of the treatment system influent and effluent will be performed in accordance with the requirements contained in the US EPA's Authorization to Discharge. Startup monitoring, as defined in the RGP, will be conducted once at commencement of the project. If monitoring results reveal effluent contamination that exceed the RGP limits, appropriate corrective measures will be implemented and additional confirmatory monitoring will be performed. Additionally, if monitoring results demonstrate reliable compliance with RGP effluent discharge limits, treatment components, not including the fractank, may be removed from the system.

Sincerely,

SAK Environmental, LLC

Prepared By:

Mark P. Grady Jr., EIT

Reviewed By:

Sherry Albert, P.E.

Approved By:

Stephen A. Sakakeeny, LSP, CPG, CHMM

Principal

Enclosure

Notice of Intent (NOI) for the Remediation General Permit

Attachments

Figure 1 – Site Location Map

Figure 2 – Boring Locations

Figure 3 – Schematic of Groundwater Treatment System

Figure 4 – Stormwater Outfall Locations

Figure 5 – Priority Resource Map

Table 1 - Total Recoverable Metals Limitations ($\mu g/L$) At Selected Dilution Ranges and Technology Based Ceiling Limitations For Facilities Located In Massachusetts (For Discharges To Freshwater at H = 50 mg/L CaCO3)

Appendix A – FST Hazardous Material Assessment Technical Memorandum

Appendix B – Stephen's Associates Geotechnical Report

Appendix C – Dilution Factor Calculations and Saugus River Data

Appendix D – Material Safety Data Sheets

B. Suggested Form for Notice of Intent (NOI) for the Remediation General Permit

1. General facility/site information. Please provide the following information about the site:

a) Name of facility/site : Route 1 Walnut St to Lynnfieid line	o Lynnfieid	d line	Facilit	Facility/site mailing address:	ress:	
Location of facility/site:	Facility SIC	y SIC	Street:	Broadway (Route 1)	from Walnut Street Sa	Street: Broadway (Route 1) from Walnut Street Saugus north to the Lynnfield
Jonoitude: 71 01' 12" W	code(s):			Line		
latitude: 42 29' 01" N	N/A					
b) Name of facility/site owner:			Town:	Town: Saugus		
Email address of facility/site owner:			State:		Zip:	County:
eleanor.duffy@mwra.state.ma.us			Jesse M	Maccachicotte	01006	
Telephone no. of facility/site owner : 617-	617-570-5458		Iviassac	llusetts	00610	ESSEX
Fax no. of facility/site owner:			Owne	r is (check one): 1	Owner is (check one): 1. Federal O 2. State/Tribal O	tate/Tribal <u>©</u>
Address of owner (if different from site):			3. Priv	ate 0 4. Other	3. Private O 4. Other O if so, describe:	
Street: 100 First Avenue						
Town: Boston	State: MA	MA	Zip: 02129	12129	County:	
c) Legal name of operator :	Opera	tor tele	aphone	Operator telephone no: 978-454-8850		
Albanese Brothers, Inc.	Opera	tor fax	no.:	Operator fax no.: 978-458-8710	Operator email:	Operator email: GLabonte@albanesebros.com
Operator contact name and title: Gary Labonte, Project Manager	onte, Proj	ect Mana	ager			
Address of operator (if different from owner):	Street:	Street: PO Box 518	PO Box 518 28 Loon Hill Road	pe		
Town: Dracut	State: MA	MA	Zip: 01826	1826	County:	

1) Check Y Ior "yes" or N Ior "no" Ior the following: Has a prior NPDES permit exclusion been granted for the discharge? Y 🔵 - N 💿 - if Y number	the discharge? V O N O if V number.
2. Has a prior NPDES application (Form 1 & 2C) ever been filed for the discharge?	en filed for the discharge?
3. Is the discharge a "new discharge" as defined by 40 CF. For sites in Massachusetts, is the discharge covered uncermitting? Y O N O	i. Is the discharge a "new discharge" as defined by 40 CFR 122.2? Y O N O For sites in Massachusetts, is the discharge covered under the Massachusetts Contingency Plan (MCP) and exempt from state bermitting? Y O N O
by Is site/facility subject to any State permitting, license, or other action which is causing the generation of lischarge? Y O N O	f) Is the site/facility covered by any other EPA permit, including: 1. Multi-Sector General Permit? Y O N O, if Y, number:
I Y, please list: I. site identification # assigned by the state of NH or MA:	if Y, number: 3. EPA Construction General Permit? Y O N O
2. permit or license # assigned: 3. state agency contact information: name, location, and	if Y, number: 4. Individual NPDES permit? Y O N O,
elepnone number:	11 Y, number: 5. any other water quality related individual or general permit? Y O N O, if Y, number:
J Is the site/facility located within or does it discharge to	Is the site/facility located within or does it discharge to an Area of Critical Environmental Concern (ACEC)? YONO
1) Based on the facility/site information and any historicalischarge falls.	Based on the facility/site information and any historical sampling data, identify the sub-category into which the potential charge falls.
Activity Category	Activity Sub-Category
- Petroleum Related Site Remediation	A. Gasoline Only Sites B. Fuel Oils and Other Oil Sites (including Residential Non-Business Remediation Discharges) C. Petroleum Sites with Additional Contamination
I - Non Petroleum Site Remediation	A. Volatile Organic Compound (VOC) Only Sites B. VOC Sites with Additional Contamination C. Primarily Heavy Metal Sites
II - Contaminated Construction Dewatering	A. General Urban Fill Sites B. Known Contaminated Sites

IV - Miscellaneous Related Discharges	A. Aquifer Pump Testing to Evaluate Formerly Contaminated Sites
2. Discharge information. Please provide information about the discharge, (attaching) Describe the discharge extraction to dis	2. Discharge information. Please provide information about the discharge, (attaching additional sheets as necessary) including:
a) Describe the discretize activities for which the Owner all Dewatering for construction activities. Hydrostatic testing and disin	static testing and disinfection of new water pipeline.
b) Provide the following information about each discharge:	
1) Number of discharge 2) What is the maximum and aver points: Catch Basins along route Average flow (include units) 0.2453	2) What is the maximum and average flow rate of discharge (in cubic feet per second, ft ³ /s)? Max. flow 0.4683 Is maximum flow a design value? Y O N O Average flow (include units) 1. Is average flow a design value or estimate? 1.
3) Latitude and longitude of each discharge within 100 feet: pt.1: lat 42°29'75.8"N long 71° 056.17"W pt.2: lat. 42°29'12.349"N pt.3: lat 42°29'7.66"N long 71° 18.88"W pt.6: lat. 42°29'1.50"N pt.7: lat long 100 pt.8: lat. 42°29'1.50"N	2°29'13.49"N long. 71° 1'10.99"W ; 2°29'13.49"N long. 71° 1'11.23"W ; 2°29'1.50"N long. 71° 1'14.87"W ; long. long. ? • etc.
4) If hydrostatic testing, total volume of the list ongoing? Y O N O discharge (gals): 238852	ttent O or seasonal O? O N O
c) Expected dates of discharge (mm/dd/yy): start 4/2011	end 10/2012
d) Please attach a line drawing or flow schematic showing water flow through the facility including: 1. sources of intake water. 2. contributing flow from the operation. 3. treatment units, and 4. discharwaters(s) SEE ATTACHED	d) Please attach a line drawing or flow schematic showing water flow through the facility including: 1. sources of intake water. 2. contributing flow from the operation. 3. treatment units, and 4. discharge points and receiving waters(s) SEE ATTACHED

3. Contaminant information.

a) Based on the sub-category selected (see Appendix III), indicate whether each listed chemical is believed present or believed absent in the potential discharge. Attach additional sheets as needed.

value	mass (kg)													
Average daily value	concentration (ug/l)	175,300		141.14		23.26		28.39		34.2	97.81		158.5	
ly value	mass (kg)													
Maximum daily value	concentration (ug/l)	424,000		287		69.2		99		126	402		371.0	
Minimum	$\frac{\text{Level}}{(\text{ML}) \text{ of}}$ $\frac{\text{Test}}{\text{Method}}$	4000	162	247	19.7	2	2	5		വ	5	2	9	
Anolytical	Method Used (method #)	SM2540	HACH 8167	8100M	SM4500	8260B	8260B	8260B		8260B	8260B	8260B	MADEP VPH	
Complo	Type (e.g., grab)	Grab	Grab	Grab	Grab	Grab	Grab	GRAB		GRAB	GRAB	Grab	GRAB	
	# of Samples	9 (3 Detecte Grab	6	9 (3 Detecte Grab	6	9 (3 Detected)	6	9 (5 Detected)		9 (5 Detecte GRAB	9 (5 Detected)	6	9 (3 Detecte	
	Believed Present	×		×		×		×	[×	×		×	
	Believed Absent		×		×		×		I			×		×
	CAS				57125	71432	108883	100414	108883; 106423;	95476; 1330207	n/a	106934	1634044	75650
	Parameter *	1. Total Suspended Solids (TSS)	2. Total Residual Chlorine (TRC)	3. Total Petroleum Hydrocarbons (TPH)	4. Cyanide (CN)	5. Benzene (B)	6. Toluene (T)	7. Ethylbenzene (E)	8. (m,p,o) Xylenes (X)		9. Total BTEX ²	10. Ethylene Dibromide (EDB) (1,2-Dibromoethane) ³	11. Methyl-tert-Butyl Ether (MtBE)	12. tert-Butyl Alcohol (TBA) (Tertiary-Butanol)

^{*} Numbering system is provided to allow cross-referencing to Effluent Limits and Monitoring Requirements by Sub-Category included in Appendix III, as well as the Test Methods and Minimum Levels associated with each parameter provided in Appendix VI.

² BTEX = Sum of Benzene, Toluene, Ethylbenzene, total \dot{X} ylenes. ³ EDB is a groundwater contaminant at fuel spill and pesticide application sites in New England.

NPDES Permit No. MAG910000 NPDES Permit No. NHG910000

					Samule	Analytical	Minimum	Maximum daily value	ly value	Average daily value	value
Parameter *	CAS Number	Believed Absent	Believed Present	# of Samples	Type (e.g., grab)	Method Used (method #)	Level (ML) of Test Method	concentration (ug/l)	mass (kg)	concentration (ug/l)	mass (kg)
13. tert-Amyl Methyl Ether (TAME)	9940508	×									
14. Naphthalene	91203		×	9 (3 Detected)	Grab	8270C	1.08	66.30		23.55	
15. Carbon Tetrachloride	56235	×		6	Grab	8260B	2				
16. 1,2 Dichlorobenzene (o-DCB)	95501	×		6	Grab	8260B	5				
17. 1,3 Dichlorobenzene (m-DCB)	541731	×		6	Grab	8260B	5				
18. 1,4 Dichlorobenzene (p-DCB)	106467	×		6	Grab	8260B	5				
18a. Total dichlorobenzene		×		6	Grab	8260B	5				
19. 1,1 Dichloroethane (DCA)	75343	×		6	Grab	8260B	5				
20. 1,2 Dichloroethane (DCA)	107062	×		6	Grab	8260B	2				
21. 1,1 Dichloroethene (DCE)	75354	×		6	Grab	8260B	5				
22. cis-1,2 Dichloroethene (DCE)	156592	×		6	Grab	8260B	5				
23. Methylene Chloride	75092	×		9	Grab	8260B	5				
24. Tetrachloroethene (PCE)	127184	×		6	Grab	8260B	5				
25. 1,1,1 Trichloro-ethane (TCA)	71556	×		6	Grab	8260B	5				
26. 1,1,2 Trichloro-ethane (TCA)	20062	×		6	Grab	8260B	5				
27. Trichloroethene (TCE)	79016	×		6	Grab	8260B	2				

aily value	m mass (kg)																
Average daily value	concentration (ug/l)							2.39	9.33								9.33
lly value	mass (kg)																
Maximum daily value	concentration (ug/l)							2.39	9.33								9.33
Minimum	$\frac{\text{Level}}{(\text{ML}) \text{ of}}$ $\frac{\text{Test}}{\text{Method}}$	2	50		1.08	1.08		1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08
Analytical	Method Used (method #)	8260B	8260B		8270C	8270C		8270C	8270C	8270C	8270C	8270C	8270C	8270C	8270C	8270C	8270C
Sample	<u>Type</u> (e.g., grab)	Grab	Grab		Grab	Grab		Grab	Grab	Grab	Grab	Grab	Grab	Grab	Grab	Grab	GRAB
	# of Samples	6	6		6	9		9 (1 Detecte	9 (1 Detecte Grab	6	6	6	6	6	6	6	9 (1 Detecte GRAB
	Believed Present							×	×								×
	Believed Absent	×	×	×	×	×	×			×	×	×	×	×	×	×	
	<u>CAS</u> Number	75014	67641	123911	108952	87865		117817		56553	50328	205992	207089	21801	53703	193395	
		28. Vinyl Chloride (Chloroethene)				32. Pentachlorophenol (PCP)	33. Total Phthalates (Phthalate esters) 4	34. Bis (2-Ethylhexyl) Phthalate [Di- (ethylhexyl) Phthalate]	35. Total Group I Polycyclic Aromatic Hydrocarbons (PAH)	a. Benzo(a) Anthracene	b. Benzo(a) Pyrene	c. Benzo(b)Fluoranthene	d. Benzo(k)Fluoranthene		f. Dibenzo(a,h)anthracene	g. Indeno(1,2,3-cd) Pyrene	36. Total Group II Polycyclic Aromatic Hydrocarbons (PAH)

⁴ The sum of individual phthalate compounds.

Page 15 of 22

Remediation General Permit Appendix V - NOI

NPDES Permit No. MAG910000 NPDES Permit No. NHG910000

					Samula	Analytical	Minimum	Maximum daily value	ly value	Average daily value	value
	CAS	Believed Absent	Believed Present	# of Samples	Type (e.g., grab)	Method Used (method #)	Level (ML) of Test Method	concentration (ug/l)	mass (kg)	concentration (ug/l)	mass (kg)
	83329	×		6	Grab	8270C	1.08				
	208968	×		6	Grab	8270C	1.08				
	120127	×		6	Grab	8270C	1.08				
Benzo(ghi) Perylene	191242	×		6	Grab	8270C	1.08				
	206440	×		6	Grab	8270C	1.08				
	86737		×	9 (1 detected)	Grab	8270C	1.08	1.4		1.4	
	91203		×	9 (1 detected	Grab	8270C	1.08	4.15		4.15	
	85018	×		6	Grab	8270C	1.08				
	129000	×		6	Grab	8270C	1.08				
	85687; 84742; 117840; 84662.	×		6	Grab	8082	.333				
37. Total Polychlorinated Biphenyls (PCBs)	131113;	4									
	16887006	×									
	7440360	×		6	Grab	60108	10				
	7440382		×	9 (4 detected)	Grab	60108	10	13.02		8.18	
	7440439	×		6	Grab	60108	100				
	16065831	×		6	Grab	60108	100				
12.19	18540299	×		6	Grab	SM3500	50				
	7440508		×	9 (1 detected)	Grab	60108	8	35		35	
	7439921		×	9 (5 detected)	Grab	60108	10	4,3		3.36	
	7439976	×		6	Grab	E245.1	0.2				
	7440020	×		6	Grab	60108	4				
	7782492	×		6	Grab	60108	50				
	7440224	×		6	Grab	E200.7	7				
	7440666	×									
-	7439896		×	9 (7 detected)		60108	09	21900		7480	
		×									

Page 16 of 22

Remediation General Permit Appendix V - NOI

						1 11 11	Minimum	Maximum daily value	faily value	Average daily value	value
Parameter *	CAS	Believed Absent	<u>Believed</u> <u>Present</u>	# of Samples	Type (e.g., grab)	Method Used (method #)	Level (ML) of Test Method	concentration (ug/l)	n mass (kg)	concentration (ug/l)	mass (kg)
b) For discharges where metals are believed present,	metals are	believe	d present, p	lease fill o	ut the follow	ing (attach	please fill out the following (attach results of any calculations):	y calculatior	s):		Γ
Step 1: Do any of the metals in the influent exceed the effluent limits in	netals in the	influen	t exceed the	effluent l	imits in	If yes, v	If yes, which metals?	۷.			
Appendix III (i.e., the limits set at zero dilution)? Y O N O	limits set at	zero dilı	ution)? Y 6	ON		Lead, arse	Lead, arsenic, copper and iron	d iron			
Step 2: For any metals which exceed the Appendix III limits, calculate the dilution factor (DF) using the formula in Part I.A.3.c (step 2) of the NOI instructions or as determined by the State prior to the submission of this NOI	which excesing the formined by the	ed the A	ppendix II Part I.A.3.c	I limits, ca (step 2) of	III limits, calculate the constant of the NOI enhance of this NOI	Committee of the	Look up the limit calculated at the corresponding dilution factor in Appendix IV. Do any of the metals in the influent have the potential to exceed the corresponding	culated at the IV. Do any	e correspond of the metals	ing dilution in the	
What is the dilution factor for applicable metals?	ctor for app	plicable n	etals?				effluent limits in Appendix IV (i.e., is the influent	pendix IV (i	e., is the inflat the calcula	uent uent	
Metal: Arsenic		DF 500	_			factor)?					
Metal: Copper		DF 260				⊙ ≻	Y O N O If Y, list which metals:	list which n	netals:		
Metal: Iron		DF 5000									
Etc.											_
4. Treatment system information. Please describe the treatment system using separate sheets as necessary, including:	nformation	. Please	describe th	e treatmen	t system usir	ng separate	sheets as nec	essary, inch	iding:		Г
a) A description of the treatment system, including a schematic of the proposed or existing treatment system:	treatment s	system, i	ncluding a s	schematic	of the propos	sed or exist	ing treatment	system:			
The treatment system will consist of the following components: a frac tank to remove readily settleable sediment and metals. Floc logs which are non-hazardous polymer blocks may be placed in the tank to enhance sediment deposition. This will be followed by bag filters to remove finer solids down to 25 micron followed by	onsist of the	following k to enhar	components:	a frac tank t deposition.	o remove read This will be foll	ily settleable lowed by bac	sediment and gillers to remo	metals. Floc lo	gs which are no down to 25 mi	on-hazardous cron followed by	. 4
granular activated carbon (GAL) to remove VOLs and trace dissolved metals. Final treated enlinent will be added prior to the frac tank in the event separate-phase product is encountered.	oarator will be	ve vous a added pi	nd trace disso	tank in the	event separate	e-phase prod	uct is encounte	ered.	Catch Dasins at	מווא נווב ובוואנוו כ	- 1
b) Identify each	Frac. tank 🗵		Air stripper \square		Oil/water separator \square	or \Box	Equalizatio	Equalization tanks Bag filter	3ag filter ⊠	GAC filter 🗵	N.
applicable treatment unit (check all that apply):	Chlorination		De- chlorination		r (please desc	cribe): Floc	Other (please describe): Floc logs (non-toxic polymer) - MSDS attached.	: polymer) - MS	DS attached.		

NPDES Permit No. MAG910000 NPDES Permit No. NHG910000

d) A description of chemical additives being used or planned to be used (attach MSDS sheets):
Flog locs if needed to enhance settling of suspended solids in frac tank. Calcium hypochlorite during hydrostatic testing for disinfection. Sodium thiosulfate to neutralize the disinfectant before discharge.
5. Receiving surface water(s). Please provide information about the receiving water(s), using separate sheets as necessary:
a) Identify the discharge pathway: Direct to receiving receiving water water with a cility receiving water water water with a cility receiving re
b) Provide a narrative description of the discharge pathway, including the name(s) of the receiving waters: Nearest catch basin that discharges to Hawkes Brook (#1-4) and Saugus River (#5-6)
c) Attach a detailed map(s) indicating the site location and location of the outfall to the receiving water: 1. For multiple discharges, number the discharges sequentially. 2. For indirect dischargers, indicate the location of the discharge to the indirect conveyance and the discharge to surface water. The map should also include the location and distance to the nearest sanitary sewer as well as the locus of nearby sensitive receptors (based on USGS topographical mapping), such as surface waters, drinking water supplies, and wetland areas.
d) Provide the state water quality classification of the receiving water SB
e) Provide the reported or calculated seven day-ten year low flow (7Q10) of the receiving water 33.6 Please attach any calculation sheets used to support stream flow and dilution calculations.
f) Is the receiving water a listed 303(d) water quality impaired or limited water? Y O N O If yes, for which pollutant(s)?
Is there a final TMDL? Y O N O If yes, for which pollutant(s)? Fecal coliform - turbidity

ty.
igibili
PA EI
HN P
SA an

Please provide the following information according to requirements of Permit Parts I.A.4 and I.A.5 Appendices II and VII.

a) Using the instructions in Appendix VII and information on Appendix II, under which criterion listed in Part I.C are you eligible for

coverage under this general permit?

A O B O C O D O E O F O

b) If you selected Criterion D or F, has consultation with the federal services been completed? Y O N O Underway O

c) If consultation with U.S. Fish and Wildlife Service and/or NOAA Fisheries Service was completed, was a written concurrence finding that the discharge is "not likely to adversely affect" listed species or critical habitat received? Y O N O

d) Attach documentation of ESA eligibility as described in the NOI instructions and required by Appendix VII, Part I.C, Step 4.

- e) Using the instructions in Appendix VII, under which criterion listed in Part II.C are you eligible for coverage under this general permit? 1 0 2 0 3 0
- and conditions that outline measures the applicant must follow to mitigate or prevent adverse effects due to activities regulated by the RGP. f) If Criterion 3 was selected, attach all written correspondence with the State or Tribal historic preservation officers, including any terms

7. Supplemental information.

Please provide any supplemental information. Attach any analytical data used to support the application. Attach any certification(s) required by the general permit. 8. Signature Requirements: The Notice of Intent must be signed by the operator in accordance with the signatory requirements of 40 CFR Section 122.22, including the following certification: I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I certify that I am aware that there are person or persons who manage the system, or those persons directly responsible for gathering the information, I certify that the significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

YNNFIELD/SAUGUS PIPELINE PROJECT	Afflaner		
Facility/Site Name: MWRA CONTRACT NO. 6584 - LYNNFIELD/SAUGUS PIPELINE PROJECT	Operator signature: Much A	Printed Name & Title: Marcella Albanese, President	Date: 05/25/11

B. Submission of NOI to EPA - All operators applying for coverage under this General Permit must submit a completed Notice of Intent (NOI) to EPA. Signed and completed NOI forms and attachments must be submitted to EPA-NE at:

U.S. Environmental Protection Agency 5 Post Office Square, Suite 100 Mail Code OEP06-4 Boston, MA 02109-3912 ATTN: Remediation General Permit NOI Processing

or electronically mailed to NPDES.Generalpermits@epa.gov

or faxed to the EPA Office at 617-918-0505

If filling out the suggested NOI form electronically on EPA's website, the signature page must be signed and faxed or mailed to EPA at the fax number and/or address listed above.

- <u>1. Filing with the states</u> A copy of any NOI form filed with EPA-NE must also be filed with state agencies. The state agency may elect to develop a state specific form or other information requirements.
- a) <u>Discharges in Massachusetts</u> In addition to the NOI, permit applicants must submit copies of the State Application Form BRPWM 12, Request for General Permit coverage for the RGP. The application form and the Transmittal Form for Permit Application and Payment may be obtained from the Massachusetts Department of Environmental Protection (MassDEP) website at www.state.ma.us/dep. Municipalities are fee-exempt, but should send a copy of the transmittal form to that address for project tracking purposes. All applicants should keep a copy of the transmittal form and a copy of the application package for their records.
 - 1) A copy of the NOI, the transmittal form, a copy of the check, and Form BRPWM 12 should be sent to:

Massachusetts Department of Environmental Protection Division of Watershed Management 627 Main Street, 2nd floor Worcester, MA 01608

2) A copy of the transmittal form and the appropriate fee should be sent to:

Massachusetts Department of Environmental Protection P.O. Box 4062 Boston, MA 02111

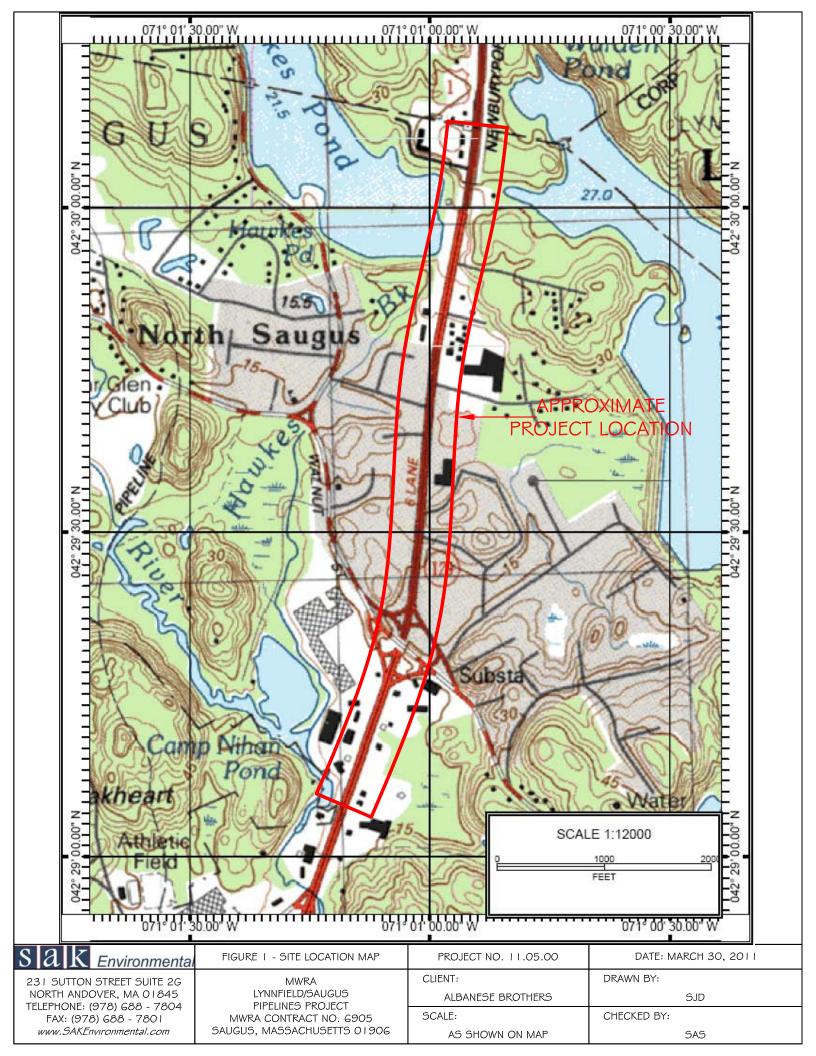
Please note: Applicants for discharges in Massachusetts should note that under 310 CMR 40.000, as a matter of state law, the general permit only applies to discharges that are **not** subject to the

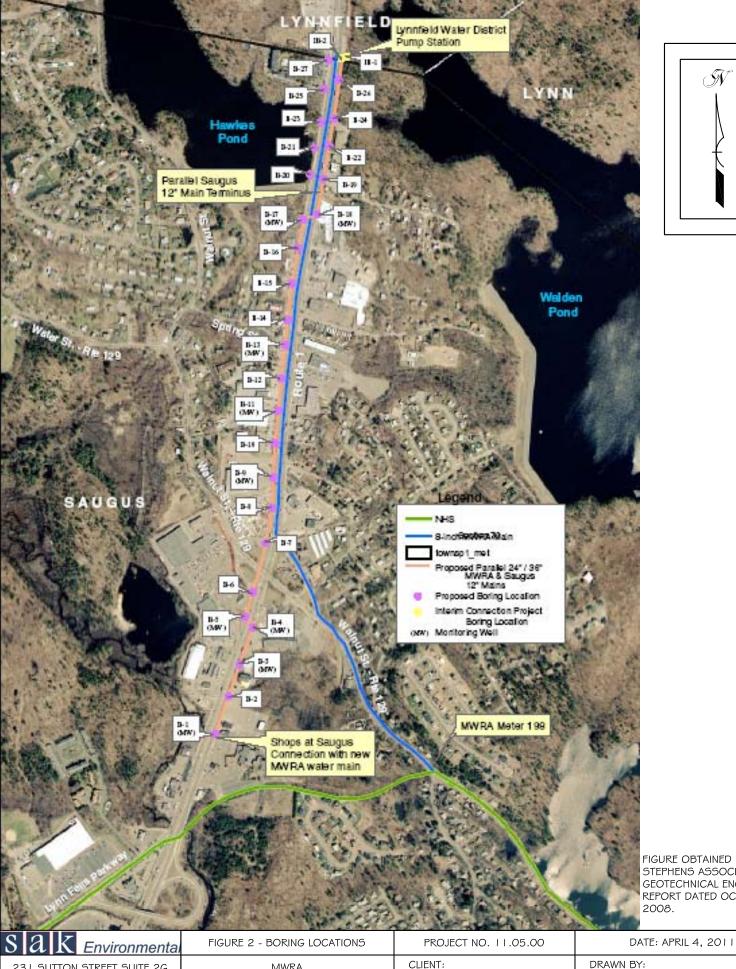
Massachusetts Contingency Plan (MCP) and 310 CMR 40.000. Therefore, discharges subject to the MCP are **not** required to fill out and submit the State Application Form BRPWM 12 or pay the state fees. However, they must submit a NOI to EPA.

b) <u>Discharges in New Hampshire</u> - applicants must provide a copy of the Notice of Intent to:

New Hampshire Department of Environmental Services Water Division Wastewater Engineering Bureau P.O. Box 95 Concord, New Hampshire 03302-0095.

<u>2. Filing with Municipalities</u> - A copy of the NOI must be submitted to the municipality in which the proposed discharge would be located.





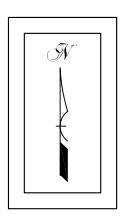


FIGURE OBTAINED FROM STEPHENS ASSOCIATES GEOTECHNICAL ENGINEERING REPORT DATED OCTOBER 6, 2008.

23 I SUTTON STREET SUITE 2G NORTH ANDOVER, MA 01845 TELEPHONE: (978) 688 - 7804 FAX: (978) 688 - 780 I www.SAKEnvironmental.com

MWRA LYNNFIELD/SAUGUS PIPELINES PROJECT MWRA CONTRACT NO. 6905 SAUGUS, MASSACHUSETTS 01906

ALBANESE BROTHERS INC.

NTS

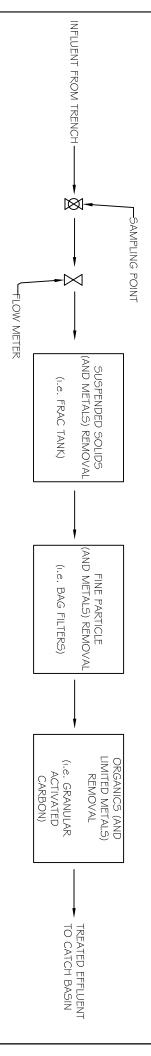
SCALE:

DRAWN BY:

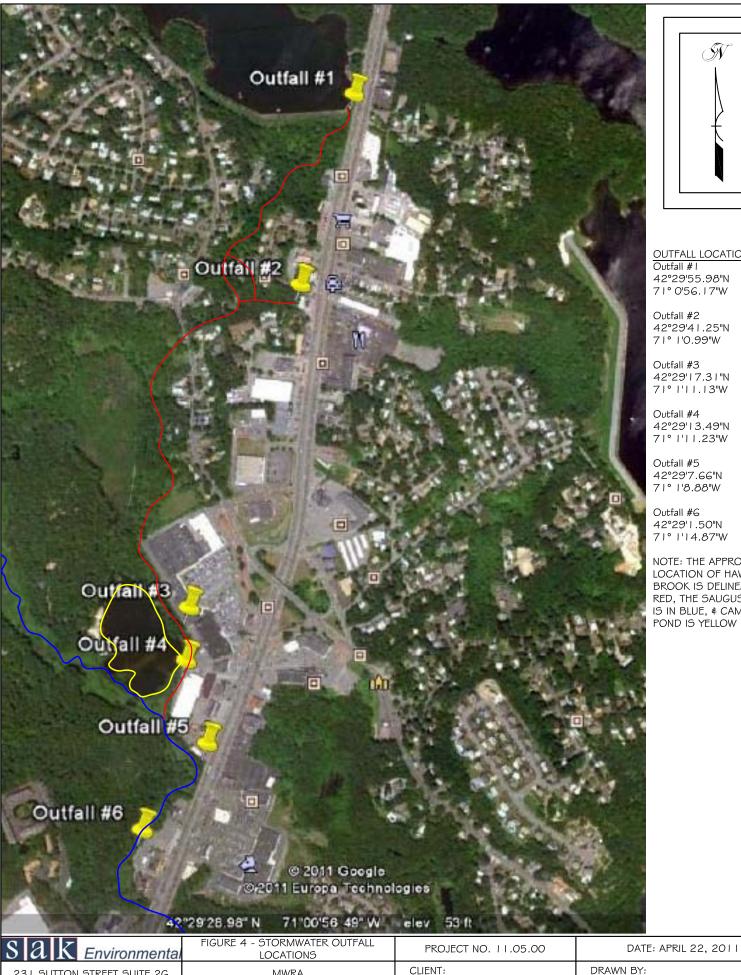
CHECKED BY:

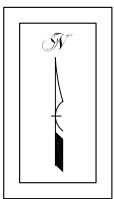
SAS

MPG



SAS	NTS	SAUGUS, MASSACHUSETTS 01906	www.SAKEnvironmental.com
CHECKED BY:	SCALE:	MWRA CONTRACT NO. 6905	FAX: (978) 688 - 7801
MPG	ALBANESE BROTHERS INC.	LYNNFIELD/SAUGUS	NORTH ANDOVER, MA 01845
DRAWN BY:	CLIENT:	MWRA	23 I SUTTON STREET, SUITE 2G
DATE: MAY 20, 2011	PROJECT NO. 11.05.00	FIGURE 3 - GROUNDWATER TREATMENT SYSTEM SCHEMATIC	S 2 K Environmental TREATMENT SYSTEM SCHEMATIC





OUTFALL LOCATIONS Outfall # I 42°29'55.98"N 71° 0'56.17"W

Outfall #2 42°29'41.25"N 71° 1'0.99"W

Outfall #3 42°29'17.31"N 71° 1'11.13"W

Outfall #4 42°29'13.49"N 71° 1′11.23″W

Outfall #5 42°29'7.66"N 71° 1'8.88"W

Outfall #6 42°29'1.50"N 71° 1′14.87"W

NOTE: THE APPROXIMATE LOCATION OF HAWKES BROOK IS DELINEATED IN RED, THE SAUGUS RIVER IS IN BLUE, & CAMP NIHAN POND IS YELLOW

23 | SUTTON STREET SUITE 2G NORTH ANDOVER, MA 01845 TELEPHONE: (978) 688 - 7804 FAX: (978) 688 - 7801 www.SAKEnvironmental.com

MWRA LYNNFIELD/SAUGUS PIPELINES PROJECT MWRA CONTRACT NO. 6905 SAUGUS, MASSACHUSETTS 01906

ALBANESE BROTHERS INC.

SCALE:

NTS

DRAWN BY:

MPG CHECKED BY:

SAS

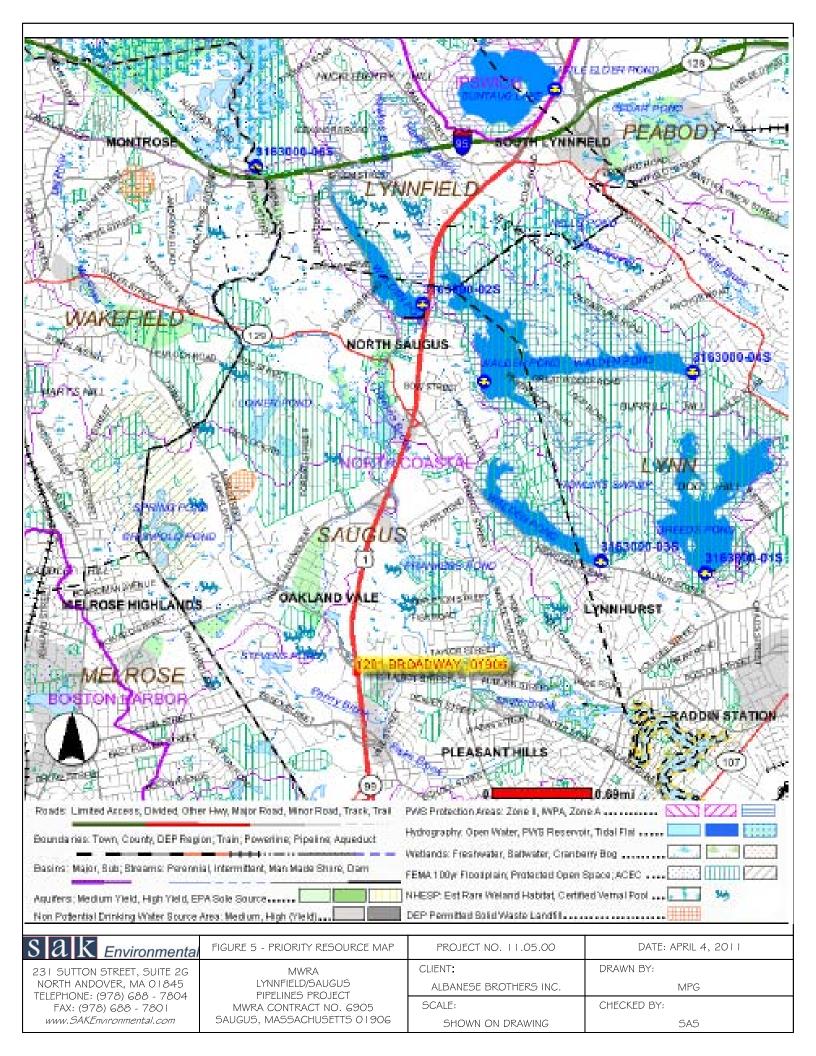


TABLE 1: FROM APPENDIX IV

TOTAL RECOVERABLE METALS LIMITATIONS (ug/L) AT SELECTED DILUTION RANGES AND TECHNOLOGY BASED CEILING LIMITATIONS

FOR FACILITIES LOCATED IN MASSACHUSETTS (for discharges to freshwater at H = 50 mg/L CaCO3)¹

		DI	LUTION RAI	NGE CONCE	NTRATION		Boring L	ocations
PARAMETER	0 - 5	5 to 10	10 to 50	50 - 100	>100	CEILING VALUE	Maxium	Average
1. Antimony	5.6	30	60	141	141	141 ¹		
2. Arsenic	10	50	100	500	540	540 ²	13	5.91
3. Cadmium	0.2	1	2	10	20	260 ³		
4. ChromiumIII (Trivalent)	48.8	244	489	1710	1710	1710		
5. ChromiumVI (Hexavalent)	11.4	57	114	570	1140	1710 ⁴		
6. Copper	5.2	26	52	260	520	2070		
7. Lead	1.3	6.5	13	66	132	430	37	35
8. Mercury	0.9	2.3	2.3	2.3	2.3	2.3 ⁵		
9. Nickel	29	145	290	1451	2380	2380		
10. Selenium	5	25	50	250	408	408 ⁶		
11. Silver	1.2	6	12	57	115	240		
12. Zinc	66.6	333	666	1480	1480	1480		
13. Iron	1000	5000	5000	5000	5000	5000	21900	7480

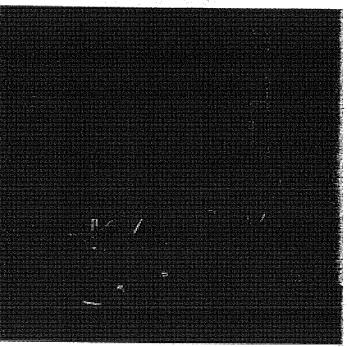
Note: Empty cells represents values below detection limits.

- 1.Based on 7Q10 Flow.
- 2.Based on 40 CFR 437.42, "The Centralized Waste Treatment Point Source Category Subpart D Multiple Wastestreams -Best Practicable Control Technology" (BPT) daily maximum for Antimony
- 3.Based on 40 CFR 445.11, "RCRA Subtitle C Landfill Best Practicable Control Technology" (BPT) for Arsenic.
- 4. Assumes Hexavalent Chromium reduced to Tri-valent Chromium in treatment.
- 5.Based on 40 CFR 437.42, "The Centralized Waste Treatment Point Source Category Subpart D Multiple Wastestreams -Best Practicable Control Technology" (BPT) daily maximum for Mercury
- 6.Based on 40 CFR 437.42, "The Centralized Waste Treatment Point Source Category Subpart D Multiple Wastestreams -Best Practicable Control Technology" (BPT) daily maximum for Selenium

Appendix A FST Hazardous Material Assessment Technical Memorandum

MASSACHUSETTS WATER RESOURCES AUTHORITY





$\frac{\text{HAZARDOUS MATERIAL ASSESSMENT TECHNICAL}}{\text{MEMORANDUM}}$

LYNNFIELD/SAUGUS PIPELINES PROJECT MWRA CONTRACT NO. 6905

> FST PROJECT NO. WM-046 SEPTEMBER 26, 2008

> > ENGINEERS
> >
> > Since 1914

1. INTRODUCTION

In accordance with the Massachusetts Water Resources Authority's (MWRA) Site Assessment Process for Identifying Hazardous Material; Fay, Spofford & Thorndike (FST) has prepared this Hazardous Material Assessment Memorandum for the Lynnfield/Saugus Pipelines Project. The assessment examined the potential for hazardous chemicals to exist within the soils and groundwater along the pipeline route. This will provide useful information to assist with the design and construction of the pipelines.

To perform the hazardous materials assessment, the following sources were reviewed and subsequent activities performed:

- First Search Technology Corporation (FirstSearch) Database. The database reports identified Massachusetts Department of Environmental Protection (MADEP)-listed sites and spills, Comprehensive Environmental Response Compensation and Liability Act (CERCLA) sites, Resource Conservation and Recovery Act (RCRA) generators, and emergency response notifications. The report was prepared in accordance with ASTM E1903-97 (2002) Standard Guide for Environmental Site Assessments: Phase II Environmental Site Assessment Process.
- MADEP file review was completed to research additional information in MADEP files regarding known releases at disposal sites in the Project Area identified with their release tracking number (RTN).
- Soil borings at twenty-seven (27) locations were drilled and continuously sampled with splitspoon sampling. Each split spoon sample was screened with a photo ionization detector (PID) for the presence of volatiles; and based upon these results and the presence of contamination evidence, soil samples were selected for laboratory analysis.
- At nine (9) of the boring locations, monitoring wells were installed and groundwater samples collected.

2. RESULTS

2.1 First Search and File Review

Based on review of the First Search Database and file review, the following Table 1 lists the sites of environmental concern that were incorporated into the boring program. The list includes:

- > Sites adjacent to the alignment that are currently either under active investigation or remediation,
- > Sites with a Release Action Outcome (RAO) status indicating contamination levels greater than background, and
- > Properties with either current or past land uses with potential to cause contamination.

WM-046 MWRA Lynnfield/Saugus Pipeline Project Contract 6905 Hazardous Material Assessment Technical Memorandum . . Ċ 1 6 : À **+1** 11. ÷ 4:0 ر ا Table 1.

		Table 1: Locations along the Alignment with the Potential for Contamination	long the A	lignment	with th	e Potential for (onfamination	
	Address	Site Name	MA DEP RTN#. '	Status & Class(a)	Phase (b)	Chemical Type	Comment	Associaled Boring
DEP-listed	595 Broadway, Saugus	Currently Kelly's Road Beef	3-0004725	HAO-A3		Oil	South of project limits.	B-1 (MW) at
siles	421 Broadway, Saugus	Commercial Property	3-0002497	RAO-A2		lio	South of project limits. Former Texaco gasoline Station. Site of concern because of RAO class.	southern end of project
	368 Broadway, Saugus	Currently Exxon Gasoline Station	3-0026940	RAO-A1		Hazardous Material		- limits to
	368 Broadway, Saugus	Currently Exxon Gasoline Station	3-0015053	RAO	ΛI	Oil	Otto conversal brandend food assult of period limits	screen ior potential
	368 Broadway, Saugus	Exxon Gasoline Station #35879	3-0011735	FAO-C1	۸I	Oil	one several number reet south of project firms.	issues from
	368 Broadway, Saugus	Exxon Gasoline Station #35879	3-0002215	RAO-A2	Λ	Hazardous Malerial		these sites
	300 Broadway, Saugus	Saugus Animal Hospital	3-0021199	RAO-A1		Oil & Hazardous Material	Site of concern because of RAO class and phase.	that are larther south.
	300 Broadway, Saugus	Saugus Animal Hospital	3-0014356	HAO-A2	=	Oil & Hazardous Material		ı
	220 Broadway, Saugus	Merit Oil Stalion	3-0003019	RÁO-A2	=	Hazardous Malerial	Site currently Hess Gasoline Station. Site of concern because of RAO class and phase.	B-3 (MW)
-1	212 Broadway, Saugus	STAR	3-0016856	RAO-A2	=	Hazardous Material	Former Texaco site and site of concern because of RAO class and phase of concern.	. B-4 (MW)
	209 Broadway, Saugus	Salvation Army	3-0017338	RAO-A2		Oil & Hazardous Material	Site of concern because of RAO class and phase.	B-11 (MW)
	190 Broadway	RTE 1 N @ Walnut Street	3-0010122	RAO-A1		liO	Spill	B-11 (MW)
	86 Broadway, Saugus	RTE 1	3-0022140	RAO-A1			Spill	B-17 (MW)
Sec 11-41-5 - Annahaman A	66 Broadway, Saugus	Currently U-Haul Site	3-0010309	RAO-A2	=	liO	Currently U-Haul site. Site of concern because of RAO class and phase.	B-18 (MW)
	8 Broadway, Lynnfield	NO LOCATION AID	3-0018741	RTN CLOSED		liO	North and down gradient of LWD Pump Station.	B-26
	8 Broadway, Lynnlield	Exxon Gasoline Station	3-0023299	RTN CLOSED		Hazardous Material		B-26
	141 Broadway	Former Towing yard				Small Quantity Hazardous Waste Generator	Possible service station at some time.	B-13 (MW)
	24-28 Broadway, Lynnfield	RESTAURANT	3-0001842	DEPNDS				B-24
Land Use	421 Broadway, Saugus	Opposite Former Texaco Site					Due to land use, site was chosen for boring	B-2
Concerns	421 Broadway, Saugus	Opposite Former BP Gas Site					Due to land use, site was chosen for boring	B-8
***************************************	421 Broadway, Saugus	Adjacent Former Gulf Site				•	Due to land use, site was chosen for boring	B-12
	421 Broadway, Saugus	Adjacent to Owen Motors					Due to land use, site was chosen for boring	B-15/B-16

⁽a) RAO = Response Action Outcome: A1=Contamination has been reduced to background or threat of release has been eliminated: A2=Contamination has not been reduced to background, and an Activity and Use Limitation has been implemented. DEPNDS=DEP Not a Disposal Site.
(b) II=Comprehensive Site Assessment. III=Identification. Evaluation, and Selection of Comprehensive Remedial Action Alternatives and the Remedial Action Plan. IV=Implementation of the Selected Remedial Action Alternative and Remedy Implementation Plan.

WM-046 MWRA Lynnfield/Saugus Pipeline Project Contract 6905

7

Hazardous Material Assessment Technical Memorandum

2.2 Field Program Design & Implementation

The field program was designed to evaluate the areas of concern and general contamination problems. A boring was placed near every site listed in Table 1- Locations Along the Alignment with the Potential for Contamination. Boring B-1 was placed at the southern end of the project area to test for contamination from sites outside of, but close to the project area. Monitoring wells were placed in select borings to test water quality. Borings not listed in the Table 1 were located to provide appropriate structural information for the pipeline route. Locations of the borings can be seen on the attached Figure, "Proposed Boring Locations".

Soil samples collected by split spoon method were collected every two feet and the soil was described. All samples were screened for volatiles by the headspace method using a photo ionization detector (PID). The soil samples for laboratory analysis were collected from the borings with monitoring wells. Any sample exhibiting anomalous PID readings was collected from the borings. Groundwater samples collected from the monitoring wells were sampled and analyzed at an approved lab for the constituents listed in Table 2.

Table 2 List of Laboratory Analyses

Soil	Analytical Method	Groundwater	Analytical Method
Volatile Organics	8260	Volatile Organics	RGP Appendix VI Methods
Semi-Volatile Organics	8270	Semi-Volatile Organics	11 .
TPH	GC/FID Mod 8100	TPH	11
VPH	MADEP*	VPH .	u
EPH	MADEP*	EPH	11
RCRA 8 Metals	6010, E200.7	PCBs	11
PCBs	8082	Cyanide	и
Conductivity	9050a	RCRA 8 Metals	ť
pН	E150.1/SW9045	Iron	tt
Ignitability	SW-846 method	Copper	11
Reactive Cyanide & Sulfide	SW-846 method	Antimony	
TCLP**	1311	Nickel	n .
		Hexavalent Chrome	ti .
*Full DEP method, providing aromatics, and individual PA		Total Suspended Solids	11
** Assumes full TCLP, orga approximately 10% of sample		Total Residual Chlorine	ti

2.3 Soil Analytical Results

Metals, petroleum hydrocarbons, PAHs and gasoline related Volatile Organic Compounds (VOCs) were detected in soil samples. Table 3 presents the results for detected contaminants including RCS-1 and RCS-2 valves for each analyte. RCS-1 standards apply to most of the alignment as it is within 500 feet of residentially zoned properties. Although commercial land use lines both sides of Route 1, the properties just behind the commercial strip are residential.

The results for metals and PAHs are generally consistent with urban fill numbers (Background Levels of Polycyclic Aromatic Hydrocarbons and Metals in Soil, Updates: Section 2.3 *Guidance for Disposal Site Risk Characterization*). In one sample total petroleum hydrocarbons (TPH) measured 1240 µg /kg. This exceeds the RCS-1 limit of 1000 µg/kg but does not exceed the RCS-2 limit of 3000 µg/kg. This sample was analyzed for VPH and EPH. No results exceeded RCS-1 standards. As TPH is utilized only if EPH and VPH analyses were not performed, the TPH results do not represent a reportable concentration. Arsenic measured 20.6 mg /kg in a sample from B-17 taken at a depth of 19-20 feet. Although this exceeds the RCS-1 and RCS-2 limit of 20 mg/kg, it is from below the depth of excavation for the project. Consequently, no soil sample from within the projected bounds of construction activities contained any contaminant that exceeded the applicable reporting concentrations.

Sample B3 S2 contained gasoline components but their concentrations did not exceed a reportable concentration. This sample also had high PID readings from the headspace analysis in the field. This boring was in front of the Hess gas station at 220 Broadway, Saugus.

2.4 Groundwater Analytical Results

Analyses of groundwater samples detected gasoline related compounds and lead. Table 4 presents the results for detected contaminants. The table presents reporting concentrations for GW-1 and GW-2 conditions. GW-1 applies on the northern end of the project near the reservoir and is applicable to borings B-17 to B-23. GW-2 conditions apply to the remainder of the project.

Lead concentrations in the samples from B9, B13 and B17 of 0.014, 0.033 and 0037 mg/l respectively exceeded the RCGW-1 and -2 standard of 0.010 mg/l. As the contaminant concentrations exceed the reporting standard, dewatering activities in these areas should be performed under a URAM.

Samples from B3, B5 and B9 contained gasoline contaminants at concentrations above the RCGW-1 standard but below the applicable RCGW-2 STANDARD. This includes benzene in all three samples and MtBE in two samples These concentrations do not trigger a URAM. However, the concentrations do exceed the standards for discharge under an NPDES Remediation General Permit (RGP).

The more restrictive regulatory limits are those that apply to an RGP. These limits will apply to the water quality of any dewatering discharge to a surface water body. Although contaminant concentrations may not exceed a reporting concentration that triggers a required initiation of a URAM, a voluntary initiation of a URAM provides the MWRA a mechanism to regulate dewatering

WM-046 MWRA Lynnfield/Saugus Pipeline Project Contract 6905

Hazardous Material Assessment Technical Memorandum discharges.

While the groundwater data indicates points of contamination, the information gathered to date does not allow for an accurate depiction of how far on either side of the point the contamination may extend. It is recommended that the final design scope include a more thorough review of DEP files on the contaminant sources, and an evaluation of potential effect of dewatering on groundwater contamination.

3. CONCLUSIONS

Although some contamination was found in the soil along the alignment, the concentrations are consistent with those seen in urban fill. The concentrations from within areas of construction fall below Massachusetts Contingency Plan (MCP) reportable concentrations and require no special handling. Construction through areas with above background contamination levels but below reporting concentrations will not require the work to be conducted as a Utility-Related Abatement Measure (URAM) under the MCP but will require that excess soil be managed and disposed of in such a manner that complies with the anti-degradation requirements of the MCP. Any soil removed from the project must be reused either in a setting with similar contamination concentrations or as daily cover at a landfill. It is the practice of the MWRA to require restricted disposal of such mildly contaminated soil to a landfill or approved fill site under the oversight of a Licensed Site Professional (LSP).

Detected concentrations above the applicable reporting concentration trigger a URAM under the MCP for pipeline projects. The lab results from the soil sampling detected levels of some contaminants but at low levels. However, only arsenic in one sample exceeded its reporting concentration for this setting (RCS-2) and it exceeded it by less than 1 mg/kg. This sample was taken at a depth below that of the proposed construction activities.

Groundwater results detected VOC levels above reportable concentrations at several locations. It is recommended that dewatering activities in any area with detected gasoline contaminants be undertaken under the auspices of a URAM. In areas with concentrations above the RC, a URAM is needed for dewatering. In areas where the concentrations do not exceed the RC, it should be anticipated that dewatering might draw in contaminants resulting in concentrations that do exceed the RCs. Table 5 provides a summary of groundwater borings which exceed GW1 standards and/or are an area that should be watched.

A National Pollutant Discharge Elimination System (NPDES) Remediation General Permit (RGP) would be required for this project due to contaminants in groundwater above RGP thresholds, in additional to the NPDES general permit for construction dewatering. Treatment under the RGP may be decided to be site specific as contaminant levels and chemicals are not consistent at all monitoring well locations. A sampling program during dewatering activities that is overseen by an LSP is recommended as a gauge for treatment options.

As with all construction projects, it is the responsibility of the contractor to ensure the health and safety of its workers.

WM-046 MWRA Lynnfield/Saugus Pipeline Project Contract 6905 Hazardous Material Assessment Technical Memorandum

Hazardous Material Assessment Technical Memorandum

				4	Lane	Soum	Miai 1	אבת הא	JII AII	laryuc	Summarized Son Analytical Results	Suits						-		-	
		Sample Identification	nification	S-8 18.	I-S 68	2-S EB	C-S C8	1-S 78	2-S 58 	82 2-5 82 2-5	7-S 69	118	815 2-t	619	918	7-S 218	9-S	818 S-2	7-S	2-5 853	2-3 852
	Depth	Depth (below ground surface)	surface)	3-5,	1-3	3-5	5-7	1-3	3-5	3-5' 7-9'	9, 3-5	7-9				7-9.	19-20.	3-5.	5-7	3-4'	7-9.
	Reportable	Reportable Concentrations					-	-	-	١.	-										
Metals	S	ZS .	Units			7 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2								1							
	100	200	mo/kg			-		5.	5.39					_	2.7				_		
Arsenic	20	R	ma/ka			ŀ			<u> </u>								20.6				
Barium	1.000	3,000	ma/kg	15.2	11.4	13.2	=	11.9	13.3			29.1	14.1	25			12.9	22.4			
Cadmium	2	30	ma/ka		T			-			1.33	├-	1.47	1.38	1.65		1.58			-	
Chromium (total)	8	200	ma/ka		T	26.9		-		-		┼	+-		22.5			23.5		<u> -</u>	
Lead	300	300	marka			-		-						29.1				88.9			
Mercury	8	99	marka							-				0.132				0.696			
Petroleum Hydrocarbons																					
	1000	3000	mg/kg						-											1240	
MADEP EPH & SVOCs																					
53	1000	3000	mg/kg										115							145	
C09-C18 Aliphatics	000'1	3000	mg/kg																	15.5	
C19-C36 Aliphatics	3000	5,000	mg/kg				1221													197	
Unadjusted C11-C22 Aromatics			µg/L										115						-	145	
Methylnaphthalene, 2-	700	90,000	пд/ка			154						-							1	-	
Benz(a)anthräcene	2000	40,000	µg/kg	22.8				31	4.			-	17.8	22.3				13.1	+	14.3	
Benzo(a)pyrene	2000	4,000	µg/kg	28.9				38	38.8	-		-	43.9	22.3							T
bis(2-Ethylhexyl)phthalate	200,000	000'002	μg/kg	113				ਲ	39	+		-	+					1230		274	
Dibenz(a,h)anihracene	DQ.	4000	µg/kg						-	-		-	21.7	12.5					+	+	
Indeno(1,2,3-cd)pyrene	7000	40,000	ug/kg	18.9				15	19.7		_		-	22.3					-		
																				-	
Adjusted C5-C8 Aliphatic Hydrocarbons	91	200	mg/kg								_										
Adjusted C9-C12 Aliphatic Hydrocarbons	1,000	3000	mg/kg																-	1	
C9-C10 Aromalle Hydrocarbons	100	200	mg/kg				3.5			-									1	1	
M,p-Xylene	300,000	300,000	µg/kg						-		_		-			1		+			
Unadjusted C5-C8 Aliphatic Hydrocarbons			µg/kg			47.7				-	-		1						+		
Unadjusted C9-C12 Aliphatic Hydrocarbons			рд/ка			36.6															
Isopropyibenzene	1,000,00	10,000,000	р д/кд			469															
n-Butylbenzene	100,000	1,000,000	µg/kg			. 546						-						1	+	+	
n-Propyibenzene	100,000	1,000,000	р 9/кд			1050		-			-	-							+	1	
Sec-Butylbenzene			µg/kg			152					-	-					1		1	1	
Elhylbenzene	40,000	1,000,000	иg/kg			147						-	-					+	\dagger		
Ethylene dibromide	100	100	µg∕kg											_				+	+		Ī
Methyl ethyl ketone	4000	50,000	µg/kg								-	-							+	+	T
Methyl Tert-Butyl Ether	100	100,000	µg/kg				1000			_	_	-	_	_			114		-	-	T
SEQ.			The second																+	-	
Aroclor 1260	2000	3000	µg/kg	96.3				7	244		4	_	315	251				381	-		
Noie: blank values were "not detected"	34																				

Table 4 Summarized Groundwater Analytical Results

Metals	Repor	Reportable Concentrations	05127						-				
Metals	1		ations		GW2	GW2	GW2	GW2	GW2	GW2	GW2	GW2	GW2
Metals	HGP	GW1	GW2	Units						the state of the s			
				7									
Chromium (total)	48.8	0,1	0.3	l/gm									
Arsenic	10	0.01	6.0	l/gm					1	A TO SECURE SHEET AND SECURE SHEET			
Barium	-	2	50	l/gm						The state of the s		1	**
Cadmium	0.2	0.004	0.004	∏g/l					and commence contains the				
Lead	0.0013	0.01	0.01	l/gm							0.033	0.037	
Selenium	5.0	0.05	0.1	l/gm									
Mercury	6:0	0.002	0.02	mg/l									
Petroleum Hydrocarbons	ale de la companya de	***************************************											
Total Petroleum Hydrocarbons	5000	200	5000	µg/L		136							-
MADEP EPH			-						1			Lucian de la company de la com	
Adjusted C11-C22 Aromatics		200	5000	µg/L		·							
C09-C18 Aliphatics		700	5000	hg/L									
C19-C36 Aliphatics		14,000	50,000	µg/L				-					
Tolal PAH		200	1000	µg/L		9.33							
Naphthalene	20	140	1000	µg/L		3.48							
2-Methylnaphthalene				µg/L		5.85							
VPH and VOC							***	A					· · · · · · · · · · · · · · · · · · ·
Adjusted C5-C8 Aliphatic		300	3000	l µg/L		66			109		8 - Jan 100 BA 67-100		
Hydrocarbons									7 00			The second secon	
Adrocarbons		200	2000	hg/L	1	2.18			7:00				
C9-C10 Aromatic		200	7000	ng/L								-10	
Hydrocarbons		A CONTRACTOR OF THE CONTRACTOR				000		11.47	2023			10.7	
Xylene - mixed isomers	100	500	000	Hg/L		0.00		20.3	66.3		-		
Naphthalene	20	140	0001	hg/L		源水水水で		#15.A	製売の多数				
Benzene	5	5	2000	rg/L	**	A CA	AN .	65 T	65	5 98	40		
Ethylbenzene	100	700	2000			t.0t	4	4.68.4	1.551S			7.99	
Methyl Tert-Butyl Ether	70	70	2000	hg/L			-93	1000	2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2				
Toluene	100	1000	40,000	Hg/L		1		3	3		7 09	-	1
Isopropylbenzene		10,000	100,000	µg/L		14.7							
n-Butylbenzene		1000	10,000	hg/L		23.4					20.5		
n-Propylbenzene		1000	10,000	µg/L							70.6		
sec-Butylbenzene			7 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	µg/L			+			7.06	28.4		
1,3,5 Trimethylbenzene		100	1000	hg/L					25.1	11 0			
1,2,4 Trimethylbenzene			100,000	µg/L		13.9	SUPPLIES THE SECOND	9 1 3 11 12	.C. 2	2			
Bold = exceeds regulatory limit GW-2		nalics a exceeds regulation	Joy limit GW-1	Exceeds regulatory limit HGP	egulatory I	mit HGP	reaced	8 S					

Hazardous Material Assessment Technical Memorandum

> WM-046 MWRA Lynnfield/Saugus Pipeline Project Contract 6905.

B-8

Hazardous Material Assessment Technical Memorandum

7.99

40

37

7 96

65

66.5

49.4

hg/L hg/L

1000

7007

66.5

6.35

14.7

hg/L hg/L

100,000

0,000

000

00

Methyl Tert-Butyl Ether

Ethylbenzene

Isopropylbenzene

Toluene

000 000

4000

hg/L

10,000

10,000

7g Hg/I

hg/L

20.5 70.6 28.4

7.09

Exceeds GW-1 & GW-2

Exceeds regulatory limit RGP

Bold = exceeds regulatory limit GW-2 기계(S을 환경환한 Fégulatory limit 면까기

1,3,5 Trimethylbenzene 1,2,4 Trimethylbenzene

sec-Butylbenzene

n-Propylbenzene

n-Butylbenzene

13.9

hg/L hg/L

100,000

10,000

1000

100

25.1

10.7

B17(GW2) 212+35.51 B13 (GW2) 200+25.08 0.033 200+25.08 B9 (GW2) - 69°5 202.3 88.7 66.3 109 Table 5 GW Borings which Exceed GW1 &/or Areas to be Watch B5 (GW2) 175+40 128 14.47 20.3 171+16.45 B3 (GW2) 27 9.33 3.48 5.85 81.2 136 99.9 66 Sample Identification/Applicable Standard Station Units mg/l mg/l mg/l mg/l mg/l ₩ I/gm hg/L hg/L hg/L µg/L hg/L hg/L hg/L hg/L hg/L hg/L hg/L hg/L hg/L 0.9 30,000 20,000 GW2 50 0.004 0.01 0.02 1000 0001 1000 2000 4000 4000 0.1 1000 1000 500 Reportable Concentrations GW1 0.1 0.01 2 0.004 0.02 0.002 0.05 200 200 1000 5000 200 1000 500 140 400 200 0.0013 48.8 5000 0.2 5.0 0.9 20 5 5 70 20 9 Total Petroleum Hydrocarbons Adjusted C11-C22 Aromatics Hydrocarbons Adjusted C9-C12 Aliphatic Adjusted C5-C8 Aliphatic Xylene - mixed isomers Petroleum Hydrocarbons 2-Methylnaphthalene C09-C18 Aliphatics C19-C36 Aliphatics C9-C10 Aromatic Chromium (total) VPH and VOC Hydrocarbons Hydrocarbons MADEP EPH Naphthalene Naphthalene Total PAH Cadmium Selenium Barium Benzene Mercury Arsenic Lead

0.037

(A)

Table 4 Summarized Groundwater Analytical Results

		Repo	Reportable Concentrations	itrations		i	3	5	2	20	_	513	719	B18
	RGP	RGP w/ DF	GW1	GW2	Units									
Metals														
Iron	•	2			l/vm	186	70.3	00 0			3			
Chromium (total)	0.048	1.7	0.1	2	, n	2	5.0	5	0.		Z		90.0	
Arsenic	.010	0.5	0.01	0.9	ma/l	0.0130	70800		0.00125		20.00			
Barium			2	20	ma/l				00.0		0.0.0			
Cadmium	0.0002	0.01	0.004	0.004	ma/l									
Lead	0.0013	990'0	0.02	0.01	ma/l			0.0440	000	0.044	0700	000	2000	
Selenium	.0050	0.25	0.05	0.1	/ou			2	3.5	0.014	0.043	.033	0.037	
Mercury	0.0009	0.0023	0.002	0.02	, E									
Petroleum Hydrocarbons					h									
Total Petroleum Hydrocarbons	2000		200	1000	µg/L		136	287	0.42					
MADEP EPH														
Adjusted C11-C22 Aromatics			200	30,000	µg/L									
C09-C18 Aliphatics			1000	1000	1/011									
C19-C36 Aliphatics			2000	20,000	j b									
Total PAH	100		200	1000	na/L		9.33							
Naphthalene	20		140	1000	ng/L		3.48							
2-Methylnaphthalene					na/L		5.85							
SVOCs					i b		3			2 2 5 5 5				
Naphthalene	20		140	1000	na/L		4 15							
2-Methylnaphthalene					ng/L		5.60							
Bis (2-ethylhexyl) phthalate	9				ng/L		2.39							
Di-n-butyl Phthlate					hg/L						3 80			
Fluorene					hg/L						4 1			
VPH														
Adjusted C5-C8 Aliphatic Hydrocarbons			400	1000	hg/L		66			109				
Adjusted C9-C12 Aliphatic Hydrocarbons			1000	1000	µg/L		81.2			88.7				
C9-C10 Aromatic Hydrocarbons			200	4000	µg/L									
Benzene	5		2	2000	na/L		O;		10.6					
Toluene					2		S							
Ethylbenzene			700	4000	na/L		42.1		6.35	9 17				
Xylene - mixed isomers			200	200	na/L		99.9		14.47	36.5			100	
Total BTEX	100				na/l		87.8		7 7 7	78.7			2.0	
Naphthalene	20		140	1000	J/011		9		200.	1.04				
MtBE	70								0.02	00.0			1	
700					i b L				1.00	27.1			7.99	

Hazardous Material Assessment Technical Memorandum

WM-046 MWRA Lynnfield/Saugus Pipelinc Project Contract 6905

1,2,4-Trimethylbenzene						25.4	·	400	
Renzene	u	1				1.02		178	
Cultoria	n	S	2000		12.8	69.2			
Ethylbenzene		700	4000	100/1	710	u d	90	ç	
Toluene						3	0.30	40	
Xylene								1	
Vatal PTCV	007					36.5		126	
lotal BIEA	001					402	5.98	146	10.7
Isopropylbenzene				14.7				7 00	į
n-Propylbenzene								20.	
								20.5	
Metnyl Tert-Butyl Ether	20	70	1000	µg/L	96.4	371			7 00
sec-Butylbenzene				na/L				302	9
1,3,5 Trimethylbenzene		100	1000	ng/L		7.9	7 06	28.4	
Bold = exceeds regulatory limit		Italics = exceeds	Italics = exceeds regulatory limit GW-	- L		?	8	t. 0.	
GW-Z		-		Exceeds regulatory limit KGP	Exceeds GW-1 & GW-2	3W-2			

Note: Blank values were "not detected"

7

GW-B1

Tuesday, May 13, 2008

Larry Durkin Fay, Spofford & Thorndike 5 Burlington Woods Burlington, MA 01803 GeoLabs, Inc. 45 Johnson Lane Braintree MA 02184 Tele: 781 848 7844 Fax: 781 848 7811

TEL: 781-221-1066 FAX: 781-221-1086

Project:

MWRA 6905

Location:

WM-04, 1.4EXP

Order No.: 0804418

Dear Larry Durkin:

GeoLabs, Inc. received 1 sample(s) on 4/28/2008 for the analyses presented in the following report.

There were no problems with the analyses and all data for associated QC met EPA or laboratory specifications except where noted in the Case Narrative.

Analytical methods and results meet requirements of 310CMR 40.1056(J) as per MADEP Compendium of Analytical Methods (CAM).

If you have any questions regarding these tests results, please feel free to call.

Sincerely,

Jim Chen

Laboratory Director

Certifications:

CT (PH-0148) - MA (M-MA015) - NH (2508) - NJ (MA009) - NY (11796) - RI (LA000252)

Date: 13-May-08

CLIENT:

Fay. Spofford & Thorndike

Project:

MWRA 6905

Lab Order:

0804418

CASE NARRATIVE

MADEP MCP Response Action Analytical Report Certification Form

Laboratory Name: GeoLabs, Inc.

Project # MW-046, 1.4-EXP

Project Location: MWRA 6905

MADEP RTN #:

This form provides certification for the following data set: 0804418 (001)

Sample Matrix: Groundwater

MCP SW-846 Methods Used: 8260B, VPH, 8270C, EPH, 8082, 8100M, 6010B, 245.1

An affirmative answer to questions A, B and C are required for "Presumptive Certainty" status

- A. Were all samples received by the laboratory in a condition consistent with that described on the Chain of custody documentation for the data set? YES
- B. Were all QA/QC procedures required for the specified method(s) included in this report followed, including the requirement to note and discuss in a narrative QC data that did not meet appropriate standards or guidelines?
- C. Does the analytical data included in this report meet all the requirements for "Presumptive Certainty" as described in Section 2.0 of the MADEP documents CAM VII A "Quality Assurance and Quality Control Guidelines for the Acquisition and Reporting of Analytical Data"? YES
- D. VPH and EPH Methods only: Was the VPH or EPH Method conducted without significant modifications (see Section 11.3 of respective Methods)

A response to questions E and F are required for "Presumptive Certainty" status

- E. Were all QC performance standards and recommendations for the specified methods achieved? NO
- F. Were results for all analyte-list compounds/elements for the specified method(s) reported?

NO

All NO answers need to be addressed in an attached Environmental Laboratory case narrative.

CLIENT:

Fay, Spofford & Thorndike

Project:

MWRA 6905

Lab Order:

0804418

CASE NARRATIVE

CASE NARRATIVE

Physical Condition of Samples

The project was received by the laboratory in satisfactory condition. The sample(s) were received undamaged, in appropriate containers with the correct preservation.

Project Documentation

The project was accompanied by satisfactory Chain of Custody documentation.

Analysis of Sample(s)

The following analytical anomalies or non-conformances were noted by the laboratory during the processing of these samples:

Hexavalent Chromium was received out of holding time.

8260 LCS percent recoveries for 1,2,4-Trimethylbenzene, 1,3,5-Trimethylbenzene, and 2,2-Dichloropropane are outside the recovery limits.

8270 Method Blank percent recovery for 2,4,6-Tribromophenol is outside the recovery limits.

8270 LCS percent recovery for 2,4-Dinitrophenol is outside the recovery limits.

I, the undersigned, attest under the pains and penalties of perjury that, based upon my personal inquiry of those responsible for obtaining the information, the material contained in this analytical report is, to the best of my knowledge and belief, accurate and complete.

Signature:

Total Change

Position: Lab Director

Printed Name: Jim Chen

Date: May 13, 2008

CLIENT:

Fay, Spofford & Thorndike

Project:

MWRA 6905

Lab Order:

0804418

CASE NARRATIVE

EPH Methods

Method for Ranges: MADEP EPH 04-1.1 Method for Target Analytes: 8270 GC/MS

Carbon Range data exclude concentrations of any surrogate(s) and/or internal standards eluting in that range

C11-C22 Aromatic Hydrocarbons exclude concentrations of Target PAH Analytes

CERTIFICATION:

Were all QA/QC procedures REQUIRED by the EPH Method-followed? YES

Were all performance/acceptance standards achieved? YES

Were any significant modifications made to the EPH method? NO

I attest under the pains and penalties of perjury that, based upon my inquiry of those individuals immediately responsible for obtaining the information, the material contained in this report is, to the best of my knowledge and belief, accurate and complete.

SIGNATURE:

LAB DIRECTOR

PRINTED NAME: Jim Chen

DATE: May 13, 2008

CLIENT:

Fay, Spofford & Thorndike

Project:

MWRA 6905

Lab Order:

0804418

CASE NARRATIVE

VPH Methods

Method for Ranges: MADEP VPH 04-1.1

Method for Target Analytes: MADEP VPH 04-1.1

Carbon Range data exclude concentrations of any surrogate(s) and/or internal standards eluting in that range.

C5-C8 Aliphatic Hydrocarbons exclude the concentration of Target Analytes eluting in that range. (MTBE, Benzene, Toluene)

C9-C12 Aliphatic Hydrocarbons exclude concentration of Farget Analytes eluting in that range (Ethylbenzene, m&p-Xylenes, o-Xylene) AND concentration of C9-C10 Aromatic Hydrocarbons.

CERTIFICATION

Were all OA/OC procedures REOUIRED by the VPH Method followed? YES Were all QA/QC performance/acceptance standards achieved? YES Were any significant modifications made to the VPH method, as specified in Sec. 11.3? NO

I attest under the pains and penalties of perjury that, based upon my inquiry of those individuals immediately responsible for obtaining the information, the material contained in this report is, to the best of my knowledge, accurate and complete.

SIGNATURE:

POSITION: LAB DIRECTOR

PRINTED NAME: Jim Chen

DATE: May 13, 2008

Reported Date: 13-May-08

CLIENT:

Fay, Spofford & Thorndike

Lab Order:

0804418

Client Sample ID: B1

Collection Date: 4/27/2008 10:00:00 AM

Project:

MWRA 6905

Date Received: 4/28/2008

Lab ID: 0804418-001

Matrix: GROUNDWATER

Analyses	Result	Det. Limit	Qual	Units	DF	Date Analyzed
TOTAL SUSPENDED SOLIDS - SM25	40-D					Analyst: AMS
Total Suspended Solids	ND	. 4.00		mg/L	1	4/30/2008
EPH RANGES - MADEP EPH						Analysts E.I.
Adjusted C11-C22 Aromatics	ND	128		μg/L	1	Analyst: RJ 4/30/2008
C09-C18 Aliphatics	ND.	128		μg/L	`1	4/30/2008
C19-C36 Aliphatics	ND	128		μg/L	1	4/30/2008
Unadjusted C11-C22 Aromatics	ND	128		μg/ L	1	4/30/2008
Surr: 1-Chloropotadecane	69.0	40-140		%REC	1	4/30/2008
Sum: o-Terphenyl	66.0	40-140		%REC	1	4/30/2008
OTAL PETROLEUM HYDROCARBO	NS - 8100M					Analyst: RuF
Total Petroleum Hydrocarbons	ND	0.247		mg/L	1	5/2/2008
Surr: o-Terphenyl	75.0	40-140		%REC	1	5/2/2008
POLYCHLORINATED BIPHENYLS - S						Analyst: GP
Aroclor 1016/1242	ND	0.333		μg/L	1	5/1/2008
Aroclor 1221	ND	0.333		μg/L	1	5/1/2008
Aroclor 1232	ND	0.333		µg/L	1	5/1/2008
Aroclor 1248	ND	0.333		hâ/r	1	5/1/2008
Aroclor 1254	ND	0.333		μg/Ľ	1	5/1/2008
Aroclor 1260	ND	0.333		μg/L	1	5/1/2008
Aroclor 1262	ND	0.333		μg/L	1	5/1/2008
Aroclor 1268	ND	0.333		μg/L	1	5/1/2008
Surr: Decachiorobiphenyl Sig 1	86.0	30-150		%REC	1	5/1/2008
Surr: Decachlorobiphenyl Sig 2	100	30-150		%REC	1	5/1/2008
Surr: Tetrachloro-m-Xylene Sig 1	74.0	30-150		%REC	1	5/1/2008
Surr: Tetrachloro-m-Xylene Sig 2	74.0	30-150		%REC	. 1	5/1/2008
TOTAL METALS BY ICP - SW6010B	ė.					Analyst: QS
Antimony	ND	0.0100		mg/L	1	4/29/2008
Arsenic	0.0130	0.0100		mg/L	1	4/29/2008
Barium	ND	2,00		mg/L	1	4/29/2008
Cadmium	ŅD	0.00400		mg/L	1	4/29/2008
Chromium	ND	0.100		mg/L	1	4/29/2008
Copper	ND	0.0400		mg/L	1	4/29/2008
Iron	1.86	0.0600		mg/L	1	4/29/2008
Lead	ND	0.0100		mg/L	1	4/29/2008
Nickel	ND	0.00400		mg/L	1	4/29/2008

- Analyte detected in the associated Method Blank
- Ε Value above quantitation range
- Analyte detected below quantitation limits
- Spike Recovery outside recovery limits

- BRL Below Reporting Limit
- H Holding times for preparation or analysis exceeded
- ND Not Detected at the Reporting Limit

Reported Date: 13-May-08

CLIENT:

Fay, Spofford & Thorndike

Client Sample ID: B1

Lab Order:

0804418

Collection Date: 4/27/2008 10:00:00 AM

Project:

Date Received: 4/28/2008

Lab ID:

MWRA 6905 0804418-001

Matrix: GROUNDWATER

Analyses	Result	Det. Limit	Qual U	nits	DF	Date Analyzed
TOTAL METALS BY ICP - SW6010B						Analyst: QS
Selenium	ND	0.0500	n	ng/L	1	4/29/2008
TOTAL SILVER - E200.7						Analyst: QS
Silver	ND	0.00700	п	ng/L	1	4/29/2008
TOTAL MERCURY - E245.1						Analyst: EC
Mercury	ND	0.0002	п	ng/L	1	4/30/2008
SEMIVOLATILE ORGANICS - SW8270C						Analyst: ZYZ
1,2,4-Trichlorobenzene	ND	1.08	μ	g/L	1	4/29/2008 9:43:00 PM
1,2-Dichlorobenzene	ND	1.08	μ	g/L	1	4/29/2008 9:43:00 PM
1,2-Dinitrobenzene	ND	1.08	μ	g/L	1	4/29/2008 9:43:00 PM
1,3-Dichlorobenzene	ND	1.08	þ	g/L	1	4/29/2008 9:43:00 PM
1,3-Dinitrobenzene	ND	1.08	μ	g/L	1	4/29/2008 9:43:00 PM
1,4-Dichlorobenzene	ND	1.08	μ	g/L	1	4/29/2008 9:43:00 PM
1,4-Dinitrobenzene	ND	1.08	μ	g/L	1	4/29/2008 9:43:00 PM
2,3,4,6-Tetrachiorophenol	ND	1.08	μ	ıg/L	1	4/29/2008 9:43:00 PM
2,4,5-Trichlorophenol	ND	1.08	μ	ıg/L	1	4/29/2008 9:43:00 PM
2,4,6-Trichlorophenol	ND	1.08	μ	ıg/L	1	4/29/2008 9:43;00 PM
2,4-Dichlorophenol	ND	1.08	۲	ıg/L	1	4/29/2008 9:43:00 PM
2,4-Dimethylphenol	ND	1.08	þ	rg/L	1	4/29/2008 9:43:00 PM
2,4-Dinitrophenol	ND	5,38	. μ	ıg/L	1	4/29/2008 9:43:00 PM
2,4-Dinitrotoluene	ND	1.08	۲	ıg/L	1	4/29/2008 9:43:00 PM
2,6-Dinitrotoluene	ND	1.08	μ	ıg/L	1	4/29/2008 9:43:00 PM
2-Chloronaphthalene	ND	1.08	μ	ıg/L	1	4/29/2008 9:43:00 PM
2-Chlorophenol	ND	1.08	۲	ıg/L	1	4/29/2008 9:43:00 PM
2-Methylnaphthalene	ND	1.08	μ	ıg/L	1	4/29/2008 9:43:00 PM
2-Methylphenol	ND	1.08	٢	ıg/L	1	4/29/2008 9:43:00 PM
2-Nitroaniline	ND	1.08		ıg/L	1	4/29/2008 9:43:00 PM
2-Nitrophenol	· ND	1.08	F	ıg/L	1	4/29/2008 9:43:00 PM
3,3'-Dichlorobenzidine	ND	1.08	Ļ	ıg/L	1	4/29/2008 9:43:00 PM
3-Methylphenol/4-Methylphenol	ND	1.08	۲	ıg/L	1	4/29/2008 9:43:00 PM
3-Nitroaniline	ND	1.08	1	ıg/L	1	4/29/2008 9:43:00 PM
4,6-Dinitro-2-Methylphenol	ND	5.38	ŀ	ıg/L	1	4/29/2008 9:43:00 PM
4-Bromophenyl Phenyl Ether	ND	1.08	ŀ	ıg/L	1	4/29/2008 9:43:00 PM
4-Chloro-3-Methylphenol	ND	1.08	١	ıg/L	1	4/29/2008 9:43:00 PM
4-Chioroaniline	ND	1.08		ıg/L	1	4/29/2008 9:43:00 PM
4-Chlorophenyl Phenyl Ether	ND	1.08	ŀ	ıg/L	1	4/29/2008 9:43:00 PM
4-Nitroaniline	ND	1.08	ļ	ıg/L	1	4/29/2008 9:43:00 PM

- В Analyte detected in the associated Method Blank
- Е Value above quantitation range
- Analyte detected below quantitation limits
- Spike Recovery outside recovery limits

- BRL Below Reporting Limit
- Holding times for preparation or analysis exceeded
- ND Not Detected at the Reporting Limit

Reported Date: 13-May-08

CLIENT:

Fay, Spofford & Thorndike

Lab Order:

0804418

Project:

MWRA 6905

Lab ID:

0804418-001

Client Sample ID: B1

Collection Date: 4/27/2008 10:00:00 AM

Date Received: 4/28/2008

Matrix: GROUNDWATER

Analyses	Result	Det. Limit	Qual Units	DF	Date Analyzed
SEMIVOLATILE ORGANICS - SW8270C					Analyst: ZYZ
4-Nitrophenol	ND	1.08	μg/L	1	4/29/2008 9:43:00 PM
Acenaphthene	ND	1.08	μg/L	1	4/29/2008 9:43:00 PM
Acenaphthylene	ND	1.08	μg/L	1	4/29/2008 9:43:00 PM
Acetophenane	ND	1.08	μg/L	1	4/29/2008 9:43:00 PM
Aniline	ND	5.38	μg/L	1	4/29/2008 9:43:00 PM
Anthracene	ND	1.08	μg/L	1	4/29/2008 9:43:00 PM
Azobenzene	ND	5.38	μg/L	1	4/29/2008 9:43:00 PM
Benz(a)Anthracene	ND	0.108	μg/L	4	4/29/2008 9:43:00 PM
Benzidine	ND	5.38	μg/L	1	4/29/2008 9:43:00 PM
Benzo(a)Pyrene	ND	0,108	μg/L	1	4/29/2008 9:43:00 PM
Benzo(b)Fluoranthene	ND	0.538	μg/L	1	4/29/2008 9:43:00 PM
Benzo(g,h,i)Perylene	ND	1.08	μg/L	1	4/29/2008 9:43:00 PM
Benzo(k)Fluoranthene	ΝD	0.538	μg/L	1	4/29/2008 9:43:00 PM
Benzyl Alcohol	ND	1.08	μg/L	1	4/29/2008 9:43:00 PM
Bis(2-Chloroethoxy)Methane	ND	1.08	μg/L	1	4/29/2008 9:43:00 PM
Bis(2-Chloroethyl)Ether	ND	1.08	μg/L	1	4/29/2008 9:43:00 PM
Bis(2-Chlaroisopropyl)Ether	ND	1.08	μg/L	1	4/29/2008 9:43:00 PM
Bis(2-Ethylhexyl)Phthalate	ND	1.08	μg/L	1	4/29/2008 9:43:00 PM
Butyl Benzyl Phthalate	ND	1.08	μg/L	1	4/29/2008 9:43:00 PM
Carbazole	ND	1.08	μg/L	1	4/29/2008 9:43:00 PM
Chrysene	ND	1.08	μg/L	1	4/29/2008 9:43:00 PM
Dibenz(a,h)Anthracene	ND	0.108	μg/L	1	4/29/2008 9:43:00 PM
Dibenzofuran	ND	1.08	µg/L	1	4/29/2008 9:43:00 PM
Diethyl Phthalate	ND	1.08	μg/L	1	4/29/2008 9:43:00 PM
Dimethyl Phthalate	ИD	1.08	μg/L	1	4/29/2008 9:43:00 PM
Di-л-Butyl Phthalate	ND	1.08	μg/L	1	4/29/2008 9:43:00 PM
Di-n-Octyl Phthalate	ND	1.08	μg/L	1	4/29/2008 9:43:00 PM
Fluoranthene	ND	1.08	μg/L	1	4/29/2008 9:43:00 PM
Fluorene	ND	1.08	μg/L	1	4/29/2008 9:43:00 PM
Hexachlorobenzene	ND	0.108	μg/L	1	4/29/2008 9:43:00 PM
Hexachlorobutadiene	ND	0.108	μg/L	1	4/29/2008 9:43:00 PM
Hexachlorocyclopentadiene	ND	5.38	μg/L	1	4/29/2008 9:43:00 PM
Hexachloroethane	ND	1.08	μg/L	1	4/29/2008 9:43:00 PM
ndeno(1,2,3-cd)Pyrene	ND	0.108	μg/L	1	4/29/2008 9:43:00 PM
sophorone	ND	1,08	μg/L	1	4/29/2008 9:43:00 PM
Naphthalene	ND	1.08	μg/L	1	4/29/2008 9:43:00 PM
Nitrobenzene	ND	1.08	μg/L	1	4/29/2008 9:43:00 PM
N-Nitrosodimethylamine	ND	5.38	µg/L	1	4/29/2008 9:43:00 PM
N-Nitrosodi-n-Propylamine	ND	1.08	µg/L	1	4/29/2008 9:43:00 PM
N-Nitrosodiphenylamine	ND	5.38	μg/L	1	4/29/2008 9:43:00 PM

- В Analyte detected in the associated Method Blank
- Е Value above quantitation range
- Analyte detected below quantitation limits
- Spike Recovery outside recovery limits

- BRL Below Reporting Limit
- Holding times for preparation or analysis exceeded H
- ND Not Detected at the Reporting Limit

Reported Date: 13-May-08

CLIENT:

Fay, Spofford & Thorndike

Lab Order:

0804418

Project:

Lab ID:

MWRA 6905 0804418-001

Client Sample ID: B1 Collection Date: 4/27/2008 10:00:00 AM

Date Received: 4/28/2008

Matrix: GROUNDWATER

Analyses	Result	Det. Limit	Qual	Units	DF	Date Analyzed
SEMIVOLATILE ORGANICS - SW8270C						Analyst: ZY Z
Pentachlorophenol	ND	1.08		μg/L	1	4/29/2008 9:43:00 PM
Phenanthrene	ND	1,08		µg/L	1	4/29/2008 9:43:00 PM
Phenof	ND	1.08		µg/L	1	4/29/2008 9:43:00 PM
Pyrene	ND	1.08		μg/L	1	4/29/2008 9:43:00 PM
Pyridine	. ND	5.38		μg/L	1	4/29/2008 9:43:00 PM
Surr. 2,4,6-Tribromophenol	4.79	15-110	S	%REC	1	4/29/2008 9:43:00 PM
Surr. 2-Fluorobiphenyl	66.6	30-130		%REC	1	4/29/2008 9:43:00 PM
Surr: 2-Fluorophenol	50.2	15-110		%REC	1	4/29/2008 9:43:00 PM
Surr: Nitrobenzene-d5	61.9	30-130		%REC	1	4/29/2008 9:43:00 PM
Surr: Phenol-d6	33.7	15-110		%REC	1	4/29/2008 9:43:00 PM
Surr: Terphenyl-d14	55.5	30-130		%REC	1	4/29/2008 9:43:00 PM
EPH TARGET ANALYTES - MADEP EPH						Analyst: ZYZ
Naphthalene	ND	1.28		μg/L	. 1	4/30/2008 4:54:00 PM
2-Methylnaphthalene	ND	1.28		μg/L	1	4/30/2008 4:54:00 PM
Acenaphthene	ND	1.28		μg/L	1	4/30/2008 4:54:00 PM
Phenanthrene	ND	1.28		μg/L	4	4/30/2008 4:54:00 PM
Acenaphthylene	ND	1.28		μg/L	1	4/30/2008 4:54:00 PM
Fluorene	ND	1.28		μg/L	1	4/30/2008 4:54:00 PM
Anthracene	ND	1.28		μg/L	1	4/30/2008 4:54:00 PM
Fluoranthene	ND	1.28		μg/L	4	4/30/2008 4:54:00 PM
Pyrene	ND	1.28		μg/L	1	4/30/2008 4:54:00 PM
Benzo(a)Anthracene	ND	0,513		µg/L	4	4/30/2008 4:54;00 PM
Chrysene	ND	1.28		μg/L	4	4/30/2008 4:54:00 PM
Benzo(b)Fluoranthene	ND	1,28		μg/L	1	4/30/2008 4:54:00 PM
Benzo(k)Fluoranthene	ND	1.28		μg/L	1	4/30/2008 4:54:00 PM
Benzo(a)Pyrene	ND	0,256		μg/L	1	4/30/2008 4:54:00 PM
Indeno(1,2,3-cd)Pyrene	ND	0.513		μg/L	1	4/30/2008 4:54:00 PM
Dibenz(a,h)Anthracene	ND	0.513		μg/L	1	4/30/2008 4:54:00 PM
Benzo(g,h,i)Perylene	ND	1.28		μg/L	1	4/30/2008 4:54:00 PM
Total PAH Target Concentration	ND	0		μg/L	1	4/30/2008 4:54:00 PM
Surr: 2,2'-Difluorobiphenyl	54.7	40-140		%REC	1	4/30/2008 4:54:00 PM
Surr: 2-Fluorobiphenyl	45.2	40-140		%REC	1	4/30/2008 4:54:00 PM
/OLATILE ORGANIC COMPOUNDS - SW	8260B					Analyst: ZYZ
1,1,1,2-Tetrachioroethane	ND	5.00		μg/L	1	5/9/2008 4:29:00 PM
1,1,1-Trichloroethane	ND	5.00		μg/L	1	5/9/2008 4:29:00 PM
1.1.2.2-Tetrachloroethane	ND	2.00		μg/L μg/L	1	5/9/2008 4:29:00 PM
· · · · · · · · · · · · · · · · · · ·	140	5.00		49/C	ı	3/3/2000 4.28.00 PM

- В Analyte detected in the associated Method Blank
- Ε Value above quantitation range
- Analyte detected below quantitation limits J
- S Spike Recovery outside recovery limits

- BRL Below Reporting Limit
- / **Н**. Holding times for preparation or analysis exceeded
 - ND Not Detected at the Reporting Limit

Reported Date: 13-May-08

CLIENT:

Fay, Spofford & Thorndike

Lab Order: Project: Lab ID:

0804418

MWRA 6905

0804418-001

Client Sample ID: B1

Collection Date: 4/27/2008 10:00:00 AM

Date Received: 4/28/2008

Matrix: GROUNDWATER

Analyses	Result	Det. Limit	Qual Units	DF	Date Analyzed
OLATILE ORGANIC COMPOUNDS	S - SW8260B				Analyst: ZYZ
1,1-Dichloroethane	ND	5.00	µg/L	1	5/9/2008 4:29:00 PM
1,1-Dichloroethene	ND	5.00	µg/L	1	5/9/2008 4:29:00 PM
1,1-Dichloropropene	ND	5.00	μg/L	1	5/9/2008 4:29:00 PM
1,2,3-Trichlorobenzene	ND	5.00	µg/L	1	5/9/2008 4:29:00 PM
1,2,3-Trichloropropane	ND	5.00	μg/L	1	5/9/2008 4:29:00 PM
1,2,4-Trichlorobenzene	ND	5.00	μg/L	1	5/9/2008 4:29:00 PM
1,2,4-Trimethylbenzene	ND	5.00	μg/L	1	5/9/2008 4:29:00 PM
1,2-Dibromo-3-Chloropropane	ND	5.00	μg/L	1	5/9/2008 4:29:00 PM
1,2-Dibromoethane	ND	2.00	μg/L	1	5/9/2008 4:29:00 PM
1,2-Dichlorobenzene	ND	5.00	μg/L	1	5/9/2008 4:29:00 PM
1,2-Dichioroethane	ND	2.00	μg/L	1	5/9/2008 4:29:00 PM
1,2-Dichloropropane	ND	2.00	μg/L	1	5/9/2008 4:29:00 PM
1,3,5-Trimethylbenzene	ND	5.00	μg/L	1	5/9/2008 4:29:00 PM
1,3-Dichlorobenzene	ND	5.00	µg/L	1	5/9/2008 4:29:00 PM
1,3-Dichloropropane	ND	5.00	μg/L	1	5/9/2008 4:29:00 PM
1,4-Dichlorobenzene	ND	5.00	ug/L	1	5/9/2008 4:29:00 PM
2,2-Dichloropropane	ND	5.00	μg/L	1	5/9/2008 4:29:00 PM
2-Butanone	ND	10.0	μg/L	1	5/9/2008 4:29:00 PM
2-Chloroethyl Vinyl Ether	ND	5.00	μg/L	1	5/9/2008 4:29:00 PM
2-Chiorotoluene	ND	5.00	µg/L	1	5/9/2008 4:29:00 PM
2-Hexanone	ND	10.0	μg/L	1	5/9/2008 4:29:00 PM
4-Chlorotoluene	ND	5.00	μg/L	1	5/9/2008 4:29:00 PM
4-isopropyltoluene	ND	5.00	μg/L	1	5/9/2008 4:29:00 PM
4-Methyl-2-Pentanone	ND	5.00	μg/L	1	5/9/2008 4:29:00 PM
Acetone	ND	50.0	μg/L	1	5/9/2008 4:29:00 PM
Acrolein	ND	50.0	μg/L	1	5/9/2008 4;29:00 PM
Acrylonitrile	ND	50.0	μg/L	1	5/9/2008 4;29:00 PM
Benzene	ND	5.00	µg/L	1	5/9/2008 4:29:00 PM
Bromobenzene	ND	5.00	μg/L	1	5/9/2008 4:29:00 PM
Bromochloromethane	ND	2.00	μg/L	1	5/9/2008 4:29:00 PM
Bromodichloromethane	ND	2.00	μg/L	1	5/9/2008 4;29:00 PM
Bromoform	ND	2.00	µg/L	1	5/9/2008 4:29:00 PM
Bromomethane	ND	2.00	μg/L	1	5/9/2008 4:29:00 PM
Carbon Disulfide	ND	5.00	µg/L	1	5/9/2008 4:29:00 PM
Carbon Tetrachloride	ND	2.00	μg/L	1	5/9/2008 4:29:00 PM
Chlorobenzene	ND	5.00	μg/L	1	5/9/2008 4:29:00 PM
Chloroethane	ND	5.00	μg/L	1	5/9/2008 4:29:00 PM
Chioroform	ND	5.00	μg/L	1.	5/9/2008 4:29:00 PM
Chloromethane	ND	5.00	μg/L	1	5/9/2008 4:29:00 PM
cis-1,2-Dichloroethene	ND	5.00	μg/L	1	5/9/2008 4:29:00 PM

- В Analyte detected in the associated Method Blank
- Ε Value above quantitation range
- Analyte detected below quantitation limits
- Spike Recovery outside recovery limits

- BRL Below Reporting Limit
- Holding times for preparation or analysis exceeded
- Not Detected at the Reporting Limit

Reported Date: 13-May-08

CLIENT:

Fay, Spofford & Thorndike

Lab Order:

0804418

Project:

MWRA 6905

Lab ID:

0804418-001

Client Sample ID: B1

Collection Date: 4/27/2008 10:00:00 AM

Date Received: 4/28/2008

Matrix: GROUNDWATER

Analyses	Result	Det. Limit	Qual Units	DF	Date Analyzed
VOLATILE ORGANIC COMPOUNDS	- SW8260B				Analyst: ZY Z
cis-1,3-Dichloropropene	ND	0.500	μg/L	1	5/9/2008 4:29:00 PM
Dibromochloromethane	ND	2.00	μg/L	1	5/9/2008 4:29:00 PM
Dibromomethane	ND	5.00	μg/L	1	5/9/2008 4:29:00 PM
Dichlorodifluoromethane	ND	5.00	μg/L	1	5/9/2008 4:29:00 PM
Ethylbenzene	ND	5.00	μg/L	1	5/9/2008 4:29:00 PM .
Hexachlorobutadiene	ND	0.500	μg/L	1	5/9/2008 4:29:00 PM
Isopropylbenzene	ND	5,00	μg/L	1	5/9/2008 4:29:00 PM
Methyl Tert-Butyl Ether	ND	5.00	μg/L	1	5/9/2008 4:29:00 PM
Methylene Chloride	ND	5.00	μg/L	1	5/9/2008 4:29:00 PM
Naphthalene	ND	20.0	μg/L	1	5/9/2008 4:29:00 PM
n-Butylbenzene	ND	5.00	μg/L	1	5/9/2008 4:29:00 PM
n-Propylbenzene	ND	5,00	μg/L	1	5/9/2008 4:29:00 PM
sec-Butylbenzene	ND	5.00	μg/L	1	5/9/2008 4:29:00 PM
Styrene	ND	5.00	μ g/L	1	5/9/2008 4:29:00 PM
tert-Butylbenzene	ND	5.00	μg/L	1	5/9/2008 4:29:00 PM
Tetrachioroethene	ND	5.00	μ g /L	1	5/9/2008 4:29:00 PM
Toluene	ND	5.00	μg/L	1	5/9/2008 4:29:00 PM
trans-1,2-Dichloroethene	ND	5.00	μg/L	1	5/9/2008 4:29:00 PM
trans-1,3-Dichloropropene	ND	0.500	µg/L	. 1	5/9/2008 4:29:00 PM
Trichloroethene	ND	5.00	μg/L	. 1	5/9/2008 4:29:00 PM
Trichlorofluoromethane	ND	5.00	μg/L	1	5/9/2008 4:29:00 PM
Vinyl Chloride	ND	2.00	μg/ L	1:	5/9/2008 4:29:00 PM
Xylenes, Total	ND	5.00	μg/L	1	5/9/2008 4:29:00 PM
Surr: 1,2-Dichloroethane-d4	117	70-130	%REC	1	5/9/2008 4:29:00 PM
Surr: 4-Bromofluorobenzene	95.9	70-130	%REC	1	5/9/2008 4:29:00 PM
Surr: Dibromofluoromethane	108	70-130	%REC	1	5/9/2008 4:29:00 PM
Surr: Toluene-d8	101	70-130	%REC	1	5/9/2008 4:29:00 PM
PH - MADEP VPH					Analyst: MR
C9-C10 Aromatic Hydrocarbons	ND	75.0	μg/L	1	5/1/2008
Unadjusted C5-C8 Aliphatic Hydrocarbons	ND	75.0	μg/L	1	5/1/2008
Unadjusted C9-C12 Aliphatic Hydrocarbons	ND	75.0	μg/Ł	1	5/1/2008
Methyl Tert-Butyl Ether	ND	5.00	μg/L	1	5/1/2008
Benzene	ND	5,00	μg/L	1	5/1/2008
Toluene	ND	5.00	μg/L	1	5/1/2008
Ethylbenzene	ND	5,00	μg/L	1	5/1/2008
m,p-Xylene	ND	5.00	μg/L	1	5/1/2008
o-Xylene	ND	5.00	μg/L	1	5/1/2008

Qualifiers:

- В Analyte detected in the associated Method Blank
- E Value above quantitation range
- Analyte detected below quantitation limits
- Spike Recovery outside recovery limits

BRL Below Reporting Limit

Holding times for preparation or analysis exceeded

ND Not Detected at the Reporting Limit

Reported Date: 13-May-08

CLIENT:

Fay, Spofford & Thorndike

Client Sample ID: B1

Lab Order:

0804418

Collection Date: 4/27/2008 10:00:00 AM

Project:

Date Received: 4/28/2008

Lab ID:

MWRA 6905 0804418-001

Matrix: GROUNDWATER

Analyses	Result	Det. Limit	Qual	Units	DF	Date Analyzed
VPH - MADEP VPH						Analyst: MR
Naphthalene	ND	20.0		μg/L	1	5/1/2008
Adjusted C5-C8 Aliphatic Hydrocarbons	ND	75.0		μg/L	1	5/1/2008
Adjusted C9-C12 Aliphatic Hydrocarbons	ND	75.0		μg/L	1	5/1/2008
Surr: 2,5-Dibromotoluene FID	74.2	70-130		%REC	1	5/1/2008
Surr: 2,5-Dibromotoluene PID	81.0	70-130		%REC	4	5/1/2008
CYANIDE, TOTAL - SM4500-CN-C,E						Analyst: WFR
Cyanide, Total	ND	0.0197		mg/L	. 1	4/30/2008
HEXAVALENT CHROMIUM - SM3500-CR-E)					Analyst: WFR
Chromium, Hexavalent	ND	0.0500	Н	mg/L	1	4/29/2008
TOTAL RESIDUAL CHLORINE - HACH 816	57					Analyst: RP
Total Residual Chlorine	ND	0.162		mg/L	1	4/28/2008

- В Analyte detected in the associated Method Blank
- E Value above quantitation range
- Analyte detected below quantitation limits
- Spike Recovery outside recovery limits

- BRL Below Reporting Limit
- H Holding times for preparation or analysis exceeded
- ND Not Detected at the Reporting Limit

Fay, Spofford & Thorndike CLIENT:

0804418 Work Order:

MWRA 6905 Project:

ANALYTICAL QC SUMMARY REPORT

Date: 13-May-08

TestCode: 6010B_W

Sample ID: MB-9991	SampType: MBLK	TestCoc	TestCode: 6010B_W	Units: mg/L		Prep Date:		RunNo: 23364	1364	
Client ID: ZZZZZ	Batch ID: 9991	Test	TestNo: SW6010B	(SW3010A)		Analysis Date: 4/29/2008	4/29/2008	SeqNo: 229512	9512	
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit RPD Ref Val	%RPD	RPDLimit	Qual
Antimony	QN	0.00600								
Arsenic	QN	0.0100								
Baríum	QN	2.00								
Cadmium	QN	0.00400								
Chromium	<u>N</u>	0.100								
Copper	Q	0.0400								
Iron	QN	0.0600								
Lead	QN	0.0100								
Nickel	QN	0.100								
Selenium	QN	0.0500								
Sample ID: LCS-9991	SampType: LCS	TestCoc	TestCode; 6010B_W	Units: mg/L		Prep Date	Prep Date: 4/29/2008	RunNo: 23364	364	
Client ID: ZZZZ	Batch ID: 9991	Test	TestNo: SW6010B	(SW3010A)		Analysis Date:	: 4/29/2008	SeqNo: 229513	9513	
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit RPD Ref Val	%RPD	RPDLimit	Qual
Antimony	1,945	0.00600	2	0	97.2	80	120			
Arsenic	1.930	0.0100	Ġ	0	96.5	80	120			
Barium	QN	2.00	₹	0	98.0	80	120			
Cadmium	1.954	0.00400	2	0	5.76	80	120			
Chromium	1.952	0.100	7	0	97.6	80	120			
Copper	2,000	0.0400	2	0	100	80	120			
Iron	1.656	0.0600	2	0	82.8	80	120			
Lead	2.000	0.0100	2	0	100	80	120			
Nicket	1.954	0.100	2	0	5.76	80	120			
Selenium	1,908	0.0500	2	0	95.4	80	120			

Qualifiers:	BRL	BRL Below Reporting Limit	E Value above quantitation range	H Holding times for preparation or analysis exceeded
	'n	Analyte detected below quantitation limits	D Not Detected at the Reporting Limit	R RPD outside recovery limits
	s	Spike Recovery outside recovery limits		- ·

Page 2 of 26

Holding times for preparation or analysis exceeded

RPD outside recovery limits

E &

E Value above quantitation range ND Not Detected at the Reporting Limit

Analyte detected below quantitation limits Spike Recovery outside recovery limits

BRL Below Reporting Limit

Qualifiers:

	_
4	Y
- 2	
(
	Ī
r	Y
7	ū
THE CHIEF	Z
A TOWN	_
۲	
ŗ	Ľ
4	1
è	-
Ę	> >
ď	2
Ė	ב
	_
¥	7
r	١
7	ζ
•	_
•	7
_	-
LY	֚֚֚֚֚֡֝֝֝֝֜֝֟֝֝֟֝֓֓֓֓֓֟֝֓֓֓֓֡֟֜֜֜֟֜֓֓֓֓֡֡֡֜֜֡֡֡֡֓֜֡֡֡֡֓֡֡֡֡֡֡֡֓֡֓֡֡֡֡֡֡֡֡
LYC	
LYUI	֚֚֚֡֝֝֝֟֝֝֟֝֟֝֝֟֝֓֓֟֝֓֓֓֟֝֓֓֟֟֓֓֓֟֟֝֓֓֓֟֟֓֓֓֓֓֟֜֟֓֓֓֓֓֡֓֡֡֡֡֡֡֡֓֡֓֡֡֡֡֡֡֡֡֡֡
LICTI	
J IY DIL	

Fay, Spofford & Thorndike

MWRA 6905 0804418

Work Order: CLIENT:

Project:

TestCode: 8082_w

RunNo: 23424	SeaNo: 229922
Prep Date: 5/1/2008	Analysis Date: 5/1/2008
Units: µg/L	(SW3510B)
TestCode: 8082_w	TestNo: SW8082
SampType: MBLK	Batch ID: 10025
Sample iD: MB-10025	Client ID: ZZZZZ

Γ			7															٦						1		
		Qual															Qual									
24	922	RPDLimit												24	i	923	RPDLimit							24	929	
RunNo: 23424	SeqNo: 229922	%RPD												RunNo: 23424		SeqNo: 229923	%RPD							RunNo: 23424	SeqNo: 229929	
		Ref Val															RPD Ref Val									
5/1/2008	5/1/2008	lighLimit F								150	150	150	150	5/1/2008		5/1/2008		140	140	150	150	150	150	5/1/2008	5/1/2008	
Prep Date:	Analysis Date:	LowLimit HighLimit RPD Ref Val								30	30	30	30	Prep Date:	-	Analysis Date: 5/1/2008	LowLimit HighLimit	40	40	30	30	30	30	Prep Date:	Analysis Date: 5/1/2008	
	4	%REC					•			88.0	92.0	0.09	0.99			∢	%REC	101	104	110	106	84.0	92.0		₹	
Units: µg/L	(SW3510B)	SPK Ref Val								0	0	0	0	Units: ug/L	•	(SW3510B)	SPK Ref Val	0	0	0	0	0	0	Units: µg/L	(SW3510B)	
TestCode: 8082_w	TestNo: SW8082	SPK value								100	100	100	100	TestCode: 8082 w	ı	TestNo: SW8082	SPK value	100	100	100	100	100	100	TestCode: 8082_w	TestNo: SW8082	
TestCoc	Testh	PQL	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0	0	0	0	TestCod		TestN	PQL	0.300	0.300	0	0	0	0	TestCod	TestN	i
SampType: MBLK	Batch ID: 10025	Result	QN	Q	Q	QN	Q.	Q	QN	88.00	92.00	60.00	00'99	SampType: LCS		Batch ID: 10025	Result	101.0	104.0	110.0	106.0	84.00	92.00	SampType: LCS	Batch ID: 10025	
Samp	Bat									Sig 1	Sig 2	s Sig 1	Sig 2	Samp	1	Batc				Sig 1	Sig 2	Sig 1	Sig 2	Samp	Batc	
Sample iD: MB-10025	Client ID: ZZZZZ	6	- 1221	- 1232	- 1248	. 1254	1260	1262	- 1268	Surr: Decachlorobiphenyl Sig 1	Surr: Decachlorobiphenyl Sig 2	Surr: Tetrachloro-m-Xylene Sig 1	Surr: Tetrachloro-m-Xylene Sig 2	Sample ID: LCS-10025		Client ID: ZZZZ		Aroclor 1016/1242	1260	Surr: Decachlorobiphenyl Sig	Surr: Decachlorobiphenyl Sig 2	Surr: Tetrachloro-m-Xylene Sig 1	Surr: Tetrachloro-m-Xylene Sig 2	Sample ID: LCS2-10025	D: ZZZZZ :0	
Sample	Client	Analyte	Aroclor 1221	Arodor 1232	Aroclor 1248	Aroclor 1254	Araclor 1260	Arodor 1262	Aroclor 1268	Surr	Surr:	Surr:	Sur:	Sample	:	Client	Analyte	Aroclor	Aroclor 1260	Surr:	Surr	Surr	Surr	Sample	Client ID:	

Client ID: ZZZZZ	Batch ID: 10025	TestNo	TestNo: SW8082	(SW3510B)		Analysis Date: 5/1/2008	le: 5/1/200	60
Analyte	Result	PaL	SPK value	POL SPK value SPK Ref Val	%REC	LowLimit	HighLimit	%REC LowLimit HighLimit RPD Ref Val
Aroclor 1016/1242	108.0	0.300	100	0	108	40	140	
Aroclor 1221	Q	0.300						
Aroclor 1232	QN	0.300						

Qua

%RPD RPDLimit

Holding times for preparation or analysis exceeded

RPD outside recovery limits

~

ND Not Detected at the Reporting Limit Value above quantitation range

> Analyte detected below quantitation limits Spike Recovery outside recovery limits

BRL Below Reporting Limit

Qualifiers:

[<u>7</u>]

Fay, Spofford & Thorndike CLIENT:

0804418 Work Order: **MWRA 6905** Project:

TestCode: 8082_w

ANALYTICAL QC SUMMARY REPORT

Sample ID: LCS2-10025	SampType: LCS	TestCod	TestCode: 8082_w	Units: µg/L		Prep Date	Prep Date: 5/1/2008	RunNo: 23424	
Client ID: ZZZZ	Batch ID: 10025	TestN	TestNo: SW8082	(SW3510B)	-	Analysis Date: 5/1/2008	s: 5/1/2008	SeqNo: 229929	
Analyte	Result	Pal	SPK value	SPK value SPK Ref Val	%REC	LowLimit	%REC LowLimit HighLimit RPD Ref Val	%RPD RPDLimit Qual	Qual
Aroclor 1248	ON	0.300							
Aroclor 1254	<u>N</u>	0.300							
Aroclor 1260	118.0	0,300	100	0	118	40	140		
Aroclor 1262	R	0.300							
Aroctor 1268	<u>N</u>	0.300							
Surr: Decachlorobiphenyl Sig 1	1 124.0	0	100	0	124	30	150		
Surr: Decachlorobiphenyl Sig 2	2 126.0	0	100	0	126	30	150		
Surr: Tetrachloro-m-Xylene Sig 1	ig 1 84.00	0	100	0	84.0	30	150		
Surr: Tetrachtoro-m-Xylene Sig 2	ig 2 92.00	0	100	0	92.0	30	150		

Fay,Spofford & Thorndike 0804418 CLIENT:

Work Order:

MWRA 6905 Project:

ANALYTICAL QC SUMMARY REPORT

S	
•	
≂	
ನ	
₹	
8790B	
٠.	
نە	
ਰ	
0	
_)	
Ţ	
3	
TestCode:	

Sample ID: MB	SampType: MBLK	TestCo	TestCode: 8260B W	Units: ug/L	<u>a</u>	Prop Date:		RunNo: 23634	634	
Client ID: 2777	Betch ID: B73634	Toot	Toethio: CW0360D		, C C C	٠ نون				
	Date: 10. K23034	i est	VOT SAVBZOUB		Anai	Anaiysis Date:	5/9/2008	seqNo: 232472	2472	
Analyte	Result	Pal	SPK value	SPK Ref Val	%REC Lov	LowLimit	HighLimit RPD Ref Val	%RPD	RPDLimit	Qual
1,1,1,2-Tetrachloroethane	ON	5.00		THE STATE OF THE S						
1,1,1-Trichloroethane	QN	5.00								
1,1,2,2-Tetrachloroethane	QN	2.00								
1,1,2-Trichloroethane	QN	5.00								
1,1-Dichloroethane	QN	5.00						-		
1,1-Dichloroethene	Q	5.00								
1,1-Dichloropropene	Q.	5.00								
1,2,3-Trichlorobenzene	QN	5.00								
1,2,3-Trichloropropane	QN	5.00								
1,2,4-Trichlorobenzene	QN	5.00								
1,2,4-Trimethylbenzene	<u>Q</u>	5.00								
1,2-Dibromo-3-Chloropropane	QN	5.00								
1,2-Dibromoethane	QN	2.00								
1,2-Dichlorobenzene	ON .	5.00								
1,2-Dichloroethane	QN	2.00								٠
1,2-Dichloropropane	QN	2.00								
1,3,5-Trimethylbenzene	QN	5,00								
1,3-Dichlorobenzene	QN	5.00								
1,3-Dichloropropane	QN	5.00								
1,4-Dichlorobenzene	QN	5.00								
2,2-Dichloropropane	QN	5,00								
2-Butanone	QN	10.0								
2-Chloroethyl Vinyl Ether	ND	5.00								
2-Chlorotoluene	QN	5.00			•			-		
2-Hexanone	QN	10.0								
4-Chlorotoluene	QN	5.00								
4-Isopropylfoluene	Q.	5.00								
4-Methyl-2-Pentanone	QN	5.00								
Acetone	ND	50.0								
Acrolein	2	50.0								
Acrylonitrile	ON	50.0								
Qualifiers: BRL Below Reporting Limit	rting Limit		E Value	Value above quantitation range	ege -		H Holding times for preparation or analysis exceeded	reparation or a	nalysis exceed	pa
	Analyte detected below quantitation limits		ND Not De	Not Detected at the Reporting Limit	g Limit		R RPD outside recovery limits	ry limits		
S Spike Recove	Spike Recovery outside recovery limits								pa	Page 4 of 26

ANALYTICAL QC SUMMARY REPORT

TestCode: 8260B_W

Fay, Spofford & Thorndike	0804418	MWRA 6905
CLIENT:	Work Order:	Project:

Client ID: ZZZZ		20000	estonge: azona A			-				
				•	יקט טמני			1000 F0001	ţ	
	Batch ID: R23634	TestNo;	TestNo: SW8260B		Analysis Date:	ate: 5/9/2008	800	SeqNo: 232472	472	
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC LowLimit	HighLimit	it RPD Ref Val	%RPD	RPDLimit	Qual
Benzene	QN	5.00								
Bromobenzene	QN	5.00			•					
Bromochloromethane	QN	2.00	*							
Bromodichloromethane	QN	2.00								
Bromoform	QN	2.00					-			
Bromomethane	QN	2.00								
Carbon Disulfide	QN	5.00								
Carbon Tetrachloride	QN	2.00								
Chlorobenzene	QN	5.00								
Chloroethane	QN	5.00								
Chloroform	QN	5.00								
Chloromethane	QN	5.00								
cis-1,2-Dichloroethene	QN	5.00		÷						
cis-1,3-Dichloropropene	QN	0.500								
Dibromochloromethane	QN	2.00		٠						
Dibromomethane	QN	5.00								
Dichlorodifluoromethane	QN	5.00								
Ethylbenzene	QN	5.00								
Hexachlorobutadiene	QN	0.500								
Isopropylbenzene	QN	5.00								
Methyl Tert-Butyl Ether	QN	5.00								
Methylene Chloride	QN	5.00								
Naphthalene	QN	20.0								
n-Butyibenzene	QN	5.00								
n-Propylbenzene	QN	5.00								
sec-Butylbenzene	QN ·	5.00								
Styrene	QN	5.00								
tert-Butylbenzene	QN	5.00					,			
Tetrachloroethene	QN	5.00								
Toluene	QN	5.00								
trans-1,2-Dichloroethene	QN	5,00								
Qualifiers: BRL Below Reporting Limit	ting Limit		E Valuea	Value above quantitation range		H	Holding times for preparation or analysis exceeded	reparation or and	lysis exceede	
	Analyte detected below quantitation limits	_	ND Not De	Not Detected at the Reporting Limit	nit	2	RPD outside recovery limits	ry limits		
S Spike Recove	Spike Recovery outside recovery limits								Dag	Dam tof 16

Page 6 of 26

Analyte detected below quantitation limits Spike Recovery outside recovery limits

~~ (2)

FOCASE VILVILLATIONS SIMMAND AND FOCAS	THE TANKE OF SUMMERS IN THE OWN	TestCode: 8260B_W	
Fay, Spofford & Thomdike	0804418	MWRA 6905	

Work Order: CLIENT:

Project:

Sample ID: MB	SampType: MBLK	TestCode:	TestCode: 8260B W	Units: µg/L		Prep Date:	le;	RunNo: 23634
Client ID: ZZZZZ	Batch ID: R23634	TestNo:	TestNo: SW8260B			Analysis Date:	te: 5/9/2008	SeaNo: 232472
	Higgs B	o IOa	SPK value	SPK Bef Val	Д П	- Francisco	۷.	
Analyte	TERROLL		l vaide	O IV IVO	79.15	LOWEIIIII	- 1	
trans-1,3-Dichloropropene	Ð	0.500						
Trichloroethene	g	5.00						
Trichlorofluoromethane	g	5.00						
Vinyl Chloride	Q.	2.00						٠
Xylenes, Total	- Q	5.00						
Surr: 1,2-Dichloroethane-d4	34.29	0	30	0	114	02	130	
Surr: 4-Bromofluorobenzene	31.33	0	30	0	104	20	130	
Surr: Dibromofluoromethane	31.35	0	30	0	104	70	130	
Surr: Toluene-d8	30.22	0 .	30	0	101	70	130	-
Sample ID: LCS	SampType: LCS	TestCode: 8260B_W	8260B_W	Units: pg/L		Prep Date:	te;	RunNo: 23634
Client ID: ZZZZZ	Batch ID: R23634	TestNo:	FestNo: SW8260B			Analysis Date:	te: 5/9/2008	SeqNo: 232473
Analyte	Result	POLS	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit RPD Ref Val	%RPD RPDLimit Qual
1,1,1,2-Tetrachloroethane	55,59	5.00	50	0	111	02	130	
1,1,1-Trichloroethane	52,85	5.00	8	0	106	70	130	
1,1,2,2-Tetrachloroethane	53.81	2.00	50	0	108	70	130	
1,1,2-Trichloroethane	53.97	5.00	20	0	108	70	130	
1,1-Dichloroethane	52.86	5.00	20	0	106	70	130	
1,1-Dichloroethene	50.31	5.00	20	0	101	70	130	
1,1-Dichloropropene	54.06	5.00	20	0	108	70	130	
1,2,3-Trichlorobenzene	49,43	5.00	20	0	98.9	20	130	
1,2,3-Trichloropropane	53.31	5.00	20	0	107	70	130	
1,2,4-Trichlorobenzene	57.31	5.00	20	0	115	70	130	
1,2,4-Trimethylbenzene	67.07	5.00	50	0	134	70	130	S
1,2-Dibromo-3-Chloropropane	52.50	5.00	20	0	105	20	130	
1,2.Dibromoethane	53.54	2.00	50	0	107	70	130	
1,2-Dichlorobenzene	64.61	5.00	. 50	0	129	70	130	
1,2-Dichloroethane	52.30	2.00	20	0	105	70	130	
1,2-Dichloropropane	51.34	2.00	90	0	103	70	130	
On all the Date Delaw Descriptor I imite	Vennum municipal de la constante de la constan	THE A PROPERTY OF THE PARTY OF	T. Volue	Walne obeste mineral tentent	***************************************	FB./F18 4 VANIMINAAAAAAAAAAAAAAAAAAAAAAAAAAAAA		To the contract of the contrac
		•		soove quantitization rai	ය දු			notable unies for preparation of analysis exceeded
Analyte detec	Analyte detected below quantitation nimits	-	ND NOT DE	Not Detected at the reporting Limit	g Limit		K KFD outside recovery limits	overy timits

Analyte detected below quantitation limits Spike Recovery outside recovery limits

r .
REPORT
5
7
\simeq
\succ
R
\mathbf{z}
Σ
Þ
\mathcal{O}_{2}
Q.
0
ICAL QC SUMM
CAJ
2
7
Y
ANAL
7

TestCode: 8260B_W

5
4 6905
MWR

Fay, Spofford & Thorndike 0804418 Work Order: Project:

CLIENT:

				102		200	į		TOTAL TOTAL		
Client ID: ZZZZZ	Batch ID: R23634	Test	TestNo: SW8260B			Analysis Date;	te: 5/9/2008	~	SeqNo: 232473	73	
Analyte	Result	PaL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD F	RPDLimit	Quai
1,3,5-Trimethylbenzene	65,37	5.00	50	0	131	70	130				S
1,3-Dichlorobenzene	64.40	5.00	50	0	129	70	130				
1,3~Dichloropropane	52.53	5.00	. 50	0	105	70	130				
1,4-Dichlorobenzene	63.75	5,00	50	0	128	7.0	130				
2,2-Dichloropropane	27.18	5.00	50	0	54.4	202	130				S
2-Butanone	47.61	10.0	50	0	95.2	70	130				
2-Chloroethyl Vinyl Ether	58.22	5.00	50	0	116	70	130				
2-Chlorotoluene	61.76	5.00	50	0	124	70	130				
2-Hexanone	47.38	10.0	90	0	94.8	70	130				
4-Chlorotoluene	61.76	5.00	50	0	124	70	130				
4-Methyl-2-Pentanone	52.79	5.00	20	0	106	70	130				
Acetone	QN	50.0	50	0	99.0	70	130	ě			
Acrolein	96.15	50.0	100	0	96.2	70	130				
Acrylonitrile	115.2	50.0	100	0	115	70	130				
Benzene	54.97	5.00	50	0	110	70	130				
Bromobenzene	57.89	5,00	90	0	116	70	130				
Bromochloromethane	50.24	2.00	50	0	100	70	130				
Bromodichloromethane	52.31	2.00	50	0	105	70	130				
Bromoform	54.96	2.00	20	0	110	70	130				
Carbon Disulfide	49.42	5.00	90	0	98.8	. 70	130				
Carbon Tetrachloride	54,54	2.00	50	0	109	70	130				
Chlorobenzene	57.68	5.00	50	0	115	70	130				
Chloroform	53.75	5.00	50	0	108	70	130				
Chioromethane	51.07	5.00	50	0	102	70	130				
cis-1,2-Dichloroethene	50.95	5.00	50	0	102	70	130				
cis-1,3-Dichloropropene	46.90	0.500	50	0	93.8	70	130				
Dibromochloromethane	54.16	2.00	50	0	108	70	130				
Dibromomethane	51.81	5.00	50	0	104	70	130				
Dichlorodifluoromethane	41.37	5.00	50	0	82.7	70	130				
Ethylbenzene	61.50	5.00	50	0	123	70	130				
Hexachlorobutadiene	61.93	0.500	20	0	124	70	130				
Oualifiers: BRL Below Reg	Below Reporting Limit		E Value	Value above quantitation range	'ge	AND THE PROPERTY OF THE PROPER	н Но	olding times for r	Holding times for preparation or analysis exceeded	vsis exceeder	
	ĭ			•)						

Holding times for preparation or analysis exceeded

RPD outside recovery limits

H X

ANALYTICAL QC SUMMARY REPORT

Fay, Spofford & Thorndike

MWRA 6905 0804418

Work Order: CLIENT:

Project:

TestCode: 8260B_W

00 - 00	F	į						
Sample ID: LCS	sambilype: LCS	TestCo	TestCode: 8260B_W	Units: µg/L		Prep Date:		RunNo: 23634
Client ID: ZZZZZ	Batch ID: R23634	Test	TestNo: SW8260B		•	Analysis Dat	Analysis Date: 5/9/2008	SeqNo: 232473
Analyte	Result	POL	SPK value	SPK Ref Val	%REC	LowLimit	LowLimit HighLimit RPD Ref Val	%RPD RPDLimit Qual
Isopropylbenzene	63.26	5.00	50	0	127	70	130	
Methyl Tert-Butyl Ether	54,30	5.00	50	0	109	70	130	
Methylene Chloride	49.72	5.00	50	0	99.4	70	130	
Naphthalene	42.94	20.0	50	0	85.9	20	130	
Styrene	57,91	5.00	90	0	116	20	130	
tert-Butyfbenzene	64.20	5.00	90	0	128	20	130	
Tetrachloroethene	57.45	5.00	50	0	115	70	130	
Toluene	59.25	5.00	50	0	118	70	130	
trans-1,2-Dichloroethene	51.37	5.00	50	0	103	70	130	
trans-1,3-Dichloropropene	48.56	0.500	50	0	97.1	70	130	
Trichtoroethene	55.19	5.00	50	0	110	70	130	
Vinyl Chloride	58.79	2.00	50	0	118	20	130	
Xylenes, Total	187.7	5.00	150	0	125	0.2	130	
Surr: 1,2-Dichloroethane-d4	30,28	0	30	0	101	70	130	
Surr: 4-Bromofluorobenzene	29.97	0	30	0	666	20	130	
Surr: Dibromoftuoromethane	30.37	0	30	0	101	20	130	
Surr: Toluene-d8	29.87	0	30	0	9.66	70	130	

BRL	BRL Below Reporting Limit	ī	Vatue above qua
'n	Analyte detected below quantitation limits	ON.	Not Detected at (
S	Spike Recovery outside recovery limits		

Value above quantitation range	Not Detected at the Reporting Limit
H	ΩN
	æ

Page 9 of 26

J. Analyte detected below quantitation limitsS. Spike Recovery outside recovery limits Spike Recovery outside recovery limits

ANALYTICAL QC SUMMARY REPORT

Fay, Spofford & Thorndike 0804418

Work Order: CLIENT:

Project:

MWRA 6905

TestCode: 8270_W

	RunNo: 2:
	4/29/2008
	Prep Date;
	Units: pg/L
	TestCode: 8270_W
П	SampType: MBLK
	Sample ID: MB-9986

) idea	- C		1			
sample IU: MB-9986	Sampiype: MBLM	lestCode: 82/0_W	W Onits: pg/L	Frep Date; 4/2	4/29/2008	KunNo: 23388	
Client ID: ZZZZZ	Batch ID: 9986	TestNo: SW8270C	(SW3510)	Analysis Date: 4/2	4/29/2008	SeqNo: 229412	
Analyte	Result	PQL SPK value	alue SPK Ref Val	%REC LowLimit HighLimit	mit RPD Ref Val	%RPD RPDLimit	Qual
1,2,4-Trichlorobenzene	ON	1.00					
1,2-Dichlorobenzene	ON	1.00					
1,2-Dínitrobenzene	ON	1.00					
1,3-Dichlorobenzene	QN	1,00					
1,3-Dinitrobenzene	QN	1.00					
1,4-Dichlorobenzene	QN	1.00			·		
1,4-Dinitrobenzene	ON .	1.00		-			
2,3,4,6-Tetrachlorophenol	QN	1.00					
2,4,5-Trichlorophenol	QV	1.00					
2,4,6-Trichlorophenol	QN	1.00					
2,4-Dichlorophenol	QN	1.00					
2,4-Dimethylphenol	ON	1.00					
2,4-Dinitrophenol	<u>Q</u>	5.00					
2,4-Dinitrotoluene	Q	1.00					
2,6-Dinitrotoluene	QN	1.00					
2-Chloronaphthalene	QN	1.00			٠		
2-Chlorophenol	ΩN	1.00					
2-Methylnaphthalene	ON	1.00					
2-Methylphenol	ON	1.00					
2-Nitroaniline	QN	1.00					
2-Nitrophenol	QN	1.00					
3,3'-Dichlorobenzidine	P	1.00					
3-Methylphenol/4-Methylphenol	ON	1.00					
3-Nitroaniline	<u>P</u>	1.00					
4,6-Dinitro-2-Methylphenol	₽.	5.00					
4-Bromophenyl Phenyl Ether	QN	1.00					
4-Chioro-3-Methylphenol	~ ON	1.00					
4-Chloroaniline	QN	1.00					•
4-Chlorophenyl Phenyl Ether	QN	1.00					
4-Nitroaniline	QN	1.00					
4-Nitrophenol	Ð	1.00					
Qualifiers: BRL Below Reporting Limit	ting Limit	E	Value above quantitation range	ange		Holding times for preparation or analysis exceeded	- F
-	Analyte detected below quantitation limits	QN.	Not Detected at the Reporting Limit	ing Lamit R		r limits	
						, J	

S Spike Recovery outside recovery limits

CLIENT: Fay, Spofford & Thorndike

Work Order: 0804418

Project: MWRA 6905

TestCode: 8270_W

ANALYTICAL QC SUMMARY REPORT

Sample ID: MB-9986	SampType: MBLK	TestCode	Code: 8270_W	Units: µg/L	Prep Date:	4/29/2008	RunNo: 23388	
Client ID: ZZZZ	Batch ID: 9986	TestNo	TestNo: SW8270C	(SW3510)	Analysis Date:	4/29/2008	SeqNo: 229412	
Analyte	Result	POL	SPK value	SPK Ref Val	%REC LowLimit H	HighLimit RPD Ref Val	%RPD RPDLimit	Qual
Acenaphthene	QN	1.00	***************************************	***************************************		THE PROPERTY OF THE PROPERTY O		
Acenaphthylene	ON	1.00						
Acetophenone	QN	1.00				-		
Aniline	QN	5.00	*					
Anthracene	QN	1,00						
Azobenzene	QN	5.00						
Benz(a)Anthracene	QN	0.100						
Benzo(a)Pyrene	QN	0.100						
Benzo(b)Fluoranthene	QN	0.500						
Benzo(g,h,i)Perylene	QN	1.00						
Benzo(k)Fluoranthene	Q	0.500						
Benzył Alcohoł	QN	1.00						
Bis(2-Chloroethoxy)Methane	Q	1.00					-	
Bis(2-Chloroethyl)Ether	QN	1.00						
Bis(2.Chloroisopropyl)Ether	QN	1.00						
Bis(2-Ethylhexyl)Phthalate	QN	1,00						
Butyi Benzyi Phthalate	QN	1.00						
Carbazole	QN	1.00						
Chrysene	QN	1.00						
Dibenz(a,h)Anthracene	QN	0.100						
Dibenzofuran	QN	1.00						
Diethyl Phthalate	Q.	1.00						
Dimethyl Phthafate 🔅	Q	1.00						
Di-n-Butyl Phthalate	QN	1.00						
Fluoranthene	QN	1.00						
Fluorene	QN	1.00			-			
Hexachlorobenzene	QN	0.100						
Hexachlorobutadiene	QV	0.100						
Hexachlorocyclopentadiene	QN	5.00						
Hexachloroethane	QN	1.00						
Indeno(1,2,3-cd)Pyrene	QN	0.100						
Onalifiers: BRL Below Reporting Limit	ing Limit		E Value ab	Value above quantitation range	. 9	H Holding times for r	Holding times for preparation or analysis exceeded	
, -	Analyte detected below quantitation limits		ND Not Dete	Not Detected at the Reporting I imit	in the second		The factor	
	control of the second s			Atha at an Incponses	LABOUR.		aly mater	

9	
Fay, Spofford & Thorndik	0804418
CLIENT:	Work Order:

MWRA 6905 Project:

TestCode: 8270_W

ANALYTICAL QC SUMMARY REPORT

Sample ID: MB-9986	SampType: MBLK	TestCoc	TestCode: 8270_W	Units: pg/L		Prep Date:	te: 4/29/2008		RunNo: 23388	888	
Citent ID: ZZZZZ	Batch ID: 9986	Test	TestNo: SW8270C	(SW3510)		Analysis Date:	te: 4/29/2008		SeqNo: 229412	412	
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit Ri	RPD Ref Val	%RPD	RPDLimit	Qual
Isophorone	ON	1.00									
Naphthalene	QN	1.00									
Nitrobenzene	QN	1.00								-	
N-Nitrosodimethylamine	ON	5.00									
N-Nitrosodi-n-Propylamine	QN	1.00									
N-Nitrosodiphenylamine	QN	5.00									
Pentachlorophenol	QN	1.00									
Phenanthrene	QN	1.00									
Phenoi	QN	1.00									
Pyrene	QN	1.00									
Pyridine	QN	5.00									
Surr: 2,4,6-Tribromophenol	10.23	0	75	0	13.6	15	150				S
Surr: 2-Fluorobiphenyl	27.88	0	20	0	55.8	30	130				
Surr: 2-Fluorophenol	27.47	0	75	0	36.6	15	110				
Surr; Nitrobenzene-d5	25.36	0	50	0	50.7	30	130				
Surr: Phenol-d6	18.96	0	75	0	25.3	15	110				
Surr: Terphenyl-d14	30.64	0	20	0	61.3	30	130				
Sample ID: LCS2-9986	SampType: LCS	TestCoc	TestCode: 8270_W	Units: µg/L		Prep Date:	te: 4/29/2008		RunNo: 23388	88	
Client ID: ZZZZZ	Batch ID: 9986	Test	TestNo: SW8270C	(SW3510)		Analysis Date:	te: 4/29/2008		SeqNo: 229413	413	
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit RI	RPD Ref Val	%RPD	RPDLimit	Qual
1,2,4-Trichlorobenzene	14.10	1.00	25	0	56.4	40	140				
1,2.Dichlorobenzene	12.37	1.00	25	0	49.5	40	140				
1,2-Dinitrobenzene	19.20	1,00	25	0	76.8	40	140				
1,3-Dichlorobenzene	11.58	1.00	25	0	46.3	40	140				
1,3-Dinitrobenzene	17,30	1.00	25	0	69.2	40	140				
1,4-Dichlorobenzene	12.03	1.00	25	0	48.1	40	140				
1,4-Dinitrobenzene	15.76	1.00	25	0	63.0	40	140				
2,3,4,6-Tetrachlorophenol	10.82	1.00	25	0	43.3	30	130				
Qualifiers: BRL Below Reporting Limit	rting Limit	A A A A A A A A A A A A A A A A A A A	E Value	Value above quantitation range	ıge		H Hok	ding times for p	Holding times for preparation or analysis exceeded	nalysis exceede	*
-	Analyte detected below quantitation limits	-	ND Not Do	Not Detected at the Reporting Limit	ng Limit	•	R RPD	RPD outside recovery limits	ery limits	,	
S Spike Recov	Spike Recovery outside recovery limits									Page	Page 11 of 26

J Analyte detected below quantitation limits Spike Recovery outside recovery limits

TestCode: 8270_W

HOLD OF THE	00011100
Project:	MWRA 6905

Fay,Spofford & Thorndike 0804418 Work Order:

CLIENT:

Sample ID: LCS2-9986	SampType: LCS	TestCoc	TestCode: 8270_W	Units: µg/L		Prep Date:	4/29/2008	RunNo: 23388	8	
Client ID: ZZZZ	Batch ID; 9986	Testh	TestNo: SW8270C	(SW3510)		Analysis Date:	4/29/2008	SeqNo: 229413	13	
Analyte	Result	Pal	SPK value	SPK Ref Val	%REC	LowLimit Hi	HighLimit RPD Ref Val	%RPD	RPDLimit	Qual
2,4,5-Trichlorophenol	12:38	1,00	25	0	49,5	30	130]
2,4,6-Trichlorophenoi	8.940	1.00	25	0	35.8	30	130	÷	-	
2,4-Dichlorophenol	15.30	1.00	25	0	61.2	30	130	,		
2,4-Dimethylphenol	14.73	1.00	25	0	58.9	30	130			
2,4-Dinitrophenol	QN	5.00	25	0	10.1	30	130			ဟ
2,4-Dinitrotoluene	18.48	1.00	25	0	73.9	40	140			
2,6-Dinitrotoluene	16.81	1.00	25	0	67.2	40	140			
2-Chloronaphthalene	14.79	1.00	25	0	59.2	40	140			
2-Chlorophenol	12.55	1.00	25	0	50.2	30	130			
2-Methyinaphthalene	15.14	1.00	25	0	9.09	40	140			-
2-Methylphenol	12.50	1.00	25	0	50.0	30	130			
2-Nitroaniline	17,48	1.00	. 25	0	669	40	140			
2-Nifrophenol	10.71	1.00	25	0	42.8	30	130			
3,3'-Díchlorobenzidine	17.53	1.00	25	Ó	70.1	40	140			
3-Methylphenol/4-Methylphenol	11.95	1.00	25	0	47.8	30	130			٠
3-Nitroaniline	17.32	1.00	25	0	69.3	40	140	•		
4,6-Dinitro-2-Methylphenol	8.285	5.00	25	0	33.1	30	130			
4-Bromophenyl Phenyl Ether	17.31	1.00	25	0	69.2	40	140			
4-Chloro-3-Methylphenoi	14.50	1.00	25	0	58.0	30	130			
4-Chloroaniline	23.18	1.00	25	0	92.7	40	140			
4-Chlorophenyl Phenyl Ether	14.82	1.00	25	0	59.3	40	140			
4-Nitroaniline	17.35	1.00	25	0	69.4	40	140			
4-Nitrophenof	11.64	1.00	25	0	46.5	30	130			
Acenaphthene	15.60	1.00	25	0	62.4	40	140			
Acenaphthylene	15.72	1,00	25	0	62.9	40	140			
Acetophenone	14.13	1.00	25	0	56.5	40	140			
Aniline	19.22	5.00	25	0	76.9	40	140			
Anthracene	18.03	1.00	25	0	72.1	40	140			
Azobenzene	16.08	5.00	25	0	64.3	40	140			
Benz(a)Anthracene	17.98	0.100	25	0	71.9	40	140	٠		
Benzo(a)Pyrene	18.74	0.100	52	0	75.0	40	140			
Onalifiers: BRL Below Reporting Limit	ing Limit		E Value a	Value above quantitation range	ge		H Holding titues for preparation or analysis exceeded	reparation or ana	lysis exceeded	
_	Analyte detected below quantitation limits		_	Not Detected at the Reporting Limit	o Limit		-	ery limits	,	
אייים שונגאואא ל	and below spanning manner			การครั้งสามาราชาชา	g Lunus			ci, y minus		

Fay, Spofford & Thorndike CLIENT:

0804418 Work Order:

MWRA 6905

Project:

TestCode: 8270_W

ANALYTICAL QC SUMMARY REPORT

Sample ID: LCS2-9986	SampType: LCS	TestCod	TestCode: 8270_W	Units: µg/L		Prep Date:	e: 4/29/2008		RunNo: 23388	388	
Client ID: ZZZZZ	Batch ID: 9986	TestN	estNo: SW8270C	(SW3510)		Analysis Date:	e: 4/29/2008		SeqNo: 229413	9413	
Analyte	Result	Pal	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit RPD	RPD Ref Val	%RPD	RPDLimit	Qual
Benzo(b)Fluoranthene	20,30	0.500	25	0	81.2	40	140				
Benzo(g,h,i)Perylene	20,31	1.00	25	0	81.2	40	140				
Benzo(k)Fluoranthene	19.58	0.500	25	0	78.3	40	140				
Benzyl Alcohol	11.20	1.00	25	. 0	44.8	40	140			٠	
Bis(2-Chloroethoxy)Methane	16.09	1.00	25	0	64.4	40	140				
Bis(2-Chloroethyl)Ether	14.26	1.00	25	0	57.0	40	140				
Bis(2-Chloroisopropyl)Ether	12.18	1.00	25	0	48.7	40	140				
Bis(2-Ethythexyl)Phthalate	15.06	1.00	25	0	60.2	40	140				
Butyl Benzyl Phthalate	14.72	1.00	25	. 0	58.9	40	140				
Carbazole	19.56	1.00	25	0	78.3	40	140				
Chrysene	19.16	1.00	. 25	0	76.6	40	140				
Dibenz(a,h)Anthracene	16.22	0.100	25	0	64.9	40	140				
Dibenzofuran	16.24	1.00	25	0	64.9	40	140				
Diethyl Phthalate	16.13	1.00	25	0	64.5	40	140				٠.
Dimethyl Phthalate	10.96	1.00	25	0	43.9	40	140				-
Di-n-Butyl Phthalate	15.78	1,00	25	0	63.1	40	140				
Di-n-Octyl Phthalate	15.74	1.00	25	0	67.9	40	140				
Fluoranthene	19.72	1.00	25	0	78.9	40	140				
Fluorene	14.27	1.00	25	0	57,1	40	140		•	•	
Hexachlorobenzene	16.90	0.100	25	0	9.79	40	140				.*
Hexachlorobutadiene	13.88	0.100	25	0	55.5	40	140				
Hexachlorocyclopentadiene	28.25	5.00	25	0	113	40	140				
Hexachloroethane	11.76	1.00	25	0	47.0	40	140				
Indeno(1,2,3-cd)Pyrene	17.36	0.100	25	0	69.4	40	140				
Isophorone	27.98	1.00	25	0	112	40	140				
Naphthalene	14.60	1.00	25	0	58,4	40	140				
Nitrobenzene	14.04	1.00	25	0	299	40	140				
N-Nitrosodimethylamine	11.14	5.00	25	0	44.6	40	140			-	
N-Nitrosodi-n-Propylamine	14.21	1.00	25	0	56.8	40	140				
N-Nitrosodiphenylamine	17.10	5.00	25	. 0	68.4	40	140				
Pentachlorophenol	11.39	1.00	25	0	45.6	30	130				. *
Qualifiers: BRL Below Reporting Limit	rting Limit		E Value	Value above quantitation range	ıge		H Holding	g times for p	Holding times for preparation or analysis exceeded	nalysis exceed	Þ
J Analyte detec	Analyte detected below quantitation limits		ND Not De	Not Detected at the Reporting Limit	g Limit		R RPD or	RPD outside recovery limits	ary limits		
S Spike Recove	Spike Recovery outside recovery limits									Pag	Page 13 of 26

Holding times for preparation or analysis exceeded RPD outside recovery limits

нж

ANALYTICAL QC SUMMARY REPORT

Fay, Spofford & Thorndike

MWRA 6905 0804418

Work Order: CLIENT:

Project:

TestCode: 8270_W

Sample ID: LCS2-9986	SampType: LCS	TestCoc	TestCode: 8270_W			Prep Date	Prep Date: 4/29/2008		RunNo; 23388		
Cilent ID: ZZZZ	Batch ID: 9986	Test	estNo: SW8270C	(SW3510)		Analysis Date: 4/29/2008	:: 4/29/2008		SeqNo: 229413	~	-
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	%REC LowLimit HighLimit RPD Ref Val	Ref Val	%RPD RPDLimit Qual	PDLimit	Quai
Phenanthrene	17.71	1.00	25	0	70.8	40	140				
Phenoi	7.975	1.00	25	0	31.9	30	130				
Pyrene	15.48	1.00	25	0	61.9	40	140	•			
Pyridine	10.66	5.00	25	0	42.6	40	140				
Surr: 2,4,6-Tribromophenol	12.16	0	. 75	0	16,2	15	110				
Surr: 2-Fluorobiphenyl	30.36	0	20	0	60.7	30	130				
Surr: 2-Fluorophenol	23.87	0	75	0	31.8	15	110				
Surr; Nitrobenzene-d5	27.87	0	20	0	22.7	30	130				
Surr: Phenol-d6	18.28	0	75	0	24.4	15	110				
Surr: Terphenyl-d14	33.91	0	20	0	67.8	30	130				

Below Reporting Limit	Щ.	Value above quantitation range
Analyte detected below quantitation limits	ND	Not Detected at the Reporting Limit
Spike Recovery outside recovery limits		

BRL Below Reporting Limit

ANALYTICAL QC SUMMARY REPORT

Fay, Spofford & Thorndike

0804418 MWRA 6905

CLIENT: Work Order:

Project:

TestCode: AG_W

Sample ID: MB-9991	SampType: MBLK	TestCoc	TestCode: AG_W	Units: mg/L		Prep Date:	***************************************	RunNo: 23365	
Client ID: ZZZZZ	Batch ID: 9991	Test	TestNo: 200.7	(SW3010A)		Analysis Date: 4/29/2008	/2008	SeqNo: 229202	
Analyte	Result	Pal	SPK value	SPK value SPK Ref Val	%REC	"REC LowLimit HighLimit RPD Ref Val	nit RPD Ref Vai	%RPD RPDLimit Qual	Qual
Silver	QN	0.00700					The state of the s		
Sample ID: LCS-9991	SampType: LCS	TestCoo	TestCode; ag_w	Units: mg/L	The state of the s	Prep Date: 4/29/2008	/2008	RunNo: 23365	
Client ID: ZZZZZ	Batch ID: 9991	Test	estNo: 200.7	(SW3010A)		Analysis Date: 4/29/2008	/2008	SeqNo: 229197	
Analyte	Result	Pal	SPK value	SPK value SPK Ref Val	%REC	%REC LowLimit HighLimit RPD Ref Val	iit RPD Ref Val	%RPD RPDLimit Qual	Qual
Silver	0.4870	0.00700	0.5	0	97.4	80 120	0;		

BRL	BRL Below Reporting Limit	ш	Value above qua
····	Analyte detected below quantitation limits	S	Not Detected at
S	Spike Recovery outside recovery limits		

Qualifiers:

Holding times for preparation or analysis exceeded

RPD outside recovery limits

ve quantitation range led at the Reporting Limit

Holding times for preparation or analysis exceeded

RPD outside recovery limits

2

E Value above quantitation range ND Not Detected at the Reporting Limit

Analyte detected below quantitation limits Spike Recovery outside recovery limits

-S

BRL Below Reporting Limit

Qunlifiers:

Fay, Spofford & Thorndike CLIENT:

0804418 Work Order: **MWRA 6905** Project:

TestCode: CN_W_SM

ANALYTICAL QC SUMMARY REPORT

Sample ID; MB-R23376	SampType: MBLK	TestCo	TestCode: CN_W_SM	Units: mg/L		Prep Date:	-		RunNo: 23376	921	
Client ID: ZZZZ	Batch ID: R23376	Test	estNo: SM 4500-CN-	Ž		Analysis Date: 4/30/2008	4/30/2008		SeqNo: 229286	286	
Analyte	Result	Pal	SPK value SPK Ref Val	SPK Ref Val	%REC	%REC LowLimit HighLimit RPD Ref Val	HighLimit RF	⊃D Ref Val	%RPD	%RPD RPDLimit	Qual
Cyanide, Total	ND	0.0197					and a fact of the restriction and the second and th				
Sample ID: LCS-R23376	SampType: LCS	TestCor	TestCode: CN_W_SM	Units: mg/L		Prep Date:			RunNo: 23376	76	
Client ID: ZZZZZ	Batch ID: R23376	Test	estNo: SM 4500-CN-	ż		Analysis Date: 4/30/2008	: 4/30/2008		SeqNo: 229287	287	
Analyte	Result	PQL	SPK value SPK Ref Val	SPK Ref Val	%REC	%REC LowLimit HighLimit RPD Ref Val	highLimit RF	²O Ref Val	%RPD	%RPD RPDLimit Qual	Qual
Cyanide, Total	0.1625	0.0197	0.183	0	88.8	85	115				

H Holding times for preparation or analysis exceeded R RPD outside recovery limits

E Value above quantitation range
ND Not Detected at the Reporting Limit

Analyte detected below quantitation limits Spike Recovery outside recovery limits

BRL Below Reporting Limit

Qualifiers:

CLIENT: Fay, Spofford & Thorndike	6)
T: Fay, Spofford &	ющ
T: Fay,Sp	ઝ
T:	y,Spoff
CLIENT:	Fa
	IENT:

0804418 Work Order: Project:

MWRA 6905

		4
	7	3
	C	J
		_
	_	7
	1	
	PFP	Į
		4
	_	_
		7
	\sim	S
	ARV	{
	<	q
	₹	ď
	-	くていて
	-	ì
	2	-
	\vdash	Š
	V,)
	,	
	_	į
	F	ر د
	•	/
		}
	-	Į
	4	(
	~	٠
	~	₹
	Ç,	ì
	<u>_</u>	ì
) 1
	MILL OF TACIFIC)
)
	\geq	1
	\geq	1
•	\geq	1
	\geq	1
-		1
	\geq	
	\geq	1

TestCode: Cr6_WW

Sample ID: MB-R23344	SampType: MBLK	TestCo	TestCode: Cr6_WW	Units: mg/L		Prep Date:	6 ;	RunNo: 23344		
Client ID: ZZZZZ	Batch ID: R23344	Test	stNo: M3500-Cr D	0	-	Analysis Dati	Analysis Date: 4/29/2008	SeqNo: 228873		
Analyte	Result	PQL	SPK value	SPK value SPK Ref Val	%REC	LowLimit	%REC LowLimit HighLimit RPD Ref Val	%RPD RP	RPDLímit	Qual
Chromium, Hexavalent	ON	0.0500								
Sample ID: LCS-R23344	SampType: LCS	TestCor	TestCode: Cr6_WW	Units: mg/L		Prep Date:	B.	RunNo; 23344		
Citent ID: ZZZZZ	Batch (D: R23344	Test	TestNo: M3500-Cr D		-	Analysis Dat	Analysis Date: 4/29/2008	SeqNo: 228874		
Analyte	Result	Pal	SPK value	SPK Ref Val	%REC	LowLimit	%REC LowLimit HighLimit RPD Ref Val	%RPD RP	RPDLimit Qual	Qual
Chromium, Hexavalent	0.4655	0.0500	0.5	0	93.1	85	115			

Page 18 of 26

Holding times for preparation or analysis exceeded

RPD outside recovery limits

H X

ND Not Detected at the Reporting Limit E Value above quantitation range

> Analyte detected below quantitation limits Spike Recovery outside recovery limits

BRL Below Reporting Limit

Qualifiers:

ANALYTICAL QC SUMMARY REPORT

TestCode: ephP_W

0804418	MWRA 6905
Work Order: 08	Project: N

Project:

Fay, Spofford & Thorndike

CLIENT:

Sample ID: MB-10000	SampType: MBLK	TestCode: ephP_W Units: µg/L	Prep Date: 4/30/2008	RunNo: 23430
Client ID: ZZZZZ	Batch ID: 10000	TestNo: MADEP EPH_ (eph_Wpr)	Analysis Date: 4/30/2008	SeqNo: 230000
Anolydo	Bosnit	IN THE YOR SHEW YOR I'VE	SPEC Loudinait High imit DOD CAR	

Sample to MD*1000	Sampighe. Morn	200	escone epul-	OHES. PG/L		Fieb Date: 4/30/2008	4/30/2008	KUNNO: 23430	430	
Client ID: ZZZZ	Batch ID: 10000	Test	TestNo: MADEP EPH_ (eph_Wpr)	H_ (eph_Wpr)	.*	Analysis Date:	4/30/2008	SeqNo: 230000	0000	
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit Hi	%REC LowLimit HighLimit RPD Ref Val	i %RPD	RPDLimit	Quai
Naphthalene	QN	1.00								
2-Methylnaphthalene	QN	1.00								
Acenaphthene	QN	1.00								
Phenanthrene	Q	.1,00								
Acenaphthylene	QN.	1.00								
Fluorene	QN.	1.00								
Anthracene	QN	1.00								
Fluoranthene	Q	1.00								
Pyrene	QN	1.00			-					
Benzo(a)Anthracene	Q	0.400								
Chrysene	g	1.00					•			
Benzo(b)Fluoranthene	QN	1,00								
Benzo(k)Fluoranthene	Q.	1.00								
Benzo(a)Pyrene	QN.	0.200								
Indeno(1,2,3-cd)Pyrene	Q.	0.400								
Dibenz(a,h)Anthracene	g.	0.400						,		
Benzo(g,h,i)Perylene	Q	1.00								
Total PAH Target Concentration	QN	0								
Surr: 2,2'-Difluorobiphenyl	18.82	0	25	0	75.3	40	140			
Surr: 2-Fluorobiphenyl	14.22	0	25	0	56.9	40	140			
Sample ID: LCS-10000	SampType: LCS	TestCoc	estCode; EPHP W	Units: µg/L	The state of the s	Prep Date:	4/30/2008	RunNo: 23430	430	

Sample ID: LCS-10000	SampType: LCS	TestCo	estCode: EPHP_W	Units: pg/L		Prep Dat	Prep Date: 4/30/2008	RunNo: 23430
Client ID: ZZZZ	Batch ID: 10000	Test	No: MADEP EP	TestNo: MADEP EPH_ (eph_Wpr)		Analysis Dat	Analysis Date: 4/30/2008	SeqNo: 230001
Analyte	Result	Pal	OL SPK value SPK Ref Val	SPK Ref Val	%REC	LowLimit	%REC LowLimit HighLimit RPD Ref Val	%RPD RPDLimit Qual
Naphthalene	20.02	1.00	50	0	40.0	40	140	
2-Methylnaphthalene	24.60	1.00	90	0	49.2	40	140	
Acenaphthene	26.47	1.00	50	0	52.9	40	140	
Phenanthrene	27.11	1.00	50	0	54.2	40	140	
Acenaphthylene	26.61	1.00	90	0	53.2	40	140	

Holding times for preparation or analysis exceeded

RPD outside recovery limits

ня

E Value above quantitation range ND Not Detected at the Reporting Limit

> Analyte detected below quantitation limits Spike Recovery outside recovery limits

BRL Below Reporting Limit

Qualifiers:

CLIENT: Fay, Spofford & Thorndike

Work Order: 0804418

MWRA 6905

Project:

TestCode: ephP_W

ANALYTICAL QC SUMMARY REPORT

Sample ID: LCS-10000	SampType: LCS	cs	TestCoc	TestCode: EPHP_W	Units: pg/L		Prep Date:	e: 4/30/2008		RunNo: 23430		
Client ID; ZZZZ	Batch ID: 10000	0000	Testh	lo: MADEP EI	TestNo: MADEP EPH_ (eph_Wpr)		Analysis Date:	e: 4/30/2008		SeqNo: 230001	- -	
Analyte	<u>.</u>	Result	Pal	SPK value	SPK Ref Val	%REC	LowLimit HighLimit	HighLimit RPD Ref Val	ef Vai	«RPD R	RPDLimit	Qual
Fluorene		31,73	1.00	50	0	63.5	40	140				
Anthracene	ı	26.94	1.00	90	0	53.9	40	140				
Fluoranthene		29.63	1,00	. 50	0	59.3	40	140				
Pyrene	•	34.65	1.00	50	0	69.3	40	140				
Benzo(a)Anthracene	•	38.23	0.400	50	0	76.5	40	140				
Chrysene	,	41.46	1.00	90	0	82.9	40	140			•	
Benzo(b)Fluoranthene		39.49	1.00	50	0	79.0	40	140				
Benzo(k)Fluoranthene		57.83	1.00	90	0	116	40	140				
Benzo(a)Pyrene		47.16	0.200	20	0	94.3	40	140				
Indeno(1,2,3-cd)Pyrene		39.96	0,400	50	0	79.9	40	140				
Dibenz(a,h)Anthracene	•	37.09	0,400	50	0	74.2	40	140				
Benzo(g,h,i)Perylene	7	43.44	1.00	50	0	86.9	40	140				-
Total PAH Target Concentration		592.4	0									
Surr: 2,2'-Difluorobiphenyl		16.96	0	25	0	67.8	40	140				
Surr: 2-Fluorobiphenyl		11.79	0	25	0	47.2	40	140				

Page 20 of 26

H Holding times for preparation or analysis exceeded R RPD outside recovery limits

RPD outside recovery limits

Not Detected at the Reporting Limit Value above quantitation range

9

Analyte detected below quantitation limits Spike Recovery outside recovery limits

BRL Below Reporting Limit

Qualifiers:

ANALYTICAL QC SUMMARY REPORT

Fay, Spofford & Thorndike

MWRA 6905 0804418

Work Order: CLIENT:

Project:

TestCode: EPHT_W

Sample ID: MB-10000	SampType: MBLK	TestCo	TestCode: EPHT_W	Units: µg/L		Prep Date:	Prep Date: 4/30/2008	RunNo: 23380	
Client ID: ZZZZZ	Batch ID: 10000	Test	estNo: MADEP EPH (eph_Wpr)	f (eph_Wpr)	•	Analysis Date: 4/30/2008	4/30/2008	SeqNo: 230418	
Analyte	Result	Pal	SPK value SPK Ref Val	SPK Ref Val	%REC	LowLimit H	%REC LowLimit HighLimit RPD Ref Val	%RPD RPDLimit Qual	Quai
Adjusted C11-C22 Aromatics	. ON	100		The statement of the st					
C09-C18 Aliphatics	O.	100							
C19-C36 Aliphatics	QN	100							
Unadjusted C11-C22 Aromatics	S ND	100							
Surr: 1-Chlorooctadecane	92.00	0	100	0	92.0	40	140		
Surr: o-Terphenyl	72.00	0	100	0	72.0	40	140		
Sample ID: LCS-10000	SampType: LCS	TestCoc	TestCode: FPHT W	Hoits: not		Pren Dafer	Pren Date: 4/20/2008	Dunkler 22200	

Sample ID: LCS-10000	SampType: LCS	TestCo	TestCode: EPHT W	Units: pg/L		Prep Da	Prep Date: 4/30/2008	RunNo: 23380		
Client ID: ZZZZZ	Batch ID: 10000	Test	TestNo: MADEP EPH (eph_Wpr)	(eph_Wpr)		Analysis Daf	Analysis Date: 4/30/2008	SeqNo: 230419	o.	
Analyte	Result	Pol	SPK value SPK Ref Val	ok Ref Val	%REC	LowLimit	%REC LowLimit HighLimit RPD Ref Val	%RPD RPDLimit Qual	PDLímit	Qual
Adjusted C11-C22 Aromatics	QN	100								
C09-C18 Aliphatics	QN	100	100	0	41.1	40	140			
C19-C36 Aliphatics	QN	100	100	0	55.6	40	140			
Unadjusted C11-C22 Aromatics	QN	100	100		56.6	40	140			
Surr: 1-Chlorooctadecane	67.00	0	100	0	67.0	40	140			
Surr: o-Terphenyl	75.00	0	100	0	75.0	40	140			

Holding times for preparation or analysis exceeded

RPD outside recovery limits

E Value above quantitation range
ND Not Detected at the Reporting Limit

Analyte detected below quantitation limits Spike Recovery outside recovery limits

BRL Below Reporting Limit

Qualifiers:

Fay, Spofford & Thorndike CLIENT:

0804418 Work Order: **MWRA 6905** Project:

TestCode: hg-245.1_w

ANALYTICAL QC SUMMARY REPORT

Sample ID: MBLK-10018	SampType: MBLK	TestCo	TestCode: hg-245.1_w	Units: mg/L		Prep Date:	Prep Date: 4/30/2008	RunNo: 23383	
Client ID: ZZZZZ	Batch ID; 10018	Test	estNo: E245. 1	(SW7470A/E2	-	Analysis Date: 4/30/2008	4/30/2008	SeqNo: 229382	
Analyte	Result	POL	SPK value SPK Ref Val	SPK Ref Val	%REC	LowLimit H	%REC LowLimit HighLimit RPD Ref Val	%RPD RPDLimit Qual	Quai
Mercury	ΩN	0.000500					THE THE PROPERTY OF THE PROPER		
Sample ID; LCS-10018 Client ID; ZZZZZ	SampType: LCS Batch ID: 10018	TestCo Testh	tCode: hg-245.1_w estNo: E245.1	TestCode: hg-245.1_w Units: mg/L TestNo: E245.1 (SW7470A/E2		Prep Date: 4/30/2008 Analysis Date: 4/30/2008	Prep Date: 4/30/2008 alysis Date: 4/30/2008	RunNo: 23383 SeqNo: 229365	
, Analyte	Result	POL	SPK value SPK Ref Val	SPK Ref Val	%REC	LowLimit H	"REC LowLimit HighLimit RPD Ref Val	%RPD RPDLimit	Qual
Mercury	0.004760	0.000500	0.005	0	95.2	80	120		

orndike	
Fay, Spofford & Thorndik	
LIENT:	

0804418 Work Order:

MWRA 6905 Project:

TestCode: TPH W

ANALYTICAL QC SUMMARY REPORT

Sample ID: MB-10037 Client ID: ZZZZZ	SampType: MBLK Batch ID: 10037	TestCor Testh	TestCode: TPH_W TestNo: 8100M	Units: mg/L (8100M)		Prep Da	Prep Date: 5/2/2008 Analysis Date: 5/2/2008	RunNo: 23455	
Analyte	Result	PQL	SPK value	SPK value SPK Ref Val	%REC	LowLimit	%REC LowLimit HighLimit RPD Ref Val	%RPD RPDLimit	Qua
Total Petroleum Hydrocarbons Surr: o-Terphenyl	ND 84.00	0,200	100	0	84.0	40	140		
Sample ID: LCS-10037	SampType: LCS	TestCoc	TestCode: TPH_W	Units: mg/L		Prep Dat	Prep Date: 5/2/2008	RunNo: 23455	
Cilent ID: ZZZZZ	Batch ID: 10037	TestA	TestNo: 8100M	(8100M)	-	Analysis Dat	Analysis Date: 5/2/2008	SeqNo: 230329	
Analyte	Resulf	PQĹ	SPK value	SPK Ref Val	%REC	LowLimit	%REC LowLimit HighLimit RPD Ref Val	%RPD RPDLimit Qual	Qual
Total Petroleum Hydrocarbons Sur: o-Terphenyl	1,536 82.00	0.200	100	0	76.8 82.0	40	140		
Sample ID: LCS2-10037 Client ID: ZZZZZ	SampType: LCS Batch ID: 10037	TestCoc	TestCode: TPH_W TestNo: 8100M	Units: mg/L (8100M)		Prep Dat Analysis Dat	Prep Date: 5/2/2008 Analysis Date: 5/2/2008	RunNo: 23455 SeqNo: 230336	
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	LowLimit HighLimit RPD Ref Val	%RPD RPDLimit	Qual
Total Petroleum Hydrocarbons Surr: o-Terphenyl	1.217	0.200	100	0	60.9	40	140	Management and the second seco	

Qualifiers:

BRL Below Reporting Limit

J Analyte detected below quantitation limits J Analyte detected below quantitation limit
S Spike Recovery outside recovery limits

Holding times for preparation or analysis exceeded RPD outside recovery limits H &

H Holding times for preparation or analysis exceeded R RPD outside recovery limits

E Value above quantitation range ND Not Detected at the Reporting Limit

Analyte detected below quantitation limits Spike Recovery outside recovery limits

BRL Below Reporting Limit

Qualifiers:

RPD outside recovery limits

CLIENT: Fay, Spoff: Work Order: 0804418	Fay,Spofford & Thorndike 0804418			ANALYTICAL Q	ANALYTICAL QC SUMMARY REPORT
Project: MWRA 6905	905			TestCod	TestCode: TRC_W
Sample ID: MB-R23331 Client ID: ZZZZZ	SampType: MBLK Batch ID: R23331	TestCode: TRC_W TestNo: Hach 8167	Units: mg/L	Prep Date: Analysis Date: 4/28/2008	RunNo: 23331 SeqNo: 228746
Analyte	Result	SPK value	SPK Ref Vai	%REC LowLimit HighLimit RPD Ref Val	of Val %RPD RPDLimit Qual
Total Residual Chlorine	QN	0,162			
	SampType: LCS	TestCode: TRC_W	Units: mg/L	Prep Date:	RunNo: 23331
Client ID: ZZZZ	Batch ID: R23331	TestNo: Hach 6167		Analysis Date: 4/28/2008	SeqNo: 228747
Analyte	Result	PQL SPK value	SPK Ref Val	%REC LowLimit HighLimit RPD Ref Val	sf Val %RPD RPDLimit Qual
Total Residual Chlorine	1.020	0.162 1	0	102 85 115	
				·	
				÷	

SampType: MBLK TestCode: TSS Units: mg/L Prep Date: 4/30/2008 RunNo: Client ID: ZZZZZ Batch ID: Result PQL SPK value SPK Ref Val %REC LowLimit HighLimit RPD Ref Val %RPD Analyse SampType: LCS TestCode: TSPK value SPK Ref Val %REC LowLimit HighLimit RPD Ref Val %RPD Samptyee SampType: LCS TestCode: TSS Units: Mg/L Prep Date: Analysis Date:	CLIENT: Fay, Spofford Work Order: 0804418 Project: MWRA 6905	Fay,Spofford & Thomdike 0804418 MWRA 6905					ANALYTIC	AL QC SUM TestCode: TSS	ANALYTICAL QC SUMMARY REPORT TestCode: TSS	KT
Result PQL SPK value SPK Ref Val %REC LowLimit HighLimit RPD Ref Val SampType: LCS TestCode: TSS Units: mg/L Prep Date: Run Batch ID: R23392 TestNo: E160.2 Analysis Date: 4/30/2008 Seq Result PQL SPK Ref Val %REC LowLimit HighLimit RPD Ref Val 75.50 4.00 66.5 0 114 80 120		SampType: MBLK Batch ID: R23392	TestCod	Je: TSS Jo: E160.2	Units: mg/L		Prep Date: Analysis Date: 4/30	2008	RunNo; 23392 SeqNo; 229438	
ND 4.00 SampType: LCS TestCode: TSS Units: mg/L Prep Date: Result Result POL SPK Ref Val %REC LowLimit HighLimit RPD Ref Val 75.50 4.00 66.5 0 114 80 120		Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit HighLim	it RPD Ref Val	%RPD RPDLimit Qual	Qual
SampType: LCS TestCode: TSS Units: mg/L Prep Date: 4/30/2008 Run Batch ID: R23392 TestNo: E160.2 Analysis Date: 4/30/2008 Seq Result POL: SPK value SPK Ref Val %REC LowLimit HighLimit RPD Ref Val 75.50 4.00 66.5 0 114 80 120		QN	4.00							
PQL SPK value SPK Ref Val %REC LowLimit HighLimit RPD Ref Val 4.00 66.5 0 114 80 120	2	SampType: LCS Batch ID: R23392	TestCoc TestN	le: TSS lo: E160.2	Units: mg/L		Prep Date: \nalysis Date: 4/30	2008	RunNo: 23392 SeqNo: 229439	
4.00 66.5 0 114 80		Result	POL	SPK value	SPK Ref Val	%REC	LowLimit HighLim	it RPD Ref Val	%RPD RPDLimit Qual	Qual
		75.50	4.00	999	0	114		·		

BRL	Below Reporting Limit	Ш	Value above quantitation range
· ·	Analyte detected below quantitation limits	Ŕ	Not Detected at the Reporting Limit
נעז	Spike Recovery outside recovery limits		

Spike Recovery outside recovery limits

BRL Below Reporting Limit

Qualifiers:

жж

Holding times for preparation or analysis exceeded RPD outside recovery limits

Page 25 of 26

	~
	Ö
	<u>+</u>
į	~
i	≥
	\leq
	5
7	7 2
(Ξ
•	7
į	
j.	

TestCode: VPH W2

ay,Spofford & Thorndike		
114	0804418	MWRA 6905
CLIENT:	Work Order:	Project:

Sample ID: MBLK	SampType: MBLK	E: MBLK	TestCod	TestCode: VPH_W2	Units: µg/L		Prep Date:		RunNo: 23429	29	
Client ID: ZZZZZ	Batch ID	Batch ID: R23429	TestN	TestNo: VPH			Analysis Date:	5/1/2008	SeqNo: 229999	666	
Analyte		Result	Pal	SPK value	SPK Ref Val	%REC	LowLimit H	HighLimit RPD Ref Val	%RPD	RPDLimit	Quai
C9-C10 Aromatic Hydrocarbons	arbons	QN	75.0								
Unadjusted C5-C8 Aliphatic Hydrocarbo	atic Hydrocarbo	Q	75.0								
Unadjusted C9-C12 Aliphatic Hydrocarb	natic Hydrocarb	ND	75.0								
Methyl Tert-Butyl Ether		ON	5.00			-					
Benzene		S	5.00								
Toluene		2	5.00								
Ethylbenzene		2	5.00								
m,p-Xylene		Q.	5.00								
o-Xylene		, QN	5.00								
Naphthalene		Q.	20.0								
Adjusted C5-C8 Aliphatic Hydrocarbons	: Hydrocarbons	Q	75.0								
Adjusted C9-C12 Aliphatic Hydrocarbon	ic Hydrocarbon	ΩN	75.0								
Surr; 2,5-Dibromotoluene FID	ne FID	72.39	0	100	0	72.4	70	130			
Surr; 2,5-Dibromotoluene PID	ine PID	73.18	0	100	0	73.2	70	130			
Sample ID: LCS	SampType: LCS	S: FCS	TestCod	TestCode: VPH_W2	Units: µg/L		Prep Date:		RunNo: 23429	29	
Client ID: ZZZZZ	Batch ID	Batch ID: R23429	TestN	TestNo: VPH			Analysis Date:	5/1/2008	SeqNo: 229997	266	
Analyte		Result	Pal	SPK value	SPK Ref Val	%REC	LowLimit H	HighLimit RPD Ref Val	%RPD	RPDLimit	Qual
C9-C10 Aromatic Hydrocarbons	arbons	82.90	75.0	100	3,664	79.2	70	130			
Unadjusted C5-C8 Aliphatic Hydrocarbo	itic Hydrocarbo	614.9	75.0	009	54.1	93.5	70	130			
Unadjusted C9-C12 Aliphatic Hydrocarb	natic Hydrocarb	483.2	75.0	009	11.39	78.6	70	130			
Methyl Tert-Butyl Ether		126.0	5.00	100	0	126	70	130			
Benzene		81.28	5.00	100	0	81.3	7.0	130			
Toluene		87.85	5,00	100	0	87.8	20	130			
Ethylbenzene		91.06	5.00	100	0	91.1	70	130			
m,p-Xylene		198,4	5.00	200	0	99.2	70	130			
o-Xylene		88.76	5.00	100	0	88.8	70	130			
Naphthalene		81,86	20.0	100	0	81.9	0,	130			
Surr; 2,5-Dibromotoluene FID	ine FID	86.10	0	100	0	86.1	20	130			
Qualifiers: BRL Belo	Below Reporting Linit			E Value	Value above quantitation range	ıge		H Holding times for	Holding times for preparation or analysis exceeded	alysis exceede	P
J Anal	Analyte detected below quantitation limits	mtitation limits		ND Not De	Not Detected at the Reporting Limit	g Limit		R RPD outside recovery limits	very limits		
S Spik	Spike Recovery outside recovery limits	overy limits								Paer	Page 25 of 26
										727	こうこういい

Page 26 of 26

ANALYTICAL QC SUMMARY REPORT

Fay, Spofford & Thorndike

0804418 MWRA 6905

CLIENT: Work Order:

Project:

TestCode: VPH_W2

Sample ID: LCS	SampType: LCS	TestCod	TestCode: VPH_W2	Units: µg/L		Prep Date:	'nì		RunNo: 23429	129	
Client ID: ZZZZZ	Batch (D: R23429	TestN	TestNo: VPH		*	Analysis Date: 5/1/2008	e: 5/1/200		SeqNo: 229997	766	
Analyte	Result	PaL	SPK value	SPK value SPK Ref Val	%REC	LowLimit	HighLimit	%REC LowLimit HighLimit RPD Ref Vai	%RPD	%RPD RPDLimit Qual	Qual
Surr: 2,5-Dibromotolvene PID	71.16	0	100	0	. 71.2	70	130	######################################			

		THE PARTY OF THE P
BRL Below Reporting Limit	E Value above quantitation range	H Holding times for preparation or analysis exceeded
J Analyte detected below quantitation limits	ND Not Detected at the Reporting Limit	R RPD outside recovery limits
S Spike Recovery outside recovery limits		Dawn JK

CHAIN OF CUSTODY RECORD GeoLabs, Inc. Environmental Laboratories 45 Johnson Lane, Braintree, MA D2184 p 781.848.7844 • f 781.848.7811 www.geolabs.com GeoLabs, Inc.

Sample Handling: circle choice Preservation Filtration

Not Needed Lab to do Lab to do Y/N

かららなる

1 85H BC つかけるとして Special Instructions のいかしない ひいろ けて Ĉ IT III

٥Ę

Page

CT RCP (Reasonable Confidence Protocols) State / Fed Program - Criteria Requirements: circle choice (s)

MCP Methods

GW-1

Fax

Turnaround: circle one

3-day

1-day 2-day いい

Address:

Client:

Contact:

Data Delivery: circle choice (s)

入むなしてもにら

≯ ⊘ 11 4 そのひょ しょ アクライ 5 UM-046 アトロア invoice to *:_ Project PO: Project. Other S-1 OC PDF Phone: email: Zax: Format: いだろう ちいけいととしている \Box 5 / 7-days トロロナ

J 45 16 ᅀᄑ 0 = 0ther **TEMPERATURE** 5,5 B = Bag P = Plastic V = Voa CH JOUN Analysis Requested छद **`**24 A = Amber G = Glass S = Summa Containers: えいいろんつ 401 7 = Other 40d 783 4 0170 5 = NaOH7 110 Ja / Preserative: Geolabs SAMPLE NUMBER 00 3 = H2S04Preservatives 2 = HN031= 15 ധാനം <7 സ Received on ice 우리돌토 3 CONTAINER 3 <u>C</u> A = Air 4 SAMPLE LOCATION / ID S = Soil N DW = Drinking Water 0 ra >-٦ COLLECTION <u>ි</u> GW = Ground Water --- ∑ u. **Matrix Codes:** 1715 5 < F W

CT (PH-0148) NY(11796) * Terms. Payment due within 30 days unless other arrangements are made. Past due balances subject to interest and cellection cost. Note: Homeowners and Law Firms must bay when desping off samples. We accept cash, check and credit cards.

MA (MA - 015) PA (68-03417)

NH (2508) NJ (MA-009) RI (LA000252)

9

Date / Time

6 = ME0H

4 = Na2S203

Received by

4

Date / Time

0T = Other

0 = 0il

SL = Sludge

WW = Waste Water

Relinquished by

280265 J&P.C of CR.03/07/08

9.7

28108



GW B3, B4, B19

Wednesday, May 14, 2008

Larry Durkin Fay, Spofford & Thorndike 5 Burlington Woods Burlington, MA 01803 GeoLabs, Inc. 45 Johnson Lane Braintree MA 02184 Tele: 781 848 7844 Fax: 781 848 7811

TEL: 781-221-1066 FAX: 781-221-1086

Project:

WM-046, 1.4 Exp

Location:

MWRA 6905

Order No.: 0804475

Dear Larry Durkin:

GeoLabs, Inc. received 3 sample(s) on 4/30/2008 for the analyses presented in the following report.

There were no problems with the analyses and all data for associated QC met EPA or laboratory specifications except where noted in the Case Narrative.

Analytical methods and results meet requirements of 310CMR 40.1056(J) as per MADEP Compendium of Analytical Methods (CAM).

If you have any questions regarding these tests results, please feel free to call.

Sincerely,

Jim Chen

Laboratory Director

Certifications:

CT (PH-0148) - MA (M-MA015) - NH (2508) - NJ (MA009) - NY (11796) - RI (LA000252)

Fay, Spofford & Thorndike

CLIENT: Project:

WM-046, 1.4 Exp

Lab Order:

0804475

CASE NARRATIVE

Date: 14-May-08

MADEP MCP Response Action Analytical Report Certification Form

Laboratory Name: GeoLabs, Inc.

Project # WM-046, 1.4 EXP

Project Location: MWRA 6905

MADEP RTN #:

This form provides certification for the following data set: 0804475 (001-003)

Sample Matrix: Groundwater

MCP SW-846 Methods Used: 8260B, VPH, 8270C, EPH, 8082, 8100M, 6010B, 245.1

An affirmative answer to questions A, B and C are required for "Presumptive Certainty" status

- A. Were all samples received by the laboratory in a condition consistent with that described on the Chain of custody documentation for the data set? YES
- B. Were all QA/QC procedures required for the specified method(s) included in this report followed, including the requirement to note and discuss in a narrative QC data that did not meet appropriate standards or guidelines?
- C. Does the analytical data included in this report meet all the requirements for "Presumptive Certainty" as described in Section 2.0 of the MADEP documents CAM VII A "Quality Assurance and Quality Control Guidelines for the Acquisition and Reporting of Analytical Data"? YES
- D. VPH and EPH Methods only: Was the VPH or EPH Method conducted without significant modifications (see Section 11.3 of respective Methods)

A response to questions E and F are required for "Presumptive Certainty" status

- E. Were all QC performance standards and recommendations for the specified methods achieved? NO NO
- F. Were results for all analyte-list compounds/elements for the specified method(s) reported?

All NO answers need to be addressed in an attached Environmental Laboratory case narrative.

CLIENT:

Fay, Spofford & Thorndike

Project:

WM-046, 1.4 Exp

Lab Order:

0804475

CASE NARRATIVE

CASE NARRATIVE

Physical Condition of Samples

The project was received by the laboratory in satisfactory condition. The sample(s) were received undamaged, in appropriate containers with the correct preservation.

Project Documentation

The project was accompanied by satisfactory Chain of Custody documentation.

Analysis of Sample(s)

Selected metals on 6010B analyzed per client request.

The following analytical anomalies or non-conformances were noted by the laboratory during the processing of these samples:

8260 LCS percent recovery for 2-Chloroethyl Vinyl Ether is outside the recovery limits.

8270 Method Blank percent recovery for 2,4,6-Tribromophenol is outside the recovery limits.

8270 LCS percent recovery for 2,4,6-Tribromophenol is outside the recovery limits.

I, the undersigned, attest under the pains and penalties of perjury that, based upon my personal inquiry of those responsible for obtaining the information, the material contained in this analytical report is, to the best of my knowledge and belief, accurate and complete.

Signature:

Jan Chan

Position: Lab Director

Printed Name: Jim Chen

Date: May 14, 2008

CLIENT:

Fay, Spofford & Thorndike

Project:

WM-046, 1.4 Exp

Lab Order:

0804475

CASE NARRATIVE

EPH Methods

Method for Ranges: MADEP EPH 04-1.1 Method for Target Analytes: 8270 GC/MS

Carbon Range data exclude concentrations of any surrogate(s) and/or internal standards eluting in that range

C11-C22 Aromatic Hydrocarbons exclude concentrations of Target PAH Analytes

CERTIFICATION:

Were all QA/QC procedures REQUIRED by the EPH Method followed? YES

Were all performance/acceptance standards achieved? YES

Were any significant modifications made to the EPH method? NO

I attest under the pains and penalties of perjury that, based upon my inquiry of those individuals immediately responsible for obtaining the information, the material contained in this report is, to the best of my knowledge and belief, accurate and complete.

SIGNATURE:

Brown Chang

LAB DIRECTOR

PRINTED NAME: Jim Chen

DATE: May 14, 2008

CLIENT:

Fay, Spofford & Thorndike

Project:

WM-046, 1.4 Exp

Lab Order:

0804475

CASE NARRATIVE

VPH Methods

Method for Ranges: MADEP VPH 04-1.1

Method for Target Analytes: MADEP VPH 04-1.1

Carbon Range data exclude concentrations of any surrogate(s) and/or internal standards eluting in that range.

C5-C8 Aliphatic Hydrocarbons exclude the concentration of Target Analytes eluting in that range. (MTBE, Benzene, Toluene)

C9-C12 Aliphatic Hydrocarbons exclude concentration of Target Analytes eluting in that range (Ethylbenzene, m&p-Xylenes, o-Xylene) AND concentration of C9-C10 Aromatic Hydrocarbons.

CERTIFICATION

Were all QA/QC procedures REQUIRED by the VPH Method followed? YES Were all QA/QC performance/acceptance standards achieved? YES Were any significant modifications made to the VPH method, as specified in Sec. 11.3? NO

I attest under the pains and penalties of perjury that, based upon my inquiry of those individuals immediately responsible for obtaining the information, the material contained in this report is, to the best of my knowledge, accurate and complete.

SIGNATURE:

Charge of the

POSITION: LAB DIRECTOR

PRINTED NAME: Jim Chen

DATE: May 14, 2008

Reported Date: 14-May-08

CLIENT:

Fay, Spofford & Thorndike

Lab Order:

0804475

Project:

WM-046, 1.4 Exp

Lab ID:

0804475-001

Client Sample ID: B3

Collection Date: 4/29/2008 10:30:00 PM

Date Received: 4/30/2008

Matrix: GROUNDWATER

Analyses	Result	Det. Limit	Qual Ur	nits	DF	Date Analyzed
TOTAL SUSPENDED SOLIDS - SM25	40-D					Analyst: AMS
Total Suspended Solids	90.0	4.00	mg	/L	1	5/1/2008
TOTAL PETROLEUM HYDROCARBO	NS - 8100M					Analyst: RuP
Total Petroleum Hydrocarbons	1.36	0.217	mg	/L	1	5/2/2008
Surr: o-Terphenyl	69.0	40-140	%F	REC	1	5/2/2008
POLYCHLORINATED BIPHENYLS - S	W8082					Analyst: GP
Aroclor 1016/1242	NÐ	0.326	μg/	′L	1	5/1/2008
Aroclor 1221	. ND	0.326	µg/	L	1	5/1/2008
Arocfor 1232	ND	0.326	μg/		1	5/1/2008
Aroclor 1248	ND	0.326	μg/	L	1	5/1/2008
Aroclor 1254	ND	0.326	μg/	L.	1	5/1/2008
Arocior 1260	ND	0.326	μg/	Ľ	1	5/1/2008
Aroclor 1262	ND	0.326	µg/		1	5/1/2008
Araclar 1268	ND	0.326	µg/		1	5/1/2008
Surr: Decachlorobiphenyl Sig 1	68.0	30-150	%F	REC	1	5/1/2008
Surr: Decachlorobiphenyl Sig 2	74.0	30-150	%F	REC	1	5/1/2008
Surr: Tetrachloro-m-Xylene Sig 1	80.0	30-150	%R	REC	1	5/1/2008
Surr: Tetrachloro-m-Xylene Sig 2	92.0	30-150	%R	REC	1	5/1/2008
TOTAL METALS BY GFAA - E200,9						Analyst: QS
Antimony	ND	0.00100	mg	/L	1	5/1/2008
Arsenic	0.00827	0.00100	mg.		1	5/1/2008
TOTAL METALS BY ICP - SW6010B						Analyst: QS
Barium	ďИ	2.00	mg.	/L	1	5/1/2008
Cadmium	ND	0.00400	mg.		1	5/1/2008
Chromium	ND	0.100	mg.		1	5/1/2008
Copper	ND	0,0400	mg,		1	5/1/2008
Iron	6.97	0.0600	.mg/		1	5/1/2008
Lead	ND	0.0100	mg/		1	5/1/2008
Nickel	ND	0.100	mg,		1	5/1/2008
Selenium	ND	0.0500	mg,		1	5/1/2008
TOTAL SILVER - E200.7						Analyst: QS
Silver	ND	0.00700	mg	л	1	5/1/2008

- B Analyte detected in the associated Method Blank
- E Value above quantitation range
- J Analyte detected below quantitation limits
- S Spike Recovery outside recovery limits

- BRL Below Reporting Limit
- H Holding times for preparation or analysis exceeded
- ND Not Detected at the Reporting Limit

Reported Date: 14-May-08

CLIENT:

Fay, Spofford & Thorndike

Lab Order:

0804475

Project:

WM-046, 1.4 Exp

Lab ID:

0804475-001

Client Sample ID: B3

Collection Date: 4/29/2008 10:30:00 PM

Date Received: 4/30/2008

Matrix: GROUNDWATER

Analyses	Result	Det. Limit	Qual U	nits	DF	Date Analyzed
TOTAL MERCURY - E245.1						Analyst: EC
Mercury	ND	0.0005	m	g/L	1	5/5/2008
SEMIVOLATILE ORGANICS - SW8270C	<u>.</u> %					Analyst: ZYZ
1,2,4-Trichlorobenzene	ND	1.06	μg	g/L	1	5/2/2008 6:18:00 AM
1,2-Dichlorobenzene	ND	1.06	μg	g/L	1	5/2/2008 6:18:00 AM
1,2-Dinitrobenzene	ND	1.06	μ	g/L	1	5/2/2008 6:18:00 AM
1,3-Dichlorobenzene	ND	1.06	μ	g/L	1	5/2/2008 6:18:00 AM
1,3-Dinitrobenzene	ND	1.06	μç	g/L	1	5/2/2008 6:18:00 AM
1,4-Dichlorobenzene	ND	1.06	μ	g/L	1	5/2/2008 6:18:00 AM
1,4-Dinitrobenzene	ND	1.06	μί	g/L	1	5/2/2008 6:18:00 AM
2,3,4.6-Tetrachlorophenol	ND	1.06	μg	g/L	1	5/2/2008 6:18:00 AM
2,4,5-Trichlorophenol	ND	1.06	μg	g/L	1	5/2/2008 6:18:00 AM
2,4,6-Trichlorophenal	ND	1.06		- g/L	1	5/2/2008 6:16:00 AM
2,4-Dichlorophenol	ND	1.06		g/L	1	5/2/2008 6:18:00 AM
2,4-Dimethylphenol	ND	1.06		g/L	1	5/2/2008 6:18:00 AM
2,4-Dinitrophenol	ИD	5.29		g/L	1	5/2/2008 6:18:00 AM
2,4-Dinitrotoluene	ND -	1.06	μς	g/L	1	5/2/2008 6:18:00 AM
2,6-Dinitrotoluene	ND	1.06	μί	g/L	1	5/2/2008 6:18:00 AM
2-Chioronaphthalene	ND	1.06	μg	g/L	1	5/2/2008 6:18:00 AM
2-Chiorophenol	ND	1.06	μg	g/L	1	5/2/2008 6:18:00 AM
2-Methylnaphthalene	5.60	1.06	μç	g/L	1	5/2/2008 6:18:00 AM
2-Methylphenol	ND	1.06	μ	g/L	1	5/2/2008 6:18:00 AM
2-Nitroaniline	ND.	1:06	μg	g/L	1	5/2/2008 6:18:00 AM
2-Nitrophenol	ND	1.06	μ	g/L	1	5/2/2008 6:18:00 AM
3,3'-Dichlorobenzidine	ND	1.06	hi	g/L	1	5/2/2008 6:18:00 AM
3-Methylphenol/4-Methylphenol	ND	1.06		g/L	1	5/2/2008 6:18:00 AM
3-Nitroaniline	ND	1.06	þí	g/L	1	5/2/2008 6:18:00 AM
4,6-Dinitro-2-Methylphenol	ND	5.29	μ	g/L	1	5/2/2008 6:18:00 AM
4-Bromophenyl Phenyl Ether	ND	1.06	րյ	g/L	1	5/2/2008 6:18:00 AM
4-Chloro-3-Methylphenol	ND	1.06	μg	g/L	1	5/2/2008 6:18:00 AM
4-Chloroaniline	ND	1.06	μς	g/L	1	5/2/2008 6:18:00 AM
4-Chlorophenyl Phenyl Ether	ND	1.06	μς	g/L	1	5/2/2008 6:18:00 AM
4-Nitroaniline	ND	1.06	μç	g/L	1	5/2/2008 6:18:00 AM
4-Nitrophenol	ND	1.06	րց	- g/L	1	5/2/2008 6:18:00 AM
Acenaphthene	ND	1.06	μ	g/L	1	5/2/2008 6:18:00 AM
Acenaphthylene	ND	1.06		g/L	1	5/2/2008 6:18:00 AM
Acetophenone	ND	1.06		- g/L	1	5/2/2008 6:18:00 AM
Anitine	ND	5.29		g/L	1	5/2/2008 6:18:00 AM
Anthracene	ND	1.06		g/L	1	5/2/2008 6:18:00 AM
Azobenzene	ND	5.29		g/L	1	5/2/2008 6:18:00 AM

- B Analyte detected in the associated Method Blank
- E Value above quantitation range
- J Analyte detected below quantitation limits
- S Spike Recovery outside recovery limits

- BRL Below Reporting Limit
- H Holding times for preparation or analysis exceeded
- ND Not Detected at the Reporting Limit

Reported Date: 14-May-08

CLIENT:

Fay, Spofford & Thorndike

Lab Order:

0804475

Project: WM-046, 1.4 Exp

Lab ID:

0804475-001

Client Sample ID: B3

Collection Date: 4/29/2008 10:30:00 PM

Date Received: 4/30/2008

Matrix: GROUNDWATER

Analyses	Result	Det. Limit	Qual Units	DF	Date Analyzed
SEMIVOLATILE ORGANICS - SW8270C					Analyst: ZY
Benz(a)Anthracene	ND	0.106	μg/L	1	5/2/2008 6:18:00 AM
Benzidine	ND	5.29	μg/Ĺ	1	5/2/2008 6:18:00 AM
Benzo(a)Pyrene	ND	0.106	μg/L	1	5/2/2008 6:18:00 AM
Benzo(b)Fluoranthene	ND	0.529	μg/L	1	5/2/2008 6:18:00 AM
Benzo(g,h,i)Perylene	ND	1.06	μg/L	1	5/2/2008 6:18:00 AM
Benzo(k)Fluoranthene	ND	0.529	μg/Ľ	1	5/2/2008 6:18:00 AM
Benzyl Alcohol	ND [.]	1.06	μg/L	1	5/2/2008 6:18:00 AM
Bis(2-Chloroethoxy)Methane	ND	1.06	µg/L	1	5/2/2008 6:18:00 AM
Bis(2-Chloroethyl)Ether	ND	1.06	μg/L	1	5/2/2008 6:18:00 AM
Bis(2-Chioroisopropyl)Ether	ND	1.06	μg/L	1	5/2/2008 6:18:00 AM
Bis(2-Ethylhexyl)Phthalate	2.39	1.06	μg/L	1	5/2/2008 6:18:00 AM
Butyl Benzyl Phthalate	ND	1.06	μg/L	1	5/2/2008 6:18:00 AM
Carbazole	ND	1.06	μg/L	1	5/2/2008 6:18:00 AM
Chrysene	ИD	1.06	μg/L	1	5/2/2008 6:18:00 AM
Dibenz(a,h)Anthracene	ND	0.106	μg/L	1	5/2/2008 6:18:00 AM
Dibenzofuran	ND	1.06	μg/L	· 1	5/2/2008 6:18:00 AM
Diethyl Phthalate	ND	1.06	μg/L	1	5/2/2008 6:18:00 AM
Dimethyl Phthalate	ND	1.06	μg/L	1	5/2/2008 6:18:00 AM
Di-n-Butyl Phthalate	ND	1.06	μg/L	1	5/2/2008 6:18:00 AM
Di-n-Octyl Phthalate	ND	1.06	μg/ L	1	5/2/2008 6:18:00 AM
Fluoranthene	ND	1.06	μg/L	1	5/2/2008 6:18:00 AM
Fluorene	ND	1.06	μg/L	1	5/2/2008 6:18:00 AM
Hexachlorobenzene	ND	0.106	μg/L	1	5/2/2008 6:18:00 AM
Hexachlorobutadiene	ND	0.106	μg/L	1	5/2/2008 6:18:00 AM
Hexachlorocyclopentadiene	ND	5.29	μg/L	1	5/2/2008 8:18:00 AM
Hexachloroethane	ND	1,06	μg/L	1	5/2/2008 6:18:00 AM
Indeno(1,2,3-cd)Pyrene	ND	0.106	μg/L	1	5/2/2008 6:18:00 AM
Isophorone	ND	1.06	μg/L	1	5/2/2008 6:18:00 AM
Naphthalene	4.15	1.06	μg/L	1	5/2/2008 6:18:00 AM
Nitrobenzene	ND	1.06	μg/L	1	5/2/2008 6:18:00 AM
N-Nitrosodimethylamine	ND	5.29	μg/L	1	5/2/2008 6:18:00 AM
N-Nitrosodi-n-Propylamine	ND	1.06	μg/L	1	5/2/2008 6:18:00 AM
N-Nitrosodiphenylamine	ND	5. 2 9	μg/L	1	5/2/2008 6:18:00 AM
Pentachlorophenol	ND	1.06	μg/L	1	5/2/2008 6:18:00 AM
Phenanthrene	ND	1.06	μg/L	1	5/2/2008 6:18:00 AM
Phenol	ND	1.06	μg/L	1	5/2/2008 6:18:00 AM
Pyrene	ND	1.06	μg/L	1	5/2/2008 8:18:00 AM
Pyridine	ND	5.29	µg/L	1	5/2/2008 6:18:00 AM
Surr: 2,4,6-Tribromophenol	98.6	15-110	%REC	1	5/2/2008 6:18:00 AM
Surr: 2-Fluorobiphenyl	76.4	30-130	%REC	1	5/2/2008 6:18:00 AM

- Analyte detected in the associated Method Blank
- Value above quantitation range
- Analyte detected below quantitation limits
- Spike Recovery outside recovery limits

- BRL Below Reporting Limit
- Η Holding times for preparation or analysis exceeded
- ND Not Detected at the Reporting Limit

Reported Date: 14-May-08

CLIENT:

Fay, Spofford & Thorndike

Lab Order:

0804475

WM-046, 1.4 Exp

Project: Lab ID:

0804475-001

Client Sample ID: B3

Collection Date: 4/29/2008 10:30:00 PM

Date Received: 4/30/2008

Matrix: GROUNDWATER

Analyses	Result	Det. Limit	Qual Units	DF	Date Analyzed
SEMIVOLATILE ORGANICS - SW82	70C	,			Analyst: ZY 2
Surr: 2-Fluorophenol	39.7	15-110	%REC	1	5/2/2008 6:18:00 AM
Surr: Nitrobenzene-d5	70.7	30-130	%REC	1	5/2/2008 6:18:00 AM
Surr: Phenol-d6	25.9	15-110	%REC	1	5/2/2008 6:18:00 AM
Surr: Terphenyl-d14	79.6	30-130	%REC	1	5/2/2008 6:18:00 AM
EPH TARGET ANALYTES - MADEP	EPH				Analyst: ZY
Naphthalene .	3.48	1.01	μg/L	1	5/6/2008 12:42:00 PM
2-Methylnaphthalene	5.8 5	1.01	μg/L	1	5/6/2008 12:42:00 PM
Acenaphthene	ND	1.01	μg/L	1	5/6/2008 12:42:00 PM
Phenanthrene	ND	1.01	μg/L	1	5/6/2008 12:42:00 PM
Acenaphthylene	ND	1.01	μg/L	1	5/6/2008 12:42:00 PM
Fluorene	ND	1.01	μg/L	1	5/6/2008 12:42:00 PM
Anthracene	ND	1.01	μg/L	1	5/6/2008 12:42:00 PM
Fluoranthene	ND	1.01	μg/L	1	5/6/2008 12:42:00 PM
Pyrene	ND	1,01	μg/L	1	5/6/2008 12:42:00 PM
Benzo(a)Anthracene	ND	0.404	μg/L	1 .	5/6/2008 12:42:00 PM
Chrysene	ND	1.01	μg/L	1	5/6/2008 12:42:00 PM
Benzo(b)Fluoranthene	ND	1.01	μg/L	1	5/6/2008 12:42:00 PM
Benzo(k)Fluoranthene	ND	1.01	μg/L	1	5/6/2008 12:42:00 PM
Benzo(a)Pyrene	ND	0.202	μg/L	1	5/6/2008 12:42:00 PM
Indeno(1,2,3-cd)Pyrene	ND	0.404	μg/L	1	5/6/2008 12:42:00 PM
Dibenz(a,h)Anthracene	ND	0.404	μg/L	1	5/6/2008 12:42:00 PM
Benzo(g,h,i)Perylene	ND	1.01	μg/L	1	5/6/2008 12:42:00 PM
Total PAH Target Concentration	9.33	0	μg/L	1	5/6/2008 12:42:00 PM
Surr: 2,2'-Difluorobiphenyl	89.6	40-140	%REC	1	5/6/2008 12:42:00 PM
Surr: 2-Fluorobiphenyl	82.8	40-140	%REC	1	5/6/2008 12:42:00 PM
OLATILE ORGANIC COMPOUNDS	- SW8260B				Analyst: MR
1,1,1,2-Tetrachloroethane	ND	5.00	μg/L	1	5/12/2008 3:38:00 PM
1,1,1-Trichloroethane	ND	5,00	μg/L	1	5/12/2008 3:38:00 PM
1,1,2,2-Tetrachloroethane	ND	2.00	μg/L	1	5/12/2008 3:38:00 PM
1,1,2-Trichloroethane	ND	5.00	μg/L	1	5/12/2008 3:38:00 PM
1,1-Dichloroethane	ND	5,00	μg/L	1	5/12/2008 3:38:00 PM
1,1-Dichloroethene	ND	5.00	μg/L	1	5/12/2008 3:38:00 PM
1,1-Dichloropropene	ND	5.00	μg/L	1	5/12/2008 3:38:00 PM
1,2,3-Trichlorobenzene	ND	5.00	μg/L	1	5/12/2008 3:38:00 PM
1,2,3-Trichloropropane	ND	5.00	μg/L	1	5/12/2008 3:38:00 PM
1,2,4-Trichlorobenzene	ND.	5.00	μg/L	1	5/12/2008 3:38:00 PM
1,2,4-Trimethylbenzene	13.9	5.00	μg/L	1	5/12/2008 3:38:00 PM

Qualifiers:

BRL Below Reporting Limit

B Analyte detected in the associated Method Blank

E Value above quantitation range

J Analyte detected below quantitation limits

S Spike Recovery outside recovery limits

H Holding times for preparation or analysis exceeded

ND Not Detected at the Reporting Limit

Reported Date: 14-May-08

CLIENT: Lab Order: Fay, Spofford & Thorndike

0804475

Project: Lab ID:

WM-046, 1.4 Exp

0804475-001

Client Sample ID: B3

Collection Date: 4/29/2008 10:30:00 PM

Date Received: 4/30/2008

Matrix: GROUNDWATER

Analyses	Result	Det. Limit	Qual Units	DF	Date Analyzed
VOLATILE ORGANIC COMPOUND	S - SW8260B				Analyst: MF
1,2-Dibromo-3-Chloropropane	ND	5.00	μg/L	. 1	5/12/2008 3:38:00 PM
1,2-Dibromoethane	ND	2.00	μg/L	1	5/12/2008 3:38:00 PM
1,2-Dichlorobenzene	ND	5.00	μg/L	1	5/12/2008 3:38:00 PM
1,2-Dichloroethane	ND	2.00	μ g/L	1	5/12/2008 3:38:00 PM
1,2-Dichloropropane	ND	2.00	μg/L	1	5/12/2008 3:38:00 PM
1,3,5-Trimethylbenzene	ND	5.00	μg/L	1	5/12/2008 3:38:00 PM
1,3-Dichlorobenzene	ND	5.00	μg/L	1	5/12/2008 3:38:00 PM
1,3-Dichloropropane	ND	5.00	μg/L	1	5/12/2008 3:38:00 PM
1,4-Dichlorobenzene	ND	5.00	μg/L	1	5/12/2008 3:38:00 PM
2,2-Dichloropropane	ND	5.00	μg/L	1	5/12/2008 3:38:00 PM
2-Butanone	ND	10.0	μg/L	1	5/12/2008 3:38:00 PM
2-Chloroethyl Vinyl Ether	ND	5.00	μg/L	1	5/12/2008 3:38:00 PM
2-Chlorotoluene	ND	5.00	μg/L	1	5/12/2008 3:38:00 PM
2-Hexanone	ND	10.0	μg/L	1	5/12/2008 3:38:00 PM
4-Chlorotoluene	ND	5.00	μg/L	1	5/12/2008 3:38:00 PM
4-isopropyitoluene	ND	5.00	µg/L	1	5/12/2008 3:38:00 PM
4-Methyl-2-Pentanone	ND	5.00	μg/L	1	5/12/2008 3:38:00 PM
Acetone	ND	50.0	μg/L	1	5/12/2008 3:38:00 PM
Acrolein	ND	50.0	μg/L	1	5/12/2008 3:38:00 PM
Acrylonitrile	ND	50.0	μg/L	1	5/12/2008 3:38:00 PM
Benzene	12.7	5.00	μg/L	1	5/12/2008 3:38:00 PM
Bromobenzene	ND	5.00	μg/L	. 1	5/12/2008 3:38:00 PM
Bromochloromethane	ND	2.00	μg/L	1	5/12/2008 3:38:00 PM
Bromodichloromethane	ND	2.00	μg/L	1	5/12/2008 3:38:00 PM
Bromoform	ND	2.00	μg/L	1	5/12/2008 3:38:00 PM
Bromomethane	ND	2.00	μg/L	1	5/12/2008 3:38:00 PM
Carbon Disuffide	ND	5.00	μg/L	1	5/12/2008 3:38:00 PM
Carbon Tetrachloride	ND	2.00	μg/L	1	5/12/2008 3:38:00 PM
Chlorobenzene	ND	5.00	μg/L	4	5/12/2008 3:38:00 PM
Chloroethane	ND	5.00	μg/L	1	5/12/2008 3:38:00 PM
Chloroform	ИD	5.00	μg/L	1	5/12/2008 3:38:00 PM
Chloromethane	ND	5.00	μg/L	1	5/12/2008 3:38:00 PM
cis-1,2-Dichloroethene	ND	5.00	μg/L	1	5/12/2008 3:38:00 PM
cis-1,3-Dichloropropene	ND	0.500	μg/L	1	5/12/2008 3:38:00 PM
Dibromochloromethane	ND	2.00	µg/L	1	5/12/2008 3:38:00 PM
Dibromomethane	ND	5.00	μg/L	1	5/12/2008 3:38:00 PM
Dichlorodifluoromethane	ND	5.00	μg/L	1	5/12/2008 3:38:00 PM
Ethylbenzene	49.4	5.00	µg/L	1	5/12/2008 3:38:00 PM
Hexachlorobutadiene	ND	0.500	μg/L	1	5/12/2008 3:38:00 PM
isopropylbenzene	14.7	5.00	μg/L	4	5/12/2008 3:38:00 PM

- В Analyte detected in the associated Method Blank
- Value above quantitation range
- Analyte detected below quantitation limits
- Spike Recovery outside recovery limits

- BRL Below Reporting Limit
- Holding times for preparation or analysis exceeded
- Not Detected at the Reporting Limit

Reported Date: 14-May-08

CLIENT:

Fay, Spofford & Thorndike

Lab Order:

0804475

Project:

WM-046, 1.4 Exp

Lab ID:

0804475-001

Client Sample ID: B3

Collection Date: 4/29/2008 10:30:00 PM

Date Received: 4/30/2008

Matrix: GROUNDWATER

Analyses	Result	Det. Limit	Qual Units	DF	Date Analyzed
VOLATILE ORGANIC COMPOUNDS	- SW8260B				Analyst: MR
Methyl Tert-Butyl Ether	ND	5.00	μ g / L	1	5/12/2008 3:38:00 PM
Methylene Chloride	ND	5.00	μg/L	1	5/12/2008 3:38:00 PM
Naphthalene	ND	20.0	μg/L	1	5/12/2008 3:38:00 PM
n-Butylbenzene	ND	5.00	μg/L	1.	5/12/2008 3:38:00 PM
n-Propyłbenzene	23.4	5.00	µg/L	1	5/12/2008 3:38:00 PM
sec-Butylbenzene	ND	5.00	μg/L	1	5/12/2008 3:38:00 PM
Styrene	ND	5.00	μg/L	1	5/12/2008 3:38:00 PM
tert-Butylbenzene	ND	5.00	μg/L	1	5/12/2008 3:38:00 PM
Tetrachloroethene	ND	5.00	μg/L	1	5/12/2008 3:38:00 PM
Toluene	ND	5.00	μg/L	1	5/12/2008 3:38:00 PM
trans-1,2-Dichloroethene	ND	5.00	μg/L	1	5/12/2008 3:38:00 PM
trans-1,3-Dichloropropene	ND	0.500	μg/L	1	5/12/2008 3:38:00 PM
Trichloroethene	ND	5.00	μg/L	1	5/12/2008 3:38:00 PM
Trichlorofluoromethane	ND	5.00	μg/L	1 .	5/12/2008 3:38:00 PM
Vinyl Chloride	ND	2.00	pg/L	1	5/12/2008 3:38:00 PM
Xylenes, Total	8.83	5.00	µg/L	1	5/12/2008 3:38:00 PM
Surr: 1,2-Dichloroethane-d4	89.6	70-130	%REC	1	5/12/2008 3:38:00 PM
Surr: 4-Bromofluorobenzene	85.0	70-130	%REC	1	5/12/2008 3:38:00 PM
Surr: Dibromofluoromethane	107	70-130	%REC	1	5/12/2008 3:38:00 PM
Surr: Toluene-d8	96.8	70-130	%REC	1	5/12/2008 3:38:00 PM
/PH - MADEP VPH				•	Analyst: MR
C9-C10 Aromatic Hydrocarbons	ND	75.0	μg/L	1	5/1/2008
Unadjusted C5-C8 Aliphatic Hydrocarbons	108	75.0	μg/L	1	5/1/2008
Unadjusted C9-C12 Aliphatic Hydrocarbons	130	75.0	μg/L	1	5/1/2008
Methyi Tert-Butyl Ether	ND	5.00	μg/L	1	5/1/2008
Benzene	9.00	5.00	μg/L	1	5/1/2008
Toluene	ND	5.00	μg/L	1	5/1/2008
Ethylbenzene	42.1	5.00	μg/L	1	5/1/2008
m,p-Xylene	6.56	5.00	μg/L	1	5/1/2008
o-Xylene	ND	5.00	µg/L	1	5/1/2008
Naphthalene	ND	20.0	μg/L	1	5/1/2008
Adjusted C5-C8 Aliphatic Hydrocarbons	99.0	75.0	h@\r	1	5/1/2008
Adjusted C9-C12 Aliphatic Hydrocarbons	81.2	75.0	hã\ŗ	1.	5/1/2008
Surr: 2,5-Dibromotoluene FID	79.5	70-130	%REC	1	5/1/2008
Surr: 2,5-Dibromotoluene PiD	70.8	70-130	%REC	1	5/1/2008

- B Analyte detected in the associated Method Blank
- E Value above quantitation range
- J Analyte detected below quantitation limits
- S Spike Recovery outside recovery limits

- BRL Below Reporting Limit
- H Holding times for preparation or analysis exceeded
- ND Not Detected at the Reporting Limit

Reported Date: 14-May-08

CLIENT:

Fay, Spofford & Thorndike

Lab Order:

0804475

Project:

WM-046, 1.4 Exp

Lab ID:

0804475-001

Client Sample ID: B3

Collection Date: 4/29/2008 10:30:00 PM

Date Received: 4/30/2008

Matrix: GROUNDWATER

Analyses	Result	Det. Limit	Qual	Units	DF	Date Analyzed
CYANIDE, TOTAL - SM4500-CN-C,E Cyanide, Total	П	0.0197		mg/L	1	Analyst: WFR 5/12/2008
HEXAVALENT CHROMIUM - SM3500-CR-E Chromium, Hexavalent) ND	0.0500		mg/L	1	Analyst: RP 5/1/2008
TOTAL RESIDUAL CHLORINE - HACH 816 Total Residual Chlorine	7 ND	0.162		mg/L	. 1	Analyst: RP 4/30/2008

J Analyte detected below quantitation limits

S Spike Recovery outside recovery limits

H Holding times for preparation or analysis exceeded

ND Not Detected at the Reporting Limit

Reported Date: 14-May-08

CLIENT:

Fay, Spofford & Thorndike

Lab Order:

0804475

Project: Lab ID: WM-046, 1.4 Exp 0804475-002 Client Sample ID: B4

Collection Date: 4/30/2008 12:00:00 PM

Date Received: 4/30/2008

Matrix: GROUNDWATER

	•			Wathx: GROUNDWATER			
Analyses	Result	Det. Limit	Qual Units	DF	Date Analyzed		
TOTAL SUSPENDED SOLIDS - SM2540-	·D				Analyst: AMS		
Total Suspended Solids	ND	4.00	mg/L	1	5/1/2008		
TOTAL PETROLEUM HYDROCARBONS	- 8100M				Analyst: RuP		
Total Petroleum Hydrocarbons	0.287	0.217	mg/L	1	5/2/2008		
Surr: o-Terphenyl	74.0	40-140	%REC	· 1	5/2/2008		
POLYCHLORINATED BIPHENYLS - SWI	B082			•	Analyst: GP		
Aroclor 1016/1242	ND	0.309	μg/L	1	5/1/2008		
Aroclor 1221	ND	0.309	μg/L	1	5/1/2008		
Aroclor 1232	ND	0.309	μg/L	1	5/1/2008		
Aroclor 1248	ND	0.309	μg/L	1	5/1/2008		
Arocior 1254	ND	0.309	μg/L	1	5/1/2008		
Aroclor 1260	ND	0.309	μg/L	1	5/1/2008		
Aroclor 1262	ND	0.309	μg/L	1	5/1/2008		
Aroclor 1268	ND	. 0.309	μg/L	1	5/1/2008		
Surr: Decachlorobiphenyl Sig 1	98.0	30-150	%REC	1	5/1/2008		
Surr: Decachlorobiphenyl Sig 2	104	30-150	%REC	1 .	5/1/2008		
Surr: Tetrachioro-m-Xylene Sig 1	72.0	30-150	%REC	1	5/1/2008		
Surr: Tetrachioro-m-Xylene Sig 2	0.08	30-150	%REC	1	5/1/2008		
TOTAL METALS BY GFAA - E200.9					Analyst: QS		
Antimony	ND	0.00100	mg/L	1	5/1/2008		
Arsenic	ND	0.00100	mg/L	1 .	5/1/2008		
TOTAL METALS BY ICP - SW6010B					Analyst: QS		
Barium	ND	2.00	mg/L	1	5/1/2008		
Cadmium .	ND	0.00400	mg/L	1	5/1/2008		
Chromium	ND	0.100	mg/L	1	5/1/2008		
Copper	ND	0.0400	mg/L	1	5/1/2008		
Iron	6.56	0.0600	mg/L	1	5/1/2008		
Lead	0.0110	0.0100	mg/L	1	5/1/2008		
Nickel	ND	0,100	mg/L	1 .	5/1/2008		
Selenium	ND	0.0500	mg/L	1	5/1/2008		
TOTAL SILVER - E200.7					Analyst: QS		
Silver	ND	0.00700	mg/L	1	5/1/2008		

Qua	lif	ier	S
-----	-----	-----	---

- B Analyte detected in the associated Method Blank
- E Value above quantitation range
- J Analyte detected below quantitation limits
- S Spike Recovery outside recovery limits

- BRL Below Reporting Limit
- H Holding times for preparation or analysis exceeded
- ND Not Detected at the Reporting Limit

Reported Date: 14-May-08

CLIENT:

Fay, Spofford & Thorndike

Lab Order:

0804475

Project:

WM-046, 1.4 Exp

Lab ID:

0804475-002

Client Sample ID: B4

Collection Date: 4/30/2008 12:00:00 PM

Date Received: 4/30/2008

Matrix: GROUNDWATER

Analyses	Result	Det. Limit	Qual	Units	DF	Date Analyzed
TOTAL MERCURY - E245.1						Analyst: EC
Mercury	ND	0.0005		mg/L	1	5/5/2008
SEMIVOLATILE ORGANICS - SW8270C						Analyst: ZYZ
1,2,4-Trichlorobenzene	ND	1.01		μg/L	1	5/2/2008 6:51:00 AM
1,2-Dichlorobenzene	ND	1.01		μg/L	1	5/2/2008 6:51:00 AM
1,2-Dinitrobenzene	ND	1.01		μg/L	1	5/2/2008 6:51:00 AM
1,3-Dichlorobenzene	ND	1.01		µg/L	1	5/2/2008 6:51:00 AM
1,3-Dinitrobenzene	ND	1.01		μg/L	1	5/2/2008 6:51:00 AM
1,4-Dichlorobenzene	ND	1.01		µg/L	1	5/2/2008 6:51:00 AM
1,4-Dinitrobenzene	ND	1.01		μg/L	. 1	5/2/2008 6:51:00 AM
2,3,4,6-Tetrachiorophenol	ND	1.01		μg/L	1	5/2/2008 6:51:00 AM
2,4,5-Trichlorophenol	ND	1.01		μg/L	1	5/2/2008 6:51:00 AM
2,4,6-Trichlorophenol	ND	1.01		µg/L	1	5/2/2008 6:51:00 AM
2,4-Dichlorophenol	ND	1.01		μg/L	1	5/2/2008 6:51:00 AM
2,4-Dimethylphenol	ND	1.01		μg/L	1	5/2/2008 6:51:00 AM
2,4-Dinitrophenol	ND	5.03		µg/L	1	5/2/2008 6:51:00 AM
2,4-Dinitrotoluene	ND	1.01	,	µg/L	1	5/2/2008 6:51:00 AM
2,6-Dinitrotoluene	ND	1.01		µg/L	1	5/2/2008 6:51;00 AM
2-Chloronaphthalene	ND	1.01		µg/L	1	5/2/2008 6:51:00 AM
2-Chlorophenol	ND	1.01		μg/L	1	5/2/2008 6:51:00 AM
2-Methylnaphthalene	ND	1.01	ĺ	μg/L	1	5/2/2008 6:51:00 AM
2-Methylphenol	, ND	1.01		μg/L	1	5/2/2008 6:51:00 AM
2-Nitroaniline	ND	1.01		μg/L	1	5/2/2008 6:51:00 AM
2-Nitrophenol	ND	1.01	j	μg/L	1	5/2/2008 6:51:00 AM
3,3'-Dichlorobenzidine	ND	1.01		μg/L	1	5/2/2008 6:51:00 AM
3-Methylphenol/4-Methylphenol	ND	1.01	J	μg/L	1	5/2/2008 6:51:00 AM
3-Nitroaniline	ND	1.01		μg/L	1	5/2/2008 6:51:00 AM
4,6-Dinitro-2-Methylphenol	ND	5.03	İ	μg/L	1	5/2/2008 6:51:00 AM
4-Bromophenyl Phenyl Ether	ND	1.01	i	μg/L	1	5/2/2008 6:51:00 AM
4-Chloro-3-Methylphenol	ND	1.01		μg/L	1	5/2/2008 6:51:00 AM
4-Chloroaniline	ND	1.01		μg/L	1	5/2/2008 6:51:00 AM
4-Chlorophenyl Pheпyl Ether	ND	1.01		μg/L	1	5/2/2008 6:51:00 AM
4-Nitroaniline	ND	1.01		μg/L	1	5/2/2008 6:51:00 AM
4-Nitrophenol	ND	1.01		μg/L	1	5/2/2008 6:51:00 AM
Acenaphthene	ND	1.01		μg/L	1	5/2/2008 6:51:00 AM
Acenaphthylene	ND	1.01		μg/ L	1	5/2/2008 6:51:00 AM
Acetophenone	ND	1.01		μg/L	1	5/2/2008 6:51:00 AM
Aniline	ND	5.03		μg/L	1	5/2/2008 6:51:00 AM
Anthracene	ND	1.01		μg/L	1	5/2/2008 6:51:00 AM
Azobenzene	ND	5.03		μg/L	1	5/2/2008 6:51:00 AM

- Analyte detected in the associated Method Blank
- Ε Value above quantitation range
- Analyte detected below quantitation limits Spike Recovery outside recovery limits
- BRL Below Reporting Limit
- Holding times for preparation or analysis exceeded
- ND Not Detected at the Reporting Limit

Reported Date: 14-May-08

CLIENT:

Fay, Spofford & Thorndike

Lab Order:

0804475

WM-046, 1.4 Exp

Project: Lab ID:

0804475-002

Client Sample ID: B4

Collection Date: 4/30/2008 12:00:00 PM

Date Received: 4/30/2008

Matrix: GROUNDWATER

Analyses	ResuIt	Det. Limit	Qual Units	DF	Date Analyzed
SEMIVOLATILE ORGANICS - SW8270C					Analyst: ZY
Benz(a)Anthracene	ND	0.101	μg/L	1	5/2/2008 6:51:00 AM
Benzidine	ND	5.03	μg/L	1	5/2/2008 6:51:00 AM
Benzo(a)Pyrene	ND	0,101	μg/ L	1	5/2/2008 6:51:00 AM
Benzo(b)Fluoranthene	ND	0.503	μg/L	1	5/2/2008 6:51:00 AM
Benzo(g,h,i)Perylene	ND	1.01	µg/L	¹ 1	5/2/2008 6:51:00 AM
Benzo(k)Fluoranthene	ND	0.503	μg/L	1	5/2/2008 6:51:00 AM
Benzyl Alcohol	ND	1.01	μg/L	1	5/2/2008 6:51:00 AM
Bis(2-Chloroethoxy)Methane	ND	1.01	µg/L	1	5/2/2008 6:51:00 AM
Bis(2-Chloroethyl)Ether	ND	1.01	μg/L	1	5/2/2008 6:51:00 AM
Bis(2-Chloroisopropyl)Ether	ND	1.01	μg/L	1	5/2/2008 6:51:00 AM
Bis(2-Ethylhexyl)Phthalate	ND	1.01	μg/L	1	5/2/2008 6:51:00 AM
Butyl Benzyl Phthaiate	ND	1.01	μg/L	1	5/2/2008 6:51:00 AM
Carbazole	ND	1.01	μg/L	1	5/2/2008 6:51:00 AM
Chrysene	ИD	1.01	μg/L	. 1	5/2/2008 6:51:00 AM
Dibenz(a,h)Anthracene	ND	0.101	μg/L	1	5/2/2008 6:51:00 AM
Dibenzofuran	ND	1.01	μg/L	. 1	5/2/2008 6:51:00 AM
Diethyl Phthalate	ND	1.01	μg/L	1	5/2/2008 6:51:00 AM
Dimethyl Phthalate	ND	1.01	μg/L	1	5/2/2008 6:51:00 AM
Di-n-Butyl Phthalate	ND	1.01	μg/L	1	5/2/2008 6:51:00 AM
Di-n-Octyl Phthalate	ND	1.01	μg/L	1	5/2/2008 6:51:00 AM
Fluoranthene	ND	1.01	μg/L	1	5/2/2008 6:51:00 AM
Fluorene	ИD	1.01	μg/L	1	5/2/2008 6:51:00 AM
Hexachiorobenzene	ND	0.101	μg/L	1	5/2/2008 6:51:00 AM
Hexachlorobutadiene	ND	0.101	μg/L	1	5/2/2008 6:51:00 AM
Hexachlorocyclopentadiene	ND	5.03	μg/L	1	5/2/2008 6:51:00 AM
Hexachloroethane	ND	1.01	μg/L	1	5/2/2008 6:51;00 AM
Indeno(1,2,3-cd)Pyrene	ND	0.101	μg/L	. 1	5/2/2008 6:51:00 AM
Sophorone	ND	1.01	μg/L	1	5/2/2008 6:51:00 AM
Naphthalene	ND	1.01	µg/L	1	5/2/2008 6:51:00 AM
Nitrobenzene	ND	1.01	μg/L	1	5/2/2008 6:51:00 AM
N-Nitrosodimethylamine	ND	5.03	μg/L	1	5/2/2008 6:51:00 AM
N-Nitrosodi-n-Propylamine	ND	1.01	μg/L	1	5/2/2008 6:51:00 AM
N-Nitrosodiphenylamine	ND	5.03	μg/L	1	5/2/2008 6:51:00 AM
Pentachiorophenol	ND	1.01	μg/L	1	5/2/2008 6:51:00 AM
Phenanthrene	ND	1.01	μg/L	1	5/2/2008 6:51:00 AM
Phenol	ND	1.01	μg/L	1	5/2/2008 6:51:00 AM
Pyrene	ND	1.01	μg/L	1	5/2/2008 6:51:00 AM
Pyridine	ND	5.03	μg/L	1	5/2/2008 6:51:00 AM
Surr: 2,4.6-Tribromophenol	89.4	15-110	%REC	1	5/2/2008 6:51:00 AM
Surr: 2-Fluorobiphenyl	72.0	30-130	%REC	1	5/2/2008 6:51:00 AM

Qualifiers:

BRL Below Reporting Limit

В Analyte detected in the associated Method Blank

E Value above quantitation range

Analyte detected below quantitation limits

Spike Recovery outside recovery limits

Holding times for preparation or analysis exceeded

ND Not Detected at the Reporting Limit

Reported Date: 14-May-08

CLIENT:

Fay, Spofford & Thorndike

Lab Order:

0804475

Client Sample ID: B4

Collection Date: 4/30/2008 12:00:00 PM

Project:

WM-046, 1.4 Exp

Date Received: 4/30/2008

Lab ID:

0804475-002

Matrix: GROUNDWATER

Analyses	Result	Det. Limit	Qual Units	DF	Date Analyzed
SEMIVOLATILE ORGANICS - SW827	WOM-1October 1		Z 2212 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	F/ 1.	
Surr: 2-Fluorophenol	44.1	15-110	%REC	1	Analyst: ZYZ
Surr: Nitrobenzene-d5	68.2	30-130	%REC	1	5/2/2008 6:51:00 AM 5/2/2008 6:51:00 AM
Surr: Phenol-d6	27.0	15-110	%REC	1	
Surr: Terphenyl-d14	95.0	30-130	%REC	1	5/2/2008 6:51:00 AM 5/2/2008 6:51:00 AM
	30.0	50-150	MINEC	ı	5/2/2006 6.5 1:00 AM
EPH TARGET ANALYTES - MADEP I	=рн				Analysts 7V3
Naphthalene	ND ND	1.04	μg/L	1	Analyst: ZYZ 5/6/2008 1:16:00 PM
2-Methylnaphthalene	ND	1.04	ug/L	1	5/6/2008 1:16:00 PM
Acenaphthene	ND	1.04	μg/L	1	5/6/2008 1:16:00 PM
Phenanthrene	ND	1.04	μg/L	1	5/6/2008 1:16:00 PM
Acenaphthylene	ND	1.04	µg/L	1	5/6/2008 1:16:00 PM
Fluorene	ND	1.04	µg/L	1	5/6/2008 1:16:00 PM
Anthracene	ND	1.04	hg/L	1	5/6/2008 1:16:00 PM
Fluoranthene	ND	1.04	μg/L	1	5/6/2008 1:16:00 PM
Pyrene	ND	1.04	µg/L	1	5/6/2008 1:16:00 PM
Benzo(a)Anthracene	ND	0.415	µg/L	1	5/6/2008 1:16:00 PM
Chrysene	ND	1.04	µg/L	1	5/6/2008 1:16:00 PM
Benzo(b)Fluoranthene	ND	1.04	μg/L	1	5/6/2008 1:16:00 PM
Benzo(k)Fluoranthene	ND	1.04	μg/L	. 1	5/6/2008 1:16:00 PM
Benzo(a)Pyrene	ND	0.207	μg/L	1	5/6/2008 1:16:00 PM
Indeno(1,2,3-cd)Pyrene	МĎ	0,415	μg/L	1	5/6/2008 1:16:00 PM
Dibenz(a,h)Anthracene	ND	0.415	μg/L	1	5/6/2008 1:16:00 PM
Benzo(g,h,i)Perylene	ND	1.04	ha\r	1	5/6/2008 1:16:00 PM
Total PAH Target Concentration	ND	0	μg/L	1	5/6/2008 1:16:00 PM
Surr: 2,2'-Difluorobiphenyl	89.6	40-140	%REC	1	5/6/2008 1:16:00 PM
Surr: 2-Fluorobiphenyl	87.4	40-140	%REC	1	5/6/2008 1:16:00 PM
OLATILE ORGANIC COMPOUNDS					Analyst: MR
1,1,1,2-Tetrachloroethane	ND	5.00	μg/L	1	5/12/2008 4:12:00 PM
1,1,1-Trichloroethane	ND	5.00	μg/L	1	5/12/2008 4:12:00 PM
1,1,2,2-Tetrachloroethane	ND	2.00	µg/L	1	5/12/2008 4:12:00 PM
1,1,2-Trichloroethane	ND	5,00	μg/L	1	5/12/2008 4:12:00 PM
1,1-Dichloroethane	ND	5.00	µg/L	ዝ	5/12/2008 4:12:00 PM
1,1-Dichloroethene	ND.	5.00	µg/L	1	5/12/2008 4:12:00 PM
1,1-Dichloropropene	ND	5.00	μg/L	1 .	5/12/2008 4:12:00 PM
1,2,3-Trichlorobenzene	ND	5.00	μg/L	1	5/12/2008 4:12:00 PM
1,2,3-Trichloropropane	ND	5.00	μg/ L	1	5/12/2008 4:12:00 PM
1,2,4-Trichlorobenzene	ND	5.00	μg/L	1	5/12/2008 4:12:00 PM
1,2,4-Trimethylbenzene	ND	5.00	µg/L	1	5/12/2008 4:12:00 PM

В Analyte detected in the associated Method Blank

Е Value above quantitation range

Analyte detected below quantitation limits

Spike Recovery outside recovery limits

BRL Below Reporting Limit

H Holding times for preparation or analysis exceeded

ND Not Detected at the Reporting Limit

Reported Date: 14-May-08

CLIENT:

Fay, Spofford & Thorndike

Lab Order:

0804475

Project:

WM-046, 1.4 Exp

Lab ID:

0804475-002

Client Sample ID: B4

Collection Date: 4/30/2008 12:00:00 PM

Date Received: 4/30/2008

Matrix: GROUNDWATER

Analyses	Result	Det. Limit	Qual Units	DF	Date Analyzed
VOLATILE ORGANIC COMPOUNDS	- SW8260B				Analyst: MR
1,2-Dibromo-3-Chloropropane	ND	5.00	μg/L	1	5/12/2008 4:12:00 PM
1,2-Dibromoethane	ND	2.00	μg/L	1	5/12/2008 4:12:00 PM
1,2-Dichlorobenzene	ND	5.00	μg/ L	1	5/12/2008 4:12:00 PM
1,2-Dichloroethane	ND	2.00	μg/L	1	5/12/2008 4:12:00 PM
1,2-Dichloropropane	ND	2.00	μg/L	1	5/12/2008 4:12:00 PM
1,3,5-Trimethylbenzene	ND	5.00	μ g/L	1	5/12/2008 4:12:00 PM
1,3-Dichlorobenzene	ND	5.00	μg/L	. 1	5/12/2008 4:12:00 PM
1,3-Dichloropropane	ND	5.00	μg/L	. 1	5/12/2008 4:12:00 PM
1,4-Dichlorobenzene	ND	5.00	μg/L	1	5/12/2008 4:12:00 PM
2,2-Dichloropropane	ND	5.00	μg/L	1	5/12/2008 4:12:00 PM
2-Butanone	ND	10.0	μg/L	. 1 ,	5/12/2008 4:12:00 PM
2-Chloroethyl Vinyl Ether	ND	5.00	μg/L	1	5/12/2008 4:12:00 PM
2-Chlorotoluene	ND	5.00	μg/L	1	5/12/2008 4:12:00 PM
2-Hexanone	ND	10.0	μg/L	1	5/12/2008 4:12:00 PM
4-Chlorotoiuene	ND	5.00	μg/L	1	5/12/2008 4:12:00 PM
4-Isopropyltoluene	ND	5.00	μg/L	1	5/12/2008 4:12:00 PM
4-Methyl-2-Pentaпone	ND	5.00	μg/L	1	5/12/2008 4:12:00 PM
Acetone	ND	50.0	μg/L	1	5/12/2008 4:12:00 PM
Acrolein	ND	50.0	μg/L	1	5/12/2008 4:12:00 PM
Acrylonitrile	ND	50,0	μg/L	1	5/12/2008 4:12:00 PM
Benzene	ND	5.00	μg/L	1	5/12/2008 4:12:00 PM
Bromobenzene	ND	5.00	μg/L	1	5/12/2008 4:12:00 PM
Bromochloromethane	ND	2,00	μg/L	1	5/12/2008 4:12:00 PM
Bromodichloromethane	ND	2.00	μg/L	1	5/12/2008 4:12:00 PM
Bromoform	ND	2.00	μg/L	1	5/12/2008 4:12:00 PM
Bromomethane	ND	2.00	μg/L	1	5/12/2008 4:12:00 PM
Carbon Disulfide	ND	5.00	μg/L	1	5/12/2008 4:12:00 PM
Carbon Tetrachloride	ND	2.00	μg/L	. 1	5/12/2008 4:12:00 PM
Chlorobenzene	ND	5.00	μg/L	1	5/12/2008 4:12:00 PM
Chioroethane	ND	5.00	μg/L	. 1	5/12/2008 4:12:00 PM
Chloroform	ND	5.00	μg/L	1	5/12/2008 4:12:00 PM
Chloromethane	ND	5.00	μg/L	1	5/12/2008 4:12:00 PM
cis-1,2-Dichloroethene	ND	5.00	μg/L	1	5/12/2008 4:12:00 PM
cis-1,3-Dichloropropene	ND	0.500	μg/L	4	5/12/2008 4:12:00 PM
Dibromochloromethane	ND	2.00	μg/L	1	5/12/2008 4:12:00 PM
Dibromomethane	ND	5.00	μg/L	1	5/12/2008 4:12:00 PM
Dichlorodifiuoromethane	ND	5.00	μg/L	1	5/12/2008 4:12:00 PM
Ethylbenzene	ND	5.00	μg/L	1	5/12/2008 4:12:00 PM
Hexachlorobutadiene	. ND	0.500	μg/L	1	5/12/2008 4:12:00 PM
sopropylbenzene	ND	5.00	μg/L	1	5/12/2008 4:12:00 PM

- B Analyte detected in the associated Method Blank
- E Value above quantitation range
- Analyte detected below quantitation limits
- S Spike Recovery outside recovery limits

- BRL Below Reporting Limit
- H Holding times for preparation or analysis exceeded
- ND Not Detected at the Reporting Limit

Reported Date: 14-May-08

CLIENT:

Fay, Spofford & Thorndike

Lab Order:

0804475

Project:

WM-046, 1.4 Exp

Lab ID:

0804475-002

Client Sample ID: B4

Collection Date: 4/30/2008 12:00:00 PM

Date Received: 4/30/2008

Matrix: GROUNDWATER

Analyses	Result	Det. Limit	Qual Units	DF	Date Analyzed
VOLATILE ORGANIC COMPOUNDS	- SW8260B				Analyst: MR
Methyl Tert-Butyl Ether	ND	5.00	µg/L	1	5/12/2008 4:12:00 PM
Methylene Chloride	ND	5.00	µg/L	1	5/12/2008 4:12:00 PM
Naphthalene	ND	20.0	μg/L	1	5/12/2008 4:12:00 PM
n-Butylbenzene	ND	5.00	μg/L	1	5/12/2008 4:12:00 PM
n-Propylbenzene	ND	5.00	μ g/ L	1	5/12/2008 4:12:00 PM
sec-Butylbenzene	ND	5.00	µg/L	1	5/12/2008 4:12:00 PM
Styrene	ND	5.00	μg/L	1	5/12/2008 4:12:00 PM
tert-Butylbenzene	ND	5.00	μg/L	. 1	5/12/2008 4:12:00 PM
Tetrachloroethene	ND	5.00	μg/L	1	5/12/2008 4:12:00 PM
Toluene	ND	5.00	μg/L	1	5/12/2008 4:12:00 PM
trans-1,2-Dichloroethene	ND	5.00	μg/L	1	5/12/2008 4:12:00 PM
trans-1,3-Dichloropropene	ND	0.500	μ g/L	1	5/12/2008 4:12:00 PM
Trichloroethene	ND	5.00	µg/L	1	5/12/2008 4:12:00 PM
Trichlorofluoromethane	ND	5.00	μg/L	1	5/12/2008 4:12:00 PM
Vinyl Chloride	ND	2.00	μg/L	1	5/12/2008 4:12:00 PM
Xylenes, Total	ND	5.00	μg/L	1	5/12/2008 4:12:00 PM
Surr: 1,2-Dichloroethane-d4	88.5	70-130	%REC	1	5/12/2008 4:12:00 PM
Surr: 4-Bromofluorobenzene	81.9	70-130	%REC	1	5/12/2008 4:12:00 PM
Surr: Dibromofluoromethane	95.8	70-130	%REC	1	5/12/2008 4:12:00 PM
Surr: Toluene-d8	98.8	70-130	%REC	1	5/12/2008 4:12:00 PM
VPH - MADEP VPH					Analyst: MR
C9-C10 Aromatic Hydrocarbons	ND	75.0	μg/L	1	5/6/2008
Unadjusted C5-C8 Aliphatic Hydrocarbons	ND	75.0	μg/L	1	5/6/2008
Unadjusted C9-C12 Aliphatic Hydrocarbons	ND	75.0	µg/L	1	5/6/2008
Methyl Tert-Butyl Ether	ND	5.00	μg/L	1	5/6/2008
Benzene	ND	5.00	μg/L	1	5/6/2008
Toluene	ND	5.00	µg/L	1	5/6/2008
Ethylbenzene	ND	5.00	μg/ L	1	5/6/2008
m,p-Xylene	ND	5.00	μ g/ L	1	5/6/2008
o-Xylene	ND	5.00	μg/L	1 -	5/6/2008
Naphthalene	ND	20.0	μg/L	ĺ	5/6/2008
Adjusted C5-C8 Aliphatic Hydrocarbons	ND	75.0	μg/L	1	5/6/2008
Adjusted C9-C12 Aliphatic Hydrocarbons	ND	75.0	μg/L	1	5/6/2008
Surr: 2,5-Dibromotoluene FID	73.4	70-130	%REC	1	5/6/2008
Surr: 2,5-Dibromotoluene PID	72.1	70-130	%REC	1	5/6/2008

Qualifiers:

BRL Below Reporting Limit

B Analyte detected in the associated Method Blank

E Value above quantitation range

J Analyte detected below quantitation limits

S Spike Recovery outside recovery limits

H Holding times for preparation or analysis exceeded

ND Not Detected at the Reporting Limit

Reported Date: 14-May-08

CLIENT:

Fay, Spofford & Thorndike

Client Sample ID: B4

Lab Order:

0804475

Collection Date: 4/30/2008 12:00:00 PM

Project:

WM-046, 1.4 Exp

Date Received: 4/30/2008

Lab ID:

0804475-002

Matrix: GROUNDWATER

Analyses	Result	Det. Limit	Qual	Units	DF	Date Analyzed
CYANIDE, TOTAL - SM4500-CN-C,E Cyanide, Total	ND	0,0197		mg/L	1	Analyst: WFR 5/12/2008
HEXAVALENT CHROMIUM - SM3500-CR-I Chromium, Hexavalent) ND	0.0500		mg/L	1	Analyst: RP 5/1/2008
TOTAL RESIDUAL CHLORINE - HACH 816 Total Residual Chlorine	5 7 ND	0.162		mg/L	1	Analyst: RP 4/30/2008

J Analyte detected below quantitation limits

S Spike Recovery outside recovery limits

H Holding times for preparation or analysis exceeded

ND Not Detected at the Reporting Limit

Reported Date: 14-May-08

CLIENT:

Fay, Spofford & Thorndike

Lab Order: Project:

0804475

WM-046, 1.4 Exp

Lab ID:

0804475-003

Client Sample ID: B18

Collection Date: 4/30/2008 2:15:00 AM

Date Received: 4/30/2008

Matrix: GROUNDWATER

Analyses	Result	Det. Limit	Qual U	nits DF	Date Analyzed
TOTAL SUSPENDED SOLIDS - SM254	0-D				Analyst: AMS
Total Suspended Solids	ND	4.00	mg	g/L 1	5/1/2008
TOTAL PETROLEUM HYDROCARBON	S - 8100M				Analyst: RuP
Total Petroleum Hydrocarbons	ND	0.208	mg	g/L 1	5/2/2008
Surr: o-Terphenyl	65.0	40-140	%1	REC 1	5/2/2008
POLYCHLORINATED BIPHENYLS - SV	V8082				Analyst: GP
Arodor 1016/1242	ND	0.309	μg	/L 1	5/1/2008
Arocior 1221	ND	0.309	μg		5/1/2008
Aroclor 1232	ND	0.309	μд	/L 1	5/1/2008
Araclor 1248	ND	0.309	μg		5/1/2008
Aroclor 1254	МD	0.309	µg	/L 1	5/1/2008
Aroclor 1260	ND	0.309	рg	/L 1	5/1/2008
Aroclor 1262	ND	0.309	þд	/L 1	5/1/2008
Aroclor 1268	ND	0.309	ь Би	/L 1	5/1/2008
Sur: Decachlorobiphenyl Sig 1	108	30-150	%	REC 1	5/1/2008
Surr: Decachiorobiphenyl Sig 2	124	30-150	%F	REC 1	5/1/2008
Surr: Tetrachloro-m-Xylene Sig 1	82.0	30-150	%F	REC 1	5/1/2008
Sum: Tetrachloro-m-Xylene Sig 2	94.0	30-150	%1	REC 1	5/1/2008
OTAL METALS BY GFAA - E200.9		at			Analyst: QS
Antimony	ND	0.00100	mg	g/L 1	5/1/2008
Arsenic	ND	0.00100	mç	g/L 1	5/1/2008
OTAL METALS BY ICP - SW6010B					Analyst: QS
Barium	ND	2.00	mg	ı/L 1	5/1/2008
Cadmium	ND	0.00400	mg	•	5/1/2008
Chromium	ND	0.100	mg		5/1/2008
Copper	ND	0.0400	mg		5/1/2008
iron	ND	0.0600	mç		5/1/2008
Lead	ND	0.0100	mg		5/1/2008
Nickel	ND	0.100	mg		5/1/2008
Selenium	ND	0.0500	mg	g/L 1	5/1/2008
OTAL SILVER - E200.7					Analyst: QS
Silver	ND	0.00700	mç	g/L 1	5/1/2008
	√₹ <u>.</u> .				

- В Analyte detected in the associated Method Blank
- Ε Value above quantitation range
- Analyte detected below quantitation limits
- Spike Recovery outside recovery limits
- BRL Below Reporting Limit
- Holding times for preparation or analysis exceeded
- ND Not Detected at the Reporting Limit

Reported Date: 14-May-08

CLIENT: Lab Order: Fay, Spofford & Thorndike

0804475

Project:

Lab ID:

WM-046, 1.4 Exp

0804475-003

Client Sample ID: B18

Collection Date: 4/30/2008 2:15:00 AM

Date Received: 4/30/2008

Matrix: GROUNDWATER

Analyses	Result	Det. Limit	Qual	Units	DF	Date Analyzed
TOTAL MERCURY - E245.1						Analyst: EC
Mercury	ND	0.0005		mg/L	1	5/5/2008
SEMIVOLATILE ORGANICS - SW8270C						Analyst: ZYZ
1,2,4-Trichlorobenzene	ND	1.03		μg/L	1	5/2/2008 7:24:00 AM
1,2-Dichiorobenzene	ND	1.03		μg/L	1	5/2/2008 7:24:00 AM
1,2-Dinitrobenzene	ND	1.03		μg/L	1	5/2/2008 7:24:00 AM
1,3-Dichlorobenzene	ND	1.03		μg/L	1	5/2/2008 7:24:00 AM
1,3-Dinitrobenzene	ND	1.03		μg/L	1	5/2/2008 7:24:00 AM
1,4-Dichiorobenzene	ND	1.03		μg/L	1	5/2/2008 7:24:00 AM
1,4-Dinitrobenzene	ND	1.03		μg/L	1	5/2/2008 7:24:00 AM
2,3,4,6-Tetrachlorophenol	ND	1.03		μg/L	1	5/2/2008 7:24:00 AM
2,4,5-Trichlorophenol	ND	1.03		µg/L	1	5/2/2008 7:24:00 AM
2,4,6-Trichlorophenol	ND	1.03		μg/L	1	5/2/2008 7:24:00 AM
2,4-Dichlorophenol	ND	1.03		μg/L	1	5/2/2008 7:24:00 AM
2,4-Dimethylphenol	ND	1.03		μg/L	1	5/2/2008 7:24:00 AM
2,4-Dinitrophenol	ND	5.15		μg/L	1	5/2/2008 7:24:00 AM
2,4-Dinitrotoluene	ND	1.03		μg/L	1	5/2/2008 7:24:00 AM
2,6-Dinitrotoluene	ND	1.03		μg/L	1	5/2/2008 7:24:00 AM
2-Chloronaphthalene	ND	1.03		μg/L	1	5/2/2008 7:24:00 AM
2-Chlorophenol	ND	1.03		μg/L	1	5/2/2008 7:24:00 AM
2-Methylnaphthalene	ND	1.03		μg/L	1	5/2/2008 7:24:00 AM
2-Methylphenol	ND	1.03		μg/L	1	5/2/2008 7:24:00 AM
2-Nitroaniline	ND	1.03		µg/L	1	5/2/2008 7:24:00 AM
2-Nitrophenol	ND	1.03		μg/L	1	5/2/2008 7:24:00 AM
3,3'-Dichlorobenzidine	ND	1.03		µg/L	1	5/2/2008 7:24:00 AM
3-Methylphenoi/4-Methylphenoi	ND	1.03		μg/L	1	5/2/2008 7:24:00 AM
3-Nitroaniline	ND	1.03		μg/L	1	5/2/2008 7:24:00 AM
4,6-Dinitro-2-Methylphenol	ND	5.15		<i></i>	1	5/2/2008 7:24:00 AM
4-Bromophenyl Phenyl Ether	ND	1.03		µg/L	1	5/2/2008 7:24:00 AM
4-Chloro-3-Methylphenol	ND	1.03		μg/L	1	5/2/2008 7:24:00 AM
4-Chloroaniline	ND	1.03		μg/L	1	5/2/2008 7:24:00 AM
4-Chiorophenyl Phenyl Ether	ND	1.03		μ g/L	1	5/2/2008 7:24:00 AM
4-Nitroaniline	ND	1.03		µg/L	1	5/2/2008 7:24:00 AM
4-Nitrophenol	ND	1.03		μg/L	1	5/2/2008 7:24:00 AM
Acenaphthene	ND	1.03		μg/L	1	5/2/2008 7:24:00 AM
Acenaphthylene	ND	1.03		μg/L	1	5/2/2008 7:24:00 AM
Acetophenone	ND	1.03		μg/L	1	5/2/2008 7:24:00 AM
Aniline	ND	5.15		μg/L	1	5/2/2008 7:24:00 AM
Anthracene	ND	1.03		μg/L	1	5/2/2008 7:24:00 AM
Azobenzene	ND	5.15		µg/L	1	5/2/2008 7:24:00 AM

- В Analyte detected in the associated Method Blank
- Е Value above quantitation range
- Analyte detected below quantitation limits
- Spike Recovery outside recovery limits

- BRL Below Reporting Limit
- H Holding times for preparation or analysis exceeded
- ND Not Detected at the Reporting Limit

Reported Date: 14-May-08

CLIENT:

Fay, Spofford & Thorndike

Lab Order:

0804475

Project:

WM-046, 1.4 Exp

Lab ID:

0804475-003

Client Sample ID: B18

Collection Date: 4/30/2008 2:15:00 AM

Date Received: 4/30/2008

Matrix: GROUNDWATER

Analyses	Result	Det. Limit	Qual U	Inits	DF	Date Analyzed
SEMIVOLATILE ORGANICS - SW8270C						Analyst: ZYZ
Benz(a)Anthracene	ND	0.103	μ	g/L	1	5/2/2008 7:24:00 AM
Benzidine	ND	5.15	μ	g/L	1	5/2/2008 7:24:00 AM
Benzo(a)Pyrene	ND	0.103	μ	g/L	1	5/2/2008 7:24:00 AM
Benzo(b)Fluoranthene	ND	0.515	μ	g/L	1	5/2/2008 7:24:00 AM
Benzo(g,h,i)Perylene	ND	1.03	μ	g/L	1	5/2/2008 7:24:00 AM
Benzo(k)Fluoranthene	ND	0.515	μ	g/L	1	5/2/2008 7:24:00 AM
Benzyl Alcohol	ND	1.03	, μ	g/L	1	5/2/2008 7:24:00 AM
Bis(2-Chloroethoxy)Methane	ND	1.03	μ	g/L	1	5/2/2008 7:24:00 AM
Bis(2-Chloroethyl)Ether	ND	1.03	μ	g/L	1	5/2/2008 7:24:00 AM
Bis(2-Chloroisopropyl)Ether	ND	1.03	μ	g/L	1	5/2/2008 7:24:00 AM
Bis(2-Ethylhexyl)Phthalate	ND	1.03	μ	g/L	1	5/2/2008 7:24:00 AM
Butyl Benzyl Phthalate	ND	1.03	إذا	g/L	1	5/2/2008 7:24:00 AM
Carbazole	ND	1.03	μ	g/L	1	5/2/2008 7:24:00 AM
Chrysene	ND	1.03	þ	g/L	1	5/2/2008 7:24:00 AM
Dibenz(a,h)Anthracene	ND	0.103	μ	g/L	1	5/2/2008 7:24:00 AM
Dibenzofuran	ND	1.03	μ	g/L	. 1	5/2/2008 7:24:00 AM
Diethyl Phthalate	ПD	1.03	μ	g/L	1	5/2/2008 7:24:00 AM
Dimethyl Phthalate	ND	1.03	μ	g/L	1	5/2/2008 7:24:00 AM
Di-n-Butyl Phthalate	ND	1.03	μ	g/L	1	5/2/2008 7:24:00 AM
Di-n-Octyl Phthalate	ND	1.03	μ	g/L	1	5/2/2008 7:24:00 AM
Fluoranthene	ND	1.03	μ	g/L	1	5/2/2008 7:24:00 AM
Fluorene	МD	1.03	μ,	g/L	1	5/2/2008 7:24:00 AM
Hexachlorobenzene	ND	0.103	μ	g/L	1	5/2/2008 7:24:00 AM
Hexachlorobutadiene	ND	0.103		g/L	1	5/2/2008 7:24:00 AM
Hexachlorocyclopentadiene	ND	5.15	μ	g/L	1	5/2/2008 7:24:00 AM
Hexachloroethane	ND	1.03	μ	g/L	1	5/2/2008 7:24:00 AM
Indeno(1,2,3-cd)Pyrene	ND	0.103	μ	g/L	1	5/2/2008 7:24:00 AM
Isophorone	ND	1.03	μ	g/L	1	5/2/2008 7:24:00 AM
Naphthalene	ND	1.03	IJ	g/L	1	5/2/2008 7:24:00 AM
Nitrobenzene	ND	1.03	μ	- g/L	1	5/2/2008 7:24:00 AM
N-Nitrosodimethylamine	ND	5.15	μ	g/L	1	5/2/2008 7:24:00 AM
N-Nitrosodi-n-Propylamine	ND	1.03	μ	g/L	1	5/2/2008 7:24:00 AM
N-Nitrosodiphenylamine	ND	5.15		g/L	1	5/2/2008 7:24:00 AM
Pentachiorophenol	ND	1.03	hi	g/L	1	5/2/2008 7:24:00 AM
Phenanthrene	ND	1.03	μg	- g/L	1	5/2/2008 7:24:00 AM
Phenoi	ND	1.03	μį	g/L	1	5/2/2008 7:24:00 AM
Pyrene	ND	1.03		g/L	1	5/2/2008 7:24:00 AM
Pyridine	ND	5.15		g/L	1	5/2/2008 7:24:00 AM
Surr: 2,4,6-Tribromophenol	83.9	15-110		REC	1	5/2/2008 7:24:00 AM
Surr: 2-Fluorobiphenyl	63.4	30-130		REC	1	5/2/2008 7:24:00 AM

- B Analyte detected in the associated Method Blank
- E Value above quantitation range
- Analyte detected below quantitation limits
- S Spike Recovery outside recovery limits

- BRL Below Reporting Limit
- H Holding times for preparation or analysis exceeded
- ND Not Detected at the Reporting Limit

Reported Date: 14-May-08

CLIENT:

Fay, Spofford & Thorndike

Lab Order:

0804475

Project:

WM-046, 1.4 Exp

Lab ID:

0804475-003

Client Sample ID: B18

Collection Date: 4/30/2008 2:15:00 AM

Date Received: 4/30/2008

Matrix: GROUNDWATER

Analyses	Result	Det. Limit	Qual Units	DF	Date Analyzed
SEMIVOLATILE ORGANICS - SW827	'0C				Analyst: ZYZ
Surr: 2-Fluorophenol	41.1	15-110	%REC	1	5/2/2008 7:24:00 AM
Surr: Nitrobenzene-d5	55.6	30-130	%REC	1	5/2/2008 7:24:00 AM
Surr: Phenol-d6	26.3	15-110	%REC	1	5/2/2008 7:24:00 AM
Surr: Terphenyl-d14	81.9	30-130	%REC	1	5/2/2008 7:24:00 AM
EPH TARGET ANALYTES - MADEP	EPH				Analyst: ZYZ
Naphthalene	ND	1.03	μg/L	1	5/6/2008 1:51:00 PM
2-Methylnaphthalene	ND	1.03	μg/L	1	5/6/2008 1:51:00 PM
Acenaphthene	ND	1.03	μg/L	1	5/6/2008 1:51:00 PM
Phenanthrene	ND	1.03	μg/L	1	5/6/2008 1:51:00 PM
Acenaphthylene	ND	1.03	μg/L	1 .	5/6/2008 1:51:00 PM
Fluorene	ND	1.03	μg/L	1	5/6/2008 1:51:00 PM
Anthracene	ND	1.03	μ g/L	1	5/6/2008 1:51:00 PM
Fluoranthene	ND	1.03	μg/L	1	5/6/2008 1:51:00 PM
Pyrene	ND	1.03	μg/L	1	5/6/2008 1:51:00 PM
Benzo(a)Anthracene	ND	0.412	μg/L	1	5/6/2008 1:51:00 PM
Chrysene	ND	1,03	μ g/ L	1	5/6/2008 1:51:00 PM
Benzo(b)Fiuoranthene	ПN	1.03	μg/L	1	5/6/2008 1:51:00 PM
Benzo(k)Fluoranthene	ND	1,03	μg/Ĺ	1	5/6/2008 1:51:00 PM
Benzo(a)Pyrene	ND	0.206	μg/L	1.	5/6/2008 1:51:00 PM
Indeno(1,2,3-cd)Pyrene	ND	0.412	μg/L	. 1	5/6/2008 1:51:00 PM
Dibenz(a,h)Anthracene	ND	0,412	µg/L	1	5/6/2008 1:51:00 PM
Benzo(g,h,i)Perylene	ND	1.03	μg/L	1	5/6/2008 1:51:00 PM
Total PAH Target Concentration	ND	c) μg/L	1	5/6/2008 1:51:00 PM
Surr: 2,2'-Difluorobiphenyl	86.0	40-140	%REC	1	5/6/2008 1:51:00 PM
Surr: 2-Fluorobiphenyl	82.1	40-140	%REC	1	5/6/2008 1:51:00 PM
VOLATILE ORGANIC COMPOUNDS	- SW8260B				Analyst: MR
1,1,1,2-Tetrachloroethane	ND	5.00) µg/L	1	5/13/2008 3:31:00 PM
1,1,1-Trichloroethane	ND	5.00) µg/L	1	5/13/2008 3:31:00 PM
1,1,2,2-Tetrachloroethane	ND	2.00	. •	1	5/13/2008 3:31:00 PM
1,1,2-Trichloroethane	ND	5.00) µg/L	1	5/13/2008 3:31:00 PM
1,1-Dichloroethane	ND	5.00) μg/L	1	5/13/2008 3:31:00 PM
1,1-Dichloroethene	ND	5.00) μg/L	1	5/13/2008 3:31:00 PM
1,1-Dichloropropene	ND	5.00) μg/L	1	5/13/2008 3:31:00 PM
1,2,3-Trichlorobenzene	ND	5.0	o µg/L	1	5/13/2008 3:31:00 PM
1,2,3-Trichloropropane	. ND	5.0	, 0	1	5/13/2008 3:31:00 PN
1,2,4-Trichlorobenzene	ND	5.0	D μg/L	1	5/13/2008 3:31:00 PM
1,2,4-Trimethylbenzene	ND	5,0	0 μg/L	1	5/13/2008 3:31:00 PN

- Analyte detected in the associated Method Blank
- E Value above quantitation range
- J Analyte detected below quantitation limits
- S Spike Recovery outside recovery limits

- BRL Below Reporting Limit
- H Holding times for preparation or analysis exceeded
- ND Not Detected at the Reporting Limit

Reported Date: 14-May-08

CLIENT:

Fay, Spofford & Thorndike

Lab Order:

0804475

Project:

WM-046, 1.4 Exp

Lab ID:

0804475-003

Client Sample ID: B18

Collection Date: 4/30/2008 2:15:00 AM

Date Received: 4/30/2008

Matrix: GROUNDWATER

Analyses	Result	Det. Limit	Qual U	nits	DF	Date Analyzed
OLATILE ORGANIC COMPOUND	S - SW8260B					Analyst: MR
1,2-Dibromo-3-Chloropropane	ND	5.00	μg	J/L	1	5/13/2008 3:31:00 PM
1,2-Dibromoethane	ND	2.00	μg	J/L	1	5/13/2008 3:31:00 PM
1,2-Dichlorobenzene	ND	5.00	μς	I /L	1	5/13/2008 3:31:00 PM
1,2-Dichloroethane	ND	2.00	μg	J/L	1	5/13/2008 3:31:00 PM
1,2-Dichloropropane	ND	2.00	μg	ı/L	1	5/13/2008 3:31:00 PM
1,3,5-Trimethylbenzene	ND	5.00	μg	ı/L	1	5/13/2008 3:31:00 PM
1,3-Dichlorobenzene	ND	5,00	μg	ı/L	1	5/13/2008 3:31:00 PM
1,3-Dichloropropane	ND	5.00	μg	ı/L	1	5/13/2008 3:31:00 PM
1,4-Dichiorobenzene	ND	5.00	рg		1	5/13/2008 3:31:00 PM
2,2-Dichloropropane	ND	5.00	μg		1	5/13/2008 3:31:00 PM
2-Butanone	ND	10.0	μg		1	5/13/2008 3:31:00 PM
2-Chloroethyl Vinyl Ether	ND	5.00	μg		1	5/13/2008 3:31:00 PM
2-Chlorotoluene	ND	5.00	μд		1	5/13/2008 3:31:00 PM
2-Hexanone	ND	10.0	μg		1	5/13/2008 3:31:00 PM
4-Chlorotoluene	ND	5.00	μg		1	5/13/2008 3:31:00 PM
4-isopropyltoluene	ND	5.00	μg		1	5/13/2008 3:31:00 PM
4-Methyl-2-Pentanone	ND	5.00	μg		1	5/13/2008 3:31:00 PM
Acetone	ND	50.0	μд		1	5/13/2008 3;31:00 PM
Acrolein	ND	50.0	μg		1	5/13/2008 3:31:00 PM
Acrylonitrile	ND	50.0	μg		1	5/13/2008 3:31:00 PM
3enzene .	ND	5.00	µg		1	5/13/2008 3:31:00 PM
Bromobenzene	ND	5.00	μg		1	5/13/2008 3:31:00 PM
Bromochloromethane	ND	2.00	μg.		1	5/13/2008 3:31:00 PM
3romodichloromethane	ND	2.00	μg.		1	5/13/2008 3:31:00 PM
Bromoform	ND	2.00	μg.		1	5/13/2008 3:31:00 PM
3romomethane	ND	2.00	μg.		1	5/13/2008 3:31:00 PM
Carbon Disulfide	ND	5.00	μg.		1	5/13/2008 3:31:00 PM
Carbon Tetrachloride	ND	2.00	μg.		1	5/13/2008 3:31:00 PM
Chlorobenzene	ND	5.00	μg,		1	5/13/2008 3:31:00 PM
Chloroethane	ND	5.00	μg,		1	5/13/2008 3:31:00 PM
Chlorofor m	ND	5.00	ha.		1	5/13/2008 3:31:00 PM
Chloromethane	ND	5.00	μg,		1	5/13/2008 3:31:00 PM
cis-1,2-Dichloroethene	ND	5.00	ha,		1	5/13/2008 3:31:00 PM
cis-1,3-Dichloropropene	ND	0.500	ha,		1	5/13/2008 3:31:00 PM
Dibromochloromethane	ND	2.00	ha,		1	5/13/2008 3:31:00 PM
Dibromomethane	ND	5.00	րց։ Աց		1	5/13/2008 3:31:00 PM 5/13/2008 3:31:00 PM
Dichlorodifluoromethane	ND	5.00	ha,		1	
Ethylbenzene	ND.	5.00	μg,		1	5/13/2008 3:31:00 PM
Hexachlorobutadiene	ND	0.500	μg/		1	5/13/2008 3:31:00 PM
Isopropylbenzene	ND	5.00				5/13/2008 3:31:00 PM
,, ,	٠.	5,00	μg/	L	1	5/13/2008 3:31:00 PM

- Analyte detected in the associated Method Blank
- Ε Value above quantitation range
- Analyte detected below quantitation limits
- Spike Recovery outside recovery limits
- BRL Below Reporting Limit
- Holding times for preparation or analysis exceeded
- ND Not Detected at the Reporting Limit

Reported Date: 14-May-08

CLIENT: Lab Order: Fav, Spofford & Thorndike

0804475

Project:

WM-046, 1.4 Exp

Lab ID:

0804475-003

Client Sample ID: B18

Collection Date: 4/30/2008 2:15:00 AM

Date Received: 4/30/2008

Matrix: GROUNDWATER

Analyses	Result	Det. Limit	Qual U	Inits	DF	Date Analyzed
OLATILE ORGANIC COMPOUNDS	- SW8260B		_			Analyst: MR
Methyl Tert-Butyl Ether	ND	5.00	μ	ıg/L	1	5/13/2008 3:31:00 PM
Methylene Chloride	ND	5.00	μ	ıg/L	1	5/13/2008 3:31:00 PM
Naphthalene	ND	20.0	μ	ıg/L	1	5/13/2008 3:31:00 PM
n-Butylbenzene	ND	5.00	μ	ıg/L	1	5/13/2008 3:31:00 PM
n-Propylbenzene	ND	5.00	۲	ıg/L	1	5/13/2008 3:31:00 PM
sec-Butylbenzene	. ND	5.00	٢	ıg/L	1	5/13/2008 3:31:00 PM
Styrene	ND	5.00	ļ.	ıg/L	1	5/13/2008 3:31:00 PM
tert-Butylbenzene	ND	5.00	.	ıg/L	1	5/13/2008 3:31:00 PM
Tetrachioroethene	ND	5.00	Ì	ıg/L	1	5/13/2008 3:31:00 PM
Toluene	ND	5.00	+	ıg/L	1	5/13/2008 3:31:00 PM
trans-1,2-Dichloroethene	ND	5.00	ŀ	ug/L	1	5/13/2008 3:31:00 PM
trans-1,3-Dichloropropene	ND	0.500	i	ug/L	1	5/13/2008 3:31:00 PM
Trichloroethene	ND	5,00	ŀ	µg/L	1	5/13/2008 3:31:00 PM
Trichlorofluoromethane	ND	5.00		ug/L	1	5/13/2008 3:31:00 PM
Vinyl Chloride	ND	2.00	ļ	ug/L	1	5/13/2008 3:31:00 PM
Xylenes, Total	ND	5.00	ļ	μg/L	1	5/13/2008 3:31:00 PN
Surr: 1.2-Dichloroethane-d4	92.2	70-130	ı	%REC	1	5/13/2008 3:31:00 PN
Surr: 4-Bromofluorobenzene	80.1	70-130	,	%REC	1	5/13/2008 3:31:00 PN
Surr: Dibromofluoromethane	112	70-130	,	%REC	1	5/13/2008 3:31:00 PN
Surr; Toluene-d8	102	70-130		%REC	1	5/13/2008 3:31:00 PN
unu saanen voi						Analyst: M F
VPH - MADEP VPH	ND	75.0	ı	μg/L	1	5/6/2008
C9-C10 Aromatic Hydrocarbons Unadjusted C5-C8 Aliphatic	ND	75.0		μg/L	1	5/6/2008
Hydrocarbons Unadjusted C9-C12 Aliphatic Hydrocarbons	ND	75.0)	μg/L	1	5/6/2008
Methyl Tert-Butyl Ether	ND	5.00)	µg/L	1	5/6/2008
Benzene	ND	5.00)	μg/L	4	5/6/2008
Toluene	ND	5.00		μg/L	1	5/6/2008
Ethylbenzene	ND	5.00		μg/L	1	5/6/2008
m,p-Xylene	ND	5.00		μg/L	1	5/6/2008
o-Xylene	ND			μg/L	1	5/6/2008
Naphthalene	ND)	μg/L	1	5/6/2008
Adjusted C5-C8 Aliphatic Hydrocarbons	ND			μg/L	1	5/6/2008
Adjusted C9-C12 Aliphatic Hydrocarbons	ND	75.0	ס	μg/L	1	5/6/2008
Surr: 2,5-Dibromotoluene FID	104	70-130	0	%REC	1	5/6/2008
Surr: 2,5-Dibromotoluene PID	87.5	70-13	Λ	%REC	1	5/6/2008

- Analyte detected in the associated Method Blank
- Ε Value above quantitation range
- Analyte detected below quantitation limits J
- Spike Recovery outside recovery limits

- BRL Below Reporting Limit
- Holding times for preparation or analysis exceeded
- Not Detected at the Reporting Limit

Reported Date: 14-May-08

CLIENT: Lab Order: Fay, Spofford & Thorndike

0804475

Project:

WM-046, 1.4 Exp

Lab ID:

0804475-003

Client Sample ID: B18

Collection Date: 4/30/2008 2:15:00 AM

Date Received: 4/30/2008

Matrix: GROUNDWATER

Analyses	Result	Det. Limit	Qual Units	DF	Date Analyzed
CYANIDE, TOTAL - SM4500-CN-C,E Cyanide, Total	ND	0.0197	mg/L	1	Analyst: WFR 5/12/2008
HEXAVALENT CHROMIUM - SM3500-CR-I Chromium, Hexavalent) ND	0.0500	mg/L	1	Analyst: RP 5/1/2008
TOTAL RESIDUAL CHLORINE - HACH 816 Total Residual Chlorine	5 7 ND	0.162	mg/L	1	Analyst: RP 4/30/2008

E Value above quantitation range

J Analyte detected below quantitation limits

S Spike Recovery outside recovery limits

H Holding times for preparation or analysis exceeded

ND Not Detected at the Reporting Limit

Fay, Spofford & Thorndike CLIENT:

0804475 Work Order: WM-046, 1.4 Exp

Project:

TestCode: 6010B_W

ANALYTICAL QC SUMMARY REPORT

Date: 14-May-08

%RPD RPDLimit SeqNo: 232685 RunNo: 23417 %REC LowLimit HighLimit RPD Ref Val Analysis Date: 5/1/2008 Prep Date: 5/1/2008 Units: mg/L (SW3010A) SPK value SPK Ref Val TestNo: SW6010B TestCode: 6010B_W 0.00400 0.100 0.0400 0.100 PQL 0.0600 0.0100 0.0100 2.00 Result 222222222 SampType: MBLK Batch ID: 10030 Sample iD: MB-10030 22722 Chromium Client ID: Cadmium Selenium Analyte Barium Copper Arsenic Nickel Lead Iron

Sample ID: LCS-10030	SampType: LCS	TestCoc	TestCode: 6010B W	Units: mg/L		Prep Da	Prep Date: 5/1/2008	బ్ల	RunNo: 23417	17	
Cirent ID: ZZZZZ	Batch ID: 10030	Test	estNo: SW6010B	(SW3010A)	7	Analysis Date: 5/1/2008	te: 5/1/200	ω	SeqNo: 232686	986	
Analyte	Result	PQL	SPK value SPK Ref Val	SPK Ref Val	%REC	LowLimit	HighLimit	"REC LowLimit HighLimit RPD Ref Val	%RPD	%RPD RPDLimit Qual	Qual
Arsenic	1.620	0.0100	. 2	0	81.0	80	120				
Barium	CN	2.00	_	0	93.4	80	120				
Cadmium	1.650	0.00400	2	0	82.5	80	120				
Chromium	1.654	0.100	2	0	82.7	80	120				
Copper	1,650	0.0400	2	0	82.5	80	120				
Iron	1.647	0.0600	2	0	82,4	80	120				
Lead	1.602	0.0100	2	0	80.1	80	120				
Nickel	1.641	0.100	2	0	82.0	80	120				
Selenium	1.614	0.0500	2	0	80.7	80	120				

Analyte detected below quantitation limits Spike Recovery outside recovery limits BRL Below Reporting Limit Qualifiers:

Not Detected at the Reporting Limit Value above quantitation range ΩŽ Ш

Holding times for preparation or analysis exceeded RPD outside recovery limits H &

WALLA TO THE TOTAL THE TOTAL TO AL TO THE TO		CERTAIN A MANAGEMENT OF THE CHAPTER AND A MANAGEMENT OF THE CANADA TO THE CONTRACT OF THE CANADA TO	MARIA ILCAL QUI SUIMINAKI KEPUKI
			=
	Fay Snofford & Thorndibe	a altoportor or amountable	0804475

0804475 Work Order:

CLIENT:

WM-046, 1.4 Exp Project:

TestCode: 8082_w

Sample ID: MB-10025	SampType: MBLK	TestCoc	TestCode: 8082 w	Units: ua/L		Pren Date:	e: 5/1/2008	RugNo: 23424	
Client ID: 2222	Ratch ID: 40026	T	Toothio: Claranes	(CINIZE TOD)		100			-
	Batch ID. 10023	189	10: SAVBU62	(SW3510B)		Analysis Date;	e: 5/1/2008	SeqNo: 229922	
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit RPD Ref Val	%RPD RPDLimit	Qual
Aroclor 1221	QN	0.300							
Aroclor 1232	QN	0.300							
Aroclor 1248	QN	0.300							
Aroclor 1254	QN	0.300							
Aroctor 1260	QN	0.300	٠						
Aroclor 1262	Q	0.300							
Aroclor 1268	ON.	00.300							
Surr: Decachlorobiphenyl Sig 1	88.00	0	100	0	88.0	30	150		
Surr: Decachlorobiphenyl Sig 2	92.00	0	100	0	92.0	30	150		
Surr: Tetrachloro-m-Xylene Sig 1	11 60.00	0	100	0	0.09	30	150		
Surr: Tetrachloro-m-Xylene Sig 2	12 66.00	0	100	0	0.99	30	150		
Sample ID: LCS-10025	SampType: LCS	TestCod	TestCode: 8082_w	Units: µg/L		Prep Date:	s: 5/1/2008	RunNo: 23424	
Client ID: ZZZZZ	Batch ID: 10025	Testi	TestNo: SW8082	(SW3510B)		Analysis Date:	e: 5/1/2008	SeqNo: 229923	
Analyte	Result	Pal	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit RPD Ref Val	%RPD RPDLimit	Qual
Aroclor 1016/1242	101.0	0.300	100	0	101	40	14.0		
Aroclor 1260	104.0	0.300	100	0	104	40	140		
Surr: Decachlorobiphenyl Sig 1	110.0	0	100	0	110	30	150		
Surr: Decachlorobiphenyl Sig 2	106.0	0	100	0	106	30	150		
Surr: Tetrachloro-m-Xylene Sig 1	1 84.00	0	100	0	84.0	30	150		
Surr: Tetrachloro-m-Xylene Sig 2	2 92.00	0	100	0	92.0	30	150		
Sample ID: LCS2-10025	SampType; LCS	TestCod	TestCode: 8082_w	Units: µg/L		Prep Date:	s: 5/1/2008	RunNo: 23424	
Client ID: ZZZZZ	Batch ID: 10025	TestN	TestNo: SW8082	(SW3510B)		Analysis Date:	e: 5/1/2008	SeqNo: 229929	
Analyte	Result	Pal	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit RPD Ref Val	%RPD RPDLimit	Qual
Aroclor 1016/1242	108.0	0.300	100	0	108	40	140		
Aroclor 1221	QN	0.300							
Aroclor 1232	CIN	0.300							
	THE REPORT OF THE PARTY OF THE						1	TO THE RESIDENCE AND A SECOND	-
Qualitiers: BRL Below Reporting Limit I Analyte detected below	Below Reporting Limit Analyte detected below aucortiteties limite	·	E Value	Value above quantitation range	ege Timit			Holding times for preparation or analysis exceeded	q
	ten testem quantification minus			not betwied at the neporting Limit	rumır S		K KFD outside recovery limits	very limits	
	Spike Recovery outside recovery limits							Pag	Page 2 of 26

0804475 Work Order: WM-046, 1.4 Exp

Project:

TestCode: 8082_w

ANALYTICAL QC SUMMARY REPORT

Sample ID: LCS2-10025	SampType: LCS	TestCod	TestCode; 8082_w	Units: µg/L		Prep Dat	Prep Date: 5/1/2008	~	RunNo: 23424	*	
Client ID: ZZZZZ	Batch ID: 10025	TestN	TestNo: SW8082	(SW3510B)	•	Analysis Date: 5/1/2008	e: 5/1/2 00	80	SeqNo: 229929	53	٠
Analyte	Result	POL	SPK value	SPK value SPK Ref Val	%REC	LowLimit	HighLimit	%REC LowLimit HighLimit RPD Ref Val	%RPD	%RPD RPDLimit	Qual
Aroclor 1248	ON	0.300									
Aroclor 1254	QN .	0.300			٠.						
Aroctor 1260	118.0	0.300	100	0	118	40	140				
Aroclor 1262	QN	0.300									
Aroclor 1268	QN	0.300									
Surr: Decachlorobiphenyl Sig 1	124.0	0	100	0	124	30	150				
Sur: Decachiorobiphenyl Sig 2	2 126.0	0	100	0	126	30	150				
Surr Tetrachloro-m-Xylene Sig 1	3.1 84.00	0	100	0	84.0	30	150				
Surr: Tetrachloro-m-Xylene Sig 2	92 92.00	0	100	0	92.0	30	150				

ND Not Detected at the Reporting Limit E Value above quantitation range

Holding times for preparation or analysis exceeded RPD outside recovery limits

Analyte detected below quantitation limits Spike Recovery outside recovery limits

BRL Below Reporting Limit

H Holding times for preparation or analysis exceeded R RPD outside recovery limits

E Value above quantitation range
ND Not Detected at the Reporting Limit

Analyte detected below quantitation limits Spike Recovery outside recovery limits

BRL Below Reporting Limit

Qualiffers:

RPD outside recovery limits

ANALYTICAL QC SUMMARY REPORT

TestCode: 8260B_W

Work Order:	0804475
Project:	WM-046, 1.4 Exp

Fay, Spofford & Thorndike

CLIENT:

The state of the s											
Sample ID: MB	SampType: MBLK	TestCo	TestCode: 8260B_W	Units: µg/L		Prep Date:	ài		RunNo: 23654	654	
Client ID: ZZZZZ	Batch ID: R23654	Test	TestNo: SW8260B			Analysis Date:	e: 5/12/2008	90	SeqNo: 232500	2500	*********
Analyte	Result	POL	SPK value	SPK Ref Val	%REC	ř LowLímit HighLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
1,1,1,2-Tetrachioroethane	QN	5.00		W							
1,1,1-Trichloroethane	₽	5.00									
1,1,2,2-Tetrachloroethane	QN	2.00									
1,1,2-Trichloroethane	Q	5.00									
1,1-Dichloroethane	QN	5.00									
1,1-Dichloroethene	QN	5.00									
1,1-Dichloropropene	QN	5.00									
1,2,3-Trichlorobenzene	QN	5,00									
1,2,3-Trichloropropane	S	5.00				-					
1,2,4-Trichlorobenzene	Q	5.00									
1,2,4-Trimethylbenzene	QN	5.00									
1,2-Dibromo~3-Chloropropane	Q	5.00									
1,2-Dibromoethane	Q.	2.00									
1,2-Dichlorobenzene	Q	5.00									
1,2-Dichloroethane	QN	2.00									
1,2-Dichloropropane	Ð	2.00					٠				
1,3,5-Trimethylbenzene	QN ·	5.00									
1,3-Dichlorobenzene	QN	5.00									
1,3-Dichloropropane	QN	5.00									
1,4-Dichlorobenzene	QN :	5.00									
2,2-Dichloropropane	QN	5.00	٠							•	
2-Butanone	S	. 10.0									
2-Chloroethyl Vinyl Ether	QN	5.00									
2-Chlorotoluene	QN	5.00									
2-Hexanone	Q	10.0								•	
4-Chlorotofuene	QN	5.00									
4-Isopropyltoluene	QN	5.00									
4-Methyi-2-Pentanone	Ð	5.00									
Acetone	QN	50.0	d								
Acrolein	ON	50.0	(2 M								
Acrylonitrile	2	50.0									
The state of the s	NAME OF THE PARTY			War and the state of the state							

0804475 Work Order:

WM-046, 1.4 Exp

Project:

TestCode: 8260B_W

Sample ID: MB	SampType: MBLK		TestCode: 8260B_W	Units: µg/L	Prep Date:		RunNo: 23654		
Client ID: ZZZZZ	Batch ID: R23654	4	TestNo: SW8260B		Analysis Date: 5/13	5/12/2008	SeqNo: 232500	00	***************************************
Analyte	Result	t Pal	SPK value	SPK Ref Val	%REC LowLimit HighLimit	mit RPD Ref Val	%RPD R	RPDLimit Q	Qual
Benzene	QN .	5.00							
Bromobenzene	<u>ON</u>	5.00	٠						
Bromochloromethane	ne ND	2.00							
Bromodichloromethane	ane	2.00							
Bromoform	ΩN	2.00							
Bromomethane	ΩN	2.00							
Carbon Disulfide	ON	5.00			٠				
Carbon Tetrachloride		2.00							
Chlorobenzene	QN	5.00			•				
Chloroethane	QN	5.00							
Chloroform	ΩN	5.00							
Chloromethane	ΩN	5.00							
cis-1,2-Dichloroethene	ene ND	5.00							
cis-1,3-Dichloropropene	oene ND	0.500							
Dibromochloromethane	nane ND	2.00							
Dibromomethane	ON	5,00							
Dichlorodifluoromethane		5.00							
Ethyibenzene	QN	4,							
Hexachlorobutadiene		_							
Isopropylbenzene	ΩN	5.00							
Methyl Tert-Butyl Ether	ther	5.00							
Methylene Chloride	ΩN .	5.00							
Naphthalene	QN	20.0				•			
n-Butylbenzene	ON								
n-Propyłbenzene	QV								
sec-Butytbenzene	QN								
Styrene	QV	5.00	. '						
tert-Butylbenzene	QN .	5.00							
Tetrachloroethene	QZ								
Toluene	QN		•						
trans-1,2-Dichloroethene	thene	5.00				- Constitution of the	and the second		
Qualifiers: BRL	. Below Reporting Limit	2.00	E Value	Value above quantitation range			reparation or ana	lysis exceeded	
·	Analyte detected below quantitation limits	limits	ND Not I	Not Detected at the Reporting Limit	g Limit R	RPD outside recovery limits	ary limits		
ß	Spike Recovery outside recovery limits	its						Page	Page 5 of 26
)	,

RPD outside recovery limits

E Value above quantitation range

ND Not Detected at the Reporting Limit

Analyte detected below quantitation limits Spike Recovery outside recovery limits

BRL Below Reporting Limit

Qualifiers:

Fay, Spofford & Thorndike
LIENT:

0804475 Work Order:

WM-046, 1.4 Exp

Project:

TestCode: 8260B_W

Sample ID: MB	SampType: MBLK	TestCo	TestCode: 8260B W	Units: ua/L		Prep Date:	te:		RunNo: 23654	24	
Client ID: ZZZZZ	Batch ID: R23654	Test	TestNo: SW8260B			Analysis Date:	te: 5/12/2008	08	SeqNo: 232500	200	······································
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
And the second s											
rans-1,5-Dictioroproperie		0,500									
Trichloroethene	QV.	5.00									
Trichlorofluoromethane	2	5.00				_					
Vinyl Chloride	QN	2.00									
Xylenes, Total	QV	5.00		4							•
Surr: 1,2-Dichloroethane-d4	28.29	0	30	0	94.3	70	130				
Surr: 4-Bromofluorobenzene	30.97	0	30	0	103	70	130				
Surr: Dibromofluoromethane	25.08	0	30	0	83.6	20	130				
Surr: Toluene-d8	30.13	0	30	0	100	70	130				
Sample ID: 50ppb Ics	SampType: LCS	TestCoo	TestCode; 8260B_W	Units: µg/L		Prep Date:	.e.		RunNo: 23654	54	
Client ID: ZZZZZ	Batch ID: R23654	Test	estNo: SW8260B			Analysis Date:	te: 5/12/2008	80	SeqNa: 232499	499	
Analyte	Result	Pal	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Vai	%RPD	RPDLimit	Qual
1,1,1,2-Tetrachloroethane	50.63	5.00	90	0	101	70	130				
1,1,1-Trichloroethane	62.92	5.00	50	0	126	70	130				
1,1,2,2-Tetrachloroethane	56.52	2.00	50	0	113	0.2	130				
1,1,2-Trichloroethane	59.33	5.00	50	0	119	70	130				
1,1-Dichloroethane	53.77	5.00	90	0	108	70	130				
1,1-Dichloroethene	55.46	2.00	50	0	111	70	130				
1,1-Dichloropropene	49.80	5.00	50	0	9.66	. 70	130				
1,2,3-Trichlorobenzene	41.18	5.00	50	0	82.4	70	130				
1,2,3-Trichloropropane	50,48	5.00	50	0.79	99.4	70	130				
1,2,4-Trichlorobenzene	40.20	5.00	50	0	80.4	70	130				
1,2,4-Trimethylbenzene	40.11	5.00	20	0	80.2	70	130				
1,2-Dibromo-3-Chloropropane	35.13	5.00	50	0	70.3	70	130				
1,2-Dibromoethane	53.72	2.00	50	0	107	70	130				
1,2-Dichlorobenzene	47.97	5.00	50	0	95.9	70	130				
1,2-Dichloroethane	45.97	2.00	20	0	91.9	22	130				
1,2-Dichloropropane	54.13	2.00	20	0	108	70	130				•

	4
	7
\sim	٠,
-	4
_	5
_	,
_	
_	=
r_	٦
-	
~	ø
`	
_	1
-	d
_	-
٠	i
<	Ū
	1
-5	
_	Ξ.
_	
_	_
	_
-	כ
_	ø
7.4	n
•	-
-	
(٦
-	•
7	
OC SHAMARY REPORT	
•	
•	
•	

TestCode: 8260B_W

WM-046, 1.4 Exp 0804475

Fay, Spofford & Thorndike

Work Order: CLIENT:

Project:

AND AND THE REAL PROPERTY OF THE PROPERTY OF T				11-24-25		Prop Date		RunNo: 23654	
Sample ID: 50ppb Ics	Samplype: LCS	lestCooe: 8zoub_vv	8,2000,44	Olice: Pyr		1			
Client ID: ZZZZZ	Batch ID: R23654	TestNo:	estNo: SW8260B		a.	Analysis Date:	: 5/12/2008	Seqivo: 232499	
Analyte	Result	POLS	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit RPD Ref Val	%RPD RPDLimit Qual	
4.3 E Trimothylbanzana	35.54	5.00	50	0	71.1	70	130		
1,3,0-Transcriptorizone	42,56	5.00	20	0	85,1	70	130		
1.3-Dichloropropane	49.82	5,00	20	0	9'66	70	130		
4 A Dichlorobenzene	43,61	5,00	20	0	87.2	70	130		
1,4-Dichlompropane	46,40	5.00	20	0	92.8	70	130		
Z,z-Dichiolopropario	50.57	10.0	20	0	101	20	130		
2-Dutatione 2-Chloroethyl Vinyl Ether	<u>Q</u>	2.00	20	0	0	20	130	.	
2-Chlorotoluene	36,33	5.00	20	0	72.7	70	130		
2_Hevanone	36.99	10.0	20	0	74.0	70	130		
4-Chlorotoluene	36.51	5.00	50	0	73.0	70	130		
4 feographical A	40.48	5.00	20	0	81.0	02	130		
4-tsoptobytoments A-Methyl-2-Pentanone	47.77	2.00	20	0	95.5	20	130		
Anatona	62.72	50.0	20	0	125	70	130		
Acrolain	124.5	20.0	100	0	124	70	130		
Acadonifile	91.62	50.0	100	0	91.6	70	130		
	53.58	5.00	20	0	107	70	130		
	46.04	5.00	20	0	92.1	70	130		
Browortloromethane	48.45	2.00	20	0	96.9	70	130		
Bromodichloromethane	50,46	2.00.	20	0	101	70	130		
Bromoform	47.45	2.00	20	0	94.9	70	130		
Bromomethane	50.92	2.00	20	0	102	70	130		
Carbon Disnifide	45,47	2.00	20	0	6.06	70	130		
Carbon Tefrachloride	47.48	2.00	20	0	95.0	70	130		
Chlorobenzene	52.34	5.00	50	0	105	70	130		
Chloroethane	60.70	2.00	20	0	121	20	130		
Chloroform	51,90	5.00	90	0	104	70	130		
Chlommethane	44.44	5.00	50	0	88.9	70	130		
cis1 2-Dichloroethene	45.82	5.00	20	0	91.6	20	130		
cis1 3. Dichloropopphe	51.73	0.500	50	0	103	70	130		
Disconochloromethane	51.40	2.00	20		103	70	130		
Dibromomethane	54.49	5.00	20	0	109	70	130	and Address and Address and Address Address Address And Address An	The second second
Onalifiers: BRL Below Rep	Below Reporting Limit		E Value	Value above quantitation range	ge			Holding times for preparation or analysis exceeded	
	Analyte detected below quantitation limits		ND Not De	Not Detected at the Reporting Limit	g Limit		R RPD outside recovery limits	wery limits	
	Spike Recovery outside recovery limits							Page 7 of 26	of 26

H Holding times for preparation or analysis exceeded R RPD outside recovery limits

E Value above quantitation range ND Not Detected at the Reporting Limit

BRL Below Reporting Limit

J Analyte detected below quantitation limits Spike Recovery outside recovery limits

Qualifiers:

RPD outside recovery limits

THE RESERVE OF THE PROPERTY OF		ANALY LICAL QU'SUMMARY REPORT
	Fay, Spofford & Thorndike	0804475

WM-046, 1.4 Exp

0804475

Work Order: CLIENT:

Project:

TestCode: 8260B_W

Sample ID: 50ppb Ics	SampType: LCS	TestCoc	TestCode: 8260B_W	Units: µg/L		Prep Date:	i		RunNo: 23654	554	
Client ID: ZZZZZ	Batch ID: R23654	Test	TestNo: SW8260B			Analysis Dat	Analysis Date: 5/12/2008	80	SeqNo: 232499	499	
Analyte	Result	POL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Quai
Dichlorodifluoromethane	41.65	5.00	50	0	83.3	70	130				
Ethylbenzene	43.72	5.00	50	0	87.4	70	130				
Hexachlorobutadiene	42.09	0.500	20	0	84.2	20	130	•			
isopropyibenzene	38.70	5.00	50	0	77.4	70	130				
Methyl Tert-Butyl Ether	96.09	5.00	20	0	102	70	130				
Methylene Chloride	47.21	5.00	50	0	94.4	70	130				
Naphthalene	35.86	20.0	50	0	7.17	70	130				
n-Butylbenzene	42.92	5.00	50	0	82.8	20	130				
n-Propylbenzene	62.80	5.00	20	0	126	70	130				
sec-Butylbenzene	36.30	5.00	20	0	72.6	20	130				
Styrene	37.38	5.00	50	0	74.8	70	130				
tert-Butylbenzene	45.04	5.00	20	0	90.1	70	130			-	
Tetrachloroethene	47.90	2.00	20	0	92.8	70	130				
Toluene	49.61	5.00	50	0	99.2	20	130				
trans-1,2-Dichloroethene	48,42	5,00	50	. 0	96.8	70	130				
trans-1,3-Dichloropropene	41.15	0.500	50	0	82.3	70	130	. •			
Trichloroethene	52.55	5.00	20	0	105	20	130				
Trichlorofluoromethane	58.59	5.00	20	0	117	70	130				
Vinyl Chloride	52,14	2.00	50	0	104	70	130				
Xylenes, Total	118.9	5.00	150	0	79.3	70	130				
Surr: 1,2-Dichloroethane-d4	30.46	0	30	0	102	70	130				
Surr: 4-Bromofluorobenzene	26.75	0	30	0	89.2	70	130				
Surr: Dibromofluoromethane	33,10	0	30	0	110	70	130				
Surr: Toluene-d8	29.80	0	30	0	99.3	70	130	,			

0804475 Work Order: WM-046, 1.4 Exp

Project:

TestCode: 8270_w

Sample ID: MB-10022	SampType: MBLK	TestCode: 8270_W	/ Units: µg/L	Prep Date:	e: 5/1/2008	8	RunNo: 23488	88	
Client ID: ZZZZZ	Batch ID: 10022	TestNo: SW8270C	0C (SW3510)	Analysis Date:	e: 5/2/2008	80	SeqNo: 230785	785	
Analyte	Result	PQL SPK value	le SPK Ref Val	%REC LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
1.2.4-Trichlorobenzene	QN	1.00							
1,2-Dichlorobenzene	Q	1.00							
1,2-Dinitrobenzene	QN	1.00							
1,3-Dichlorobenzene	Q	1,00							
1,3-Dinitrobenzene	QN	1.00			-				
1,4-Dichlorobenzene	QN	1.00							
1,4-Dinitrobenzene	QN.	1.00							-
2,3,4,6-Tefrachlorophenoi	QN	1.00							
2.4.5-Trichlorophenol	QN	1.00							
2.4.6-Trichlorophenol	QN	1.00							
2,4-Dichlorophenol	Q	1.00							
2,4-Dimethylphenol	QN .	1.00							
2,4-Dinitrophenol	ΩN	5.00							
2,4-Dinitrotoluene	QN	1.00							
2,6-Dinitrotoluene	QZ	1.00					•		
2-Chloronaphthalene	QN	1.00							
2-Chlorophenol	ΩZ	1,00							
2-Methyinaphthalene	ΩZ	1.00							
2-Methylphenol	ΩN	1.00							
2-Nitroaniline	QN	1.00							
2-Nitrophenol	OZ.	1.00							
3,3'-Dichlorobenzidine	QN	1.00							
3-Methylphenol/4-Methylphenol		1.00						-	
3-Nitroaniline		1.00							
4,6-Dinitro-2-Methylphenol	Q.	5.00							
4-Bromophenyl Phenyl Ether	ND	1.00							
4-Chloro-3-Methylphenol	QN	1.00							
4-Chloroaniline	QV.	1.00							
4-Chlorophenyl Phenyl Ether	QN	1.00							
4-Nitroaniline	Q N	1.00							
4-Nitrophenol	QN	1.00		A A CARACTER MANAGEMENT AND A CARE CONTRACTOR OF THE STATE OF THE STAT		The state of the s		THE RESERVE THE PERSON NAMED IN	
Qualifiers; BRL Below Rep	Below Reporting Limit Analyte detected below anantitation limits	E Va	Value above quantitation range Not Detected at the Reporting Limit	nge 1g Limit	π ω	Holding times for preparation or analysis exceeded RPD outside recovery limits	preparation or a cry limits	nalysis excee	led
	Spike Recovery outside recovery limits							P_{c}	Page 9 of 26
ı									,

RPD outside recovery limits

H R

E Value above quantitation range ND Not Detected at the Reporting Limit

> Analyte detected below quantitation limits Spike Recovery outside recovery limits

BRL Below Reporting Limit

Qualifiers:

- 2	١.
<u> </u>	2
-	-
- 4	_
_ 6	Š
H	Ι
-	Y
on Maria	
, <u>, , , , , , , , , , , , , , , , , , </u>	>
- 5	Y
	Y
4	ď
-	✓
_ >	>
- 6	
- 5	>
	_
Ξ	_
- 5-	_
4	۲.
r	,
`	
_	•
•	
	٠,
-	_
Ϋ́	1
-	٠.
<u> </u>	
-	
E	
\rightarrow	•
VILLA	7
-	-
-	1
Ε,	-
AMA	
-	۲
_	4

Fay, Spofford & Thorndike

WM-046, 1.4 Exp

0804475

CLIENT: Work Order:

Project:

TestCode: 8270_w

Sample ID: MB-10022	SampType: MBLK	TestCode: 8270_W	W_07	Units: µg/L		Prep Date:	Prep Date: 5/1/2008		RunNo: 23488	
Client ID: ZZZZZ	Batch ID: 10022	TestNo: SW8270C	N8270C	(SW3510)		Analysis Date: 5/2/2008	5/2/2008		SeqNo: 230785	
Analyte	Result	POL SPI	< value	SPK value SPK Ref Val	%REC	LowLimit H	%REC LowLimit HighLimit RPD Ref Val	Ref Val	%RPD RPDLimit Qual	nit Qual
Acenaphthene	QN	1.00								
Acenaphthylene	Q	1.00								

Analyte	Result	POL	SPK value	SPK Ref Val	%REC	LowLimit Hig	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Acenaphthene	9	1.00									
Acenaphthylene	2	1.00									
Acetophenone	9	1.00									
Aniline	QN	5.00									
Anthracene	9	1.00									
Azobenzene	Q	5.00									
Benz(a)Anthracene	Q.	0.100									
Benzidine	Q.	5.00									
Benzo(a)Pyrene	Q	0.100									
Benzo(b)Ftuoranthene	Q	0.500									
Benzo(g,h,i)Perylene	QN	1.00									
Benzo(k)Fluoranthene	Q	0.500									
Benzyl Alcohol	Q	1.00									
Bis(2-Chloroethoxy)Methane	Q	1.00									
Bis(2-Chloroethyi)Ether	QN	1.00									
Bis(2-Chloroisopropyl)Ether	Q	1.00			÷						
Bis(2-Ethylhexyl)Phthalate	QN	1.00						4			
Butyl Benzyl Phthalate	QN	1.00									
Carbazole	Q	1.00									
Chrysene	QN	1.00									
Dibenz(a,h)Anthracene	QN N	0.100									
Diberizofuran	Q	1.00	,				٠				
Diethyl Phthalate	N	1.00									
Dimethyl Phthalate	Q.	1.00									
Di-n-Butyl Phthalate	Q.	1.00									
Di-n-Octyl Phthalate	2	1.00									
Fluoranthene	N Q	1.00									
Fluorene	QN	1.00									
Hexachlorobenzene	QN	0.100									
Hexachlorobutadiene	QN	0.100									
Hexachlorocyclopentadiene	9	5.00									
			The state of the s	THE REAL PROPERTY AND THE PERTY AND THE PERT	The state of the s						

140 140

40

62.3 55.1

0 0

25

1.00

15.58 13.78 RPD outside recovery limits

H &

E Value above quantitation range
ND Not Detected at the Reporting Limit Value above quantitation range

> Analyte detected below quantitation limits Spike Recovery outside recovery limits

> > S

BRL Below Reporting Limit

Qualifiers:

1,4-Dichlorobenzene 1,3-Dinifrobenzene

ANALYTICAL QC SUMMARY REPORT

TestCode: 8270_w

WM-046, 1.4 Exp Project:

0804475

Work Order:

CLIENT:

Fay, Spofford & Thorndike

Sample ID; MB-10022	SampType: MBLK	TestCoo	TestCode: 8270_W	Units: µg/L		Prep Date:	5/1/2008	Ru	RunNo: 23488	88	
Client ID: ZZZZZ	Batch ID: 10022	Test	TestNo: SW8270C	(SW3510)	.·	Analysis Date:	5/2/2008	Sec	SeqNo: 230785	785	
Analyte	Result	Pal	SPK value	SPK Ref Val	%REC	LowLimit H	HighLimit RPD Ref Val	/al	%RPD	RPDLimit	Qual
Hexachloroethane	QN	1.00									
Indeno(1,2,3-cd)Pyrene	QN.	0.100									
Isophorone	QN	1.00									
Naphthalene	QN	1.00									
Nitrobenzene	QN	1.00	-								
N-Nitrosodimethylamine	ND	5.00						*			
N-Nitrosodi-n-Propylamine	QN	1.00									
N-Nitrosodiphenylamine	QN	5.00									
Pentachlorophenoi	QN	1.00								-	
Phenanthrene	ON	1.00		*						-	
Phenoi	QN	1.00									
Pyrene	QN	1.00									
Pyridine	QN	5.00									
Surr: 2,4,6-Tribromophenol	QN	0	75	.00	0	15	150				တ
Surr: 2-Finorobiphenyl	35.64	0	50	0	71.3	30	130				
Surr 2-Fluorophenol	35,40	0	75	0	47,2	15	110				
Sur: Nitrobenzene-d5	34.07	0	50	0	68.1	30	130				
Surr: Phenol-d6	25.30	0	75	0	33.7	15	110				
Sun: Terphenyl-d14	35.34	0	20	0	70.7	30	130				
Sample ID: LCS-10022	SampType: LCS	TestCo	TestCode: 8270_w	Units: µg/L		Prep Date:	5/1/2008	R	RunNo: 23488	188	
Client ID: ZZZZZ	Batch ID: 10022	Test	TestNo: SW8270C	(SW3510)		Analysis Date:	5/2/2008	Se	SeqNo: 230786	1786	
Analyte	Result	POL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit RPD Ref Val	Val	%RPD	RPDLimit	Qual
1.2.4-Trichlorobenzene	15,42	1.00	25	0	61.7	40	140				
1,2-Dichlorobenzene	14.42	1.00	25	0	57.7	40	140				
1,2. Dinitrobenzene	18.36	1.00	25	0	73.4	40	140				-
1,3-Dichlorobenzene	13.19	1.00	25	0	52.8	40	140				

	۰
	1
<u>ند</u> م	
_	,
<u> </u>	
Ē	
≂	į
-	
_	
	_
_ ₽	
-	۲
2	-
-	ì
-	•
	٥
7	٦
	-
\subset	١
4	ĺ
AI OC	/
	ז
	1
$\overline{}$	7
<u>_</u>)
	í
` <u>`</u> _	٠
120	١
-	l
	(
<u> →</u>	4
Sec.	1
<	
	•

TestCode: 8270_w

Work Order:	0804475
Project:	WM-046, 1.4 Exp

Project:

Fay, Spofford & Thorndike

CLIENT:

Const. 10: 100 40022	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1								
Sample to: Los-touzz	Sampiybe: Lus	estcode: 8270_w	₩	Units: pg/L		Prep Date: 5/1/2008	5/1/2008	RunNo: 23488	
Client ID: ZZZZZ	Batch ID: 10022	TestNo: SW8270C	V8270C	(SW3510)	1	Analysis Date: 5/2/2008	5/2/2008	SeqNo: 230786	
Analyte	Result	POL SPF	value ,	SPK value SPK Ref Val	%REC	LowLimit Hi	%REC LowLimit HighLimit RPD Ref Val	%RPD RPDLimit Qual	it Qual
1,4-Dinitrobenzene	13.56	1.00	25	0	54.2	40	140		
O 2 4 & Totrachloropool		90	Ĺ	(;	1			

			ł							2	
Citent ID: 22222	Batch ID: 100 <u>2</u> 2	TestNo	TestNo: SW8270C	(SW3510)		Analysis Date:	.e: 5/2/2008		SeqNo: 230786	786	
Analyte	Result	Pal	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
1,4-Dinitrobenzene	13.56	1.00	25	0	54.2	40	140				
2,3,4,6-Tetrachlorophenol	14.64	1.00	25	0	58.5	30	8				
2,4,5-Trichtorophenot	16.01	1.00	25	0	64.0	30	130				
2,4,6-Trichlorophenol	15.14	1.00	25	0	60.5	30	130				
2,4-Dichlorophenol	15.58	1.00	25	0	62.3	30	130				
2,4-Dimethylphenol	15.21	1.00	25	0	8.09	30	130				
2,4-Dinitrophenoi	15.26	5.00	25	0	61.0	30	130				
2,4-Dinitratoluene	17.29	1.00	25	0	69.2	40	140		٠		
2,6-Dinitrotoluene	15.89	1.00	25	0	63.6	40	140				
2-Chloronaphthalene	15.36	1.00	25	0	61.4	40	140				
2-Chlorophenol	16.03	1.00	25	0	64.1	30	130				
2-Methylnaphthalene	15,24	1.00	25	0	61.0	40	140				
2-Methylphenol	14.11	1.00	. 25	0	56.4	30	130				
2-Nitroaniline	16,56	1.00	25	0	66.2	40	140				
2-Nitrophenol	11.62	1.00	25	0	46.5	30	130				
3,3'-Dichlorobenzidine	13.82	1.00	25	0	55.3	40	140				
3-Methylphenol/4-Methylphenol	12.40	1.00	25	0	49.6	. 30	130				
3-Nitroaniline	16.30	1.00	25	0	65.2	40	140				
4,6-Dinítro-2-Methylphenol	23.36	5.00	25	0	93.5	30	130				
4-Bromophenyl Phenyl Ether	16.40	1.00	25	0	65.6	40	140				
4-Chforo-3-Methylphenol	15.97	1.00	25	0	63.9	30	130				
4-Chloroanilline	21.64	1.00	25	0	9.98	40	140				
4-Chlorophenyl Phenyl Ether	14.22	1.00	25	0	56.9	40	140				
4-Nitroaniline	16.32	1,00	25	0	65.3	40	140				
4-Nifrophenol	9.595	1.00	22	0	38.4	30	130				
Acenaphthene	15.48	1.00	25	0	61.9	40	140				
Acenaphthylene	16.29	1.00	25	0	65.2	40	140				
Acetophenone	15.04	1.00	25	0	60.2	40	140				
Aniline	19.26	5.00	25	0	77.0	40	140				
Anthracene	17.08	1.00	25	0	68.3	40	140				
Azobenzene	16.54	5.00	25	0	66.2	40	140				
Qualifiers: BRL Below Reporting Limit	g Linit		E Value a	Value above quantitation range	mgc		H Ho	Iding times for p	Holding times for preparation or analysis exceeded	lysis exceeder	
	Analyte detected below quantitation limits		ND Not Det	Not Detected at the Reporting Limit	ng Linit			RPD outside recovery limits	ry limits		_
S Spike Recovery	Spike Recovery outside recovery limits									Page	Page 12 of 26

0804475 Work Order:

WM-046, 1.4 Exp

Project:

TestCode: 8270_w

Complete	Sample ID: LCS-10022	SampType: LCS	TestCo	TestCode: 8270_w	Units: µg/L		Prep Date:	5/1/2008		RunNo: 23488	88	
14.86 0.100 25 0.643 0.460 0.643 0.643 0.643 0.440 0.643		Batch ID: 10022	Test	Vo: SW8Z70C	(SW3510)	-	Analysis Date:			SeqNo: 230	786	
14.86 0.100 25 0 64.3 40 140 140 14.86 0.100 25 0 64.3 40 14	Analyte	Result	PaL	SPK value	SPK Ref Val	%REC			ef Val	%RPD	RPDLimit	Qual
17.56 0.500 25 0 64.3 40 140 140 141 14.56 0.500 25 0 77.2 40 14	Benz(a)Anthracene	14,86	0.100	25	0	59.5	40	140				
17.56 1.050 25 1.02 40 1	Велzo(a)Ругепе	16,08	0.100	25	0	64.3	40	140				
48.08 1.00 25 0 72.3 40 140 17.89 0.500 25 0 55.6 40 140 18.99 1.00 25 0 55.6 40 140 ther 17.13 1.00 25 0 68.5 40 140 ther 1.04 25 0 68.5 40 140 ther 1.00 25 0 68.5 40 140 ther 1.00 25 0 68.5 40 140 ther 1.00 25 0 61.7 40 140 18.40 1.00 25 0 67.8 40 140 18.50 1.00 25 0 67.8 40 140 18.57 1.00 25 0 67.8 40 140 18.57 1.00 25 0 62.8 40 140 18.58	Benzo(b)Fluoranthene	17.56	0.500	25	0	70.2	40	140				
rane 17.60 0.500 2.5 0 70.4 40 140 Fig. 1.50 2.5 0 0 56.6 4.0 140 Fig. 1.00 2.5 0 0 64.6 4.0 140 Fig. 1.00 2.5 0 0 67.2 4.0 140 Fig. 1.00 2.5 0 0 77.8 4.0 140 Fig. 1.00 2.5 0 0 77.8 4.0 140 Fig. 1.00 2.5 0 0 77.8 4.0 140 Fig. 1.00 2.5 0 0 67.2 4.0 140 Fig. 1.00 2.5 0 0 67.5 4.0 140 Fig. 1.00 2.5 0 0 0 67.5 4.0 140 Fig. 1.00 2.5 0 0 0 67.5 4.0 140 Fig. 1.00 2.0 0 0 67.5 4.0 140 Fig. 1.00 2.0 0 0 67.5 4.0 140 Fig. 1.00 2.0 0 0 67.5	Benzo(g,h,i)Perylene	18.08	1.00	25	0	72.3	40	140				
13.89 1.00 25 0 65.6 40 140 her 14.05 1.00 25 0 68.5 40 140 her 14.05 1.00 25 0 68.5 40 140 her 14.05 1.00 25 0 68.5 40 140 112.94 1.00 25 0 64.2 40 140 118.46 1.00 25 0 67.5 40 140 118.40 1.00 25 0 67.5 40 140 118.40 1.00 25 0 67.5 40 140 118.50 1.00 25 0 67.5 40 140 118.50 1.00 25 0 67.5 40 140 118.50 1.00 25 0 67.5 40 140 118.50 1.00 25 0 67.5 40 140 118.50 1.00 25 0 67.5 40 140 118.50 1.00 25 0 67.5 40 140 118.50 1.00 25 0 67.7 40 140	Benzo(k)Fluoranthene	17.60	0.500	25.	0	70.4	40	140				
her 17.13 1.00 25 0 68.5 40 140 her 16.16 1.00 25 0 64.6 40 140 her 12.94 1.00 25 0 51.7 40 140 12.54 1.00 25 0 51.7 40 140 18.90 1.00 25 0 51.7 40 140 18.90 1.00 25 0 51.2 40 140 18.80 1.00 25 0 54.8 40 140 18.80 1.00 25 0 64.1 40 140 18.80 1.00 25 0 64.1 40 140 18.80 1.00 25 0 64.1 40 140 18.80 1.00 25 0 64.1 40 140 18.80 1.00 25 0 64.1 40 140 18.80 1.00 25 0 64.1 40 140 18.80 1.00 25 0 64.1 40 140 18.43 0.10 25 0 65.7 40 140 18.43 0.10 25 0 65.7 40 140 18.44 0.10 25 0 65.7 40 140 18.58 0.10 25 0 65.7 40 140 18.58 0.10 25 0 65.7 40 140 18.59 0.10 25 0 65.7 40 140 18.50 0.10 25 0 65.7 40 140 18.50 0.10 25 0 65.7 40 140 18.50 0.10 25 0 65.7 40 140 18.50 0.10 25 0 65.7 40 140 18.50 0.10 25 0 65.7 40 140 18.50 0.10 25 0 65.7 40 140 18.50 0.10 25 0 65.7 40 140 18.50 0.10 25 0 65.7 40 140 18.50 0.10 0.5 5.0 0 65.7 40 140 18.50 0.10 0.5 5.0 0 65.7 40 140 18.50 0.10 0.5 5.0 0 65.7 40 140 18.50 0.10 0.5 5.0 0 65.7 40 140 18.50 0.10 0.5 5.0 0 65.7 40 140 18.50 0.10 0.5 5.0 0 65.7 40 140 18.50 0.10 0.5 5.0 0 65.7 40 140 18.50 0.10 0.5 5.0 0 65.7 40 140 18.50 0.10 0.5 5.0 0 65.7 40 140 18.50 0.10 0.5 5.0 0 65.7 40 140 18.50 0.10 0.5 5.0 0 65.7 40 140 18.50 0.10 0.5 5.0 0 65.7 40 140 18.50 0.10 0.5 5.0 0 65.7 40 140 18.50 0.10 0.5 5.0 0 65.7 40 140 18.50 0.10 0.5 5.0 0 65.7 40 140 18.50 0.10 0.5 5.0 0 65.7 40 140 18.50 0.10 0.5 5.0 0 65.7 40 140 18.50 0.10 0.5 5.0 0 65.7 40 140 18.50 0.10 0.10 0.10 0.10 0.10 0.10 0.10 0	Benzyl Alcohol	13.89	1.00	. 25	0	55.6	40	140				
ther 16.16 1.00 25 0 64.6 40 140 te 12.94 1.00 25 0 56.2 40 140 18.46 1.00 25 0 51.7 40 140 18.5 1.00 25 0 51.7 40 140 18.5 1.00 25 0 51.8 40 140 18.5 1.00 25 0 67.8 40 140 16.02 1.00 25 0 67.8 40 140 16.02 1.00 25 0 67.8 40 140 16.02 1.00 25 0 64.1 40 140 17.2 4 1.00 25 0 64.1 40 140 18.6 1.00 25 0 64.1 40 140 18.6 1.00 25 0 64.1 40 140 18.6 1.00 25 0 64.1 40 140 18.6 1.00 25 0 64.1 40 140 18.6 1.00 25 0 67.8 40 140 18.6 1.00 140 18.6 1.00 140 18.6 1.00 140 18.6 1.00 140 18.6 1.00	Bis(2-Chloroethoxy)Methane	17.13	1.00	25	. 0	68.5	40	140				
te 14.05 1.00 25 0 56.2 40 140 12.54 1.00 25 0 51.7 40 140 12.54 1.00 25 0 51.7 40 140 16.90 1.00 25 0 73.8 40 140 16.80 1.00 25 0 67.6 40 140 16.80 1.00 25 0 67.6 40 140 172.24 1.00 25 0 64.1 40 140 173.24 1.00 25 0 64.1 40 140 173.24 1.00 25 0 64.1 40 140 173.24 1.00 25 0 64.1 40 140 173.24 1.00 25 0 64.1 40 140 173.24 1.00 25 0 64.1 40 140 173.24 1.00 25 0 64.1 40 140 173.24 1.00 25 0 64.1 40 140 173.24 1.00 25 0 64.1 40 140 173.24 1.00 25 0 64.1 40 140 173.24 1.00 25 0 64.1 40 140 173.24 1.00 25 0 64.1 40 140 173.24 1.00 25 0 64.1 40 140 173.24 1.00 25 0 64.1 40 140 173.25 1.00 25 0 64.1 40 140 173.26 1.00 25 0 64.1 40 140 173.27 1.00 25 0 64.1 40 140 173.28 6 1.00 25 0 64.1 40 140 173.29 1.00 25 0 64.1 40 140 173.20 1.00 25 0 64.1 40 140 173.20 1.00 25 0 64.1 40 140 173.20 1.00 25 0 64.1 40 140 173.20 1.00 25 0 64.1 40 140 173.20 1.00 25 0 64.1 40 140 173.20 1.00 25 0 64.1 40 140 173.20 1.00 25 0 64.1 40 140 173.20 1.00 25 0 64.1 40 140 173.20 1.00 25 0 64.1 40 140 173.20 1.00 25 0 64.1 40 140 173.20 1.00 25 0 64.1 40 140 173.20 1.00 25 0 64.1 40 140 173.20 1.00 25 0 64.1 40 140 173.20 1.00 25 0 64.1 40 140 173.20 1.00 25 0 64.1 40 140 173.20 1.00 25 0 64.1 40 140 173.20 1.00 25 0 64.1 40 140 173.20 1.00 25 0 64.1 40 140 173.20 1.00 25 0 64.1 40 140 174.20 1.00 25 0 64.1 40 140 175.20 1.00 25 0	Bis(2-Chloroethyl)Ether	16.16	1.00	25	0	64.6	40	140				
(e) 12.94 1.00 25 0 51.7 40 140 12.54 1.00 25 0 50.2 40 140 18.66 1.00 25 0 50.2 40 140 18.67 1.00 25 0 67.2 40 140 16.80 1.00 25 0 67.2 40 140 16.80 1.00 25 0 67.2 40 140 12.24 1.00 25 0 67.2 40 140 12.24 1.00 25 0 63.4 40 140 13.20 1.00 25 0 63.4 40 140 14.3 1.00 25 0 65.8 40 140 14.4 1.00 25 0 65.7 40 140 12.74 1.00 25 0 61.5 40 140 12.5	Bis(2-Chloroisopropyl)Ether	14.05	1.00	25	0	56.2	40	140				
12.54 1,00 25 0 50.2 40 140 18.46 1,00 25 0 67.6 40 140 18.90 1,00 25 0 67.6 40 140 16.80 1,00 25 0 67.2 40 140 16.80 1,00 25 0 67.2 40 140 15.24 1,00 25 0 67.2 40 140 15.86 1,00 25 0 64.1 40 140 13.20 1,00 25 0 62.8 40 140 14.19 1,00 25 0 65.7 40 140 16.43 1,10 25 0 65.7 40 140 16.44 1,00 25 0 65.7 40 140 16.53 0,100 25 0 62.2 40 140 16.56 1,00 <td>Bis(2-Ethylhexyl)Phthalate</td> <td>12.94</td> <td>1.00</td> <td>25</td> <td>0</td> <td>51.7</td> <td>40</td> <td>140</td> <td></td> <td></td> <td></td> <td></td>	Bis(2-Ethylhexyl)Phthalate	12.94	1.00	25	0	51.7	40	140				
18.46 1,00 25 0 73.8 40 140 16.90 1,00 25 0 67.6 40 140 16.02 1,00 25 0 67.2 40 140 16.02 1,00 25 0 64.1 40 140 16.02 1,00 25 0 64.1 40 140 12.24 1,00 25 0 64.1 40 140 14.28 1,00 25 0 64.1 40 140 18.67 1,00 25 0 65.8 40 140 14.19 1,00 25 0 65.7 40 140 16.43 0,100 25 0 65.7 40 140 16.43 0,100 25 0 65.7 40 140 16.43 0,100 25 0 65.7 40 140 16.56 1,00<	Butyl Benzyl Phthalate	12.54	1.00	25	0	50.2	40	140				
16.90 1,00 25 0 67.6 40 140 13.71 0,100 25 0 64.8 40 140 16.80 1,00 25 0 64.1 40 140 15.24 1,00 25 0 63.4 40 140 15.86 1,00 25 0 63.4 40 140 13.20 1,00 25 0 63.4 40 140 18.67 1,00 25 0 63.4 40 140 14.19 1,00 25 0 65.8 40 140 14.19 0,100 25 0 65.7 40 140 15.38 0,100 25 0 61.5 40 140 15.58 0,100 25 0 61.5 40 140 15.58 0,100 25 0 61.5 40 140 14.46 1 </td <td>Carbazole</td> <td>18.46</td> <td>1.00</td> <td>25</td> <td>0</td> <td>73.8</td> <td>40</td> <td>140</td> <td></td> <td></td> <td></td> <td></td>	Carbazole	18.46	1.00	25	0	73.8	40	140				
13.71 0.100 25 0 64.1 40 140 16.80 1.00 25 0 64.1 40 140 16.02 1.00 25 0 64.1 40 140 12.24 1.00 25 0 63.4 40 140 13.20 1.00 25 0 63.4 40 140 14.19 1.00 25 0 74.7 40 140 14.19 1.00 25 0 74.7 40 140 14.19 0.100 25 0 74.7 40 140 14.24 0.100 25 0 65.7 40 140 15.38 0.100 25 0 61.5 40 140 15.46 1.00 25 0 61.5 40 140 14.46 1.00 25 0 62.2 40 140 16.36 50 </td <td>Chrysene</td> <td>16,90</td> <td>1.00</td> <td>25</td> <td>0</td> <td>9'29</td> <td>40</td> <td>140</td> <td></td> <td></td> <td></td> <td></td>	Chrysene	16,90	1.00	25	0	9'29	40	140				
16.80 1.00 25 0 67.2 40 140 16.02 1.00 25 0 64.1 40 140 17.24 1.00 25 0 64.1 40 140 18.67 1.00 25 0 68.4 40 140 18.67 1.00 25 0 747 40 140 14.19 1.00 25 0 56.8 40 140 13.68 0.100 25 0 56.8 40 140 12.74 1.00 25 0 56.8 40 140 12.75 1.00 25 0 56.8 40 140 12.86 0.100 25 0 51.0 40 140 12.65 0.100 25 0 51.0 40 140 14.46 1.00 25 0 61.5 40 140 14.46 1.00 25 0 61.5 40 140 15.61 1.00 25 0 61.5 40 140 16.36 2.00 25 0 62.4 40 140 16.36 2.00 25 0 62.4 40 140 16.36 2.00 25 0 62.4 40 140 16.36 2.00 25 0 62.4 40 140 16.36 2.00 25 0 62.4 40 140 16.36 2.00 25 0 62.4 40 140 16.36 2.00 25 0 62.4 40 140 16.36 2.00 25 0 62.4 40 140 16.36 2.00 25 0 62.4 40 140 16.36 2.00 25 0 62.4 40 140 16.36 2.00 25 0 62.4 40 140 16.36 2.00 25 0 62.4 40 140 16.36 2.00 25 0 62.4 40 140 16.36 2.00 25 0 62.4 40 140 16.36 2.00 25 0 62.4 40 140 16.36 2.00 25 0 62.4 40 140 17.00 2	Dibenz(a,h)Anthracene	13.71	0.100	25	0	54.8	40	. 140				
16.02 1.00 25 0 64.1 40 140 140 140 140 140 140 140 140 140	Dibenzofuran	16.80	1.00	25	0	67.2	40	140				
12.24 1.00 25 0 49.0 40 140 15.86 1.00 25 0 63.4 40 140 13.20 1.00 25 0 52.8 40 140 14.19 1.00 25 0 74.7 40 140 14.19 1.00 25 0 56.8 40 140 14.39 0.100 25 0 54.7 40 140 15.38 0.100 25 0 54.7 40 140 15.38 0.100 25 0 65.7 40 140 15.38 0.100 25 0 61.2 40 140 16.58 1.00 25 0 62.2 40 140 14.46 1.00 25 0 62.2 40 140 16.59 5.00 25 0 65.4 40 140 16.36 5.0<	Diethyl Phthalate	16,02	1.00	25	0	64.1	40	140			٠	
15.86 1.00 25 0 63.4 40 140 13.20 1.00 25 0 74.7 40 140 18.67 1.00 25 0 74.7 40 140 14.19 1.00 25 0 65.7 40 140 14.19 1.00 25 0 65.7 40 140 13.68 0.100 25 0 51.0 40 140 15.38 0.100 25 0 62.2 40 140 16.56 1.00 25 0 62.2 40 140 14.46 1.00 25 0 62.2 40 140 16.56 1.00 25 0 62.2 40 140 16.36 5.00 25 0 62.4 40 140 16.36 5.00 25 0 62.4 40 140 16.36 5.00 </td <td>Dimethyl Phthalate</td> <td>12.24</td> <td>1.00</td> <td>25</td> <td>0</td> <td>49.0</td> <td>40</td> <td>140</td> <td></td> <td></td> <td></td> <td></td>	Dimethyl Phthalate	12.24	1.00	25	0	49.0	40	140				
13.20 1.00 25 0 52.8 40 140 18.67 1.00 25 0 74.7 40 140 14.19 1.00 25 0 56.8 40 140 16.43 0.100 25 0 65.7 40 140 13.68 0.100 25 0 54.7 40 140 12.74 1.00 25 0 61.5 40 140 15.38 0.100 25 0 61.5 40 140 28.66 1.00 25 0 61.5 40 140 14.46 1.00 25 0 62.2 40 140 14.46 1.00 25 0 62.4 40 140 16.36 5.00 25 0 62.4 40 140 16.36 5.00 25 0 62.4 40 140 16.36 5.00<	Di-n-Butyl Phthalate	15.86	1.00	25	0	63.4	40	140				
18.67 1,00 25 0 74.7 40 140 14.19 1,00 25 0 56.8 40 140 16.43 0,100 25 0 65.7 40 140 13.68 0,100 25 0 54.7 40 140 15.38 0,100 25 0 61.5 40 140 28.66 1,00 25 0 62.2 40 140 16.58 1,00 25 0 62.2 40 140 14.46 1,00 25 0 62.2 40 140 12.05 5.00 25 0 62.4 40 140 aw Reporting Limit 16.36 5.00 25 0 65.4 40 140 aw Reporting Limit 16.36 5.00 25 0 65.4 40 140 aw Reporting Limit 16.36 140 140 140	Di-n-Octyl Phthalate	13.20	1.00	25	0	52.8	40	140				
14.19 1.00 25 0 56.8 40 140 16.43 0.100 25 0 65.7 40 140 13.68 0.100 25 0 54.7 40 140 12.74 1.00 25 0 61.5 40 140 28.66 1.00 25 0 62.2 40 140 15.66 1.00 25 0 62.2 40 140 14.46 1.00 25 0 62.2 40 140 14.46 1.00 25 0 62.4 40 140 15.01 25 0 62.4 40 140 16.36 5.00 25 0 62.4 40 140 w Reporting Limit 16.36 1.00 55 0 65.4 40 140 w Reporting Limit 5.00 25 0 65.4 40 140 w Reporting Limit 1.00 1.00 1.00 1.00 1.00 1.00 1.00	Fluoranthene	18.67	1.00	25	0	74.7	40	140				
16.43 0.100 25 0 65.7 40 140 13.68 0.100 25 0 54.7 40 140 12.74 1.00 25 0 61.5 40 140 15.38 0.100 25 0 61.5 40 140 15.66 1.00 25 0 62.2 40 140 14.46 1.00 25 0 62.2 40 140 16.05 5.00 25 0 62.4 40 140 16.36 5.00 25 0 62.4 40 140 16.36 5.00 25 0 62.4 40 140 16.36 5.00 25 0 65.4 40 140 16.36 5.00 25 0 65.4 40 140 16.36 5.00 25 0 65.4 40 140 16.60 16.60	Fluorene	14,19	1.00	25	.0	56.8	40	140				
13.68 0.100 25 0 54.7 40 140 12.74 1.00 25 0 61.5 40 140 15.38 0.100 25 0 61.5 40 140 28.66 1.00 25 0 62.2 40 140 15.56 1.00 25 0 62.2 40 140 12.05 5.00 25 0 48.2 40 140 16 15.61 1.00 25 0 62.4 40 140 16.36 5.00 25 0 62.4 40 140 16.36 5.00 25 0 65.4 40 140 16.36 5.00 25 0 65.4 40 140 16.36 5.00 25 0 65.4 40 140 16.36 5.00 25 0 65.4 40 140 16.36 <td>Hexachlorobenzene</td> <td>16.43</td> <td>0.100</td> <td>25</td> <td>0</td> <td>65.7</td> <td>40</td> <td>140</td> <td></td> <td></td> <td></td> <td></td>	Hexachlorobenzene	16.43	0.100	25	0	65.7	40	140				
12.74 1.00 25 0 51.0 40 140 15.38 0.100 25 0 61.5 40 140 28.66 1.00 25 0 145 40 140 15.56 1.00 25 0 62.2 40 140 14.46 1.00 25 0 48.2 40 140 16.36 5.00 25 0 62.4 40 140 16.36 5.00 25 0 62.4 40 140 16.36 5.00 25 0 65.4 40 140 16.36 5.00 25 0 65.4 40 140 16.36 5.00 25 0 65.4 40 140 16.36 5.00 25 0 65.4 40 140 16.36 5.00 25 0 65.4 40 140 16.40 1.00 <td>Hexachlorobutadiene</td> <td>13.68</td> <td>0.100</td> <td>25</td> <td>0</td> <td>54.7</td> <td>40</td> <td>140</td> <td></td> <td></td> <td>-</td> <td></td>	Hexachlorobutadiene	13.68	0.100	25	0	54.7	40	140			-	
15.38 0.100 25 0 61.5 40 140 28.66 1.00 25 0 145 40 140 15.56 1.00 25 0 62.2 40 140 14.46 1.00 25 0 67.8 40 140 16.05 5.00 25 0 62.4 40 140 16.36 5.00 25 0 65.4 40 140 16.36 5.00 25 0 65.4 40 140 16.36 5.00 25 0 65.4 40 140 16.36 5.00 25 0 65.4 40 140 16.36 5.00 25 0 65.4 40 140 16.36 5.00 25 0 65.4 40 140 16.40 140 140 140 140 140 16.36 16.56 16.4	Hexachloroethane	12.74	1.00	25	0	51.0	40	140				
28.66 1.00 25 0 140 140 15.56 1.00 25 0 62.2 40 140 14.46 1.00 25 0 57.8 40 140 1e 12.05 5.00 25 0 62.4 40 140 over Reporting Limit 16.36 5.00 25 0 65.4 40 140 over Reporting Limit E Value above quantitation range H Holding times for preparation or analysis calculate recovery limits xe Recovery outside recovery limits RD outside recovery limits RD outside recovery limits	Indeno(1,2,3-cd)Pyrene	15,38	0.100	25	0	61.5	40	140				
15.56 1.00 25 0 62.2 40 140 14.46 1.00 25 0 57.8 40 140 12.05 5.00 25 0 48.2 40 140 16.36 5.00 25 0 62.4 40 140 16.36 5.00 25 0 65.4 40 140 16.36 5.00 25 0 65.4 40 140 16.36 5.00 25 0 65.4 40 140 16.36 5.00 25 0 65.4 40 140 16.36 5.00 25 0 65.4 40 140 16.36 5.00 25 0 65.4 40 140 16.36 4 40 140 140 140 140 16.36 5.00 5 4 40 140 140 140 16.36	isophorone	28.66	1.00	25	0	115	40	140				
14.46 1.00 25 0 57.8 40 140 12.05 5.00 25 0 48.2 40 140 16.36 1.00 25 0 62.4 40 140 ow Reporting Limit E Value above quantitation range H Holding times for preparation or analysis calculation that it is Reporting Limit R RPD outside recovery limits	Naphthalene	15.56	1.00	25	0	62.2	40	140				
12.05 5.00 25 0 48.2 40 140 16.36 1.00 25 0 62.4 40 140 16.36 5.00 25 0 65.4 40 140 1 We porting Limit E Value above quantitation range E Value above quantitation range H Holding times for preparation or analysis can be recovery limits 1 Se Recovery outside recovery limits RD outside recovery limits R RPD outside recovery limits	Nitrobenzene	14.46	1.00	25	0	57.8	40	140				
16.36 1.00 25 0 62.4 40 140 16.36 5.00 25 0 65.4 40 140 19. Reporting Limit E Value above quantitation range H Holding times for preparation or analysis calculated below quantitation limits ND Not Detected at the Reporting Limit R RPD outside recovery limits is Recovery purities.	N-Nitrosodimethylamine	12.05	5.00	25	0	48.2	40	140				
16.36 5.00 25 0 65.4 40 140 The separation limits ND Not Detected at the Reporting Limit RESERVENCY purisible recovery limits REPD outside REPORT REPORT	N-Nitrosodi-л-Propylamine	15.61	1.00	. 25	0	62.4	40	140				
BRL Below Reporting Limit J Analyte detected below quantitation limits Spike Recovery outside recovery limits E Value above quantitation range H Holding times for preparation or analysis ex R RPD outside recovery limits	N-Nitrosodiphenylamine	16.36	5.00	25	0	65.4	40	140				
Analyte detected below quantitation limits ND Not Detected at the Reporting Limit Spike Recovery outside recovery limits	BRL	ting Limit		Ċ	above quantitation ran	ge			imes for pr	eparation or an	alysis exceeded	1
Spike Recovery outside recovery limits		cted below quantitation limits			tected at the Reportin	s Limit			ide recover	y limits		
		ery outside recovery limits									Dane	13.05.76

0804475 Work Order: WM-046, 1.4 Exp

Project:

TestCode: 8270_w

ANALYTICAL QC SUMMARY REPORT

Sample ID: LCS-10022	SampType: LCS	TestCode: 8270_w	Units: pg/L		Prep Dat	Prep Date; 5/1/2008		RunNo: 23488	80	
Client ID: ZZZZ	Batch (D: 10022	TestNo: SW8270C	C (SW3510)	-	Analysis Dat	Analysis Date: 5/2/2008		SeqNo: 230786	86	
Analyte	Result	PQL SPK value	SPK value SPK Ref Val	%REC	LowLimit	LowLimit HighLimit RPD Ref Val	D Ref Val	%RPD	%RPD RPDLimit Qual	Qual
Pentachlorophenol	21.62	1.00 25	5 0	86.5	30	130				
Phenanthrene	17.12	1.00 25	. 0	68.5	40	140	-			
Phenol	8.705	1.00	0 2	34.8	30	130				
Pyrene	14.20	1.00 25	0	56.8	40	140				
Pyridine	10.14	5.00	0	40.6	40	140				
Surr: 2,4,6-Tribromophenol	1.610	0 75	0 2	2.15	15	110				S
Surr: 2-Fluorobiphenyi	30.29	0 50	0 0	9.09	30	130		٠		
Surr: 2-Fluorophenol	31.20	0 75	0 2	41.6	15	110				
Surr: Nitrobenzene-d5	28.62	0 50	0 (57.2	30	130				
Surr: Phenol-d6	22.49	0 75	0	30.0	15	110				
Surr: Terphenyl-d14	29.31	0 50	0 (58.6	30	130				

E Value above quantitation range ND Not Detected at the Reporting Limit Analyte detected below quantitation limits Spike Recovery outside recovery limits

BRL Below Reporting Limit

Qualifiers:

- s

Holding times for preparation or analysis exceeded RPD outside recovery limits H K

RPD outside recovery limits

E Value above quantitation range ND Not Detected at the Reporting Limit

J Analyte detected below quantitation limits Spike Recovery outside recovery limits

BRL Below Reporting Limit

Qualifiers:

CLIENT: Fay, Spofford & Thomdike

Work Order: 0804475

WM-046, 1.4 Exp

Project:

TestCode: AG_W

Sample ID: WB-10030	SampType: MBLK	TestCoα	TestCode: AG_W	Units: mg/L		Prep Date	Prep Date: 5/1/2008	RunNo: 23444	
Client ID: ZZZZZ	Batch ID: 10030	Test	estNo: 200.7	(SW3010A)		Analysis Dat	Analysis Date: 5/1/2008	SeqNo: 230172	
Analyte	Result	PQL	SPK value	SPK value SPK Ref Val	%REC	LowLinnit	%REC LowLimit HighLimit RPD Ref Val	%RPD RPDLimit Qual	Qual
Silver	ON	0.00700							
Sample ID: LCS-10030	SampType: LCS	TestCoo	TestCode: AG_W	Units: mg/L		Prep Date	Prep Date: 5/1/2008	RunNo: 23444	
Client ID: ZZZZZ	Batch ID; 10030	Test	TestNo: 200.7	(SW3010A)		Analysis Datı	Analysis Date: 5/1/2008	SeqNo: 230173	
Analyte	Result	PQL	SPK value	SPK value SPK Ref Val	%REC	LowLimit	"REC LowLimit HighLimit RPD Ref Val	%RPD RPDLimit Qual	Qual
Silver	0.4440	0.00700	0.5	0,004	88.0	80	120		

0804475 Work Order: WM-046, 1.4 Exp

Project:

TestCode: CN_W_SM

ANALYTICAL QC SUMMARY REPORT

Sample ID: MB-R23624	SampType: MBLK	TestCo	TestCode: CN_W_SM	Units: mg/L		Prep Date;	;e	RunNo: 23624	
Client ID: ZZZZZ	Batch ID: R23624	Test	TestNo: SM 4500-CN-	,	•	Analysis Date	Analysis Date: 5/12/2008	SeqNo: 232074	
Analyte	Result	POL	SPK value SPK Ref Val	SPK Ref Val	%REC	LowLimiŧ	%REC LowLimit HighLimit RPD Ref Val	%RPD RPDLimit	Qual
Cyanide, Total	ΩN	0.0197						**************************************	
Sample ID: LCS-R23624 Client ID: ZZZZZ	SampType: LCS Batch ID: R23624	TestCo	FestCode: CN_W_SM TestNo: SM 4500-CN-	Units: mg/L	,	Prep Date: Analysis Date:	Prep Date: Analysis Date: 5/12/2008	RunNo: 23624 SeqNo: 232075	
Analyte	Result	POL	SPK value SPK Ref Val	SPK Ref Val	%REC	LowLimit	"REC LowLimit HighLimit RPD Ref Val	%RPD RPDLimit	Quai
Cyanide, Total	0,1726	0.0197	0.183	0	94.3	85	115		

BRL Below Reporting Limit

Qualifiers:

Analyte detected below quantitation limits Spike Recovery outside recovery limits

ND Not Detected at the Reporting Limit

E Value above quantitation range

Holding times for preparation or analysis exceeded

RPD outside recovery limits

RPD outside recovery limits

%

E Value above quantitation range ND Not Detected at the Reporting Limit

> Analyte detected below quantitation limits Spike Recovery outside recovery limits

- s

BRL Below Reporting Limit

Qualifiers:

CLIENT: Fay, Spofford & Thorndike

Work Order: 0804475

WM-046, 1.4 Exp

Project:

TestCode: Cr6_WW

Sample ID: MB-R23406	SampType: MBLK	TestCo	TestCode: Cr6_WW	Units: mg/L		Prep Date:		RunNo: 23406	
Client ID: ZZZZZ	Batch ID: R23406	Test	estNo: M3500-Cr D	0		Analysis Date: 5/1/2008	2008	SeqNo: 229635	
Analyte	Result	POL	SPK value SPK Ref Val	SPK Ref Val	%REC	%REC LowLimit HighLimit RPD Ref Val	nit RPD Ref Val	%RPD RPDLimit Qual	Qual
Chromium, Hexavalent	, ON	0.0500				W			
Sample ID: LCS-R23406	SampType: LCS	TestCoc	TestCode: Cr6_WW	Units: mg/L	Mary and the state of the state	Prep Date:	The second secon	RunNo: 23406	***************************************
Client ID: ZZZZZ	Batch ID: R23406	Testh	estNo: M3500-Cr D		•	Analysis Date: 5/1/2008	2008	SeqNo: 229636	
Analyte	Result	PQL	SPK value SPK Ref Val	SPK Ref Val	%REC	%REC LowLimit HighLimit RPD Ref Val	nit RPD Ref Val	%RPD RPDLimit Qual	Quai
Chromium, Hexavalent	0.4430	0.0500	0.5	0	88.6	85 115	15		

Analyte detected below quantitation limits Spike Recovery outside recovery limits

- S

REPORT	
OC SUMMARY	
ANALYTICAL C	

TestCode: EPHP W

WM-046, 1.4 Exp
Project:

0804475

Work Order: CLIENT:

Fay, Spofford & Thorndike

Sample ID: MB-10035	SampType: MBLK	TestCo	TestCode: EPHP W	Units: µg/L		Prep Date:	5/2/2008	RunNo: 23517		
Client ID: ZZZZ	Batch ID: 10035	Test	TestNo: MADEP EPH_ (eph_Wpr)	- (eph_Wpr)	Ā	Analysis Date: 5/6/2008	5/6/2008	SeqNo: 231064		
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit H	LowLimit HighLimit RPD Ref Val	%RPD RPD	RPDLimit Qual	
Naphthalene	S	1.00								
2-Methylnaphthalene	QV	1.00								
Acenaphthene	S	1.00								
Phenanthrene	QN	1.00								
Acenaphthylene	R	1.00								
Fluorene	Q	1.00								
Anthracene	QN	1.00								
Fluoranthene	QN	1.00								
Pyrene	S	1,00								
Benzo(a)Anthracene	N	0.400								
Сһгуѕепе	Q	1.00								
Benzo(b)Fluoranthene	QN	1.00								
Benzo(k)Fluoranthene	QN	1.00		•						
Benzo(a)Pyrene	2	0.200								
Indeno(1,2,3-cd)Pyrene	QN	0.400								
Dibenz(a,h)Anthracene	QN	0.400							-	
Benzo(g,h,i)Perylene	QN	1.00								
Total PAH Target Concentration	QN.	0								
Surr; 2,2'-Diffuorobiphenyl	25.46	0	25	0	102	40	140			
Surr: 2-Fluorobiphenyl	21.05	0	. 25	0	84.2	40	140			
Sample ID: LCS-10035	SampType: I CS	TestCo	PestCode: FDHD W	Inite: ma/l		Prop Date:	E/9/2008	D. 1986. 2004.1		

Sample ID: LCS-1035 SampType: LCS TestCode: EPHP_W Units: µg/L Prep Date: 5/2/2008 5/2/2008 RunNo: 23517 Client ID: LCS-1035 Batch ID: 10035 TestNo: MADEP EPH_ (eph_Wpr) Analysis Date: 5/6/2008 5/6/2008 SeqNo: 231065 Analyte Analyte Sexult PQL SPK value SPK Ref Val %REC LowLimit HighLimit RPD Ref Val %RPD RPDLimit Qualities 2-Methylnaphthalene 35.15 1.00 50 0 50 0 40 140 Analysis Date: 5/6/2008 Analysis core of a nulysis exceeded Acenaphthalene 35.15 1.00 50 0 87.4 40 140 Analysis core of a nulysis exceeded Acenaphthalene 43.68 1.00 50 0 87.4 40 140 Analysis exceeded Acenaphthylinene 39.11 1.00 50 0 78.2 40 140 Analysis exceeded Analyse detected below quantifaction limits Brown Datested at the Reporting Limit Brown Datested at the Reporting Limit	Surr: 2-Fivorobipnenyl	nenyi	21.05	0	25	0	84.2	40	140		
Result PQL SPK Ref Val %REC LowLimit HighLimit RPD Ref Val RPD Ref RPD Ref RPD	Sample ID: LCS-10 Client ID: ZZZZ	S	pe: LCS ID: 10035	TestCode	E EPHP_W	Units: µg/L PH_ (eph_Wpr)		Prep Dat Analysis Dat	e; 5/2/2008 e: 5/6/2008	RunNo: 23517 SeqNo: 231065	
Second Parameter Second Period Second Period	Analyŧe		Result	Pal	SPK value	SPK Ref Vai	%REC	LowLimit	HighLimit RPD Ref Val		=
Sample S	Naphthalene		29.84	1.00	50	0	59.7	40	140		
## 40.49	2-Methylnaphthalent	a)	35.15	1.00	20	0	70.3	40	140		
43.68 1.00 50 0 87.4 40 39.11 1.00 50 0 78.2 40 RL Below Reporting Limit E Value above quantitation range F Value above quantitation limits ND Not Detected at the Reporting Limit	Acenaphthene		40.49	1.00	50	0	81.0	40	140		
39.11 1.00 50 0 78.2 40 RL Below Reporting Limit B Value above quantitation limits ND Not Detected at the Reporting Limit ND Not Detected at the Reporting Limit	Phenanthrene		43.68	1.00	50	0	87.4	40	140		
BRL Below Reporting Limit E Value above quantitation range J Analyte detected below quantitation limits ND Not Detected at the Reporting Limit	Acenaphthylene		39.11	1.00	20	0	78.2	40	140		
ND Not Detected at the Reporting Limit	- Andrews	Below Reporting Limit			1	above quantitation ran	ge		H Holding times fo	r preparation or analysis exceeded	
	J	Analyte detected below qu	uantitation limits		ND Not Do	tected at the Reportin	g Limit		R RPD outside reco	wery limits	

0804475 Work Order: WM-046, 1.4 Exp

Project:

TestCode: EPHP W

ANALYTICAL QC SUMMARY REPORT

Sample ID: LCS-10035	SampType: LCS	TestCo	TestCode: EPHP_W	Units: µg/L		Prep Date:	Prep Date: 5/2/2008	RunNo: 23517	
Client ID: ZZZZZ	Batch ID: 10035	Test	TestNo: MADEP EPH_ (eph_Wpr)	(eph_Wpr)	,	Analysis Date:	5/6/2008	SeqNo: 231065	
Analyte	Result	. POL	SPK value S	SPK Ref Val	%REC	LowLimit HighLimit	lighLimit RPD Ref Val	%RPD RPDLimit	Qual
Fluorene	47.68	1.00	50	0	95.4	40	140		
Anthracene	46.42	1.00	90	0	92.8	40	140		
Fluoranthene	47.87	1.00	20	0	95.7	40	140		
Pyrene	50.81	1,00	50	0	102	40	140		
Benzo(a)Anthracene	49.14	0.400	20	0	. 6.86	40	140		
Chrysene	49.65	1.00	90	0	99.3	40	140		
Benzo(b)Fluoranthene	47.36	1.00	50	0	94.7	40	140		
Benzo(k)Fluoranthene	90'09	1.00	90	0	122	40	140		
Benzo(a)Pyrene	55.99	0.200	20	0	112	40	140		
Indeno(1,2,3-cd)Pyrene	51.72	0.400	20	0	103	40	140		
Dibenz(a,h)Anthracene	51.69	0.400	50	0	103	40	140		
Benzo(g,h,i)Perylene	49.96	1.00	90	0	6.66	40	140		
Total PAH Target Concentration	797.5	0							
Surr: 2,2'-Difluorobiphenyl	22.61	0	25	0	90.4	40	140		
Surr. 2-Fluorobiphenyl	19.88	0	25	0	79.5	40	140		

E Value above quantitation range
ND Not Detected at the Reporting Limit Analyte detected below quantitation limits Spike Recovery outside recovery limits

BRL Below Reporting Limit

Qualifiers:

Holding times for preparation or analysis exceeded RPD outside recovery limits н ч

RPD outside recovery limits

H R

E Value above quantitation range
ND Not Detected at the Reporting Limit

Analyte detected below quantitation limits Spike Recovery outside recovery limits

- s

BRL Below Reporting Limit

Qualifiers:

CLIENT: Fay, Spofford & Thorndike

Work Order: 0804475

Project: WM-046, 1.4 Exp

TestCode: hg-245.1_w

Client ID: ZZZZZ Batch ID: 10071 Test Analyte Result PQL Mercury ND 0.000500 Sample ID: LCS-10071 SampType: LCS Client ID: ZZZZZ Batch ID: Test Analyte Result PQL	TestCode: hg-245.1_w	Units: mg/L	Prep Date:	Prep Date: 5/5/2008	RunNo: 23475	
ND 0.00 D: LCS-10071 SampType: LCS Batch D: 10071 Result	TestNo; E245. 1	(SW7470A/E2	Analysis Date: 5/5/2008	5/5/2008	SeqNo: 230595	
ND 0.00 D: LCS-10071 SampType: LCS : ZZZZZ Batch ID: 10071 Result	. SPK value	SPK Ref Val	C LowLimit H	%REC LowLimit HighLimit RPD Ref Val	%RPD RPDLimit Qual	Qual
SampType: LCS Batch ID: 10071 Result	0.000500					
): ZZZZ Batch ID: 10071 Te	TestCode: hg-245.1_w	Units: mg/L	Prep Date:	Prep Date: 5/5/2008	RunNo: 23475	
Result	TestNo: E245.1	(SW7470A/E2	Analysis Date: 5/5/2008	5/5/2008	SeqNo: 230596	
***************************************	POL SPK value SPK Ref Val		C LowLimit F	%REC LowLimit HighLimit RPD Ref Val	%RPD RPDLimit Qual	Quai
Mercury 0.005060 0.000500	0,000500 0.005	0 101	1 80	120		

RPD outside recovery limits

~

ND Not Detected at the Reporting Limit Value above quantitation range

> Analyte detected below quantitation limits Spike Recovery outside recovery limits

BRL Below Reporting Limit

Qualifiers:

ш

Fay, Spofford & Thorndike CLIENT:

0804475 Work Order: WM-046, 1.4 Exp

Project:

TestCode: TPH_W

TestCode: TPH W	Unite: ma/l				
	- Carrier 1981	ï	Prep Date: 5/2/2008	RunNo: 23455	
TestNo: 8100M	(8100M)	Analy	Analysis Date: 5/2/2008	SeqNo: 230328	
Result PQL SPK value	SPK Ref Val	"REC LOW	%REC LowLimit HighLimit RPD Ref Val	%RPD RPDLimit	Qual
ND 0.200 84.00 0 100	0	84.0	40 140	The state of the s	
TestCode: TPH_W	Units: mg/L	Pr	Prep Date: 5/2/2008	RunNo: 23455	
TestNo: 8100M	(8100M)	Analy	Analysis Date: 5/2/2008	SeqNo: 230329	
PQL SPK value	SPK Ref Val	%REC Low	LowLimit HighLimit RPD Ref Val	%RPD RPDLimit	Qual
0.200	0	76.8			
82.00 0 100	0	82.0	40 140		
TestCode: TPH_W	Units: mg/L	Pr	Prep Date: 5/2/2008	RunNo: 23455	
TestNo: 8100M	(8100M)	Analy	Analysis Date: 5/2/2008	SeqNo: 230336	
PQL SPK value	SPK Ref Val	%REC Low	Limit HighLimit RPD Ref	%RPD RPDLimit	Qual
0.200	0	6.09	40 140		
63.00 0 100	0	63.0	40 140		
. P		SPK value SPP	SPK value SPK Ref Val 2 0	SPK value SPK Ref Val 2 0	SPK value SPK Ref Val %REC LowLimit HighLimit RPD Ref Val %RPD RPDLimit 2 0 60.9 40 140 100 0 63.0 40 140

0804475 Work Order:

WM-046, 1.4 Exp

Project:

TestCode: TRC_W

ANALYTICAL QC SUMMARY REPORT

Cliont ID: 72777	SampType: MBLK	TestCo	TestCode: TRC_W	Units: mg/L		Prep Date:	te:	RunNo: 23379	
Cilein ib.	Batch ID: R23379	Test	estNo: Hach 8167	•	7	Analysis Da	Analysis Date: 4/30/2008	SeqNo: 229309	
Analyte	Result	Pal	SPK value	SPK value SPK Ref Val	%REC	LowLimit	%REC LowLimit HighLimit RPD Ref Val	%RPD RPDLimit Qual	Qual
Total Residual Chlorine	QN	0.162						there is a second and the second and	
Sample ID: LCS-R23379 Client ID: ZZZZZ	SampType: LCS Batch ID: R23379	TestCod	FestCode: TRC_W TestNo: Hach 8167	Units: mg/L		Prep Date: Analysis Date:	Prep Date: Analysis Date: 4/30/2008	RunNo: 23379 SeqNo: 229310	
Analyte	Result	PQL	SPK value	SPK value SPK Ref Val	%REC	LowLimit	%REC LowLimit HighLimit RPD Ref Val	%RPD RPDLimit Qual	Qual
Total Residual Chlorine	1.060	0.162	+	0	106	85	115		

E Value above quantitation range
ND Not Detected at the Reporting Limit

Analyte detected below quantitation limits Spike Recovery outside recovery limits

- ×

BRL Below Reporting Limit

Qualifiers:

I z

Holding times for preparation or analysis exceeded RPD outside recovery limits

RPD outside recovery limits

E Value above quantitation range ND Not Detected at the Reporting Linnit

Analyte detected below quantitation limits Spike Recovery outside recovery limits

- ×

BRL Below Reporting Limit

Qualifiers:

Fay, Spofford & Thorndike CLIENT:

0804475 Work Order: WM-046, 1.4 Exp

Project:

TestCode: TSS

Sample ID: MB-R23456	SampType: MBLK	TestCode: TSS	TSS	Units: mg/L		Prep Date:		RunNo: 23456	
Client ID: ZZZZZ	Batch ID: R23456	TestNo:	estNo: E160.2		*	Analysis Date: 5/1/2008	1/2008	SeqNo: 230315	
Analyte	Result	POL	3PK value	SPK value SPK Ref Val	%REC	LowLimit HighLi	%REC LowLimit HighLimit RPD Ref Val	%RPD RPDLimit Qual	iit Qual
Total Suspended Solids	ON	4.00					Transfer the second sec		
Sample ID: LCS-R23456	SampType: LCS	TestCode: TSS	TSS	Units: mg/L		Prep Date:	The state of the s	RunNo: 23456	
Client ID: ZZZZZ	Batch ID: R23456	TestNo:	estNo: E160.2		•	Analysis Date: 5/1/2008	1/2008	SeqNo: 230316	
Analyte	Result	Pat s	SPK value	SPK Ref Val	%REC	LowLimit HighLi	%REC LowLimit HighLimit RPD Ref Val	%RPD RPDLimit	iit Qual
Total Suspended Solids	74.00	4.00	66.5	0	111	80	120		

Analyte detected below quantitation limits Spike Recovery outside recovery limits

Fay, Spofford & Thomdike 0804475 Work Order: CLIENT: Project:

WM-046, 1.4 Exp

TestCode: VPH_W2

Sample IU: MBLK Samp	SampType: MBLK	TestCor	TestCode: VPH_W2	Units: µg/L		Prep Date:	iri		RunNo: 23429	129	
Client ID: ZZZZZ Batcl	Batch ID: R23429	Test	TestNo; VPH		`	Analysis Date:	5/1/2008		SeqNo: 229999	666	
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit R	RPD Ref Val	%RPD	RPDLimit	Qual
C9-C10 Aromatic Hydrocarbons	ON	75.0					Maria (1997)				
Unadjusted C5-C8 Aliphatic Hydrocarbo	QN	75.0									
Unadjusted C9-C12 Aliphatic Hydrocarb	Q	75.0									
Methyl Tert-Butyl Ether	Q	5.00									
Benzene	2	5.00						,			-
Toluene	Q	5.00					-				
Ethylbenzene	Q	5.00									
m.p-Xylene	QN	5.00		e sign							
o-Xylene	R	5.00									
Naphthalene	S	20.0									
Adjusted C5-C8 Aliphatic Hydrocarbons	QV	75.0									
Adjusted C9-C12 Aliphatic Hydrocarbon	QN	75.0									
Surr: 2,5-Dibromotoluene FID	72.39	0	100	0	72.4	20	130				
Surr: 2,5-Dibromotoluene PID	73.18	0	100	0	73.2	70	130				
Sample ID: MBLK SampT	SampType: MBLK	TestCod	TestCode: VPH_W2	Units: µg/L		Prep Date:			RunNo: 23551	51	
Client ID: 22222 Batch	Batch ID: R23551	TestN	TestNo: VPH		4	Anatysis Date:	: 5/6/2008		SeqNo: 231337	337	
Analyte	Result	POL	SPK value	SPK Ref Val	%REC	LowLimit HighLimit		RPD Ref Val	%RPD	RPDLimit	Oual
C9-C10 Aromatic Hydrocarbons	QN	75.0									
Unadjusted C5-C8 Aliphatic Hydrocarbo	QN	75.0									
Unadjusted C9-C12 Aliphatic Hydrocarb	ON	75.0	- : "								
Methyl Tert-Butyl Ether	ON	5.00									
Benzene	ON	5.00									
Toluene -	ON	5.00									
Ethylbenzene	QV	5.00									
m,p-Xylene	Q	5,00									
o~Xylene	Q.	5.00									
Naphthalene	QV	20.0									
Adjusted C5-C8 Aliphatic Hydrocarbons	ND	75.0									
One Wiere RRI Relow Reporting I imit	The second secon		T Volta	NAMES OF THE PROPERTY OF THE P		A VALORED A STATE OF THE STATE	1				
-	and antique franches			value above qualitization range Mot Detected of the Paris of the				aing umes for p	Holding times for preparation or analysis exceeded	alysis exceede	ত্
J Analyte detected perow quantitation timits	duammenton muss		ND Not De	Not Detected at the Reporting Limit	S Limit		R RPL	RPD outside recovery limits	ay limits		
Special programmy	TO SO COLOR										

Page 25 of 26

ANALYTICAL QC SUMMARY REPORT

TestCode: VPH_W2

Fay, Spofford & Thorndike 0804475 Work Order:

CLIENT:

WM-046, 1.4 Exp

Project:

Sample ID: MBLK	SampType: MBLK	TestCo	TestCode: VPH_W2	Units: µg/L		Prep Date:	6.		RunNo: 23551		
Client ID: ZZZZZ	. Batch ID: R23551		TestNo: VPH		1	nalysis Dat	Analysis Date: 5/6/2008		SeqNo: 231337	4	
Analyte	Result	PQL	PQL SPK value SPK Ref Val	SPK Ref Val	%REC	LowLimit	%REC LowLimit HighLimit RPD Ref Val	ef Vai	%RPD RPDLimit Qual	PDLimit	Quai
Adjusted C9-C12 Aliphatic Hydrocarbon	drocarbon ND	75.0	· · · · · · · · · · · · · · · · · · ·								
Surr: 2,5-Dibromotoluene FID	ID 71.91	0	100	0	71.9	70	130				
Surr: 2,5-Dibromotoluene PID	ID 73.18	0	100	0	73.2	70	130				
									***************************************	THE PERSON NAMED IN COLUMN TWO	

Sample ID: LCS	SampType: LCS	TestCo	estCode: VPH W2	Units: µg/L		Prep Date:	(e;	, , , , , , , , , , , , , , , , , , ,	RunNo: 23429	The second secon
Citent ID: ZZZZZ	Batch ID: R23429	Test	TestNo: VPH)		Analysis Da	Analysis Date: 5/1/2008		SeqNo: 229997	
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	HighLimit RPD Ref Val	%RPD RPDLimit	-imit Qual
C9-C10 Aromatic Hydrocarbons	82.90	75.0	100	3.664	79.2	70	130			
Unadjusted C5-C8 Aliphatic Hydrocarbo	rocarbo 614.9	75.0	009	54.1	93.5	70	130			
Unadjusted C9-C12 Aliphatic Hydrocarb	drocarb 483.2	75.0	009	11.39	78.6	70	130			4
Methyl Tert-Butyl Ether	126.0	5.00	100	0	126	70	130			
Benzene	81.28	5.00	100	0	81.3	70	130			
Toluene	87.85	5.00	100	0	87.8	70	130			
Ethylbenzene	91.06	5.00	100	0	91,1	20	130			
m,p-Xyłene	198.4	5.00	200	0	99.2	20	130			
o.Xylene	88.76	5.00	100	0	88.8	70	130			
Naphthalene	81.86	20.0	100	0	81.9	20	130			
Surr; 2,5-Dibromotoluene FID	86.10	0	100	0	86.1	70	130			
Surr: 2,5-Dibromotoluene PID	71.16	0	100	0	71.2	70	130			
Sample ID: LCS	SampType: LCS	TestCo	TestCode: VPH_W2	Units: µg/L		Prep Date:	B;		RunNo: 23551	
Client ID: ZZZZZ	Batch ID: R23551	Test	TestNo: VPH		*	Analysis Date:	e: 5/6/2008		SeqNo: 231335	
Apolyte	Breedl	Ö	order yes	In you was with yas	J 10 %	tion; Prio	Linkling	17/470 000 size(147)D size(1770 D 000)		:

Sample ID: LCS	SampType: LCS	TestCod	TestCode: VPH_W2	Units: µg/L		Prep Date:	, to		RunNo: 23551	51	
Cilent ID: ZZZZZ	Batch ID: R23551	TestN	TestNo: VPH			Analysis Date:	e: 5/6/2008		SeqNo: 231335	335	
Analyte	Result	Pal	SPK value	SPK value SPK Ref Val	%REC	LowLimit	%REC LowLimit HighLimit RPD Ref Val	Ref Val	%RPD	%RPD RPDLimit Qual	Qual
C9-C10 Aromatic Hydrocarbons	82.21	75.0	100	3.687	78.5	70	130				
Unadjusted C5-C8 Aliphatic Hydrocarbo	arbo 634.4	75.0	900	24.07	102	20	130				
Unadjusted C9-C12 Aliphatic Hydrocarb	scarb 528.0	75.0	9009	11.85	86.0	70	130				
Methyl Tert-Butyl Ether	126.9	5.00	100	0	127	20	130				
Benzene	78.69	5.00	100	0	78.7	70	130				
Ounlifters: BRL Below Reporting Limit J Analyte detected below	Below Reporting Limit Analyte detected below quantitation limits		E Value a	E Value above quantitation range ND Not Detected at the Reporting Limit	nge ig Limit		H Holdin R RPD on	Holding times for preparation RPD outside recovery limits	Holding times for preparation or analysis exceeded RPD outside recovery limits	nalysis exceed	þ
S Spike Recovery	Spike Recovery outside recovery limits		÷							Day	Dave 25 of 36

RPD outside recovery limits

E Value above quantitation range
ND Not Detected at the Reporting Limit

J Analyte detected below quantitation limits
S Spike Recovery outside recovery limits

BRL Below Reporting Limit

Qualifiers:

CLIENT: Fay, Spofford & Thorndike

Work Order: 0804475

WM-046, 1.4 Exp

Project:

TestCode: VPH_W2

Sample ID: LCS	SampType: LCS	TestCoc	TestCode: VPH_W2	Units: µg/L		Prep Date:	e;	RunNo: 23551		
Client ID: ZZZZZ	Batch ID: R23551	Test	estNo: VPH			Analysis Dat	Analysis Date: 5/6/2008	SeqNo: 231335		
Analyte	Result	Pal	SPK value	SPK value SPK Ref Val	%REC	LowLimit	%REC LowLimit HighLimit RPD Ref Val	%RPD RPDLimit Qual	'DLimit	Qual
Toluene	83.78	5,00	100	0	83.8	70	130			
Ethylbenzene	87,86	5.00	100	0	87.9	20	130			
m,p-Xyfene	186.8	5.00	200	0	93.4	20	130			
o-Xylene	83.91	5.00	100	0	83.9	70	130			
Naphthalene	70.62	20.0	100	0	70.6	70	130			
Surr: 2,5-Dibromotoluene FID	94.42	0	100	0	94.4	70	130			
Surr: 2,5-Dibromotoluene PID	77.13	0	100	0	77.1	22	130			

というというというと _ **4** 10 N 0 = 0ther ŏ LEMPERATURE Ð NH (2508) NJ (MA-009) RI (LA000252) しらならいべ 1 55 X × B = Bag P = Plastic V = Voa B ハナガガナ Page vioro H O 4 Analysis Requested X 2 HEXKNOREU 6000 4 PLOA 9 CT RCP (Reasonable Confidence Protocols) 4 からびと Date / Time 4130108 Containers: A = Amber G = Glass S = Summa SAPLIED BOTILES \checkmark Special Instructions 301040 Invoice to *: LARRY ATTACHED KULLYSIS 4 o with pla からく × # dI MYD MA (MA - 015) PA (68-03417) State / Fed Program - Criteria Requirements: circle choice (s) HOL 1 1 2044080 7 = 0ther ۲-& od Έ, Project PO: 5 4437 Project: (004) OCT (PH-0148) NY(11796) 1 0229 5 = Na0H6 ≈ MEOH 85PC 10CK 1 乂 HAR 1202A Preserative GeoLabs SAMPLE NUMBER 4 = Na2S20314 MCP Methods 3 = H2S04-003 4475 - 602 メネンのグ 4475-001 Kinnel Terms, Psyment due within 30 days untiese other arrangements are mode. Past due bittaness stitled to interest and collect.
 Note. Homeowners and Law Firms must pay when drupping off samples. We accept cash, check and credit cards. Other Preservatives 4475 Received by 2 = HNO31 = HG g: circle choice (Done によるよう Not Needed おきしてモンLab to do Preservation Lab to do Y/N -* §* 5548 <u>^-</u> ξ 00 Received on ice Ø. Sample Handling: Filtration PT (5 >~ 5 <u>ر</u> 3 5 Preservation CONTAINER Data Delivery: circle choice (s) ema PDF Phone: email: Fax: S. ટુ _ > 4 4 ļ Date / Time CHAIN OF CUSTODY RECORD OT = Other A = AirLOCATION / ID GeoLabs, Inc. Environmental Laboratories 45 Johnson Lane, Braintree, MA 02184 Format: p 781.848.7844 • 1781.848.7811 S = Soil(Jeok) 10 = 0 ž 177 ひいなんいい O C4 DW = Orinking Water Ď のいなりいるする ŝ ß www.geolabs.com (5/7-days) SL = Studge Turnaround; circle one Ĉ LAD 2 1 an -au - az po 700 280265.J&P.C of CR.03/07/08 COLLECTION S. 120ch 7 15 که د 'n, GW = Ground Water WW = Waste Water h- --- 5 L Relinquished by: Matrix Codes: GeoLabs, Inc. Address: . 2-day 4 3 Contact: 4130 43 Client: 口点下出

 $\tilde{\mathcal{E}}$

		†

GU B17, B13, B11, B9, B5

Thursday, May 15, 2008

Larry Durkin Fay,Spofford & Thorndike 5 Burlington Woods Burlington, MA 01803 GeoLabs, Inc. 45 Johnson Lane Braintree MA 02184 Tele: 781 848 7844 Fax: 781 848 7811

TEL: 781-221-1066 FAX: 781-221-1086

Project:

WM-046, 1.4 Exp

Location:

Order No.: 0805025

Dear Larry Durkin:

GeoLabs, Inc. received 6 sample(s) on 5/2/2008 for the analyses presented in the following report.

There were no problems with the analyses and all data for associated QC met EPA or laboratory specifications except where noted in the Case Narrative.

Analytical methods and results meet requirements of 310CMR 40.1056(J) as per MADEP Compendium of Analytical Methods (CAM).

If you have any questions regarding these tests results, please feel free to call.

Sincerely,

Jim Chen

Laboratory Director

Certifications:

CT (PH-0148) - MA (M-MA015) - NH (2508) - NJ (MA009) - NY (11796) - RI (LA000252)

Date: 15-May-08

CLIENT:

Fay, Spofford & Thorndike

Project:

WM-046, 1.4 Exp

Lab Order:

0805025

CASE NARRATIVE

MADEP MCP Response Action Analytical Report Certification Form

Laboratory Name: GeoLabs, Inc.

Project # WM-046, 1.4 EXP

Project Location: MWRA 6905

MADEP RTN #:

This form provides certification for the following data set: 0805025 (001-006)

Sample Matrix: Groundwater

MCP SW-846 Methods Used: 8260B, VPH, 8270C, EPH, 8082, 8100M, 6010B, 245.1

An affirmative answer to questions A, B and C are required for "Presumptive Certainty" status

- A. Were all samples received by the laboratory in a condition consistent with that described on the Chain of custody documentation for the data set? YES
- B. Were all QA/QC procedures required for the specified method(s) included in this report followed. including the requirement to note and discuss in a narrative OC data that did not meet appropriate standards or guidelines? YES
- C. Does the analytical data included in this report meet all the requirements for "Presumptive Certainty" as described in Section 2.0 of the MADEP documents CAM VII A "Quality Assurance and Quality Control Guidelines for the Acquisition and Reporting of Analytical Data"? YES
- D. VPH and EPH Methods only: Was the VPH or EPH Method conducted without significant modifications (see Section 11.3 of respective Methods)

A response to questions E and F are required for "Presumptive Certainty" status

- E. Were all QC performance standards and recommendations for the specified methods achieved? NO
- F. Were results for all analyte-list compounds/elements for the specified method(s) reported?

NO

All NO answers need to be addressed in an attached Environmental Laboratory case narrative.

CLIENT:

Fay.Spofford & Thorndike

Project:

WM-046, I.4 Exp

Lab Order:

0805025

CASE NARRATIVE

CASE NARRATIVE

Physical Condition of Samples

The project was received by the laboratory in satisfactory condition. The sample(s) were received undamaged, in appropriate containers with the correct preservation.

Project Documentation

The project was accompanied by satisfactory Chain of Custody documentation.

Analysis of Sample(s)

Selected metals on 6010B analyzed per client request.

The following analytical anomalies or non-conformances were noted by the laboratory during the processing of these samples:

Hexavalent Chromium and Total Residual Chlorine were analyzed out of holding time.

8260 Run 23612 LCS percent recovery for 1,2,4-Trichlorobenzene is outside the recovery limits.

8260 Run 23706 LCS percent recovery for 2-Chloroethyl Vinyl Ether is outside the recovery limits.

8270 LCS percent recoveries for 2,4-Dinitrophenol and Benzidine are outside the recovery limits.

I, the undersigned, attest under the pains and penalties of perjury that, based upon my personal inquiry of those responsible for obtaining the information, the material contained in this analytical report is, to the best of my knowledge and belief, accurate and complete.

Signature:

Position: Lab Director

Printed Name: Jim Ch

Date: May 15, 2008

CLIENT:

Fay, Spofford & Thorndike

Project:

WM-046, 1.4 Exp

Lab Order:

0805025

CASE NARRATIVE

EPH Methods

Method for Ranges: MADEP EPH 04-1.1 Method for Target Analytes: 8270 GC/MS

Carbon Range data exclude concentrations of any surrogate(s) and/or internal standards eluting in that range

C11-C22 Aromatic Hydrocarbons exclude concentrations of Target PAH Analytes

CERTIFICATION:

Were all QA/QC procedures REQUIRED by the EPH Method followed? YES

Were all performance/acceptance standards achieved? YES

Were any significant modifications made to the EPH method? NO

I attest under the pains and penalties of perjury that, based upon my inquiry of those individuals immediately responsible for obtaining the information, the material contained in this report is, to the best of my knowledge and belief, accurate and complete.

SIGNATURE:

LAB DIRECTOR

PRINTED NAME: Jim/Chen

DATE: May 15, 2008

CLIENT:

Fay, Spofford & Thorndike

Project:

WM-046, 1.4 Exp

Lab Order:

0805025

CASE NARRATIVE

VPH Methods

Method for Ranges: MADEP VPH 04-1.1

Method for Target Analytes: MADEP VPH 04-1.1

Carbon Range data exclude concentrations of any surrogate(s) and/or internal standards eluting in that range.

C5-C8 Aliphatic Hydrocarbons exclude the concentration of Target Analytes eluting in that range. (MTBE, Benzene, Toluene)

C9-C12 Aliphatic Hydrocarbons exclude concentration of Target Analytes eluting in that range (Ethylbenzene, m&p-Xylenes, o-Xylene) AND concentration of C9-C10 Aromatic Hydrocarbons.

CERTIFICATION

Were all QA/QC procedures REQUIRED by the VPH Method followed? YES Were all QA/QC performance/acceptance standards achieved? YES Were any significant modifications made to the VPH method, as specified in Sec. 11.3? NO

I attest under the pains and penalties of perjury that, based upon my inquiry of those individuals immediately responsible for obtaining the information, the material contained in this report is, to the best of my knowledge accurate and complete.

SIGNATURE:

POSITION: LAB DIRECTOR

PRINTED NAME:

DATE: May 15, 2008

Reported Date: 15-May-08

CLIENT:

Fay, Spofford & Thorndike

Lab Order:

0805025

Project:

WM-046, 1.4 Exp

Lab ID:

0805025-001

Client Sample ID: B17

Collection Date: 4/30/2008 9:10:00 PM

Date Received: 5/2/2008

Matrix: GROUNDWATER

0803023-001				Matrix: GROU	UNDWATER	
Analyses	Result	Det. Limit	Qual Units	DF	Date Analyzed	
TOTAL SUSPENDED SOLIDS - SM25	40-D				Analyst: AMS	
Total Suspended Solids	ND	4.00	mg/L	1	5/5/2008	
EPH RANGES - MADEP EPH					Analyst: RJ	
Adjusted C11-C22 Aromatics	ND	103	μg/L	. 1	5/9/2008	
C09-C18 Aliphatics	ND	103	μg/L	1	5/9/2008	
C19-C36 Aliphatics	ND	103	μg/L	1	5/9/2008	
Unadjusted C11-C22 Aromatics	ND	103	μg/L	1	5/9/2008	
Surr: 1-Chlorooctadecane	65.0	40-140	%REC	1	5/9/2008	
Surr: o-Terphenyl	78.0	40-140	%REC	1	5/9/2008	
TOTAL PETROLEUM HYDROCARBO	NS - 8100M				Analyst: BuB	
Total Petroleum Hydrocarbons	ND	0.206	mg/L	1	Analyst: RuP 5/5/2008	
Surr: o-Terphenyl	65.0	40-140	%REC	1	5/5/2008	
POLYCHLORINATED BIPHENYLS - S	W8082	•			Analyst: GP	
Arocior 1016/1242	ND	0.313	μg/L	1	5/6/2008	
Aroclor 1221	ND	0.313	μg/L	1	5/6/2008	
Aroclor 1232	ND	0.313	μg/L	1	5/6/2008	
Aroclor 1248	ND	0.313	μg/L	1	5/6/2008	
Arocior 1254	ND	0.313	μg/L	1	5/6/2008	
Aroclor 1260	ND	. 0.313	μg/L	1	5/6/2008	
Aroclor 1262	ND	0,313	μg/L	1	5/6/2008	
Aroclor 1268	ND	0.313	μg/L	1	5/6/2008	
Surr: Decachlorobiphenyl Sig 1	90.0	30-150	%REC	1	5/6/2008	
Surr: Decachlorobiphenyl Sig 2	92.0	30-150	%REC	1	5/6/2008	
Surr: Tetrachloro-m-Xylene Sig 1	70.0	30-150	%REC	4	5/6/2008	
Surr: Tetrachloro-m-Xylene Sig 2	78.0	30-150	%REC	1	5/6/2008	
OTAL METALS BY GFAA - E200.9					Analyst: QS	
Antimony	ND	0.00100	mg/L	1	5/6/2008	
Arsenic	ND	0.00100	-	1	5/6/2008	
OTAL METALS BY ICP - SW6010B					Analyst; QS	
Barium	ND	2.00	mg/L	1	5/3/2008	
Cadmium	ND	0.00400	mg/L	1	5/3/2008	
Chromium	ND	0.100	mg/L	1	5/3/2008	
Copper	ND	0.0400	mg/L	1	5/3/2008	
Iron	ND	0.0600	mg/L	1	5/3/2008	

- 3 Analyte detected in the associated Method Blank
- E Value above quantitation range
- J Analyte detected below quantitation limits
- S Spike Recovery outside recovery limits

- BRL Below Reporting Limit
- H Holding times for preparation or analysis exceeded
- ND Not Detected at the Reporting Limit

Reported Date: 15-May-08

CLIENT:

Fay, Spofford & Thorndike

Lab Order:

0805025

00000020

Project: Lab ID: WM-046, 1.4 Exp

0805025-001

Client Sample ID: B17

Collection Date: 4/30/2008 9:10:00 PM

Date Received: 5/2/2008

Matrix: GROUNDWATER

Analyses	Result	Det. Limit	Qual U	nits	DF	Date Analyzed
TOTAL METALS BY ICP - SW6010B						Analyst: QS
Lead	0.0370	0.0100	mg	g/L	1	5/3/2008
Nickel	ND	0.100	mg	g/L	1	5/3/2008
Selenium	ND	0.0500	mg	g/L	1	5/3/2008
TOTAL SILVER - E200.7		•				Апаlyst: QS
Silver	ND	0.00700	mg	g/L	1	5/5/2008
TOTAL MERCURY - E245.1						Analyst: EC
Mercury	ND	0.0005	mg	g/L	1	5/5/2008
SEMIVOLATILE ORGANICS - SW8270C						Analyst: ZYZ
1,2,4-Trichlorobenzene	ND	1.00	μд	/L	1	5/7/2008 2:50:00 PM
1,2-Dichlorobenzene	ND	1.00	µg		1	5/7/2008 2:50:00 PM
1,2-Dinitrobenzene	ND	1.00	μg	/L	1	5/7/2008 2:50:00 PM
1,3-Dichlorobenzene	ND	1.00	μg	ı/L	1	5/7/2008 2:50:00 PM
1,3-Dinitrobenzene	ND	1.00	μ9	ı/L	1	5/7/2008 2:50:00 PM
1,4-Dichlorobenzene	ND	1.00	μд	/L	1	5/7/2008 2:50:00 PM
1,4-Dinitrobenzene	ND	1.00	μg	ı/L	1	5/7/2008 2:50:00 PM
2,3,4,6-Tetrachlorophenol	ND	1.00	μg	/L	1	5/7/2008 2:50:00 PM
2,4,5-Trichlorophenol	ND	1.00	μд	/L	1	5/7/2008 2:50:00 PM
2,4,6-Trichlorophenol	ND	1.00	μд		1	5/7/2008 2:50:00 PM
2,4-Dichlorophenol	ND	1.00	μд	ı/L	· 1	5/7/2008 2:50:00 PM
2,4-Dimethylphenoi	ND	1.00	μд	ı/L	. 1	5/7/2008 2:50:00 PM
2,4-Dinitrophenol	ND	5.00	μg	/L	1	5/7/2008 2:50:00 PM
2,4-Dinitrotoluene	ND	1.00	μд	/L	1	5/7/2008 2:50:00 PM
2,6-Dinitrotoluene	ND	1.00	μд	/L	1	5/7/2008 2:50:00 PM
2-Chloronaphthalene	ND	1.00	μд	ı/L	1	5/7/2008 2:50:00 PM
2-Chlorophenol	ND	1.00	μд	/L .	1	5/7/2008 2:50:00 PM
2-Methylnaphthalene	ND	1.00	µд	/L	1	5/7/2008 2:50:00 PM
2-Methylphenol	ND	1.00	μg	/L	1	5/7/2008 2:50:00 PM
2-Nitroaniline	ND	1.00	μд	/L	1	5/7/2008 2:50:00 PM
2-Nitrophenol	ND	1.00	μg	/L	1	5/7/2008 2:50:00 PM
3,3'-Dichlorobenzidine	ND	1.00	μg		1	5/7/2008 2:50:00 PM
3-Methylphenol/4-Methylphenol	ND	1.00	μд	/L	1	5/7/2008 2:50:00 PM
3-Nitroaniline	ND	1.00	μд	/L	1	5/7/2008 2:50:00 PM
4,6-Dinitro-2-Methylphenol	ND	5.00	рд	/L	1	5/7/2008 2:50:00 PM
4-Bromophenyl Phenyl Ether	ND	1.00	μд	/L	1	5/7/2008 2:50:00 PM
4-Chloro-3-Methylphenol	ND	1.00	hã	/L	1	5/7/2008 2:50:00 PM
4-Chloroaniline	ND	1.00	μβ		1	5/7/2008 2:50:00 PM

B Analyte detected in the associated Method Blank

E Value above quantitation range

J Analyte detected below quantitation limits

S Spike Recovery outside recovery limits

BRL Below Reporting Limit

H Holding times for preparation or analysis exceeded

ND Not Detected at the Reporting Limit

Reported Date: 15-May-08

CLIENT:

Fay, Spofford & Thorndike

Lab Order:

0805025

Project:

WM-046, 1.4 Exp

Lab ID:

0805025-001

Client Sample ID: B17

Collection Date: 4/30/2008 9:10:00 PM

Date Received: 5/2/2008

Matrix: GROUNDWATER

Analyses	Result	Det. Limit	Qual U	nits	DF	Date Analyzed
SEMIVOLATILE ORGANICS - SW8270C						Analyst: ZY
4-Chlorophenyl Phenyl Ether	ND	1.00	μ	g/L	1	5/7/2008 2:50:00 PM
4-Nitroaniline	ND	1.00		g/L	1	5/7/2008 2:50:00 PM
4-Nitrophenol	ND	1.00	μ	g/L	1	5/7/2008 2:50:00 PM
Acenaphthene	ŇD	1.00	μς	g/L	1	5/7/2008 2:50:00 PM
Acenaphthylene	ND	1.00	μί	g/L	1	5/7/2008 2:50:00 PM
Acetophenone	ND	1.00	μς	g/L	1	5/7/2008 2:50:00 PM
Aniline	ND	5.00	μg	g/L	1	5/7/2008 2:50:00 PM
Anthracene	ND	1.00	μς	g/L	1	5/7/2008 2:50:00 PM
Azobenzene	ND	5.00	μς	9/L	1	5/7/2008 2:50:00 PM
Benz(a)Anthracene	ND	0.100	μς	g/L	1	5/7/2008 2:50:00 PM
Benzidine	ND	5.00	μο	g/L .	1	5/7/2008 2:50:00 PM
Benzo(a)Pyrene	ND	0.100		J/L	1	5/7/2008 2:50:00 PM
Benzo(b)Fluoranthene	ND	0.500	μς	_J /L	1	5/7/2008 2:50:00 PM
Benzo(g,h,i)Perylene	ND	1.00	μο	g/L	1	5/7/2008 2:50:00 PM
Benzo(k)Fluoranthene	ND	0.500	μς	g/L	1	5/7/2008 2:50:00 PM
Benzyl Alcohol	ND	1.00	μς	g/L	1	5/7/2008 2:50:00 PM
Bis(2-Chloroethoxy)Methane	ND	1.00	μς	g/L	1	5/7/2008 2:50:00 PM
Bis(2-Chloroethyl)Ether	ND	1.00		3/L	1	5/7/2008 2:50:00 PM
Bis(2-Chloroisopropyl)Ether	ND	1.00	μ	g/L	1	5/7/2008 2:50:00 PM
Bis(2-Ethylhexyl)Phthalate	ND	1.00	μς	3/L	1	5/7/2008 2:50:00 PM
Butyl Benzyl Phthalate	ND	1.00	μο	g/L	1	5/7/2008 2:50:00 PM
Carbazole	ND	1.00	· μο	g/L	1 .	5/7/2008 2:50:00 PM
Chrysene	ND	1.00	μς	ı/L	1	5/7/2008 2:50:00 PM
Dibenz(a,h)Anthracene	ND	0.100	μς		1	5/7/2008 2:50:00 PM
Dibenzofuran	ND	1.00	μg	j/L	1	5/7/2008 2:50:00 PM
Diethyl Phthalate	ND	1.00	HS.	ı/L	1	5/7/2008 2:50:00 PM
Dimethyl Phthalate	ND	1.00	μς	ı/L	1	5/7/2008 2:50:00 PM
Di-n-Butyl Phthalate	ND	1.00	μο	ı/L	1	5/7/2008 2:50:00 PM
Di-n-Octyl Phthalate	ND	1.00	μο	_I /L	1	5/7/2008 2:50:00 PM
Fluoranthene	ND	1.00	μς	ı/L	1	5/7/2008 2:50:00 PM
Fluorene	ND	1.00	μg	ı/L	1	5/7/2008 2:50:00 PM
Hexachlorobenzene	ND	0.100	ħĈ		1	5/7/2008 2:50:00 PM
Hexachlorobutadiene	ND	0.100	μς		1	5/7/2008 2:50:00 PM
Hexachlorocyclopentadiene	· ND	5.00	μg	/L	1	5/7/2008 2:50:00 PM
Hexachloroethane	ND	1.00	μς		. 1	5/7/2008 2:50:00 PM
Indeno(1,2,3-cd)Pyrene	ND	0.100	μg		1	5/7/2008 2:50:00 PM
sophorone	ND	1.00	μ9		1	5/7/2008 2:50:00 PM
Naphthalene	ND	1.00	μд		1	5/ 7 /2008 2:50:00 PM
Nitrobenzene	ND	1.00	μд		1	5/7/2008 2:50:00 PM
N-Nitrosodimethylamine	ND	5.00	μg		1	5/7/2008 2:50:00 PM

B Analyte detected in the associated Method Blank

E Value above quantitation range

J Analyte detected below quantitation limits

S Spike Recovery outside recovery limits

BRL Below Reporting Limit

H Holding times for preparation or analysis exceeded

ND Not Detected at the Reporting Limit

Reported Date: 15-May-08

CLIENT:

Fay, Spofford & Thorndike

0805025

Client Sample ID: B17

Lab Order:

Collection Date: 4/30/2008 9:10:00 PM

Project:

WM-046, 1.4 Exp

Date Received: 5/2/2008

Lab ID:

0805025-001

Matrix: GROUNDWATER

<u> </u>	Result	Det. Limit	Qual	Units	DF	Date Analyzed
ATILE ORGANICS - SW8270C						Analyst: ZYZ
odi-n-Propylamine	NĎ	1.00		μg/L	1	5/7/2008 2:50:00 PM
odiphenylamine	NĎ	5.00		μg/L	1	5/7/2008 2:50:00 PM
orophenol	ND	1.00		μg/L	1	5/7/2008 2:50:00 PM
hrene	ИD	1.00		μg/L	1	5/7/2008 2:50:00 PM
	ND	1.00		μg/L	1	5/7/2008 2:50:00 PM
	ND	1.00		μg/L	1	5/7/2008 2:50:00 PM
	ND	5.00		μg/L	1	5/7/2008 2:50:00 PM
2,4,6-Tribromophenol	52.8	15-110		%REC	1	5/7/2008 2:50:00 PM
2-Fluorobiphenyl	75.4	30-130		%REC	1	5/7/2008 2:50:00 PM
2-Fluorophenol	40.2	15-110		%REC	1	5/7/2008 2:50:00 PM
Nitrobenzene-d5	62.8	30-130		%REC	1	5/7/2008 2:50:00 PM
Phenol-d6	28.5	15-110		%REC	1	5/7/2008 2:50:00 PM
Ferphenyl-d14	92.2	30-130		%REC	1	5/7/2008 2:50:00 PM
GET ANALYTES - MADEP EPH				•		Analyst: ZY Z
iene	ND	1.03		µg/L	1	5/6/2008 2:25:00 PM
naphthalene	ND	1.03		μg/L	1	5/6/2008 2:25:00 PM
thene	NĎ	1.03		μg/L	1	5/6/2008 2:25:00 PM
hrene	ND	1.03		μg/L	1	5/6/2008 2:25:00 PM
thylene	ND	1.03		μg/L	1	5/6/2008 2:25:00 PM
	ND	1.03		μg/L	1	5/6/2008 2:25:00 PM
ene	ND	1.03		μg/L	1	5/6/2008 2:25:00 PM
nene	ND	1.03		μg/L	1	5/6/2008 2:25:00 PM
:	NĎ	1.03		μg/L	1	5/6/2008 2:25:00 PM
Anthracene	ND	0,412		μg/L	1	5/6/2008 2:25:00 PM
B	ND	1.03		μg/L	1	5/6/2008 2:25:00 PM
Fluoranthene	ND	1.03		μg/L	1	5/6/2008 2:25:00 PM
Fluoranthene	ND	1.03		μg/L	1.	5/6/2008 2:25:00 PM
Pyrene	ND	0,206	•	μg/L	1	5/6/2008 2:25:00 PM
,2,3-cd)Pyrene	ND	0.412		μg/L	1	5/6/2008 2:25:00 PM
,h)Anthracene	ND	0.412		μg/L	1	5/6/2008 2:25:00 PM
h,i)Perylene	ND	1.03		μg/L	1	5/6/2008 2:25:00 PM
H Target Concentration	ND	0		μg/L	1	5/6/2008 2:25:00 PM
2,2'-Difluorobiphenyl	83.7	40-140		%REC	1	5/6/2008 2:25:00 PM
2-Fluorobíphenyl	69.6	40~140		%REC	1	5/6/2008 2:25:00 PM
E ORGANIC COMPOUNDS - SW82	สกล	-				Analyst: MR
e Organic Compodinds - 34462 chloroethane	ND.	5.00		μg/L	1	Analyst, MR 5/14/2008 8;47:00 PM
						5/14/2008 8:47:00 PM
etrachloroethane	ND	2.00		μ g /L	1	5/14/2008 8:4

Analyte detected in the associated Method Blank

Ε Value above quantitation range

J Analyte detected below quantitation limits

Spike Recovery outside recovery limits

BRL Below Reporting Limit

H Holding times for preparation or analysis exceeded

ND Not Detected at the Reporting Limit

Reported Date: 15-May-08

CLIENT:

Fay, Spofford & Thorndike

Lab Order:

0805025

Project:

WM-046, 1.4 Exp

Lab ID:

0805025-001

Client Sample ID: B17

Collection Date: 4/30/2008 9:10:00 PM

Date Received: 5/2/2008

Matrix: GROUNDWATER

Analyses	Result	Det. Limit	Qual Units	DF	Date Analyzed
VOLATILE ORGANIC COMPOUNDS	6 - SW8260B		***************************************		Analyst: MR
1,1,2-Trichloroethane	ND	5.00	µg/L	1	5/14/2008 8:47:00 PM
1,1-Dichloroethane	ND	5.00	μg/L	1	5/14/2008 8:47:00 PM
1,1-Dichloroethene	ND	5.00	μg/L	1	5/14/2008 8:47:00 PM
1,1-Dichloropropene	ND	5.00	μg/L	1	5/14/2008 8:47:00 PM
1,2,3-Trichlorobenzene	ND	5.00	μg/L	1	5/14/2008 8:47:00 PM
1,2,3-Trichloropropane	ND	5.00	μg/L	1	5/14/2008 8:47:00 PM
1,2,4-Trichlorobenzene	ND	5.00	μg/L	1	5/14/2008 8:47:00 PM
1.2,4-Trimethylbenzene	ND	5.00	μg/L	1	5/14/2008 8:47:00 PM
1,2-Dibromo-3-Chloropropane	ND	5.00	μg/L	1	5/14/2008 8:47:00 PM
1,2-Dibromoethane	ND	2.00	μg/L	1	5/14/2008 8:47:00 PM
1,2-Dichlorobenzene	ND	5.00	μg/L	1	5/14/2008 8:47:00 PM
1,2-Dichloroethane	ND	2.00	μg/L	1	5/14/2008 8:47:00 PM
1,2-Dichloropropane	ND	2.00	μg/L	1	5/14/2008 8:47:00 PM
1,3,5-Trimethylbenzene	ND	5.00	μg/L	1	5/14/2008 8:47:00 PM
1,3-Dichlorobenzene	ND	5.00	μg/ L	1	5/14/2008 8:47:00 PM
1,3-Dichloropropane	ND	5.00	μg/L	- 1	5/14/2008 8:47:00 PM
1,4-Dichlorobenzene	ND	5.00	μg/L	1	5/14/2008 8:47:00 PM
2,2-Dichloropropane	ND	5.00	μg/L	1	5/14/2008 8:47:00 PM
2-Butanone	ND	10.0	μg/L	1	5/14/2008 8:47:00 PM
2-Chloroethyl Vinyl Ether	ND	5.00	µg/L	1	5/14/2008 8:47:00 PM
2-Chiorotoluene	ND	5.00	μg/L	1	5/14/2008 8:47:00 PM
2-Hexanone	ND	10.0	μg/L	1	5/14/2008 8:47:00 PM
4-Chlorotoluene	ND	5.00	µg/L	1	5/14/2008 8:47:00 PM
4-isopropyltaluene	ND	5.00	μg/L	1	5/14/2008 8:47:00 PM
4-Methyl-2-Pentanone	ND	5.00	μg/L	1	5/14/2008 8:47:00 PM
Acetone	ИD	50.0	μg/L	1	5/14/2008 8:47:00 PM
Acrolein	ИD	50.0	μg/L	1	5/14/2008 8:47:00 PM
Acrylonitrile	ND	50.0	μg/L	1	5/14/2008 8:47:00 PM
Benzene	ND	5,00	µg/L	1	5/14/2008 8:47:00 PM
Bromobenzene	ND	5.00	µg/L	1	5/14/2008 8:47:00 PM
Bromochloromethane	ND	2.00	μg/L	1	5/14/2008 8:47:00 PM
Bromodichloromethane	ND	2.00	μg/L	1	5/14/2008 8:47:00 PM
Bromoform	ND	2.00	µg/L	1	5/14/2008 8:47:00 PM
Bromomethane	ИD	2.00	⊬g/L	1	5/14/2008 8:47:00 PM
Carbon Disulfide	ND	5.00	μg/L	1	5/14/2008 8:47:00 PM
Carbon Tetrachloride	ND	2.00	րց/L	1	5/14/2008 8:47:00 PM
Chlorobenzene	ND	5.00	μg/L	1	5/14/2008 8:47:00 PM
Chloroethane	ND	5.00	μg/L	1	5/14/2008 8:47:00 PM
Chloroform	ND	5.00	рg/L	1	5/14/2008 8:47:00 PM
Chłoromethane	ND	5.00	нд/L	1	5/14/2008 8:47:00 PM

- B Analyte detected in the associated Method Blank
- E Value above quantitation range
- J Analyte detected below quantitation limits
- S Spike Recovery outside recovery limits

- BRL Below Reporting Limit
- H Holding times for preparation or analysis exceeded
- ND Not Detected at the Reporting Limit

Reported Date: 15-May-08

CLIENT:

Fay, Spofford & Thorndike

Lab Order:

0805025

Project:

WM-046, 1.4 Exp

Lab ID:

0805025-001

Client Sample ID: B17

Collection Date: 4/30/2008 9:10:00 PM

Date Received: 5/2/2008

Matrix: GROUNDWATER

Analyses	Result	Det. Limit	Qual Units	DF	Date Analyzed
VOLATILE ORGANIC COMPOUNDS	5 - SW8260B				Analyst: MR
cis-1,2-Dichloroethene	ND	5.00	μg/L	1	5/14/2008 8:47:00 PM
cis-1,3-Dichloropropene	ND	0.500	μg/L	1	5/14/2008 8:47:00 PM
Dibromochloromethane	ND	2.00	μg/L	1	5/14/2008 8:47:00 PM
Dibromomethane	ND	5.00	μg/L	1	5/14/2008 8:47:00 PM
Dichlorodifluoromethane	ND	5.00	μg/L	1	5/14/2008 8:47:00 PM
Ethylbenzene	ND	5.00	μg/L	1	5/14/2008 8:47:00 PM
Hexachlorobutadiene	ND	0.500	μg/L	1	5/14/2008 8:47:00 PM
Isopropylbenzene	ND	5.00	μg/L	1	5/14/2008 8:47:00 PM
Methyl Tert-Butyl Ether	ND	5.00	μg/L	1.	5/14/2008 8:47:00 PM
Methylene Chloride	ND	5.00	μg/L	1	5/14/2008 8:47:00 PM
Naphthalene	ND	20.0	μg/L	1	5/14/2008 8:47:00 PM
n-Butylbenzene	ND	5.00	μg/L	1	5/14/2008 8:47:00 PM
n-Propylbenzene	ND	5.00	μg/L	1	5/14/2008 8:47:00 PM
sec-Butylbenzene	ND	5.00	μg/L	1	5/14/2008 8:47:00 PM
Styrene	ND	5.00	μg/L	1	5/14/2008 8:47:00 PM
tert-Butylbenzene	ND	5.00	μg/L	1	5/14/2008 8:47:00 PM
Tetrachloroethene	ND	5.00	μg/L	1	5/14/2008 8:47:00 PM
Toluene	ND	5.00	μg/L	1	5/14/2008 8:47:00 PM
trans-1,2-Dichloroethene	ND	5.00	μg/L	1	5/14/2008 8:47:00 PM
trans-1,3-Dichloropropene	ND	0.500	μg/L	1	5/14/2008 8:47:00 PM
Trichloroethene	ND	5.00	μg/L	1	5/14/2008 8:47:00 PM
Trichlorofluoromethane	ND	5.00	μg/ L	1	5/14/2008 8:47:00 PM
Vinyl Chloride	ND	2.00	μg/L	1	5/14/2008 8:47:00 PM
Xylenes, Total	ND	5.00	μg/L	1	5/14/2008 8:47:00 PM
Surr: 1,2-Dichloroethane-d4	95.0	70-130	%REC	1	5/14/2008 8:47:00 PM
Surr: 4-Bromofluorobenzene	81.4	70-130	%REC	1	5/14/2008 8:47:00 PM
Surr: Dibromofluorometnane	113	70-130	%REC	1	5/14/2008 8:47:00 PM
Surr: Toluene-d8	102	70-130	%REC	1	5/14/2008 8:47:00 PM
			•		
PH - MADEP VPH					Analyst: kd
C9-C10 Aromatic Hydrocarbons	ND	75.0	μg/L	1	5/9/2008
Unadjusted C5-C8 Aliphatic Hydrocarbons	ND	75.0	μġ/L	1	5/9/2008
Unadjusted C9-C12 Aliphatic Hydrocarbons	ND	75.0	μg/L	1	5/9/2008
Methyl Tert-Butyl Ether	7,99	5.00	μg/L	1	5/9/2008
Benzene	ND	5.00	μg/L	1	5/9/2008
Toluene	ND	5.00	μg/L	1	5/9/2008
Ethylbenzene	ND	5.00	μg/L	1	5/9/2008
m,p-Xylene	10.7	5.00	μg/L	1	5/9/2008

- B Analyte detected in the associated Method Blank
- 8 Value above quantitation range
- J Analyte detected below quantitation limits
- S Spike Recovery outside recovery limits

- BRL Below Reporting Limit
- H Holding times for preparation or analysis exceeded
- ND Not Detected at the Reporting Limit

Reported Date: 15-May-08

CLIENT:

Fay, Spofford & Thorndike

Lab Order:

0805025

Project:

WM-046, 1.4 Exp

Lab ID:

0805025-001

Client Sample ID: B17

Collection Date: 4/30/2008 9:10:00 PM

Date Received: 5/2/2008

Matrix: GROUNDWATER

Analyses	Result	Det. Limit	Qual	Units	DF	Date Analyzed
VPH - MADEP VPH						Analyst: kd
o-Xylene	ND	5.00		μg/L	1	5/9/2008
Naphthalene	ND	20.0		μg/L	1	5/9/2008
Adjusted C5-C8 Aliphatic Hydrocarbons	ND	75.0		μg/L	1	5/9/2008
Adjusted C9-C12 Aliphatic Hydrocarbons	ND	75.0		μg/L	1	5/9/2008
Surr: 2,5-Dibromotoluene FID	102	70-130		%REC	1	5/9/2008
Surr: 2,5-Dibromotoluene PID	75.8	70-130		%REC	1	5/9/2008
CYANIDE, TOTAL - SM4500-CN-C,E						Analyst: WFR
Cyanide, Total	ND	0.0197		mg/L	1	5/12/2008
· HEXAVALENT CHROMIUM - SM3500-CR-I	`					Analyst: WFR
Chromium, Hexavalent	ИD	0.0500	Н	mg/L	1	5/6/2008
TOTAL RESIDUAL CHLORINE - HACH 816	i7					Analyst: RP
Total Residual Chlorine	ND	0.162	Н	mg/L	1	5/5/2008

В Analyte detected in the associated Method Blank

Έ Value above quantitation range

J Analyte detected below quantitation limits

Spike Recovery outside recovery limits

H Holding times for preparation or analysis exceeded

ND Not Detected at the Reporting Limit

Reported Date: 15-May-08

CLIENT:

Fay, Spofford & Thorndike

Lab Order:

0805025

WM-046, 1.4 Exp

Project: Lab ID:

0805025-002

Client Sample ID: B13

Collection Date: 4/30/2008 10:05:00 PM

Date Received: 5/2/2008

Matrix: GROUNDWATER

Analyses	Result	Det. Limit	Qual Units	DF	Date Analyzed
TOTAL SUSPENDED SOLIDS - SM25	40-D				Analyst: AM !
Total Suspended Solids	12.0	4,00	mg/L	1	5/5/2008
			Ū		
EPH RANGES - MADEP EPH					Analyst: RJ
Adjusted C11-C22 Aromatics	ND	102	μg/L	1	5/9/2008
C09-C18 Aliphatics	ND	102	μg/L	1	5/9/2008
C19-C36 Aliphatics	ND	102	μg/L	1	5/9/2008
Unadjusted C11-C22 Aromatics	ND	102	μg/L	1	5/9/2008
Surr: 1-Chlorooctadecane	72.0	40-140	%REC	1	5/9/2008
Surr: o-Terphenyl	76.0	40-140	%REC	1	5/9/2008
TOTAL PETROLEUM HYDROCARBO	NC . 0400B				Analysis Dur
Total Petroleum Hydrocarbons	ND ND	0.205	mg/L	1	Analyst: Ru F 5/5/2008
Surr: o-Terphenyl	70.0	40-140	%REC	1	5/5/2008
22 3 Torphony		75-140	MICO	'	0/0/2000
POLYCHLORINATED BIPHENYLS - S	W8082				Analyst: GP
Arocior 1016/1242	ND	0.309	μ 9/ L	1	5/6/2008
Aroclor 1221	ND	0.309	μg/L	1	5/6/2008
Aroclor 1232	ND	0.309	μg/L	1	5/6/2008
Arodor 1248	ND	0.309	μg/L	1	5/6/2008
Aroclor 1254	ND	0.309	μg/L	1	5/6/2008
Arocior 1260	ND	0.309	μg/L	1	5/6/2008
Aroclor 1262	ND	0.309	μg/L	1	5/6/2008
Aroclor 1268	ND	0.309	μg/L	1	5/6/2008
Surr: Decachlorobiphenyl Sig 1	94.0	30-150	%REC	1	5/6/2008
Surr: Decachlorobiphenyl Sig 2	90.0	30-150	%REC	1	5/6/2008
Surr: Tetrachloro-m-Xylene Sig 1	79.0	30-150	%REC	1	5/6/2008
Surr: Tetrachloro-m-Xylene Sig 2	83.0	30-150	%REC	1	5/6/2008
FOTAL METALS BY GFAA - E200.9					Analyst: QS
Antimony	ND	0,00100	mg/L	1	5/6/2008
Arsenic	ND	0.00100	mg/L	1	5/6/2008
TOTAL METALS BY ICP - SW6010B					Analyst SS
Barium	ND	2.00	mg/L	1	Analyst: QS 5/3/2008
Cadmium	ND	0.00400	mg/L	1	5/3/2008
Chromium	ND	0.100	mg/L	1	5/3/2008
Copper	ND	0.0400	mg/L	1	5/3/2008
Iron	ND	0.0600	mg/L	1	5/3/2008

- B Analyte detected in the associated Method Blank
- E Value above quantitation range
- J Analyte detected below quantitation limits
- S Spike Recovery outside recovery limits

- BRL Below Reporting Limit
- H Holding times for preparation or analysis exceeded
- ND Not Detected at the Reporting Limit

Reported Date: 15-May-08

CLIENT:

Fay, Spofford & Thorndike

Lab Order:

0805025

Project:

WM-046, 1.4 Exp

Lab ID:

0805025-002

Client Sample ID: B13

Collection Date: 4/30/2008 10:05:00 PM

Date Received: 5/2/2008

Matrix: GROUNDWATER

Analyses	Result	Det. Limit	Qual U	nits	DF	Date Analyzed
TOTAL METALS BY ICP - SW6010B		***************************************				Analyst: QS
Lead	0.0330	0.0100	mg	g/L	1	5/3/2008
Nickel	ND	0.100	m	g/L	. 1	5/3/2008
Selenium	ND	0.0500	វាថ្ង	g/L	· 1	5/3/2008
TOTAL SILVER - E200.7						Analyst: QS
Silver	ND	0.00700	m	g/L	1	5/5/2008
TOTAL MERCURY - E245.1						Analyst: EC
Mercury	ND	0.0005	mç	g/L	1	5/5/2008
SEMIVOLATILE ORGANICS - SW8270C						Analyst: ZYZ
1,2,4-Trichiorobenzene	ND	1.02	рд	/L	1	5/7/2008 3:27:00 PM
1,2-Dichlorobenzene	ND	1.02	μд	/L	1	5/7/2008 3:27:00 PM
1,2-Dinitrobenzene	ND	1.02	μg	/L	1	5/7/2008 3:27:00 PM
1,3-Dichlorobenzene	ND	1.02	μg	/L	1	5/7/2008 3:27:00 PM
1,3-Dinitrobenzene	ND	1.02	μд	/L	1	5/7/2008 3:27:00 PM
1,4-Dichlorobenzene	ND	1.02	μд	/L	1	5/7/2008 3:27:00 PM
1,4-Dinitrobenzene	ND	1.02	μg	/L	*1	5/7/2008 3:27:00 PM
2,3,4,6-Tetrachlorophenol	ND	1.02	þд	/L	1	5/7/2008 3:27:00 PM
2,4,5-Trichlorophenol	ND	1.02	μg	/L	1	5/7/2008 3:27:00 PM
2,4,6-Trichlorophenol	ND	1.02	μд	/L	1	5/7/2008 3:27:00 PM
2,4-Dichlorophenol	ИD	1.02	μg	/L	1	5/7/2008 3:27:00 PM
2,4-Dimethylphenol	ND	1.02	μд	/L	. 1	5/7/2008 3:27:00 PM
2,4-Dinitrophenol	ND	5.10	μg	/L	1	5/7/2008 3:27:00 PM
2,4-Dinitrotoluene	ND	1.02	μg	/L	1	5/7/2008 3:27:00 PM
2,6-Dinitrotoluene	ND	1.02	µg	/L	1	5/7/2008 3:27:00 PM
2-Chioronaphthalene	ND	1.02	рд	/L	1	5/7/2008 3:27:00 PM
2-Chlorophenol	ND	1.02	μg	/L	1	5/7/2008 3:27:00 PM
2-Methylnaphthalene	ND	1.02	þд	/L	1	5/7/2008 3:27:00 PM
2-Methylphenol	ND	1.02	μд	/L	∴ 1	5/7/2008 3:27:00 PM
2-Nitroaniline	ND	1.02	μg	/L	1	5/7/2008 3:27:00 PM
2-Nitrophenol	ND	1.02	μд	/L	1	5/7/2008 3:27:00 PM
3,3'-Dichlorobenzidine	ND	1.02	μg	/L	1	5/7/2008 3:27:00 PM
3-Methylphenol/4-Methylphenol	ND	1.02	μд	/L	1	5/7/2008 3:27:00 PM
3-Nitroaniline	ND	1.02	μд	/L	1	5/7/2008 3:27:00 PM
4,6-Dirittro-2-Methylphenol	ND	5.10	μд	/L	1	5/7/2008 3:27:00 PM
4-Bromophenyl Phenyl Ether	ND	1.02	μд	/L	1	5/7/2008 3:27:00 PM
4-Chloro-3-Methylphenol	ND	1.02	μд		1	5/7/2008 3:27:00 PM
4-Chloroaniline	ND	1.02	μg	/L	1	5/7/2008 3:27:00 PM

- B Analyte detected in the associated Method Blank
- E Value above quantitation range
- J Analyte detected below quantitation limits
- S Spike Recovery outside recovery limits

- BRL Below Reporting Limit
- H Holding times for preparation or analysis exceeded
- ND Not Detected at the Reporting Limit

Reported Date: 15-May-08

CLIENT:

Fay, Spofford & Thorndike

Lab Order:

0805025

WM-046, 1.4 Exp

Project: Lab ID:

0805025-002

Client Sample ID: B13

Collection Date: 4/30/2008 10:05:00 PM

Date Received: 5/2/2008

Matrix: GROUNDWATER

Analyses	Result	Det. Limit	Qual	Units	DF	Date Analyzed
SEMIVOLATILE ORGANICS - SW8270C						Analyst: ZY
4-Chlorophenyl Phenyl Ether	ND	1.02		μg/L	1	5/7/2008 3:27:00 PM
4-Nitroaniline	ND	1.02		μg/L	1	5/7/2008 3:27:00 PM
4-Nitrophenol	ND	1.02		μg/L	1	5/7/2008 3:27:00 PM
Acenaphthene	ND	1.02		μg/L	1	5/7/2008 3:27:00 PM
Acenaphthylene	ND	1.02		μg/L	1	5/7/2008 3:27:00 PM
Acetophenone	ND	1.02		µg/L	1	5/7/2008 3:27:00 PM
Aniline	DM	5.10		µg/L	1	5/7/2008 3:27:00 PM
Anthracene	ND	1.02		μg/L	1	5/7/2008 3:27:00 PM
Azobenzene	ND	5.10		µg/L	1	5/7/2008 3:27:00 PM
Benz(a)Anthracene	ND	0.102		μg/L	1	5/7/2008 3:27:00 PM
Benzidine	ND	5.10		µg/∟	1	5/7/2008 3;27:00 PM
Benzo(a)Pyrene	ND	0.102		µg/L	1	5/7/2008 3:27:00 PM
Benzo(b)Fluoranthene	ND	0.510		μg/L	1	5/7/2008 3:27:00 PM
Benzo(g,h,i)Perylene	ND	1.02		µg/L	1 .	5/7/2008 3:27:00 PM
Benzo(k)Fluoranthene	ND	0.510		μg/L	1	5/7/2008 3:27:00 PM
Benzyl Alcohol	ND	. 1.02		µg/L	1	5/7/2008 3:27:00 PM
Bis(2-Chloroethoxy)Methane	ND	1.02		μg/L	1	5/7/2008 3:27:00 PM
Bis(2-Chloroethyl)Ether	ND	1.02		µg/L	1	5/7/2008 3:27:00 PM
Bis(2-Chloroisopropyl)Ether	ND	1.02		µg/L	1	5/7/2008 3:27:00 PM
Bis(2-Ethylhexyl)Phthalate	ND	1.02		μg/L	1	5/7/2008 3:27:00 PM
Butyl Benzyl Phthalate	ND	1.02		μg/L	1	5/7/2008 3:27:00 PM
Carbazole	ND	1.02		μg/L	1	5/7/2008 3:27:00 PM
Chrysene	ND	1.02		μg/Ļ	1	5/7/2008 3:27:00 PM
Dibenz(a,h)Anthracene	ND	0.102		μg/L	1	5/7/2008 3;2 7 :00 PM
Dibenzofuran	ND	1.02		μg/L	1	5/7/2008 3:27:00 PM
Diethyl Phthalate	ND	1.02		μg/L	1	5/7/2008 3:27:00 PM
Dimethyl Phthaiate	ND	1.02		μg/L	1	5/7/2008 3:27:00 PM
Di-n-Butyl Phthalate	ND	1.02		μg/L	1	5/7/2008 3:27:00 PM
Di-n-Octyl Phthalate	ND	1.02		µg/ L	1	5/7/2008 3:27:00 PM
Fluoranthene	ND	1.02		μg/L	1	5/7/2008 3:27:00 PM
Fluorene	ND	1.02		µg/L	1	5/7/2008 3:27:00 PM
Hexachlorobenzene	ND	0.102		μg/L	1	5/7/2008 3:27:00 PM
-lexachlorobutadiene	ND	0,102		μg/L	1	5/7/2008 3:27:00 PM
Hexachlorocyclopentadiene	ND	5.10		μg/L	1	5/7/2008 3:27:00 PM
-lexachloroethane	ND	1.02		μg/L	1	5/7/2008 3:27:00 PM
ndeno(1,2,3-cd)Pyrene	ND	0.102		μg/L	1 .	5/7/2008 3:27:00 PM
Isophorone	ND	1.02		μg/L	1	5/7/2008 3:27:00 PM
Naphthalene	ND	1.02		μg/L	1	5/7/2008 3:27:00 PM
Nitrobenzene	ND	1.02		μg/L	1	5/7/2008 3:2 7 :00 PM
N-Nitrosodimethylamine	ND	5.10		μg/L	1	5/7/2008 3:27:00 PM

Qualifiers:

- B Analyte detected in the associated Method Blank
- E Value above quantitation range
- J Analyte detected below quantitation limits
- S Spike Recovery outside recovery limits

BRL Below Reporting Limit

- H Holding times for preparation or analysis exceeded
- ND Not Detected at the Reporting Limit

Reported Date: 15-May-08

CLIENT:

Fay, Spofford & Thorndike

Lab Order:

0805025

WM-046, 1.4 Exp

Project: Lab ID:

0805025-002

Client Sample ID: B13

Collection Date: 4/30/2008 10:05:00 PM

Date Received: 5/2/2008

Matrix: GROUNDWATER

Analyses	Result	Det. Limit	Qual Units	DF	Date Analyzed
SEMIVOLATILE ORGANICS - SW8270C					Analyst: ZY Z
N-Nitrosodi-n-Propytamine	ND	1.02	μg/L	1	5/7/2008 3:27:00 PM
N-Nitrosodiphenylamine	ND	5.10	µg/L	1	5/7/2008 3:27:00 PM
Pentachlorophenol	ND	1.02	μg/L	1	5/7/2008 3:27:00 PM
Phenanthrene	ND	1.02	μg/L	1	5/7/2008 3:27:00 PM
Phenol	ND	1.02	µg/L	1	5/7/2008 3:27:00 PM
Pyrene	ND	1.02	µg/∟	1	5/7/2008 3:27:00 PM
Pyridine	ND	5.10	μg/L	1	5/7/2008 3:27:00 PM
Surr: 2,4,6-Tribromophenol	45.6	15-110	%REC	1	5/7/2008 3:27:00 PM
Surr: 2-Fluorobiphenyl	83.1	30-130	%REC	1	5/7/2008 3:27:00 PM
Surr: 2-Fluorophenol	45.8	15-110	%REC	া	5/7/2008 3:27:00 PM
Surr: Nitrobenzene-d5	66,5	30-130	%REC	1	5/7/2008 3:27:00 PM
Surr: Phenol-d6	31.5	15-110	%REC	1	5/7/2008 3:27:00 PM
Surr: Terphenyl-d14	113	30-130	%REC	1	5/7/2008 3:27:00 PM
EPH TARGET ANALYTES - MADEP EPH					Analyst: ZY Z
Naphthalene	ND	1.02	μg/L	1	5/6/2008 2:59:00 PM
2-Methylnaphthalene	ND	1.02	μg/L	1	5/6/2008 2:59:00 PM
Acenaphthene	ND	1.02	μ g/L	1	5/6/2008 2:59:00 PM
Phenanthrene	ND	1.02	μg/L	1	5/6/2008 2:59:00 PM
Acenaphthylene	ND	1.02	μg/L	1	5/6/2008 2:59:00 PM
Fluorene	ND	1.02	μg/L	1	5/6/2008 2:59:00 PM
Anthracene	ND	1.02	μg/L	1	5/6/2008 2:59:00 PM
Fluoranthene	ND	1.02	μg/L	1	5/6/2008 2:59:00 PM
Pyrene	ND	1.02	μg/L	1	5/6/2008 2:59:00 PM
Benzo(a)Anthracene	ИD	0.408	µg/L	1	5/6/2008 2:59:00 PM
Chrysene	ND	1.02	μg/L	1	5/6/2008 2:59:00 PM
Benzo(b)Fluoranthene	ND	1.02	μg/L	1	5/6/2008 2:59:00 PM
Benzo(k)Fluoranthene	ND	1.02	μg/ L	1	5/6/2008 2:59:00 PM
Benzo(a)Pyrene	ND	0.204	μg/L	1	5/6/2008 2:59:00 PM
Indeno(1,2,3-cd)Pyrene	ND	0.408	μg/L	1	5/6/2008 2:59:00 PM
Dibenz(a,h)Anthracene	ND	0.408	μg/L	1	5/6/2008 2:59:00 PM
Benzo(g,h,i)Perylene	ND	1.02	μg/Ĺ	1	5/6/2008 2:59:00 PM
Total PAH Target Concentration	ND	0	μg/L	1	5/6/2008 2:59:00 PM
Surr: 2,2'-Difluorobiphenyl	89.6	40-140	%REC	1	5/6/2008 2:59:00 PM
Surr: 2-Fluorobiphenyl	99.4	40-140	%REC	1	5/6/2008 2:59:00 PM
VOLATILE ORGANIC COMPOUNDS - SW	/8260B				Analyst: MR
1,1,1,2-Tetrachloroethane	ND	5.00	μg/L	1	5/8/2008 5:26:00 PM
1,1,1-Trichloroethane	ND	5.00	μg/L	1	5/8/2008 5:26:00 PM

- В Analyte detected in the associated Method Blank
- Ε
- J Analyte detected below quantitation limits
- Value above quantitation range
- Spike Recovery outside recovery limits

- BRL Below Reporting Limit
- H Holding times for preparation or analysis exceeded
- ND Not Detected at the Reporting Limit

Reported Date: 15-May-08

CLIENT:

Fay, Spofford & Thorndike

Client Sample ID: B13

Lab Order:

0805025

Collection Date: 4/30/2008 10:05:00 PM

Project:

WM-046, 1.4 Exp

Date Received: 5/2/2008

Lab ID:

0805025-002

Matrix: GROUNDWATER

Analyses	Result	Det. Limit	Qual Units	DF	Date Analyzed
OLATILE ORGANIC COMPOUND	S - SW8260B				Analyst: MF
1,1,2,2-Tetrachloroethane	ND	2.00	μg/L	1	5/8/2008 5:26:00 PM
1,1,2-Trichloroethane	DN	5.00	μg/L	1	5/8/2008 5:26:00 PM
1,1-Dichloroethane	ND	5.00	µg/L	1	5/8/2008 5:26:00 PM
1,1-Dichloroethene	ND	5.00	μg/L	1	5/8/2008 5:26:00 PM
1,1-Dichloropropene	ND	5.00	μg/L	1	5/8/2008 5:26:00 PM
1,2,3-Trichlorobenzene	ND	5.00	րց/Լ	1	5/8/2008 5:26:00 PM
1,2,3-Trichloropropane	ND	5.00	μg/L	1	5/8/2008 5:26:00 PM
1,2,4-Trichlorobenzene	ND	5.00	μg/L	1	5/8/2008 5:26:00 PM
1,2,4-Trimethylbenzene	128	5.00	μg/L	1	5/8/2008 5:26:00 PM
1,2-Dibromo-3-Chloropropane	ND	5.00	μg/L	1	5/8/2008 5:26:00 PM
1.2-Dibromoethane	ND	2.00	μg/L	1	5/8/2008 5:26:00 PM
1,2-Dichlorobenzene	ND	5.00	μg/L	1	5/8/2008 5:26:00 PM
1,2-Dichloroethane	ND	2.00	μg/L	1	5/8/2008 5:26:00 PM
1,2-Dichloropropane	ND	2.00	μg/L	1	5/8/2008 5:26:00 PM
1,3,5-Trimethylbenzene	28.4	5.00	μg/L	1	5/8/2008 5:26:00 PM
1,3-Dichlorobenzene	ND	5.00	μg/L	1	5/8/2008 5:26:00 PM
1,3-Dichloropropane	ND	5.00	μg/L	1	5/8/2008 5:26:00 PM
1,4-Dichlorobenzene	ND	5.00	μg/L	1	5/8/2008 5:26:00 PM
2,2-Dichloropropane	ND	5.00	μg/L	1	5/8/2008 5:26:00 PM
2-Butanone	ND	10.0	μg/L	1	5/8/2008 5:26:00 PM
2-Chloroethyl Vinyl Ether	ND	5.00	μg/L	1	5/8/2008 5:26:00 PM
2-Chlorotoluene	ND	5.00	μg/L	1	5/8/2008 5:26:00 PM
2-Hexanone	ND	10.0	μg/L	1	5/8/2008 5:26:00 PM
4-Chlorotoluene	ND	5.00	μg/L	1	5/8/2008 5:26:00 PM
4-isopropyltoluene	ND	. 5.00	μg/L	1	5/8/2008 5:26:00 PM
4-Methyl-2-Pentanone	ND	5.00	μg/L	1	5/8/2008 5:26:00 PM
Acetone	ND	50.0		1	5/8/2008 5:26:00 PM
Acrolein	ND	50.0		1	5/8/2008 5:26:00 PM
Acrylonitrile	ND	50.0	μg/L	1	5/8/2008 5:26:00 PM
Benzene	ND	5.00	· -	1	5/8/2008 5:26:00 PM
Bromobenzene	ND	5.00	μg/L	4	5/8/2008 5:26:00 PM
Bromochloromethane	ND	2.00		1	5/8/2008 5:26:00 PM
Bromodichloromethane	ND	2.00	, •	1	5/8/2008 5:26:00 PM
Bromoform	ND	2.00	, 0	1	5/8/2008 5:26:00 PM
Bromomethane	ND	2.00		1	5/8/2008 5:26:00 PM
Carbon Disulfide	ND	5.00		1	5/8/2008 5:26:00 PN
Carbon Tetrachloride	ND	2.00		1	5/8/2008 5:26:00 PN
Chlorobenzene	ND	5.00	. •	1	5/8/2008 5:26:00 PN
Chloroethane	ND	5.00		1	5/8/2008 5:26:00 PN
Chloroform	ND	5.00		1	5/8/2008 5;26:00 PM

- Analyte detected in the associated Method Blank
- Value above quantitation range Ε
- Analyte detected below quantitation limits
- Spike Recovery outside recovery limits

- BRL Below Reporting Limit
- H Holding times for preparation or analysis exceeded
- ND Not Detected at the Reporting Limit

Reported Date: 15-May-08

CLIENT:

Fay, Spofford & Thorndike

Lab Order:

Project:

Lab ID:

0805025

0805025-002

Client Sample ID: B13

WM-046, 1.4 Exp

Collection Date: 4/30/2008 10:05:00 PM

Date Received: 5/2/2008

Matrix: GROUNDWATER

Analyses	Result	Det. Limit	Qual [Juits	DF	Date Analyzed
OLATILE ORGANIC COMPOUNDS	- SW8260B					Analyst: MF
Chloromethane	ND	5.00	μ	g/L	1	5/8/2008 5:26:00 PM
cis-1,2-Dichloroethene	ND	5.00	р	g/L	1	5/8/2008 5:26:00 PM
cis-1,3-Dichloropropene	ND	0.500		g/L	1	5/8/2008 5:26:00 PM
Dibromochloromethane	ND	2.00	ц	g/L	1	5/8/2008 5:26:00 PM
Dibromomethane	ND	5.00	μ	g/L	1	5/8/2008 5:26:00 PM
Dichlorodifluoromethane	ND	5.00	μ	g/L	1	5/8/2008 5:26:00 PM
Ethylbenzene	40.0	5.00	μ	g/L	1	5/8/2008 5:26:00 PM
Hexachlorobutadiene	ND	0.500	μ	g/L	1	5/8/2008 5:26:00 PM
sopropylbenzene	7.0 9	5.00	μ	g/L	1	5/8/2008 5:26:00 PM
Methyl Tert-Butyl Ether	ND	5.00	μ	g/L	1	5/8/2008 5:26:00 PM
Methylene Chloride	ND	5.00		g/L	1	5/8/2008 5:26:00 PM
Naphthalene	. ND	20.0	P	g/L	1	5/8/2008 5:26:00 PM
n-Butylbenzene	ND	5.00	· P	g/L	1	5/8/2008 5:26:00 PM
n-Propylbenzene	20.5	5.00		g/L	1	5/8/2008 5:26:00 PM
sec-Butylbenzene	70.6	5.00	μ	g/L	1	5/8/2008 5:26:00 PM
Styrene	ND	5.00	μ	g/L	1	5/8/2008 5:26:00 PM
tert-Butylbenzene	ND	5.00	ħ	g/L	1	5/8/2008 5:26:00 PM
Tetrachloroethene	ND	5.00	μ	g/L	1	5/8/2008 5:26:00 PM
Toluene	ND	5.00	μ	g/L	1	5/8/2008 5:26:00 PM
trans-1,2-Dichloroethene	ND	5.00	μ	g/L	1	5/8/2008 5:26:00 PM
trans-1,3-Dichloropropene	ND	0.500	μ	g/L	1	5/8/2008 5:26:00 PM
Trichloroethene	ND	5:00	μ	g/L	1	5/8/2008 5:26:00 PM
Trichiorofluoromethane	ND	5.00	μ	g/L	1	5/8/2008 5:26:00 PM
Vinyl Chloride	ND	2.00	μ	g/L	1	5/8/2008 5:26:00 PM
Xylenes, Total	126	5.00	μ	g/L	1	5/8/2008 5:26:00 PM
Surr: 1,2-Dichloroethane-d4	114	70-130	%	REC	1	5/8/2008 5:26:00 PM
Surr: 4-Bromofluorobenzene	115	70-130	9/	REC	1	5/8/2008 5:26:00 PM
Surr: Dibromofluoromethane	118	70-130	%	REC	1	5/8/2008 5:26:00 PM
Surr: Toluene-d8	105	70-130	%	REC	1	5/8/2008 5:26:00 PM
PH - MADEP VPH						Analyst: kd
C9-C10 Aromatic Hydrocarbons	ND	75.0	Ц	g/L	1	5/9/2008
Unadjusted C5-C8 Aliphatic Hydrocarbons	ND	75.0		g/L	1	5/9/2008
Unadjusted C9-C12 Aliphatic Hydrocarbons	ND	75.0	μ	g/L	1	5/9/2008
Methyl Tert-Butyl Ether	ND	5.00	μ	g/L	1	5/9/2008
Benzene	ND	5.00	μ	g/L	1	5/9/2008
Toluene	ND	5.00	h	g/L	1	5/9/2008
Ethylbenzene	ND	5.00	μ	g/L	1	5/9/2008

- В Analyte detected in the associated Method Blank
- \mathbf{E} Value above quantitation range
- Analyte detected below quantitation limits
- Spike Recovery outside recovery limits

- BRL Below Reporting Limit
- Holding times for preparation or analysis exceeded
- ND Not Detected at the Reporting Limit

Reported Date: 15-May-08

CLIENT: Lab Order:

Fay, Spofford & Thorndike

Project:

0805025

WM-046, 1.4 Exp

Lab ID:

0805025-002

Client Sample ID: B13

Collection Date: 4/30/2008 10:05:00 PM

Date Received: 5/2/2008

Matrix: GROUNDWATER

Analyses	Result	Det. Limit	Qual	Units	DF	Date Analyzed
VPH - MADEP VPH						Analyst: kd
m,p-Xylene	ND	5.00		μg/Ŀ	1	5/9/2008
o-Xylene	ND	5.00		µg/L	1	5/9/2008
Naphthalene	ND:	20.0		μg/L	1	5/9/2008
Adjusted C5-C8 Aliphatic Hydrocarbons	ND	75.0		μg/L	1	5/9/2008
Adjusted C9-C12 Aliphatic Hydrocarbons	ND	75.0		µg/L	1	5/9/2008
Surr: 2,5-Dibromotoluene FID	83.6	70-130		%REC	1	5/9/2008
Surr: 2,5-Dibromotoluene PID	72.1	70-130		%REC	1	5/9/2008
CYANIDE, TOTAL - SM4500-CN-C.E						Analyst: WFR
Cyanide, Total	ND	0.0197		mg/L	1	5/12/2008
HEXAVALENT CHROMIUM - SM3500-CR-I	1					Analyst: WFR
Chromium, Hexavalent	ND	0.0500	Н	mg/L	1	5/6/2008
TOTAL RESIDUAL CHLORINE - HACH 816	57					Analyst: RP
Total Residual Chlorine	ND	0.162	Н	mg/L	1	5/5/2008

- В Analyte detected in the associated Method Blank
- E Value above quantitation range
- Analyte detected below quantitation limits
- Spike Recovery outside recovery limits

- BRL Below Reporting Limit
- Holding times for preparation or analysis exceeded Н
- Not Detected at the Reporting Limit

Reported Date: 15-May-08

CLIENT: Lab Order: Fay, Spofford & Thorndike

000000

0805025

WM-046, 1.4 Exp

Project: Lab ID:

0805025-003

Client Sample ID: B11

Collection Date: 4/30/2008 11:40:00 PM

Date Received: 5/2/2008

Matrix: GROUNDWATER

Lab 1b. 0003023-003			.VI	Matrix: GROUNDWATER				
Analyses	Result	Det. Limit	Qual Units	DF	Date Analyzed			
TOTAL SUSPENDED SOLIDS - SM2	540-D				Analyst: AM:			
Total Suspended Solids	424	4.00	mg/L	1	5/5/2008			
EPH RANGES - MADEP EPH					Analyst: RJ			
Adjusted C11-C22 Aromatics	ND	108	μg/L	1	5/9/2008			
C09-C18 Aliphatics	ND	108	μg/L	1	5/9/2008			
C19-C36 Aliphatics	ND	108	μg/L	1	5/9/2008			
Unadjusted C11-C22 Aromatics	ND	108	μg/L	1	5/9/2008			
Surr: 1-Chlorooctadecane	72.0	40-140	%REC	1	5/9/2008			
Surr: o-Terphenyl	76.0	40-140	%REC	1	5/9/2008			
TOTAL PETROLEUM HYDROCARBO	ONS - 8100M	.*			Analyst: RuP			
Total Petroleum Hydrocarbons	ND ND	0.227	mg/L	1	5/7/2008			
Surr: o-Terphenyl	99.0	40-140	%REC	1	5/7/2008			
, ,		, ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	70.120	,	3/1/2000			
POLYCHLORINATED BIPHENYLS -	–				Analyst: GP			
Aroclor 1016/1242	ND	0.319	μg/L	1	5/6/2008			
Aroclor 1221	ND	0.319	µg/L	1	5/6/2008			
Aroclor 1232	ND	0.319	μg/L	1	5/6/2008			
Aroclor 1248	ИD	0.319	μg/L	1	5/6/2008			
Aroclor 1254	ND	0.319	μg/L	1	5/6/2008			
Aroclor 1260	ND	0.319	μg/L	1	5/6/2008			
Aroclor 1262	ND	0.319	μg/L	1	5/6/2008			
Aroclar 1268	ND	0.319	μg/L	1	5/6/2008			
Surr: Decachlorobiphenyl Sig 1	106	30-150	%REC	1	5/6/2008			
Surr: Decachlorobiphenyl Sig 2	103	30-150	%REC	1	5/6/2008			
Surr: Tetrachloro-m-Xylene Sig 1	85.0	30-150	%REC	1	5/6/2008			
Surr: Tetrachloro-m-Xylene Sig 2	0.98	30-150	%REC	1	5/6/2008			
DISSOLVED METALS BY GFAA - E2	00.9				Analyst: QS			
Antimony	МÐ	0.00100	mg/L	1	5/6/2008			
Arsenic	0.0101	0.00100	mg/L	1	5/6/2008			
DISSOLVED METALS BY ICP - SW6	010E				Analysis CS			
Barium	ND	2.00	mg/L	1	Analyst: QS 5/3/2008			
Cadmium	ND	0.00400	mg/L	1	5/3/2008			
Chromium	ND	0.100	mg/L	1	5/3/2008			
Copper	0.0350	0.00800	mg/L	1	5/3/2008			
Iron	21.9	0.600	mg/L	10	5/3/2008			

- B Analyte detected in the associated Method Blank
- E Value above quantitation range
- J Analyte detected below quantitation limits
- S Spike Recovery outside recovery limits

- BRL Below Reporting Limit
- H Holding times for preparation or analysis exceeded
- ND Not Detected at the Reporting Limit

Reported Date: 15-May-08

CLIENT:

Fay, Spofford & Thorndike

0805025

Lab Order: 080

WM-046, 1.4 Exp

Project: Lab ID:

0805025-003

Client Sample ID: B11

Collection Date: 4/30/2008 11:40:00 PM

Date Received: 5/2/2008

Matrix: GROUNDWATER

Analyses	Result	Det. Limit Q	ual Units	DF	Date Analyzed
DISSOLVED METALS BY ICP - SW6010E	3				Analyst: QS
Lead	0.0430	0.0100	mg/L	1	5/3/2008
Nickel	ND	0.100	mg/L	1	5/3/2008
Selenium	ND	0.0500	mg/L	1	5/3/2008
DISSOLVED SILVER - E200.7					Analyst: QS
Silver-Dissofved	ND	0.00700	mg/L	1	5/5/2008
DISSOLVED MERCURY - E245.1					Analyst: EC
Mercury-Dissolved	ND	0.000500	mg/L	1	5/5/2008
SEMIVOLATILE ORGANICS - SW8270C					Analyst: ZYZ
1,2,4-Trichlorobenzene	ND	1.04	µg/∟	1	5/7/2008 4:05:00 PM
1,2-Dichlorobenzene	ND	1.04	µg/∟	1	5/7/2008 4:05:00 PM
1,2-Dinitrobenzene	ND	1.04	μg/L	1	5/7/2008 4:05:00 PM
1,3-Dichlorobenzene	ND	1.04	µg/L	1	5/7/2008 4:05:00 PM
1,3-Dinitrobenzene	ND	1.04	μg/L	4	5/7/2008 4:05:00 PM
1,4-Dichlorobenzene	ND	1.04	µg/L	1	5/7/2008 4:05:00 PM
1,4-Dinitrobenzene	ND	1.04	μg/L	1	5/7/2008 4:05:00 PM
2,3,4,6-Tetrachlorophenol	ND	1,04	μg/L	1	5/7/2008 4:05:00 PM
2,4,5-Trichlorophenol	ND	1.04	μg/L	. 1	5/7/2008 4:05:00 PM
2,4,6-Trichlorophenol	ND	1.04	μg/L	1	5/7/2008 4:05:00 PM
2,4-Dichlorophenol	ND	1.04	μg/L	1	5/7/2008 4:05:00 PM
2,4-Dimethylphenol	ND	1.04	µg/L	1	5/7/2008 4:05:00 PM
2,4-Dinitrophenol	ND	5.21	μg/L	1	5/7/2008 4:05:00 PM
2,4-Dinitrotoluene	ND	1.04	μg/L	1	5/7/2008 4:05:00 PM
2,6-Dinitrotoluene	DN	1.04	µg/L	1 .	5/7/2008 4:05:00 PM
2-Chloronaphthalene	ND	1.04	μg/L	. 1	5/7/2008 4:05:00 PM
2-Chlorophenol	ND	1.04	μg/L	1	5/7/2008 4:05:00 PM
2-Methylnaphthalene	ND	1.04	μg/L	1	5/7/2008 4:05:00 PM
2-Methylphenol	ND	1.04	μg/L	1	5/7/2008 4:05:00 PM
2-Nitroaniline	ND	1.04	μg/L	1	5/7/2008 4:05:00 PM
.2-Nitrophenol	ND	1.04	μg/L	1	5/7/2008 4:05:00 PM
3,3'-Dichlorobenzidine	ND	1.04	μg/ L	1	5/7/2008 4:05:00 PM
3-Methylphenol/4-Methylphenol	ND	1.04	μg/L	1	5/7/2008 4:05:00 PM
3-Nitroaniline	ND	1.04	μg/L	1	5/7/2008 4:05:00 PM
4,6-Dinitro-2-Methylphenol	ND	5.21	μg/L	1	5/7/2008 4:05:00 PM
4-Bromophenyl Phenyl Ether	ND	1.04	μg/L	1	5/7/2008 4:05:00 PM
4-Chioro-3-Methylphenol	NE	1.04	μg/L	1	5/7/2008 4:05:00 PM
4-Chloroaniline	NE	1,04	μg/L	1	5/7/2006 4:05:00 PM

- B Analyte detected in the associated Method Blank
- E Value above quantitation range
- J Analyte detected below quantitation limits
- S Spike Recovery outside recovery limits

- BRL Below Reporting Limit
- H Holding times for preparation or analysis exceeded
- ND Not Detected at the Reporting Limit

Reported Date: 15-May-08

CLIENT:

Fay, Spofford & Thorndike

Lab Order:

0805025

Project:

WM-046, 1.4 Exp

Lab ID:

0805025-003

Client Sample ID: B11

Collection Date: 4/30/2008 11:40:00 PM

Date Received: 5/2/2008

Matrix: GROUNDWATER

Analyses	Result	Det. Limit	Qual Units	DF	Date Analyzed
SEMIVOLATILE ORGANICS - SW8270C					Analyst: ZY Z
4-Chlorophenyl Phenyl Ether	ND	1.04	μg/L	1	5/7/2008 4:05:00 PM
4-Nitroaniline	ND	1.04	μg/L	1	5/7/2008 4:05:00 PM
4-Nitrophenol	ND	1.04	μg/L	1	5/7/2008 4:05:00 PM
Acenaphthene	ND	1.04	μg/L	1	5/7/2008 4:05:00 PM
Acenaphthylene	ND	1.04	µg/L	1	5/7/2008 4:05:00 PM
Acetophenone	ND	1.04	μg/L	1	5/7/2008 4:05:00 PM
Aniline	ND	5.21	μg/L	1	5/7/2008 4:05:00 PM
Anthracene	ND	1.04	μg/L	1	5/7/2008 4:05:00 PM
Azobenzene	ND	5.21	μg/L	1	5/7/2008 4:05:00 PM
Benz(a)Anthracene	ND	0.104	μg/L	1	5/7/2008 4:05:00 PM
Benzidine	ND	5.21	μg/L	1	5/7/2008 4:05:00 PM
Benzo(a)Pyrene	ND	0.104	μg/L	1	5/7/2008 4:05:00 PM
Benzo(b)Fluoranthene	ND	0.521	μg/L	1	5/7/2008 4:05:00 PM
Benzo(g,h,i)Perylene	ND	1.04	μg/L	1	5/7/2008 4:05:00 PM
Benzo(k)Fluoranthene	ND	0.521	μg/L	1	5/7/2008 4:05:00 PM
Benzyl Alcohol	ND	1.04	µg/L	1	5/7/2008 4:05:00 PM
Bis(2-Chloroethoxy)Methane	ND	1.04	μ g /L	1	5/7/2008 4:05:00 PM
Bis(2-Chloroethyl)Ether	ND	1.04	μg/L	1	5/7/2008 4:05:00 PM
Bis(2-Chloroisopropyl)Ether	ND	1.04	μg/L	1	5/7/2008 4:05:00 PM
Bis(2-Ethylhexyl)Phthalate	ND	1.04	μg/L	1	5/7/2008 4:05:00 PM
Butyl Benzyl Phthalate	ND	1.04	μg/L	1	5/7/2008 4:05:00 PM
Carbazole	ND	1.04	μg/L	1	5/7/2008 4:05:00 PM
Chrysene	ND	1.04	μg/L	1	5/7/2008 4:05:00 PM
Dibenz(a,h)Anthracene	ND	0.104	μg/L	1	5/7/2008 4:05:00 PM
Dibenzofuran	ND	1.04	μg/L	1	5/7/2008 4:05:00 PM
Diethyl Phthalate	ND	1.04	μg/L	1	5/7/2008 4:05:00 PM
Dimethyl Phthalate	ND	1.04	μg/L	1	5/7/2008 4:05:00 PM
Di-n-Butyl Phthalate	3.89	1.04	μg/L	1	5/7/2008 4:05:00 PM
Di-n-Octyl Phthalate	ND	1.04	μg/L	1	5/7/2008 4:05:00 PM
Fluoranthene	ND	1.04	μg/L	1	5/7/2008 4:05:00 PM
Fluorene	ND	1.04	μg/L	1	5/7/2008 4:05:00 PM
Hexachlorobenzene	ND	0.104	μg/L	1	5/7/2008 4:05:00 PM
Hexachlorobutadiene	ND	0.104	μg/L	4	5/7/2008 4:05:00 PM
Hexachlorocyclopentadiene	ND	5.21	μg/L	1	5/7/2008 4:05:00 PM
Hexachloroethane	ND	1.04	µg/L	1	5/7/2008 4:05:00 PM
Indeno(1,2,3-cd)Pyrene	ND	0.104	μg/L	1	5/7/2008 4:05:00 PM
Isophorone	ND	1.04	μg/L	1	5/7/2008 4:05:00 PM
Naphthalene	ND	1.04	μg/L	1	5/7/2008 4:05:00 PM
Nitrobenzene	ND	1.04	μg/L	1	5/7/2008 4:05:00 PM
N-Nitrosodimethylamine	ND	5.21	μg/L	1	5/7/2008 4:05:00 PM

- В Analyte detected in the associated Method Blank
- E Value above quantitation range
- Analyte detected below quantitation limits
- Spike Recovery outside recovery limits

- BRL Below Reporting Limit
- H Holding times for preparation or analysis exceeded
- ND Not Detected at the Reporting Limit

Reported Date: 15-May-08

CLIENT:

Fay, Spofford & Thorndike

Lab Order:

0805025

Client Sample ID: B11

Collection Date: 4/30/2008 11:40:00 PM

Project:

WM-046, 1.4 Exp

Date Received: 5/2/2008

Lab ID:

0805025-003

Matrix: GROUNDWATER

Analyses	Result	Det. Limit	Qual U	Inits	DF	Date Analyzed
SEMIVOLATILE ORGANICS - SW8270C						Analyst: ZYZ
N-Nitrosodi-n-Propylamine	ND	1.04	p:	g/L	1	5/7/2008 4:05:00 PM
N-Nitrosodiphenylamine	ND	5.21	þ	g/L	1	5/7/2008 4:05:00 PM
Pentachioropheno!	ND	1.04	μ	g/L	1	5/7/2008 4:05:00 PM
Phenanthrene	ND	1.04	μ	g/L	1	5/7/2008 4:05:00 PM
Phenol	ND	1.04	μ	g/L	1	5/7/2008 4:05:00 PM
Pyrene	ND	1.04	μ	g/L	1	5/7/2008 4:05:00 PM
Pyridine	ND	5.21	μ	g/L	1	5/7/2008 4:05:00 PM
Surr: 2,4,6-Tribromophenol	44.6	15-110	%	6REC	1	5/7/2008 4:05:00 PM
Surr: 2-Fluorobiphenyl	72.5	30-130	0/6	6REC	1	5/7/2008 4:05:00 PM
Surr: 2-Fluorophenol	40.9	15-110	%	6REC	1	5/7/2008 4:05:00 PM
Surr: Nitrobenzene-d5	61.7	30-130	%	6REC	1	5/7/2008 4:05:00 PM
Surr: Phenoi-d6	27.7	15-110	%	6REC	1	5/7/2008 4:05:00 PM
Surr: Terphenyl-d14	78.6	30-130	9/	6REC	1	5/7/2008 4:05:00 PM
EPH TARGET ANALYTES - MADEP EPI	4					Analyst: ZYZ
Nachthalene	ND	1.08	п	ıg/L	1	5/6/2008 3:34:00 PM
2-Methylnaphthalene	ND	1.08		ig/L	1	5/6/2008 3:34:00 PM
Acenaphthene	ND	1.08		ıg/L	1	5/6/2008 3:34:00 PM
Phenanthrene	ND	1.08		ıg/L	1	5/6/2008 3:34:00 PM
Acenaphthylene	ND	1.08	•	ig/L	1	5/6/2008 3:34:00 PM
Fluorene	ND	1.08		ıg/L	1	5/6/2008 3:34:00 PM
Anthracene	ND	1.08		ıg/L	1	5/6/2008 3:34:00 PM
Fivoranthene	ND	1.08		ig/L	1	5/6/2008 3:34:00 PM
Pyrene	ND	1.08	-	ıg/L	1	5/6/2008 3:34:00 PM
Benzo(a)Anthracene	ND	0.430		ıg/L	1	5/6/2008 3:34:00 PM
Chrysene	ND	1.08		ig/L	1	5/6/2008 3:34:00 PM
Benzo(b)Fluoranthene	ND	1.08		ig/L	1	5/6/2008 3:34:00 PM
Benzo(k)Fluoranthene	ND	1.08		ig/L	1	5/6/2008 3:34:00 PM
Benzo(a)Pyrene	ND	0.215		ig/L	1	5/6/2008 3:34:00 PM
Indeno(1,2,3-cd)Pyrene	ND	0.430	=	ıg/L	1	5/6/2008 3:34:00 PM
Dibenz(a,h)Anthracene	ND	0.430		ıg/L	1	5/6/2008 3:34:00 PM
Benzo(g,h,i)Perylene	ND	1.08	,	ıg/L	1	5/6/2008 3:34:00 PM
Total PAH Target Concentration	ND	0		ıg/L	1	5/6/2008 3:34:00 PM
Surr: 2,2'-Difluorobiphenyl	89.4	40-140		%REC	1	5/6/2008 3:34:00 PM
Surr: 2-Fluorobiphenyl	94.2	40-140		%REC	1	5/6/2008 3:34:00 PM
VOLATILE ORGANIC COMPOUNDS - S	Meacab					Analyst: MR
1.1.1.2-Tetrachioroethane	ND ND	5.00		ug/L	1	5/8/2008 6:00:00 PM
r, r, z-retrachioroethane	NU	5.00	·	agr L	1	5/8/2008 6:00:00 PM

Analyte detected in the associated Method Blank

Value above quantitation range

Analyte detected below quantitation limits J

Spike Recovery outside recovery limits

BRL Below Reporting Limit

Holding times for preparation or analysis exceeded

Not Detected at the Reporting Limit

Reported Date: 15-May-08

CLIENT:

Fay, Spofford & Thorndike

Lab Order:

0805025

0803023

Project: Lab ID: WM-046, 1.4 Exp 0805025-003 Client Sample ID: B11

Collection Date: 4/30/2008 11:40:00 PM

Date Received: 5/2/2008

Matrix: GROUNDWATER

Analyses	Result	Det. Limit	Qual Ui	nits	DF	Date Analyzed
VOLATILE ORGANIC COMPOUNDS	S - SW8260B					Analyst: M R
1,1,2,2-Tetrachioroethane	ND	2.00	μg.	/L	1	5/8/2008 6:00:00 PM
1,1,2-Trichloroethane	ND	5.00	μg	/L	1	5/8/2008 6:00:00 PM
1,1-Dichloroethane	ND	5.00	μg	/L	1	5/8/2008 6:00:00 PM
1,1-Dichloroethene	ND	5.00	μg,	/L	1	5/8/2008 6:00:00 PM
1,1-Dichloropropene	ND	5.00	μg	/L	1	5/8/2008 6:00:00 PM
1,2,3-Trichlorobenzene	ND	5.00	μg	/L	1	5/8/2008 6:00:00 PM
1,2,3-Trichloropropane	ND	5.00	рgи	/L	1	5/8/2008 6:00:00 PM
1,2,4-Trichlorobenzene	ND	5,00	μg	/L	1	5/8/2008 6:00:00 PM
1,2,4-Trimethylbenzene	11.9	5.00	μg/	/L	1	5/8/2008 6:00:00 PM
1,2-Dibromo-3-Chloropropane	ND	5.00	μg/	/L	1	5/8/2008 6:00:00 PM
1,2-Dibromoethane	ND	2.00	нди	/L	1	5/8/2008 6:00:00 PM
1,2-Dichlorabenzene	ND	5.00	µg/		1	5/8/2008 6:00:00 PM
1,2-Dichloroethane	ND	2.00	μg/		1	5/8/2008 6:00:00 PM
1,2-Dichloropropane	ND	2.00	μg/		1	5/8/2008 6:00:00 PM
1,3,5-Trimethylbenzene	7.06	5.00	μg/	/L	1	5/8/2008 6:00:00 PM
1,3-Dichlorobenzene	ND	5.00	μg/		1	5/8/2008 6:00:00 PM
1,3-Dichloropropane	ND	5.00	µg/	/L	1	5/8/2008 6:00:00 PM
1,4-Dichlorobenzene	ND	5.00	ha/	/L	1	5/8/2008 6:00:00 PM
2,2-Dichloropropane	ND	5.00	µg/		1	5/8/2008 6:00:00 PM
2-Butanone	ND	10.0	μg/	/L	1	5/8/2008 6:00:00 PM
2-Chloroethyl Vinyl Ether	ND	5.00	µg/		1	5/8/2008 6:00:00 PM
2-Chlorotoluene	ND	5.00	μg/		1	5/8/2008 6:00:00 PM
2-Hexanone	ND	10.0	μg/		1	5/8/2008 6:00:00 PM
4-Chlorotoluene	ND	5.00	μg/		1	5/8/2008 6:00:00 PM
4-Isopropyitaluene	ND	5.00	μg/		1	5/8/2008 6:00:00 PM
4-Methyl-2-Pentanone	ND	5.00	. о µg/		1	5/8/2008 6:00:00 PM
Acetone	. ND	50.0	ug/		1	5/8/2008 6:00:00 PM
Acrolein	ND	50.0	μg/		1	5/8/2008 6:00:00 PM
Acrylonitrile	ND	50.0	µg/		1	5/8/2008 6:00:00 PM
Benzene	ND	5.00	μg/		1	5/8/2008 6:00:00 PM
Bromobenzene	ND	5.00	. շ /քպ		1	5/8/2008 6:00:00 PM
Bromochioromethane	ND	2.00	ug/		1	5/8/2008 6:00:00 PM
Bromodichloromethane	ND	2.00	µg/		1	5/8/2008 6:00:00 PM
Bromoform	ND	2.00	⊬ə⁄ µg/		1	5/8/2008 6:00:00 PM
Bromomethane	ND	2.00	ha\		1	5/8/2008 6:00:00 PM
Carbon Disulfide	ND	5.00	hā,		, 1	5/8/2008 6:00:00 PM
Carbon Tetrachloride	ND	2.00	μg/		1	5/8/2008 6:00:00 PM
Chlorobenzene	ND	5.00	, pg/		1	5/8/2008 6:00:00 PM
Chioroethane	ND	5.00	, pg/ 		1	5/8/2008 6:00:00 PM
Chloroform	ND	5.00	ha,		1	5/8/2008 6:00:00 PM

- B Analyte detected in the associated Method Blank
- E Value above quantitation range
- J Analyte detected below quantitation limits
- S Spike Recovery outside recovery limits

- BRL Below Reporting Limit
- H Holding times for preparation or analysis exceeded
- ND Not Detected at the Reporting Limit

Reported Date: 15-May-08

CLIENT:

Fay, Spofford & Thorndike

Lab Order:

0805025

0003023

Project: Lab ID: WM-046, 1.4 Exp 0805025-003 Client Sample ID: B11

Collection Date: 4/30/2008 11:40:00 PM

Date Received: 5/2/2008

Matrix: GROUNDWATER

Analyses	Result	Det. Limit	Qual	Units	DF	Date Analyzed
OLATILE ORGANIC COMPOUNDS	- SW8260B					Analyst: MR
Chloromethane	ND	5.00	ı	μg/L	1	5/8/2008 6:00:00 PM
cis-1,2-Dichloroethene	ND	5.00	1	μg/L	1	5/8/2008 6:00:00 PM
cis-1,3-Dichloropropene	ND	0.500		μg/L	1	5/8/2008 6:00:00 PM
Dibromochloromethane	ND	2.00	i	μg/L	1	5/8/2008 6:00:00 PM
Dibromomethane	ND	5.00		μg/L	1	5/8/2008 6:00:00 PM
Dichlorodifluoromethane	ND	5.00	I	μg/L	1	5/8/2008 6:00:00 PM
Ethylbenzene	5.98	5.00	!	μg/L	1	5/8/2008 6:00:00 PM
Hexachlorobutadiene	ND	0.500		μg/L	1	5/8/2008 6:00:00 PM
!sopropylbenzene	ND	5.00		μg/L	1	5/8/2008 6:00:00 PM
Methyl Tert-Butyl Ether	ND	5.00		μg/L	1	5/8/2008 6:00:00 PM
Methylene Chloride	ND	5.00		μg/L	1	5/8/2008 6:00:00 PM
Naphthalene	ND	20.0		μg/L	1	5/8/2008 6:00:00 PM
n-Butylbenzene	ND	5.00		μg/L	. 1	5/8/2008 6:00:00 PM
n-Propylbenzene	ND	5.00		μg/L	. 1	5/8/2008 6:00:00 PM
sec-Butylbenzene	ND	5.00		μg/Ľ	1	5/8/2008 6:00:00 PM
Styrene	ND	5.00		μg/L	1	5/8/2008 6:00:00 PM
tert-Butylbenzene	ND	5.00		μg/L	1	5/8/2008 6:00:00 PM
Tetrachloroethene	ND	5.00		μg/L	1	5/8/2008 6:00:00 PM
Toluene	ND	5.00		μg/L	1	5/8/2008 6:00:00 PM
trans-1,2-Dichloroethene	ND	5.00		μg/L	1	5/8/2008 6:00:00 PM
trans-1,3-Dichloropropene	ND	0.500		μg/L	1	5/8/2008 6:00:00 PM
Trichloroethene	ND	5.00		μg/L	1	5/8/2008 6:00:00 PM
Trichlorofluoromethane	ND	5.00		μg/L	1	5/8/2008 6:00:00 PM
Vinyl Chloride	ND	2.00		μg/L	1	5/8/2008 6:00:00 PM
Xylenes, Total	ND	5.00		μg/L	1	5/8/2008 6:00:00 PM
Surr: 1,2-Dichloroethane-d4	110	70-130		%REC	1	5/8/2008 6:00:00 PM
Surr: 4-Bromofluorobenzene	111	70-130		%REC	1	5/8/2008 6:00:00 PM
Surr: Dibromofluoromethane	96.5	70-130		%REC	1	5/8/2008 6:00:00 PM
Surr: Toluene-d8	103	70-130		%REC	1	5/8/2008 6:00:00 PM
/PH - MADEP VPH						Anaiyst: kd
C9-C10 Aromatic Hydrocarbons	ND	75,0)	μg/Ľ	1	5/9/2008
Unadjusted C5-C8 Aliphatic Hydrocarbons	ND	75.0)	μg/L	1	5/9/2008
Unadjusted C9-C12 Aliphatic Hydrocarbons	ND	75.0)	μg/L	1	5/9/2008
Methyl Tert-Butyl Ether	ND	5.00)	μg/ L	1	5/9/2008
Benzene	ND	5.00)	μg/L	1	5/9/2008
Toluene	ND	5.00)	μg/L	1	5/9/2008
Ethylbenzene	ND	5.00)	µg/L	1	5/9/2008

B Analyte detected in the associated Method Blank

E Value above quantitation range

J Analyte detected below quantitation limits

S Spike Recovery outside recovery limits

BRL Below Reporting Limit

H Holding times for preparation or analysis exceeded

ND Not Detected at the Reporting Limit

Reported Date: 15-May-08

CLIENT:

Fay, Spofford & Thorndike

Lab Order:

0805025

Project:

WM-046, 1.4 Exp

Lab ID:

0805025-003

Client Sample ID: B11

Collection Date: 4/30/2008 11:40:00 PM

Date Received: 5/2/2008

Matrix: GROUNDWATER

Analyses	Result	Det. Limit	Qual	Units	DF	Date Analyzed
VPH - MADEP VPH						Analyst: kd
m,p-Xylene	ND	5.00		μg/L	1	5/9/2008
o-Xylene	ND	5.00		μg/L	1	5/9/2008
Naphthalene	ND	20.0		μg/L	1	5/9/2008
Adjusted C5-C8 Aliphatic Hydrocarbons	ND	75.0		μg/L	1	5/9/2008
Adjusted C9-C12 Aliphatic Hydrocarbons	ND	75.0		µg/L	1	5/9/2008
Surr: 2,5-Dibromotoluene FID	72.8	70-130		%REC	1	5/9/2008
Surr: 2,5-Dibromotoluene PID	76.4	70-130		%REC	1	5/9/2008
CYANIDE, TOTAL - SM4500-CN-C,E						Analyst: WFR
Cyanide, Total	ND	0.0197		mg/L	1	5/12/2008
HEXAVALENT CHROMIUM - SM3500-CR-I	3					Analyst: WFR
Chromium, Hexavalent	ND	0.0500	Н	mg/L	1	5/6/2008
TOTAL RESIDUAL CHLORINE - HACH 816	7					Analyst: RP
Total Residual Chlorine	ND	0.162	Н	mg/L	1	5/5/2008

- Analyte detected in the associated Method Blank В
- E Value above quantitation range
- Analyte detected below quantitation limits

Spike Recovery outside recovery limits

BRL Below Reporting Limit

Holding times for preparation or analysis exceeded

ND Not Detected at the Reporting Limit

Reported Date: 15-May-08

CLIENT:

Fay, Spofford & Thorndike

Lab Order:

Client Sample ID: B9

0805025

Collection Date: 5/1/2008 1:00:00 AM

Project:

WM-046, 1.4 Exp

Date Received: 5/2/2008

Lab ID:

0805025-004

Matrix: GROUNDWATER

Lab ID: 0805025-004	Matrix: GROUNDWATER							
Analyses	Result	Det. Limit	Qual Units	DF	Date Analyzed			
TOTAL SUSPENDED SOLIDS - 5M2540)-D				Analyst: AMS			
Total Suspended Solids	ND	4.00	mg/L	1	5/5/2008			
					Analyst: RJ			
EPH RANGES - MADEP EPH	ND	103	μg/L	1	5/9/2008			
Adjusted C11-C22 Aromatics	ND	103	μg/L	1	5/9/2008			
C09-C18 Aliphatics	ND	103	μg/L	1	5/9/2008			
C19-C36 Aliphatics	ND	103	μg/L	1	5/9/2008			
Unadjusted C11-C22 Aromatics	60.0	40-140	%REC	1	5/9/2008			
Surr: 1-Chloroctadecane	72.0	40-140	%REC	1	5/9/2008			
Surr: o-Terphenyl	72.0	40-140	ANLO	,	0,072000			
TOTAL PETROLEUM HYDROCARBON	S - 8100M				Analyst: RuP			
Total Petroleum Hydrocarbons	ND	0.206	mg/L	1	5/5/2008			
Surr: o-Terphenyl	97.0	40-140	%REC	1	5/5/2008			
POLYCHLORINATED BIPHENYLS - SV	Jones				Analyst: GP			
Aroclor 1016/1242	ND	0.306	μg/L	1	5/6/2008			
Aroclor 1221	ND	0.306	hā\r ha\r	1	5/6/2008			
Aroclor 1221	ND	0.306	μg/L	1	5/6/2008			
A contract of the contract of	ND	0.306	μg/L	1	5/6/2008			
Aroclor 1248 Aroclor 1254	ND	0.306	μg/L	. 1	5/6/2008			
	ND	0.306	µg/L	1	5/6/2008			
Aroclor 1260	ND	0.306	μg/L	1	5/6/2008			
Aroclor 1262	ND	0.306	μg/L	1	5/6/2008			
Aroclor 1268	78.0	30-150	%REC	1	5/6/2008			
Surr: Decachiorobiphenyl Sig 1	77.0	30-150	%REC	, 1	5/6/2008			
Surr: Decachiorobiphenyl Sig 2	50.0	30-150	%REC	1	5/6/2008			
Surr: Tetrachloro-m-Xylene Sig 1		_	%REC	1	5/6/2008			
Surr: Tetrachloro-m-Xylene Sig 2	57.0	30-150	WREC	1	3/0/2000			
TOTAL METALS BY GFAA - E200.9					Analyst: QS			
Antimony	ND	0.00100	mg/L	1	5/6/2008			
Arsenic	ND	0.00100	mg/L	1	5/6/2008			
TOTAL METALS BY ICP - SW6010B				-	Analyst: QS			
Barium	ND	2.00	mg/L	1	5/3/2008			
Cadmium	ND	0.00400	mg/L	1	5/3/2008			
Chromium	ND	0.100	mg/L	1	5/3/2008			
Copper	, ND	0.0400	mg/∟	1	5/3/2008			
Iron	0.109		mg/L	1	5/3/2008			

- Analyte detected in the associated Method Blank В
- Е Value above quantitation range
- Analyte detected below quantitation limits
- Spike Recovery outside recovery limits

- BRL Below Reporting Limit
- Holding times for preparation or analysis exceeded Н
- ND Not Detected at the Reporting Limit

Reported Date: 15-May-08

CLIENT:

Fay, Spofford & Thorndike

Lab Order:

0805025

WM-046, 1.4 Exp

Project: Lab ID:

0805025-004

Client Sample ID: B9

Collection Date: 5/1/2008 1:00:00 AM

Date Received: 5/2/2008

Matrix: GROUNDWATER

Analyses	Result	Det. Limit	Qual Units	DF	Date Analyzed
TOTAL METALS BY ICP - SW6010B					Analyst: Q\$
Lead	0.0140	0.0100	mg/L	1	5/3/2008
Nickel	ND	0.100	mg/L	1	5/3/2008
Selenium	ND	0.0500	mg/L	1	5/3/2008
TOTAL SILVER - E200.7					Analyst: QS
Silver	ND	0.00700	mg/L	1	5/5/2008
TOTAL MERCURY - E245.1					Analyst: EC
Mercury	ŊD	0.0005	mg/L	1	5/5/2008
SEMIVOLATILE ORGANICS - SW8270C					Analyst: ZYZ
1,2,4-Trichlorobenzene	ND	1.03	μg/L	1	5/7/2008 4:43:00 PM
1,2-Dichlorobenzene	ND	1.03	μg/L	1	5/7/2008 4:43:00 PM
1,2-Dinitrobenzene	ND	1.03	μg/L	1	5/7/2008 4:43:00 PM
1,3-Dichlorobenzene	ND	1.03	μg/L	1	5/7/2008 4:43:00 PM
1,3-Dinitrobenzene	ŊD	1.03	µg/L	1	5/7/2008 4:43:00 PM
1.4-Dichlorobenzene	ND	1.03	μg/L	1	5/7/2008 4:43:00 PM
1,4-Dinitrobenzene	ND	1.03	μg/L	1	5/7/2008 4:43:00 PM
2,3,4,6-Tetrachiorophenol	ND	1.03	μg/L	1	5/7/2008 4:43:00 PM
2,4,5-Trichlorophenol	ND	1.03	μg/L	1	5/7/2008 4:43:00 PM
2,4,6-Trichlorophenol	ND	1.03	μg/L	1	5/7/2008 4:43:00 PM
2,4-Dichlorophenol	ND	1.03	μg/L	1	5/7/2008 4:43:00 PM
2,4-Dimethylphenol	ND	1.03	μg/L	1	5/7/2008 4:43:00 PM
2,4-Dinitrophenol	ND	5.15	μg/L	1	5/7/2008 4:43:00 PM
2,4-Dinitrotoluene	ND	1.03	μ g /L	1	5/7/2008 4:43:00 PM
2,6-Dinitrotoluene	ND	1.03	μg/L	1	5/7/2008 4:43:00 PM
2-Chioronaphthaiene	ND	1.03	μg/L	1	5/7/2008 4:43:00 PM
2-Chiorophenol	ND	1.03	μg/L	1	5/7/2008 4:43:00 PM
2-Methylnaphthalene	ND	1.03	μg/L	1	5/7/2008 4:43:00 PM
2-Methylphenol	ND	1.03	μg/L	1	5/7/2008 4:43:00 PM
2-Nitroaniline	ND	1.03	μg/L	1	5/7/2008 4:43:00 PM
2-Nitrophenol	ND	1.03	μg/L	1	5/7/2008 4:43:00 PM
3,3'-Dichlorobenzidine	ND	1.03	μg/L	1	5/7/2008 4:43:00 PM
3-Methylphenol/4-Methylphenol	ND	1.03	µg/L	1 .	5/7/2008 4:43:00 PM
3-Nitroaniline	ND	1.03	µg/L	1	5/7/2008 4:43:00 PM
4,6-Dinitro-2-Methylphenol	ND	5.15	μg/L	1	5/7/2008 4:43:00 PM
4-Bromophenyl Phenyl Ether	ND	1.03	μg/L	1	5/7/2008 4:43:00 PM
4-Chloro-3-Methylphenol	ND	1.03	μg/L	1	5/7/2008 4:43:00 PM
4-Chloroaniline	ND	1.03	μg/L	1	5/7/2008 4:43:00 PM

- B Analyte detected in the associated Method Blank
- E Value above quantitation range
- J Analyte detected below quantitation limits
- S Spike Recovery outside recovery limits

- BRL Below Reporting Limit
- H Holding times for preparation or analysis exceeded
- ND Not Detected at the Reporting Limit

Reported Date: 15-May-08

CLIENT: Lab Order: Fay, Spofford & Thorndike

0805025

WM-046, 1.4 Exp

Project: Lab ID:

0805025-004

Client Sample ID: B9

Collection Date: 5/1/2008 1:00:00 AM

Date Received: 5/2/2008

Matrix: GROUNDWATER

analyses	Result	Det. Limit	Qual U	nits	DF	Date Analyzed
EMIVOLATILE ORGANICS - SW8270C						Analyst: ZY
4-Chlorophenyl Phenyl Ether	ND	1.03	μ	g/L	1	5/7/2008 4:43:00 PM
4-Nitroaniline	ND	1.03	μ	g/L	1	5/7/2008 4:43:00 PM
4-Nitrophenot	ND	1.03	μ	g/L	1	5/7/2008 4:43:00 PM
Acenaphthene	ND	1.03	μ	g/L	1	5/7/2008 4:43:00 PM
Acenaphthylene	ND	1.03	μ	g/L	1	5/7/2008 4:43:00 PM
Acetophenone	ND	1.03	μ	g/L	1	5/7/2008 4:43:00 PM
Aniline	ND	5.15	μ	g/L	1	5/7/2008 4:43:00 PM
Anthracene	ND	1.03	μ	g/L	1	5/7/2008 4:43:00 PM
Azobenzene	ND	5.15	μ	g/L	1	5/7/2008 4:43:00 PM
Benz(a)Anthracene	ND	0.103	μ	g/L	1	5/7/2008 4:43:00 PM
Benzidine	ND	5.15	μ	g/L	1	5/7/2008 4:43:00 PM
Benzo(a)Pyrene	ND	0.103	μ	ıg/L	1	5/7/2008 4:43:00 PM
Benzo(b)Fluoranthene	ND	0.515	μ	ıg/L	1	5/7/2008 4:43:00 PM
Benzo(g,h,i)Perylene	ND	1.03	μ	ıg/L	1	5/7/2008 4:43:00 PM
Benzo(k)Fluoranthene	ND	0.515	μ	ıg/L	1	5/7/2008 4:43:00 PM
Benzyl Alcohol	ND	1.03	ц	ıg/L	1	5/7/2008 4:43:00 PM
Bis(2-Chloroethoxy)Methane	ND	1.03	μ	ig/L	1	5/7/2008 4:43:00 PM
Bis(2-Chloroethyl)Ether	ND	1.03	μ	ıg/L	1	5/7/2008 4:43:00 PM
Bis(2-Chloroisopropyl)Ether	ND	1.03	μ	ıg/L	1	5/7/2008 4:43:00 PM
Bis(2-Ethylhexyl)Phthalate	ND	1.03	μ	ıg/L	1	5/7/2008 4:43:00 PM
Butyl Benzyl Phthalate	ND	1.03	μ	ıg/L	1	5/7/2008 4:43:00 PM
Carbazole	ND	1.03	Ļ	ıg/L	1	5/7/2008 4:43:00 PM
Chrysene	ND	1.03	۲	ıg/L	1	5/7/2008 4:43:00 PM
Dibenz(a,h)Anthracene	ND	0.103	Ļ	ıg/L	1	5/7/2008 4:43:00 PM
Dibenzofuran	ND	1.03	· 4	ıg/L	1	5/7/2008 4:43:00 PM
Diethyl Phthalate	ND	1.03	Ļ	ıg/L	1	5/7/2008 4:43:00 PM
Dimethyl Phthalate	ND	1.03	4	ıg/L	1	5/7/2008 4:43:00 PM
Di-л-Butyl Phthalate	ND	1.03	Ļ	ıg/L	1	5/7/2008 4:43:00 PM
Di-n-Octyl Phthalate	ND	1.03	۲	ıg/L	1	5/7/2008 4:43:00 PM
Fluoranthene	ND	1.03	Ļ	ig/L	1	5/7/2008 4:43:00 PM
Fluorene	ND	1.03	ŀ	ıg/L	1	5/7/2008 4:43:00 PM
Hexachiorobenzene	ИD	0.103	ŀ	ıg/L	1	5/7/2008 4:43:00 PM
Hexachiorobutadiene	ND	0.103	Ļ	ıg/L	1	5/7/2008 4:43:00 PM
Hexachlorocyclopentadiene	ND	5.15	1	ıg/L	1	5/7/2008 4:43:00 PM
Hexachloroethane	ND	1,03	ŀ	ıg/L	1	5/7/2008 4:43:00 PM
indeno(1,2,3-cd)Pyrene	ND	0,103		ıg/L	1	5/7/2008 4:43:00 PM
Isophorone	ND	1.03	}	ıg/L	1	5/7/2008 4:43:00 PM
Naphthalene	ND	1.03		ıg/L	1	5/7/2008 4:43:00 PM
Nitrobenzene	ND	1.03		.g/L	1	5/7/2008 4:43:00 PM
N-Nitrosodimethylamine	ND	5.15		.g/L	1	5/7/2008 4:43:00 PM

- Analyte detected in the associated Method Blank
- E Value above quantitation range
- Analyte detected below quantitation limits
- Spike Recovery outside recovery limits

- BRL Below Reporting Limit
- Holding times for preparation or analysis exceeded
- ND Not Detected at the Reporting Limit

Reported Date: 15-May-08

CLIENT:

Fay, Spofford & Thorndike

Lab Order:

0805025

Project:

WM-046, 1.4 Exp

Lab ID:

0805025-004

Client Sample ID: B9

Collection Date: 5/1/2008 1:00:00 AM

Date Received: 5/2/2008

Matrix: GROUNDWATER

Analyses	Result	Det. Limit	Qual Units	DF	Date Analyzed
SEMIVOLATILE ORGANICS - SW8270	C				Analyst: ZY Z
N-Nitrosodi-n-Propylamine	ND	1.03	μg/L	1	5/7/2008 4:43:00 PM
N-Nitrosodiphenylamine	ND	5.15	μg/L	1	5/7/2008 4:43:00 PM
Pentachlorophenol	ND	1.03	μg/L	1	5/7/2008 4:43:00 PM
Phenanthrene	ND	1.03	μg/L	1	5/7/2008 4:43:00 PM
Phenol	ND	1.03	μg/L	1	5/7/2008 4:43:00 PM
Pyrene	ND	1.03	μg/L	1	5/7/2008 4:43:00 PM
Pyridine	ND	5 .15	μg/L	1	5/7/2008 4:43:00 PM
Surr: 2,4,6-Tribromophenol	38.3	15-110	%REC	1	5/7/2008 4:43:00 PM
Surr: 2-Fluorobiphenyl	75,6	30-130	%REC	1	5/7/2008 4:43:00 PM
Surr: 2-Fluorophenol	42.3	15-110	%REC	1	5/7/2008 4:43:00 PM
Surr: Nitrobenzene-d5	59.5	30-130	%REC	1	5/7/2008 4:43:00 PM
Surr: Phenol-d6	31.0	15-110	%REC	1	5/7/2008 4:43:00 PM
Surr: Terphenyl-d14	102	30-130	%REC	1	5/7/2008 4:43:00 PM
EPH TARGET ANALYTES - MADEP EF	'H				Analyst: ZY Z
Naphthalene	ND	1.03	μg/L	1	5/6/2008 4:08:00 PM
2-Methylnaphthalene	ND	1.03	μg/L	1	5/6/2008 4:08:00 PM
Acenaphthene	ND	1.03	μg/L	1	5/6/2008 4:08:00 PM
Phenanthrene	ND	1.03	μg/L	1	5/6/2008 4:08:00 PM
Acenaphthylene	ND	1.03	µg/L	1	5/6/2008 4:08:00 PM
Fluorene	ND	1.03	µg/L	1	5/6/2008 4:08:00 PM
Anthracene	ND	1.03	μg/L	1	5/6/2008 4:08:00 PM
Fluoranthene	ND	1.03	ug/L	1	5/6/2008 4:08:00 PM
Pyrene	ND	1.03	ug/L	1	5/6/2008 4:08:00 PM
Benzo(a)Anthracene	ND	0.412	μg/L	1	5/6/2008 4:08:00 PM
Chrysene	ND	1.03	µg/L	. 1	5/6/2008 4:08:00 PM
Benzo(b)Fluoranthene	ND	1.03	µg/L	1	5/6/2008 4:08:00 PM
Benzo(k)Fluoranthene	ND	1.03	μg/L	1	5/6/2008 4:08:00 PM
Benzo(a)Pyrene	ND	0.206	µg/L	1	5/6/2008 4:08:00 PM
Indeno(1,2,3-cd)Pyrene	ND	0.412	μg/L	1	5/6/2008 4:08:00 PM
Dibenz(a,h)Anthracene	ND	0.412	μg/L	1	5/6/2008 4:08:00 PM
Benzo(g,h,i)Perylene	ND 1	1.03	μg/L	1	5/6/2008 4:08:00 PM
Total PAH Target Concentration	ND	0	рд/L рд/L	1	5/6/2008 4:08:00 PM
Surr: 2,2'-Diffuorobiphenyl	90.4	40-140	%REC	1	5/6/2008 4:08:00 PM
Surr: 2-Fluorobiphenyl	85.6	40-140	%REC	1	5/6/2008 4:08:00 PM 5/6/2008 4:08:00 PM
adiv 2 i idalosipiidilyi	05.0	40-140	76KEC		5/6/2008 4:08:00 PM
OLATILE ORGANIC COMPOUNDS - S					Analyst: MR
1,1,1,2-Tetrachloroethane	ND	5.00	μg/ L	1	5/8/2008 6:33:00 PM
1,1,1-Trichloroethane	ИĎ	5.00	µg/L	1	5/8/2008 6:33:00 PM

- B Analyte detected in the associated Method Blank
- E Value above quantitation range
- J Analyte detected below quantitation limits
- S Spike Recovery outside recovery limits

- BRL Below Reporting Limit
- H Holding times for preparation or analysis exceeded
- ND Not Detected at the Reporting Limit

Reported Date: 15-May-08

CLIENT:

Fay, Spofford & Thorndike

Lab Order: 0

0805025

WM-046, 1.4 Exp

Project: Lab ID:

0805025-004

Client Sample ID: B9

Collection Date: 5/1/2008 1:00:00 AM

Date Received: 5/2/2008

Matrix: GROUNDWATER

Analyses	Result	Det. Limit	Qual Units	DF	Date Analyzed
OLATILE ORGANIC COMPOUNDS	5 - SW8260B	_			Analyst: MR
1,1,2,2-Tetrachioroethane	ND	2.00	μg/L	1	5/8/2008 6:33:00 PM
1,1,2-Trichloroethane	ND	5.00	μg/L	1	5/8/2008 6:33:00 PM
1,1-Dichloroethane	ND	5.00	μg/L	1	5/8/2008 6:33:00 PM
1,1-Dichloroethene	ND	5.00	րց/∟	1	5/8/2008 6:33:00 PM
1,1-Dichloropropene	ND	5.00	µg/L	1	5/8/2008 6:33:00 PM
1,2,3-Trichlorobenzene	ND	5.00	μg/L	1	5/8/2008 6:33:00 PM
1,2,3-Trichloropropane	ND	5.00	μg/L	1.	5/8/2008 6:33:00 PM
1,2,4-Trichlorobenzene	ND	5.00	µg/L	1	5/8/2008 6:33:00 PM
1,2,4-Trimethylbenzene	25.1	5.00	μg/L	1	5/8/2008 6:33:00 PM
1,2-Dibromo-3-Chloropropane	ND	5.00	μg/L	1	5/8/2008 6:33:00 PM
1,2-Dibromoethane	ND	2.00	μg/L	1	5/8/2008 6:33:00 PM
1,2-Dichlorobenzene	ND.	5.00	μg/L	1	5/8/2008 6:33:00 PM
1,2-Dichloroethane	ND	2.00	μg/L	1	5/8/2008 6:33:00 PM
1,2-Dichloropropane	ND	2.00	μg/L	1	5/8/2008 6:33:00 PM
1,3,5-Trimethylbenzene	7.90	5.00	μg/L	1	5/8/2008 6:33:00 PM
1,3-Dichlorobenzene	. ND	.5.00	μg/L	1	5/8/2008 6:33:00 PM
1,3-Dichloropropane	ND	5.00	μg/L	1	5/8/2008 6:33:00 PM
1,4-Dichlorobenzene	ND	5.00	μg/L	1	5/8/2008 6:33:00 PM
2,2-Dichloropropane	ND	5.00	μg/L	1	5/8/2008 6:33:00 PM
2-Butanone	ND	10.0	μg/L	1	5/8/2008 6:33:00 PM
2-Chloroetny! Vinyl Ether	ND	5.00	μg/L	1	5/8/2008 6:33:00 PM
2-Chlorotoluene	ND	5.00	μg/L	1	5/8/2008 6:33:00 PM
2-Hexanone	ND	10.0	μg/L	1	5/8/2008 6:33:00 PM
4-Chlorotoluene	ND	5.00	μg/L	1	5/8/2008 6:33:00 PM
4-(sopropy)toluene	ND	5.00	µg/L	1	5/8/2008 6:33:00 PM
4-Methyl-2-Pentanone	ND	5.00	μg/L	1	5/8/2008 6:33:00 PM
Acetone	ND	50.0	μg/L	1	5/8/2008 6:33:00 PM
Acrolein	ND	50.0	μg/L	1	5/8/2008 6:33:00 PM
Acrylonitrile	ND	50.0	μg/L	1	5/8/2008 6:33:00 PM
Benzene	ND	5.00	μg/L	1	5/8/2008 6:33:00 PM
Bromobenzene	, ND	5.00	μg/L	1	5/8/2008 6:33:00 PM
Bromochloromethane	ND	2.00	μg/L	1	5/8/2008 6:33:00 PM
Bromodichloromethane	, ND	2.00	μg/L	1	5/8/2008 6:33:00 PM
Bromoform	ND	2.00	μg/L	1	5/8/2008 6:33:00 PM
Bromomethane	DN	2.00	μg/L	1	5/8/2008 6:33:00 PM
Carbon Disulfide	ND	5.00	μg/L	1	5/8/2008 6:33:00 PM
Carbon Tetrachloride	ND	2.00	μg/L	1	5/8/2008 6:33:00 PM
Chlorobenzene	ND	5.00	μg/L	1	5/8/2008 6:33:00 PM
Chloroethane	ND	5.00	μg/Ľ	1	5/8/2008 6:33:00 PM
Chloroform	ND	5.00	μg/L	1	5/8/2008 6:33:00 PM

- B Analyte detected in the associated Method Blank
- E Value above quantitation range
- J Analyte detected below quantitation limits
- S Spike Recovery outside recovery limits

- BRL Below Reporting Limit
- H Holding times for preparation or analysis exceeded
- ND Not Detected at the Reporting Limit

Reported Date: 15-May-08

CLIENT:

Fay, Spofford & Thorndike

Lab Order:

0805025

Project:

WM-046, 1.4 Exp

Lab ID:

0805025-004

Client Sample ID: B9

Collection Date: 5/1/2008 1:00:00 AM

Date Received: 5/2/2008

Matrix: GROUNDWATER

Analyses	Result	Det. Limit	Qual Units	DF	Date Analyzed
VOLATILE ORGANIC COMPOUNDS	6 - SW8260B				Analyst: MR
Chloromethane	ND	5.00	µg/L	1	5/8/2008 6:33:00 PM
cis-1,2-Dichloroethene	ND	5.00	μg/L	1	5/8/2008 6:33:00 PM
cis-1,3-Dichloropropene	ND	0.500	μg/L ·	1	5/8/2008 6:33:00 PM
Dibromochloromethane	ND	2.00	μg/L	1	5/8/2008 6:33:00 PM
Dibromomethane	ND	5.00	µg/L	1	5/8/2008 6:33:00 PM
Dichlorodifluoromethane	ND	5.00	μg/L	1	5/8/2008 6:33:00 PM
Ethylbenzene	9.17	5.00	μg/L	1	5/8/2008 6:33:00 PM
Hexachlorobutadiene	ND	0.500	μg/L	1	5/8/2008 6:33:00 PM
Isopropylbenzene	ND	5.00	μg/L	1	5/8/2008 6:33:00 PM
Methyl Tert-Butyl Ether	ND	5.00	μg/L	1	5/8/2008 6:33:00 PM
Methylene Chloride	ND	5.00	μg/L	1	5/8/2008 6:33:00 PM
Naphthalene	ND	20.0	μg/L	1	5/8/2008 6:33:00 PM
n-Butylbenzene	ND	5.00	μg/L	1	5/8/2008 6:33:00 PM
n-Propylbenzene	ND	5.00	μg/L	1	5/8/2008 6:33;00 PM
sec-Butylbenzene	ND	5.00	· μg/L	1	5/8/2008 6:33:00 PM
Styrene	ND	5.00	μg/L	1	5/8/2008 6:33:00 PM
tert-Butylbenzene	ND	5.00	μg/L	1	5/8/2008 6:33:00 PM
Tetrachloroethene	ND	5.00	μg/L	1	5/8/2008 6:33:00 PM
Toluene	ND	5.00	μg/L	1	5/8/2008 6:33;00 PM
trans-1,2-Dichloroethene	ND	5,00	μg/L	1	5/8/2008 6:33:00 PM
trans-1,3-Dichloropropene	ND	0.500	μg/L	1	5/8/2008 6:33:00 PM
Trichloroethene	ND	5.00	μg/L	1	5/8/2008 6:33:00 PM
Trichlorofluoromethane	ND	5.00	μg/L	1	5/8/2008 6:33:00 PM
Vinyl Chloride	ND	2.00	μg/L	1	5/8/2008 6:33:00 PM
Xylenes, Total	36.5	5.00	μg/L	1	5/8/2008 6:33:00 PM
Surr: 1,2-Dichloroethane-d4	114	70-130	%REC	1	5/8/2008 6:33:00 PM
Surr: 4-Bromofluorobenzene	103	70-130	%REC	1	5/8/2008 6:33:00 PM
Surr: Dibromofluoromethane	102	70-130	%REC	1	5/8/2008 6:33:00 PM
Surr: Toluene-d8	105	70-130	%REC	1	5/8/2008 6:33:00 PM
/PH - MADEP VPH					Analyst: kd
C9-C10 Aromatic Hydrocarbons	ND	75.0	μg/L	1	5/9/2008
Unadjusted C5-C8 Aliphatic Hydrocarbons	616	75.0	μg/L	1	5/9/2008
Unadjusted C9-C12 Aliphatic Hydrocarbons	356	75.0	μg/L	1	5/9/2008
Methyl Tert-Butyl Ether	371	5.00	μg/L	1	5/9/2008
Benzene	69.2	5.00	μg/L	1	5/9/2008
Toluene	66. <i>5</i>	5.00	μg/L	1	5/9/2008
Ethylbenzene	65.0	5.00	μg/L	1	5/9/2008

B Analyte detected in the associated Method Blank

E Value above quantitation range

J Analyte detected below quantitation limits

S Spike Recovery outside recovery limits

BRL Below Reporting Limit

H Holding times for preparation or analysis exceeded

ND Not Detected at the Reporting Limit

Reported Date: 15-May-08

CLIENT:

Fay, Spofford & Thorndike

Lab Order:

0805025

Project:

WM-046, 1.4 Exp

Lab ID:

0805025-004

Client Sample ID: B9

Collection Date: 5/1/2008 1:00:00 AM

Date Received: 5/2/2008

Matrix: GROUNDWATER

Analyses	Result	Det. Limit	Qual	Units	DF	Date Analyzed
VPH - MADEP VPH						Analyst: kd
m,p-Xylene	138	5.00		μg/L	1	5/9/2008
o-Xylene	64.3	5.00		μg/L	1	5/9/2008
Naphthalene	66.3	20.0		μg/L	1	5/9/2008
Adjusted C5-C8 Aliphatic Hydrocarbons	109	75.0		μ́g/L	1	5/9/2008
Adjusted C9-C12 Aliphatic Hydrocarbons	88.7	75.0		µg/L	1	5/9/2008
Surr: 2,5-Dibromotoluene FiD	102	70-130		%REC	1	5/9/2008
Surr: 2,5-Dibromotoluene PID	74.1	70-130		%REC	1	5/9/2008
CYANIDE, TOTAL - SM4500-CN-C,E	٠					Analyst: WFR
Cyanide, Total	ND	0.0197		mg/L	1	5/12/2008
HEXAVALENT CHROMIUM - SM3500-CR-I)					Analyst: WFR
Chromium, Hexavalent	ND	0.0500	Н	mg/L	1	5/6/2008
TOTAL RESIDUAL CHLORINE - HACH 816	67					Analyst: RP
Total Residual Chlorine	ND	0,162	Н	mg/L	1	5/5/2008

- B Analyte detected in the associated Method Blank
- E Value above quantitation range
- J Analyte detected below quantitation limits
- S Spike Recovery outside recovery limits

- BRL Below Reporting Limit
- H Holding times for preparation or analysis exceeded
- ND Not Detected at the Reporting Limit

Reported Date: 15-May-08

CLIENT:

Fay, Spofford & Thorndike

Lab Order:

0805025

Project:

0803023

Lab ID:

WM-046, 1.4 Exp

0805025-005

Client Sample ID: B5

Collection Date: 5/1/2008 2:20:00 AM

Date Received: 5/2/2008

Matrix: GROUNDWATER

Analyses	Result	Det. Limit	Qual Units	DF	Date Analyzed
TOTAL SUSPENDED SOLIDS - SM254	40-D				Analyst: AM
Total Suspended Solids	ND	4.00	mg/L	1	5/5/2008
EPH RANGES - MADEP EPH					Analyst: RJ
Adjusted C11-C22 Aromatics	ND	102	μg/L	1	5/9/2008
C09-C18 Aliphatics	ND	102	μg/L	1	5/9/2008
C19-C36 Aliphatics	ND	102	μg/L	1 .	5/9/2008
Unadjusted C11-C22 Aromatics	ND	102	μg/L	1	5/9/2008
Surr: 1-Chlorooctadecane	53.0	40-140	%REC	1	5/9/2008
Surr: o-Terphenyl	85.0	40-140	%REC	1	5/9/2008
TOTAL PETROLEUM HYDROCARBOI	VS - 8100M				Analyst: RuP
Total Petroleum Hydrocarbons	0.420	0.206	mg/L	1	5/7/2008
Surr: o-Terphenyl	104	40-140	%REC	1	5/7/2008
POLYCHLORINATED BIPHENYLS - S	W8082				Analyst: GP
Aroclor 1016/1242	ND	0.305	μg/L	1	5/6/2008
Aroclor 1221	ND	0,305	μg/L	1	5/6/2008
Aroclor 1232	ND	0.305	μg/L	1	5/6/2008
Aroclor 1248	ND	0.305	μg/L	1 .	5/6/2008
Aroclar 1254	ND	0.305	μg/L	1	5/6/2008
Arocior 1260	ND	0.305	μg/L	1	5/6/2008
Aroclor 1262	ND	0.305	μg/L	1	5/6/2008
Aroclor 1268	ND	0.305	μg/L	1	5/6/2008
Surr: Decachlorobiphenyl Sig 1	99.0	30-150	%REC	1	5/6/2008
Surr: Decachlorobiphenyl Sig 2	91.0	30-150	%REC	1	5/6/2008
Surr: Tetrachloro-m-Xylene Sig 1	81.0	30-150	%REC	1	5/6/2008
Surr: Tetrachloro-m-Xylene Sig 2	81.0	30-150	%REC	1	5/6/2008
FOTAL METALS BY GFAA - E200.9		,			Analyst: QS
Antimony	ND	0.00100	mg/L	1	5/6/2008
Arsenic	0.00135	0.00100	mg/L	1	5/6/2008
FOTAL METALS BY ICP - SW6010B					Analyst: QS
Barium	ND	2.00	mg/L	1	5/3/2008
Cadmium	ND	0.00400	mg/L	1	5/3/2008
Chromium 1	ND	0.100	mg/L	1	5/3/2008
Copper	ND	0.0400	mg/L	1	5/3/2008
Iron	14.8	0.600	mg/L	10	5/3/2008

- B Analyte detected in the associated Method Blank
- E Value above quantitation range
- J Analyte detected below quantitation limits
- S Spike Recovery outside recovery limits

- BRL Below Reporting Limit
- H Holding times for preparation or analysis exceeded
- ND Not Detected at the Reporting Limit

Reported Date: 15-May-08

CLIENT:

Fay, Spofford & Thorndike

0805025

Lab Order: Project:

WM-046, 1.4 Exp

Lab ID:

0805025-005

Client Sample ID: B5

Collection Date: 5/1/2008 2:20:00 AM

Date Received: 5/2/2008

Matrix: GROUNDWATER

Analyses	Result	Det. Limit	Qual Units	DF	Date Analyzed
TOTAL METALS BY ICP - SW6010B					Analyst: QS
Lead	0.0300	0.0100	mg/L	1	5/3/2008
Nickel	ND	0.100	mg/L	1	5/3/2008
Selenium	ND	0.0500	mg/L	. 1	5/3/2008
TOTAL SILVER - E200.7					Analyst: QS
Silver	ND	0.00700	mg/L	1	5/5/2008
TOTAL MERCURY - E245.1					Analyst: EC
Mercury	ND	0.0005	mg/L	1	5/5/2008
SEMIVOLATILE ORGANICS - SW8270C					Analyst: ZY2
1,2,4-Trichlorobenzene	ND	1.02	μg/L	1	5/7/2008 5:23:00 PM
1,2-Dichlorobenzene	ND	1.02	μg/L	1	5/7/2008 5:23:00 PM
1,2-Dinitrobenzene	ND	1.02	μg/L	1	5/7/2008 5:23:00 PM
1,3-Dichlorobenzene	ND	1.02	μg/L	1	5/7/2008 5:23:00 PM
1,3-Dinitrobenzene	ND	1.02	μg/L	1	5/7/2008 5:23:00 PM
1,4-Dichlorobenzene	ND	1.02	μg/L	1	5/7/2008 5:23:00 PM
1,4-Dinitrobenzene	ND	1.02	μg/L	1	5/7/2008 5:23:00 PM
2,3,4,6-Tetrachlorophenol	ND	1.02	μg/L	1	5/7/2008 5:23:00 PM
2,4,5-Trichlorophenol	ND	1.02	μg/L	1	5/7/2008 5:23:00 PM
2,4,6-Trichlorophenal	ND	1.02	μg/L	1	5/7/2008 5:23:00 PM
2,4-Dichlorophenol	ND	1.02	μg/L	1	5/7/2008 5:23:00 PM
2,4-Dimethylphenol	ND	1.02	μg/L	1	5/7/2008 5:23:00 PM
2,4-Dinitrophenal	ND	5.10	μg/L	1	5/7/2008 5:23:00 PM
2,4-Dinitrotoluene	ND	1.02	μg/L	1	5/7/2008 5:23:00 PM
2,6-Dinitrotoluene	ND	1.02	μg/L	1	5/7/2008 5:23:00 PM
2-Chloronaphthalene	ND	1.02	μg/L	1	5/7/2008 5:23:00 PM
2-Chlorophenol	ND	1.02	μg/L	1	5/7/2008 5:23:00 PM
2-Methylnaphthalene	ND	1.02	μg/L	1	5/7/2008 5:23:00 PM
2-Methylphenol	ND	1.02	µg/L	1	5/7/2008 5:23:00 PM
2-Nitroaniline	ND	1.02	μg/L	1	5/7/2008 5:23:00 PM
2-Nitrophenal	ND	1.02	μg/L	1	5/7/2008 5:23:00 PM
3,3'-Dichlorobenzidine	ND	1.02	μg/L	1	5/7/2008 5:23:00 PM
3-Methylphenol/4-Methylphenol	ND	1.02	μg/L	1	5/7/2008 5:23:00 PM
3-Nitroaniline	ND	1.02	μg/L	1	5/7/2008 5:23:00 PM
4,6-Dinitro-2-Methylphenol	ND	5.10	μg/L	1	5/7/2008 5:23:00 PM
4-Bromophenyl Phenyl Ether	ND	1.02	μg/L	1	5/7/2008 5:23:00 PM
4-Chloro-3-Methylphenol	ND	1.02	μg/L	1	5/7/2008 5;23:00 PM
4-Chloroaniline	ND	1.02	μg/L	1	5/7/2008 5:23:00 PM

- Analyte detected in the associated Method Blank
- E Value above quantitation range
- Analyte detected below quantitation limits
- Spike Recovery outside recovery limits

- BRL Below Reporting Limit
- Holding times for preparation or analysis exceeded
- Not Detected at the Reporting Limit

Reported Date: 15-May-08

CLIENT:

Fay, Spofford & Thorndike

Lab Order:

0805025

Project:

WM-046, 1.4 Exp

Lab ID:

0805025-005

Client Sample ID: B5

Collection Date: 5/1/2008 2:20:00 AM

Date Received: 5/2/2008

Matrix: GROUNDWATER

Analyses	Result	Det. Limit	Qual	Units	DF	Date Analyzed
SEMIVOLATILE ORGANICS - SW8270C			<i></i>			Analyst: ZY
4-Chlorophenyl Phenyl Ether	ND	1.02		μg/L	1	5/7/2008 5:23:00 PM
4-Nitroaniline	ND	1.02		μg/L	1	5/7/2008 5:23:00 PM
4-Nitrophenol	ND	1.02		μg/L	1	5/7/2008 5:23:00 PM
Acenaphthene	ND	1.02		μg/L	1	5/7/2008 5:23:00 PM
Acenaphthylene	ND	1.02		µg/L	1	5/7/2008 5:23:00 PM
Acetophenone	ND	1.02		μg/L	1	5/7/2008 5:23:00 PM
Aniline	ФИ	5.10		μg/L	1	5/7/2008 5:23:00 PM
Anthracene	ND	1.02		μg/L	1	5/7/2008 5:23:00 PM
Azobenzene	ND	5.10		μg/L	1	5/7/2008 5:23:00 PM
Benz(a)Anthracene	ND	0.102		μg/L	1	5/7/2008 5:23:00 PM
Benzidine	ND	5.10		μg/L	. 1	5/7/2008 5:23:00 PM
Benzo(a)Pyrene	ND	0.102		μg/L	1	5/7/2008 5:23:00 PM
Benzo(b)Fluoranthene	ND	0.510		μg/L	1	5/7/2008 5:23:00 PM
Benzo(g,h,i)Perylene	ND	1.02		µg/L	1	5/7/2008 5:23:00 PM
Benzo(k)Fluoranthene	ND	0.510		μg/L	1	5/7/2008 5:23:00 PM
Benzyl Alcohol	ND	1.02		μg/L	1	5/7/2008 5:23:00 PM
Bis(2-Chloroethoxy)Methane	ND	1.02		μg/L	1	5/7/2008 5:23:00 PM
Bis(2-Chloroethyl)Ether	ND	1.02		μg/L	1	5/7/2008 5:23:00 PM
Bis(2-Chloroisopropyl)Ether	ND	1.02		μg/L	1	5/7/2008 5:23:00 PM
Bis(2-Ethylhexyl)Phthalate	ND	1.02		μg/L	1	5/7/2008 5:23:00 PM
Butyl Benzyl Phthalate	ND	1.02		μg/L	1	5/7/2008 5:23:00 PM
Carbazole	ND	1.02		μg/L	1	5/7/2008 5:23:00 PM
Chrysene	ND	1.02		μg/L	1	5/7/2008 5:23:00 PM
Dibenz(a,h)Anthracene	ND	0.102		μg/L	1	5/7/2008 5:23:00 PM
Dibenzofuran	1.83	1.02		μg/L	1	5/7/2008 5:23:00 PM
Diethyl Phthalate	ND	1.02		μg/L	1	5/7/2008 5:23:00 PM
Dimethyl Phthalate	ND	1.02		μg/L	1	5/7/2008 5:23:00 PM
Di-n-Butyl Phthalate	ND	1.02		μg/L	1	5/7/2008 5:23:00 PM
Di-π-Octyl Phthalate	ND	1.02		μg/L	1	5/7/2008 5:23:00 PM
=luoranthene	ND	1.02		µg/L	1	5/7/2008 5:23:00 PM
Fluorene	1.40	1.02		μg/L	1	5/7/2008 5:23:00 PM
Hexachlorobenzene	ND	0.102		ug/L	1	5/7/2008 5:23:00 PM
Hexachlorobutadiene	ND	0.102		-g μg/L	1	5/7/2008 5:23:00 PM
Hexachlorocyclopentadiene	ND	5.10		rg/L	1	5/7/2008 5:23:00 PM
Hexachloroethane	ND	1.02		ug/L	1	5/7/2008 5:23:00 PM
ndeno(1,2,3-cd)Pyrene	ND	0.102		ug/L	1	5/7/2008 5:23:00 PM
sophorone	ND	1.02		ug/L	1	5/7/2008 5:23:00 PM
Naphthalene	ND	1.02	4	ug/L	1	5/7/2008 5:23:00 PM
Nitrobenzene	ND	1.02		ug/L	1	5/7/2008 5:23:00 PM
N-Nitrosodimethylamine	ND	5.10	· ·	ug/L ⊔g/L	1	5/7/2008 5:23:00 PM

- B Analyte detected in the associated Method Blank
- E Value above quantitation range
- J Analyte detected below quantitation limits
- S Spike Recovery outside recovery limits

- BRL Below Reporting Limit
- H Holding times for preparation or analysis exceeded
- ND Not Detected at the Reporting Limit

Reported Date: 15-May-08

CLIENT:

Fay, Spofford & Thorndike

Lab Order:

0805025

Project:

WM-046, 1.4 Exp

Lab ID:

0805025-005

Client Sample ID: B5

Collection Date: 5/1/2008 2:20:00 AM

Date Received: 5/2/2008

Matrix: GROUNDWATER

Analyses	Result	Det. Limit	Qual Units	DF	Date Analyzed
SEMIVOLATILE ORGANICS - SW827	70C			(10 - 1 - 10 - 10 - 10 - 10 - 10 - 10 -	Analyst: ZY Z
N-Nitrosodi-n-Propylamine	ND	1.02	μg/L	1	5/7/2008 5:23:00 PM
N-Nitrosodiphenylamine	ND	5.10	μg/L	1	5/7/2008 5:23:00 PM
Pentachlorophenol	ND	1.02	µg/∟	1	5/7/2008 5:23:00 PM
Phenanthrene	ND	1.02	μg/L	· 1	5/7/2008 5:23:00 PM
Phenol	ND	1.02	μg/L	1	5/7/2008 5:23:00 PM
Pyrene	DN	1.02	μg/L	1	5/7/2008 5:23:00 PM
Pyridine	ND	5.10	μg/L	. 1	5/7/2008 5:23:00 PM
Surr: 2,4,6-Tribromophenol	61.4	15-110	%REC	1	5/7/2008 5:23:00 PM
Surr: 2-Fluorobiphenyl	89.1	30-130	%REC	1	5/7/2008 5:23:00 PM
Surr: 2-Fluorophenol	44.4	15-110	%REC	. 1	5/7/2008 5:23:00 PM
Surr: Nitrobenzene-d5	67.3	30-130	%REC	1	5/7/2008 5:23:00 PM
Surr; Phenol-d6	33.5	15-110	%REC	1	5/7/2008 5:23:00 PM
Surr: Terphenyl-d14	117	30-130	%REC	. 1	5/7/2008 5:23:00 PM
EPH TARGET ANALYTES - MADEP	EPH				Analyst: ZYZ
Naphthalene	ND	1.02	μg/L	1	5/6/2008 4:42:00 PM
2-Methylnaphthalene	ND	1,02	μg/L	1	5/6/2008 4:42:00 PM
Acenaphthene	ND	1.02	μg/L	1	5/6/2008 4:42:00 PM
Phenanthrene	ND	1.02	µg/L	1	5/6/2008 4:42:00 PM
Acenaphthylene	ND	1.02	μg/L	1	5/6/2008 4:42:00 PM
Fluorene	ND	1.02	μg/L	1	5/6/2008 4:42:00 PM
Anthracene	ND	1.02	μg/ L	1	5/6/2008 4:42:00 PM
Fluoranthene	ND	1.02	μg/L	1	5/6/2008 4:42:00 PM
Pyrene	ND	1.02	μg/L	1	5/6/2008 4:42:00 PM
Benzo(a)Anthracene	ND	0.406	μg/L	1	5/6/2008 4:42:00 PM
Chrysene	ND	1.02	μg/L	1	5/6/2008 4:42:00 PM
Benzo(b)Fluoranthene	ND	1.02	μg/L	1	5/6/2008 4:42:00 PM
Benzo(k)Fluoranthene	σи	1.02	μg/L	1	5/6/2008 4:42:00 PM
Benzo(a)Pyrene	ND	0.203	μg/Ľ	1	5/6/2008 4:42:00 PM
Indeno(1,2,3-cd)Pyrene	ND	0.406	μg/L	1	5/6/2008 4:42:00 PM
Dibenz(a,h)Anthracene	ND	0.406	μg/L	1	5/6/2008 4:42:00 PM
Beпzo(g,h,i)Perylene	ND	1.02	μg/L	1	5/6/2008 4:42:00 PM
Total PAH Target Concentration	ND	0	μg/L	1	5/6/2008 4:42:00 PM
Surr: 2,2'-Difluorobiphenyl	97.7	40-140	%REC	1	5/6/2008 4:42:00 PM
Surr: 2-Fluorobiphenyl	95.3	40-140	%REC	1	5/6/2008 4:42:00 PM
OLATILE ORGANIC COMPOUNDS	- SW8260R				Analyst: MR
1,1,1,2-Tetrachloroethane	ND	5.00	μg/L	1	5/8/2008 7:06:00 PM
1.1.1-Trichloroethane	ND	5.00	pg/L	1	5/8/2008 7:06:00 PM

- B Analyte detected in the associated Method Blank
- E Value above quantitation range
- J Analyte detected below quantitation limits
- S Spike Recovery outside recovery limits

- BRL Below Reporting Limit
- H Holding times for preparation or analysis exceeded
- ND Not Detected at the Reporting Limit

Reported Date: 15-May-08

CLIENT:

Fay, Spofford & Thorndike

Lab Order:

0805025

Project: Lab ID:

WM-046, 1.4 Exp

0805025-005

Client Sample ID: B5

Collection Date: 5/1/2008 2:20:00 AM

Date Received: 5/2/2008

Matrix: GROUNDWATER

Analyses	Result	Det. Limit	Qual Un	nits	DF	Date Analyzed
OLATILE ORGANIC COMPOUNDS	- SW8260B					Analyst: MF
1,1,2,2-Tetrachloroethane	ND	2.00	` µg/	Ľ	1	5/8/2008 7:06:00 PM
1,1,2-Trichloroethane	ND	5.00	μg/	r_	1	5/8/2008 7:06:00 PM
1,1-Dichloroethane	ND	5.00	μġ/	Ľ	1	5/8/2008 7:06:00 PM
1,1-Dichloroethene	ND	5.00	μġ/	Ľ	1	5/8/2008 7:06:00 PM
1,1-Dichloropropene	ND	5.00	μg/	'L	1	5/8/2008 7:06:00 PM
1,2,3-Trichlorobenzene	ND	5.00	μg/	L .	1	5/8/2008 7:06:00 PM
1,2,3-Trichloropropane	ND	5.00	μg/	L	1	5/8/2008 7:06:00 PM
1,2,4-Trichlorobenzene	ND	5.00	µg/	Ľ	1	5/8/2008 7:06:00 PM
1,2,4-Trimethylbenzene	ND	5.00	µg/	Ľ	1	5/8/2008 7:06:00 PM
1,2-Dibromo-3-Chloropropane	ND	5.00	µд/	L	1	5/8/2008 7:06:00 PM
1,2-Dibromoethane	ND	2.00	μg/	L	1	5/8/2008 7:06:00 PM
1,2-Dichlorobenzene	ND	5.00	μg/	L	1	5/8/2008 7:06:00 PM
1,2-Dichloroethane	ND	2.00	μg/	L	1	5/8/2008 7:06:00 PM
1,2-Dichloropropane	ND	2.00	μg/		1	5/8/2008 7:06:00 PM
1,3,5-Trimethylbenzene	ND	5.00	μg/		1	5/8/2008 7:06:00 PM
1,3-Dichlorobenzene	ND	5.00	μg/		1	5/8/2008 7:06:00 PM
1,3-Dichloropropane	ND	5.00	μg/		1	5/8/2008 7:06:00 PM
1,4-Dichlorobenzene	ND	5.00	μg/		1	5/8/2008 7:06:00 PM
2,2-Dichloropropane	ND	5.00	μg/		1	5/8/2008 7:06:00 PM
2-Butanone	ND	10.0	μg/		1	5/8/2008 7:06:00 PM
2-Chloroethyl Vinyl Ether	ND	5.00	μg/		1	5/8/2008 7:06:00 PM
2-Chlorotoluene	ND	5.00	, с µg/		1	5/8/2008 7:06:00 PM
2-Hexanone	ND	10.0	. о µg/		1	5/8/2008 7:06:00 PM
4-Chlorotoluene	ND	5.00	μg/		1	5/8/2008 7:06:00 PM
4-Isopropyltoluene	ND	5.00	μg/		1	5/8/2008 7:06:00 PM
4-Methyl-2-Pentanone	ND	5.00	, с /дц		1	5/8/2008 7:06:00 PM
Acetone	· ND	50.0	µg/		1	5/8/2008 7:06:00 PM
Acrolein	ND	50.0	µg/		1	5/8/2008 7:06:00 PM
Acrylonitrile	ND	50.0	гэ/ µg/		· 1	5/8/2008 7:06:00 PM
Benzene	ND	5.00	µg/		1	5/8/2008 7:06:00 PM
Bromobenzene	ND	5.00	µg/		1	5/8/2008 7:06:00 PM
Bromochloromethane	ND	2.00	ид/ Удц		, 1	5/8/2008 7:06:00 PM
Bromodichloromethane	ND	2.00	pg/		1	5/8/2008 7:06:00 PM
Bromoform	ND	2.00	μg/		1	5/8/2008 7:06:00 PM
Bromomethane	ND	2.00	μg/		1	5/8/2008 7:06:00 PM
Carbon Disulfide	ND	5.00	μg/		. 1	5/8/2008 7:06:00 PM
Carbon Tetrachloride	ND	2.00	ha. hay		1	5/8/2008 7:06:00 PM
Chlorobenzene	ND	5.00	μg/		1. 1.	5/8/2008 7:06:00 PM
Chloroethane	ND	5.00	, еч / ру		1	5/8/2008 7:06:00 PM
Chioroform	ND	5.00	ha\ ha\		, 1	5/8/2008 7:06:00 PM

Analyte detected in the associated Method Blank

Е Value above quantitation range

J Analyte detected below quantitation limits

Spike Recovery outside recovery limits

BRL Below Reporting Limit

H Holding times for preparation or analysis exceeded

ND Not Detected at the Reporting Limit

Reported Date: 15-May-08

CLIENT:

Fay, Spofford & Thorndike

Lab Order:

0805025

Project:

Lab ID:

WM-046, 1.4 Exp 0805025-005

Client Sample ID: B5

Collection Date: 5/1/2008 2:20:00 AM

Date Received: 5/2/2008

Matrix: GROUNDWATER

Analyses	Result	Det. Limit	Qual Units	DF	Date Analyzed
OLATILE ORGANIC COMPOUNDS	- SW8260B				Analyst: MR
Chloromethane	ND	5.00	μg/L	1	5/8/2008 7:06:00 PM
cis-1,2-Dichloroethene	ND	5.00	μg/L	1	5/8/2008 7:06;00 PM
cis-1,3-Dichloropropene	ND	0.500	µg/L	1	5/8/2008 7:06:00 PM
Dibromochloromethane	ND	2.00	μg/L	1	5/8/2008 7:06:00 PM
Dibromomethane	ND	5.00	μg/L	1	5/8/2008 7:06:00 PM
Dichlorodifluoromethane	ND	5.00	μg/L	1	5/8/2008 7:06:00 PM
Ethylbenzene	ND	5.00	μg/L	1	5/8/2008 7:06:00 PM
Hexachlorobutadiene	ND	0,500	μg/L	4	5/8/2008 7:06:00 PM
Isopropylbenzene	ND	5.00	μg/L	1	5/8/2008 7:06:00 PM
Methyl Tert-Butyl Ether	ND	5.00	μg/L	1	5/8/2008 7:06:00 PM
Methylene Chloride	ND	5.00	μg/L	1	5/8/2008 7:06:00 PM
Naphthalene	ND	20.0	μg/L	1	5/8/2008 7:06:00 PM
n-Butylbenzene	ND	5.00	μg/L	1	5/8/2008 7:06:00 PM
n-Propylbenzene	ND	5.00	μg/L	4	5/8/2008 7:06:00 PM
sec-Butylpenzene	ND	5.00	μ g/ L	1	5/8/2008 7:06:00 PM
Styrene	ND	5.00	μg/L	1	5/8/2008 7:06:00 PM
tert-Butylbenzene	ND	5.00	μg/L	1	5/8/2008 7:06:00 PM
Tetrachloroethene	ND	5.00	μg/L	1	5/8/2008 7:06:00 PM
Toluene	ND	5.00	μg/L	1	5/8/2008 7:06:00 PM
trans-1,2-Dichloroethene	ND	5.00	µg/L	- 1	5/8/2008 7:06:00 PM
trans-1,3-Dichloropropene	ND	0,500	μg/L	1	5/8/2008 7:06:00 PM
Trichloroethene	ND	5.00	μg/L	1	5/8/2008 7:06:00 PM
Trichlorofluoromethane	ND	5.00	µg/L	1	5/8/2008 7:06:00 PM
Vinyl Chloride	ND	2.00	µg/∟	1	5/8/2008 7:06:00 PM
Xylenes, Total	ND	5.00	μg/L	4	5/8/2008 7:06:00 PM
Surr: 1,2-Dichloroethane-d4	117	70-130	%REC	1	5/8/2008 7:06:00 PM
Surr: 4-Bromofluorobenzene	100	70-130	%REC	1	5/8/2008 7:06:00 PM
Surr: Dibromofluoromethane	116	70-130	%REC	.1	5/8/2008 7:06:00 PM
Surr: Toluene-d8	109	70-130	%REC	1	5/8/2008 7:06:00 PM
VPH - MADEP VPH					Analyst: kd
C9-C10 Aromatic Hydrocarbons	ND	75.0	μg/L	1	5/9/2008
Unadjusted C5-C8 Aliphatic	140	75.0		1	5/9/2008
Hydrocarbons			, 5, -		
Unadjusted C9-C12 Aliphatic Hydrocarbons	ND	. 75.0) µg/L	1	5/9/2008
Methyl Tert-Butyl Ether	96. <i>4</i>	5.00	, ,	1	5/9/2008
Benzene	12.6			1	5/9/2008
Toluene	6.35	5.00) μ g /L	1	5/9/2008
Ethylbenzene	ND	5.00) µg/L	1	5/9/2008

Analyte detected in the associated Method Blank В

Е Value above quantitation range

j Analyte detected below quantitation limits

Spike Recovery outside recovery limits

BRL Below Reporting Limit

Holding times for preparation or analysis exceeded H

Not Detected at the Reporting Limit

Reported Date: 15-May-08

CLIENT:

Fay, Spofford & Thorndike

Lab Order:

0805025

WM-046, 1.4 Exp

Project: Lab ID:

0805025-005

Client Sample ID: B5

Collection Date: 5/1/2008 2:20:00 AM

Date Received: 5/2/2008

Matrix: GROUNDWATER

Analyses	Result	Det. Limit	Qual	Units	DF	Date Analyzed
VPH - MADEP VPH						Analyst: kd
m,p-Xylene	8.76	5.00		μg/L	1	5/9/2008
o-Xylene	5.71	5.00		μg/L	1	5/9/2008
Naphthalene	20.3	20.0		μg/L	1	5/9/2008
Adjusted C5-C8 Aliphatic Hydrocarbons	ND	75.0		µg/L	1	5/9/2008
Adjusted C9-C12 Aliphatic Hydrocarbons	ND	75.0		µg/L	1	5/9/2008
Surr: 2,5-Dibromotoluene FID	84.1	70-130		%REC	1	5/9/2008
Surr: 2,5-Dibromotoluene PID	82.6	70-130		%REC	1	5/9/2008
CYANIDE, TOTAL - SM4500-CN-C.E						Analyst: WFR
Cyanide, Total	ND	0.0197		mg/L	4	5/12/2008
HEXAVALENT CHROMIUM - SM3500-CR-I)					Analyst: WFR
Chromium, Hexavalent	ND	0.0500	H	mg/L	1	5/6/2008
TOTAL RESIDUAL CHLORINE - HACH 816	57		-			Analyst: RP
Total Residual Chlorine	ND	0.162	Н	mg/L	1	5/5/2008

- В Analyte detected in the associated Method Blank
- Е Value above quantitation range
- J Analyte detected below quantitation limits
- Spike Recovery outside recovery limits

- BRL Below Reporting Limit
- Holding times for preparation or analysis exceeded
- ND Not Detected at the Reporting Limit

Reported Date: 15-May-08

CLIENT:

Fay, Spofford & Thorndike

Lab Order:

0805025

Project:

WM-046, 1.4 Exp

Lab ID:

0805025-006

Client Sample ID: Trip Blank

Collection Date: 5/1/2008

Date Received: 5/2/2008

Matrix: OTHER

Analyses	Result	Det. Limit	Qual Units	DF	Date Analyzed
VOLATILE ORGANIC COMPOUNDS	S - SW8260B				Analyst: MR
1,1,1,2-Tetrachloroethane	ND	5.00	μg/L	1	5/8/2008 7:39:00 PM
1,1,1-Trichloroethane	ND	5.00	μg/L	1	5/8/2008 7:39:00 PM
1,1,2,2-Tetrachloroethane	ND	2.00	μg/L	1	5/8/2008 7:39:00 PM
1,1,2-Trichloroethane	ND	5.00	μg/L	1	5/8/2008 7:39:00 PM
1,1-Dichloroethane	ND	5.00	µg/L	1	5/8/2008 7:39:00 PM
1,1-Dichloroethene	ND	5.00	μg/L	1	5/8/2008 7:39:00 PM
1,1-Dichloropropene	ND	5.00	μg/L	1	5/8/2008 7:39:00 PM
1,2,3-Trichlorobenzene	ND	5.00	μg/L	1	5/8/2008 7:39:00 PM
1.2,3-Trichloropropane	ND	5.00	μg/L	1	5/8/2008 7:39:00 PM
1,2,4-Trichlorobenzene	ND	5.00	μg/L	1	5/8/2008 7:39:00 PM
1,2,4-Trimethylbenzene	ND	5.00	μg/L	1	5/8/2008 7:39:00 PM
1,2-Dibromo-3-Chloropropane	ND	5.00	µg/L	1	5/8/2008 7:39:00 PM
1,2-Dibromoethane	ND	2.00	μg/L	1	5/8/2008 7:39:00 PM
1,2-Dichlorobenzene	ND	5.00	μg/L	1	5/8/2008 7:39:00 PM
1,2-Dichloroethane	ND	2.00	μg/L	1	5/8/2008 7:39:00 PM
1,2-Dichloropropane	ND	2.00	μg/L	1	5/8/2008 7:39:00 PM
1,3,5-Trimethylbenzene	ND	5.00	μg/L	1	5/8/2008 7:39:00 PM
1,3-Dichloroberizene	ND	5.00	μg/L	4	5/8/2008 7:39:00 PM
1,3-Dichloropropane	ND	5.00	μg/L	1	5/8/2008 7:39:00 PM
1,4-Dichlorobenzene	ND	5.00	μg/L	1	5/8/2008 7:39:00 PM
2,2-Dichloropropane	ND	5.00	µg/L	1	5/8/2008 7:39:00 PM
2-Butanone	ND	10.0	μg/L	1	5/8/2008 7:39:00 PM
2-Chloroethyl Vinyl Ether	ND	5.00	μg/L	1	5/8/2008 7:39:00 PM
2-Chlorotoluene	ND	5.00	µ9/L	1	5/8/2008 7:39:00 PM
2-Hexanone	ND	10.0	μg/L	1	5/8/2008 7:39:00 PM
4-Chlorotoluene	ND	5.00	μg/L	1	5/8/2008 7:39:00 PM
4-Isopropyltoluene	ND	5.00	μg/ L	1	5/8/2008 7:39:00 PM
4-Methyl-2-Pentanone	ND	5.00	μg/L	1	5/8/2008 7:39:00 PM
Acetone	ND	50.0	μg/L	1	5/8/2008 7:39:00 PM
Acrolein	ND	50.0	μg/L	1	5/8/2008 7:39:00 PM
Acrylonitrile	ND	50.0	μg/L	1	5/8/2008 7:39:00 PM
Benzene	ND	5,00	μg/L	1	5/8/2008 7:39:00 PM
Bromobenzene	ND	. 5,00	μg/L	1	5/8/2008 7:39:00 PM
Bromochioromethane	ND	2.00	μg/L	1	5/8/2008 7:39:00 PM
Bromodichloromethane	ND.	2.00	μg/L	1	5/8/2008 7:39:00 PM
Bromoform	ND	2.00	μ g/L	1	5/8/2008 7:39:00 PM
Bromomethane	ND	2.00	μg/L	1	5/8/2008 7:39:00 PM
Carbon Disulfide	ND	5.00	μg/L	1	5/8/2008 7:39:00 PM
Carbon Tetrachloride	ND	2.00	μg/L	1	5/8/2008 7:39:00 PM
Chlorobenzene	ND	5.00	μg/L	1	5/8/2008 7:39:00 PM

Qualifiers:

- B Analyte detected in the associated Method Blank
- E Value above quantitation range
- J Analyte detected below quantitation limits
- S Spike Recovery outside recovery limits

- BRL Below Reporting Limit
- H Holding times for preparation or analysis exceeded
- ND Not Detected at the Reporting Limit

Reported Date: 15-May-08

CLIENT:

Fay, Spofford & Thorndike

Lab Order:

0805025

Project:

WM-046, 1.4 Exp

Lab ID:

0805025-006

Client Sample ID: Trip Blank

Collection Date: 5/1/2008 Date Received: 5/2/2008

Matrix: OTHER

Analyses	Result	Det. Limit	Qual Units	DF DF	Date Analyzed
VOLATILE ORGANIC COMPOUNDS	- SW8260B				Analyst: MR
Chloroethane	ND	5.00	µg/L	1	5/8/2008 7:39:00 PM
Chloroform	ND	5.00	μg/L	1	5/8/2008 7:39:00 PM
Chloromethane	ND	5.00	µg/L	1	5/8/2008 7:39:00 PM
cis-1,2-Dichloroethene	ND	5.00	μ g/L	1	5/8/2008 7:39:00 PM
cis-1,3-Dichloropropene	ND	0.500	μg/L	1	5/8/2008 7:39:00 PM
Dibromochloromethane	ND	2.00	µg/L	1	5/8/2008 7:39:00 PM
Dibromomethane	ND	5.00	μg/L	1	5/8/2008 7:39:00 PM
Dichlorodifluoromethane	ND	5.00	μg/L	1	5/8/2008 7:39:00 PM
Ethylbenzene	ND	5.00	μg/L	1	5/8/2008 7:39:00 PM
Hexachiorobutadiene	ND	0.500	μg/L	1	5/8/2008 7:39:00 PM
Isopropylbenzene	ND	5.00	μg/L	1	5/8/2008 7:39;00 PM
Methyl Tert-Butyl Ether	ND	5.00	μg/L	1	5/8/2008 7:39:00 PM
Methylene Chloride	ND	5.00	μg/L	1	5/8/2008 7:39:00 PM
Naphthalene	ND	20.0	μg/L	1	5/8/2008 7:39:00 PM
n-Butylbenzene	ND	5.00	μg/L	1 .	5/8/2008 7:39:00 PM
n-Propylbenzene	ND	5.00	μ g/L	1	5/8/2008 7:39:00 PM
sec-Butylbenzene	ND	5.00	μg/L	1	5/8/2008 7:39:00 PM
Styrene	ND	5.00	μg/L	1	5/8/2008 7:39:00 PM
tert-Butylbenzene	ND	5.00	μg/L	1	5/8/2008 7:39:00 PM
Tetrachioroethene	ND	5,00	μg/L	1	5/8/2008 7:39:00 PM
Toluene	.ND	5.00	μg/L	. 1	5/8/2008 7:39:00 PM
trans-1,2-Dichloroethene	ND.	5.00	μg/L	<u> </u>	5/8/2008 7:39:00 PM
trans-1,3-Dichloropropene	ND	0.500	μg/L	1	5/8/2008 7:39:00 PM
Trichloroethene	ND	5.00	μg/L	1	5/8/2008 7:39:00 PM
Trichlorofluoromethane	ND	5.00	μg/L	1	5/8/2008 7:39:00 PM
Vinyl Chloride	ND	2,00	μg/L	1	5/8/2008 7:39:00 PM
Xylenes, Total	ND	5,00	μg/L	1	5/8/2008 7:39:00 PM
Surr: 1,2-Dichloroethane-d4	115	70-130	%REC	1	5/8/2008 7:39:00 PM
Surr: 4-Bromofiuorobenzene	103	70-130	%REC	1	5/8/2008 7:39:00 PM
Surr: Dibromofluoromethane	117	70-130	%REC	1	5/8/2008 7:39:00 PM
Surr: Toluene-d8	108	70-130	%REC		5/8/2008 7:39:00 PM
/PH - MADEP VPH					Analyst: kd
C9-C10 Aromatic Hydrocarbons	ND	75.0	μg/L	1	5/13/2008
Unadjusted C5-C8 Aliphatic Hydrocarbons	ND	75.0	μg/L	1	5/13/2008
Unadjusted C9-C12 Aliphatic Hydrocarbons	ND	75.0	μg/L	1	5/13/2008
Methyl Tert-Butyl Ether	ND	5.00	μg/L	1	5/13/2008
Benzene	ND	5.00	μg/L	1	5/13/2008

Qualifiers:

- Analyte detected in the associated Method Blank
- \mathbf{E} Value above quantitation range
- Analyte detected below quantitation limits
- Spike Recovery outside recovery limits

- BRL Below Reporting Limit
- Holding times for preparation or analysis exceeded
- ND Not Detected at the Reporting Limit

Reported Date: 15-May-08

CLIENT:

Fay, Spofford & Thorndike

Lab Order:

0805025

Project:

WM-046, 1.4 Exp

Lab ID:

0805025-006

Client Sample ID: Trip Blank

Collection Date: 5/1/2008

Date Received: 5/2/2008

Matrix: OTHER

Analyses	Result	Det. Limit	Qual (Units	DF	Date Analyzed
VPH - MADEP VPH						Analyst: kd
Toluene	ND	5.00	ŀ	ug/L	1	5/13/2008
Ethylbenzene	ND	5.00	ŀ	ug/L	1	5/13/2008
m,p-Xylene	ND	5.00	ŀ	ug/L	1	5/13/2008
o-Xylene	ND	5.00	ŀ	ig/L	1	5/13/2008
Naphthalene	ND	20.0	ŀ	ug/ L	1	5/13/2008
Adjusted C5-C8 Aliphatic Hydrocarbons	ND	75.0	. 1	ug/L ∙	1	5/13/2008
Adjusted C9-C12 Aliphatic Hydrocarbons	ND	75.0	٢	ıg/L	1	5/13/2008
Surr: 2,5-Dibromotoluene FID	74.7	70-130	9	%REC	1	5/13/2008
Surr: 2,5-Dibromotoluene PID	76.8	70-130	9	%REC	1	5/13/2008

Analyte detected in the associated Method Blank

Е Value above quantitation range

Analyte detected below quantitation limits

S Spike Recovery outside recovery limits

Holding times for preparation or analysis exceeded Н

Not Detected at the Reporting Limit

Fay, Spofford & Thorndike CLIENT:

0805025 Work Order: WM-046, 1.4 Exp Project:

ANALYTICAL QC SUMMARY REPORT

Date: 15-May-08

TestCode: 6010B_W

Sample ID: MB-10051	SampType: MBLK	TestCoc	TestCode: 6010B_W	Units: mg/L		Prep Date	Prep Date; 5/2/2008	RunNo: 23445	9	
Client ID: ZZZZ	Batch ID: 10051	Test	TestNo: SW6010B	(SW3010A)		Analysis Dat	Analysis Date: 5/3/2008	SeqNo: 233260	90	
Analyte	Result	Pal	SPK value	SPK value SPK Ref Val	%REC	LowLimit	%REC LowLimit HighLimit RPD Ref Val		%RPD RPDLimit Qual	Qual
Barium	QN	2.00								
Cadmium	QN	0.00400								
Chromium	QN	0.100								
Copper	QN	0.0400		•						
Iron	<u>N</u>	0.0600								
Lead	QN	0.0100							٠	
Nickel	QN	0.100								
Selenium	QN	0.0500								

		***************************************	***************************************					
Sample ID: LCS-10051	SampType: LCS	TestCo	TestCode: 6010B_W	Units: mg/L		Prep Dat	Prep Date: 5/2/2008	RunNo; 23445
Client ID: ZZZZZ	Batch ID: 10051	Test	estNo: SW6010B	(SW3010A)	~	Analysis Dat	Analysis Date: 5/3/2008	SeqNo: 233261
Analyte	Result	PQL	SPK value	SPK value SPK Ref Val	%REC	LowLimit	%REC LowLimit HighLimit RPD Ref Val	%RPD RPDLimit Qual
Barium	QN	2.00	****	0	88.9	80	120	
Cadmium	1.768	0.00400	2	0	88.4	80	120	
Chromium	1.783	0.100	2	0	89.2	80	120	
Copper	1.808	0.0400	2	. 0	90.4	80	120	
Iron	1.821	0.0600	8	0	91.0	80	120	
Lead	1.821	0.0100	2	0	91.0	80	120	
Nickel	1.820	0.100	2	0	91.0	. 80	120	
Selenium	1.865	0.0500	2	0	93.2	80	120	

BRL Below Reporting Limit Qualifiers:

Analyte detected below quantitation limits Spike Recovery outside recovery limits

E Value above quantitation range

ND Not Detected at the Reporting Limit

H Holding times for preparation or analysis exceeded R RPD outside recovery limits

RPD outside recovery limits

Page 2 of 33

PORT	
REP	
IARY	
UMUM	
OC SUI	
CAL (
_	
XIII	
ANALYTIC	

Fay, Spofford & Thorndike

WM-046, 1.4 Exp

0805025

Work Order: CLIENT:

Project:

TestCode: 8082_w

Sample ID: MB-10073	SampType: MBLK	TestCode: 8082_w	Units: µg/L	Prep Date: 5/6/2008	8 RunNo: 23512
Client ID: ZZZZZ	Batch ID: 10073	TestNo: SW8082	(SW3510B)	Analysis Date: 5/6/2008	8 SeqNo: 231034

		,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	ı											1			ſ					1	J		
		Qual														Quai									Qual
2	34	RPDLimit												2	35	RPDLimit							2	142	RPDLimit
RunNo: 23512	SeqNo: 231034	%RPD												RunNo: 23512	SeqNo: 231035	%RPD							RunNo: 23512	SeqNo: 231042	%RPD
전	й	ef Val	-											 	Š	ef Val							Ŋ	Ϋ́	ef Val
800	800	t RPD Ref Val								_	~	~		908	800	t RPD Ref Val	0	-		0	_	0	800	800	it RPD Ref Val
5/6/2008	: 5/6/2008	HighLimit								150	150	150	150	5/6/2008	3: 5/6/2008	HighLimít	140	140	150	150	150	150	5/6/2008	s: 5/6/2008	HighLimit
Prep Date:	Analysis Date:	LowLimit		•						30	30	30	30	Prep Date:	Analysis Date:	LowLimit	40	40	30	30	30	30	Prep Date:	Analysis Date:	LowLimit
	₹	%REC								103	108	80.0	86.0		∢	%REC	75.0	83.0	107	97.0	86.0	81.0		4	%REC
Units: µg/L	(SW3510B)	SPK Ref Val								0	0	0	0	Units: µg/L	(SW3510B)	SPK Ref Val	0	0	0	0	0	0	Units: µg/L	(SW3510B)	SPK Ref Val
12_w	18082	SPK value SF								100	100	100	100	32_w	18082	SPK value SI	100	100	100	100	100	100	32_w	18082	SPK value Si
estCode: 8082_w	TestNo: SW8082													estCode: 8082_w	TesiNo: SW8082								estCode: 8082_w	TestNo: SW8082	
TestC	je L	PQL	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0	0	0	0	Test	Te	POL	0.300	0.300	0	0	0	0	Test	Te	POL
MBLK	10073	Result	QN	9	9	QN	Q	9	R	103.0	108.0	80.00	86.00	SOT	10073	Result	75.00	83.00	107.0	97.00	86.00	81.00	SOT	10073	Result
SampType: MBLK	Batch ID: 10073													SampType: LCS	Batch ID: 10073								SampType: LCS	Batch ID: 10073	
SS	_									Sig 1	Sig 2	ne Sig 1	ne Sig 2	Se	_				Sig 1	Sig 2	ne Sig 1	ne Sig 2	Ss		
10073	72									Surr: Decachlorobiphenyl Sig	Surr: Decachlorobiphenyl Sig 2	Surr: Tetrachloro-m-Xylene Sig	Surr: Tetrachloro-m-Xylene Sig 2	-10073	ZZ		12		Surr; Decachlorobiphenyl Sig.	Surr; Decachlorobiphenyl Sig 2	Surr: Tetrachloro-m-Xylene Sig 1	Surr: Tetrachloro-m-Xylene Sig 2	2-10073	ZZ	
Sample ID: MB-10073	D: ZZZZZ		1221	1232	1248	1254	1260	1262	1268	: Decachik	Decachic	Tetrachk	: Tetrachk	Sample ID: LCS-10073	D: ZZZZZ	**	Aroctor 1016/1242	1260	: Decachit	Decachit	Tetrachi	: Tetrachl	Sample ID: LCS2-10073	D: ZZZZZ	д.
Sample	Client ID:	Analyte	Araclar 122	Aroclor 1232	Aroclor 1248	Aroclor 1254	Araclar 1260	Aroclor 1262	Aroclor 1268	Surr	Surr	Surr	Sur	Sample	Client ID:	Analyte	Aroctor	Aroclor 1260	Surr	Surr	Surr	Sur	Sample	Client ID:	Analyte

Client ID: ZZZZZ		Batch ID: 10073	TestNo:	TestNo: SW8082	(SW3510B)		Analysis Date: 5/6/2008	e: 5/6/2 00	œ	SeqNo: 231042	042	
Analyte		Result	Pal	SPK value	SPK value SPK Ref Val	%REC	LowLimit	HighLimit	%REC LowLimit HighLimit RPD Ref Val	%RPD	%RPD RPDLImit Qu	8
Arocior 1016/1242 Arocior 1221	11242	75.00 ND	0.300	100	0	75.0	40	140				
Aroclor 1232		QN	0.300									
Qualifiers:	BRL Below Reporting Limit	NAMES AND ADDRESS OF THE PROPERTY OF THE PROPE		E Value	Value above quantitation range	nge	200	H	Holding times for preparation or analysis exceeded	preparation or an	alysis exceede	l g
i	J Analyte detected below quantitation limits	quantitation limits		ND Not De	Not Detected at the Reporting Limit	ug Limit		~	RPD outside recovery limits	rery limits		
	S Spike Recovery outside recovery limits	recovery finnits									Pa	Page 2

ANALYTICAL QC SUMMARY REPORT

Fay, Spofford & Thorndike

WM-046, 1.4 Exp

0805025

Work Order: CLIENT:

Project:

TestCode: 8082_w

Sample ID: LCS2-10073	SampType: LCS	TestCoc	TestCode: 8082_w	Units: µg/L		Prep Dat	Prep Date: 5/6/2008	RunNo: 23512	3512	
Client ID: ZZZZZ	Batch ID: 10073	Testh	estNo: SW8082	(SW3510B)		Analysis Dal	Analysis Date: 5/6/2008	SeqNo: 231042	31042	
Analyte	Result	PQL	SPK value	SPK value SPK Ref Val	%REC	LowLimit	%REC LowLimit HighLimit RPD Ref Val		%RPD RPDLimit Qual	Qual
Aroclor 1248	QN	00:300			***************************************					
Aroclor 1254	ON .	0.300								
Aroclor 1260	81.00	0.300	100	0	81.0	40	140			
Aroclor 1262	QN	0.300								
Aroclor 1268	ON.	0.300								
Surr: Decachlorobiphenyl Sig 1	1 102.0	0	100	0	102	30	150			
Surr: Decachlorobiphenyl Sig 2	2 88.00	0	100	0	88.0	30	150			
Surr: Tetrachloro-m-Xylene Sig 1	g 1 82.00	0	100	0	82.0	30	150			
Surr: Tetrachloro-m-Xylene Sig 2	g 2 77.00	0	100	0	77.0	30	150			

BRL Below Reporting Limit Qualifiers:

Analyte detected below quantitation limits

Spike Recovery outside recovery limits

E Value above quantitation range ND Not Detected at the Reporting Limit

Holding times for preparation or analysis exceeded

RPD outside recovery limits

CLIENT: Fay, Spofford & Thorndike

Work Order: 0805025

Project: WM-046, 1.4 Exp

	×	
	Δ	
١	ᆽ	
į	90978	
Ç	20	
	ė	
•	돗	
C	۲	
	Lest Code:	
_	9	
•	_	

Sample ID: MB	SampType: MBLK	TestCode: 8	TestCode: 8260B W	Units: µg/L		Prep Date:			RunNo: 23612	612	
Client ID: ZZZZZ	Batch ID: R23612	TestNo	TestNo: SW8260B		Αņ	Analysis Date:	5/8/2008		SedNo: 232929	2929	
Analyte	Resuit	Pal	SPK value	SPK Ref Val	%REC L	LowLimit F	ghLimit	RPD Ref Val	%RPD	RPDLímit	Quai
1.1.2-Tetrachloroethane	QN	5.00									
1,1,1-Trichloroethane	Ð	5.00									
1,1,2,2-Tetrachloroethane	QN	2,00		•							
1,1,2-Trichloroethane	ON	5.00					4				
1,1-Dichloroethane	QN	5.00	••								
1,1-Dichloroethene	- Q	5.00									
1,1-Dichloropropene	QN	5.00			٠						
1,2,3-Trichlorobenzene	QN	5.00									
1,2,3-Trichloropropane	ON.	5.00								-	
1,2,4-Trichlorobenzene	ON.	5.00									
1,2,4-Trimethylbenzene	2	5.00			-						
1,2-Dibromo-3-Chioropropane	ON.	5.00									
1,2-Dibromoethane	QN	2.00									
1,2-Dichlorobenzena	Q	5.00									
1,2-Dichloroethane	QN	2.00					٠				
1,2-Dichloropropane	QN	2.00									
1,3,5-Trimethylbenzene	Q	5.00									
1,3-Dichlorobenzene	Q	5.00									
1,3-Dichloropropane	Ñ	9.00									
1,4-Dichlorobenzene	QN	5,00									
2,2-Dichloropropane	QN	5.00									
2-Butanone	ON	10.0					-				
2-Chloroethyl Vinyl Ether	QN	5.00									
2-Chlorotoluene	QN	5.00									
2-Hexanone	QN	10.0									
4-Chiorotoluene	Q	2.00									
4-Isopropyltoluene	ON.	5.00									
4-Methyt-2-Pentanone	S	5.00					٠				
Acetone	S	50.0									
Acrolein	QN	50.0									
Acrytonitrile	QN	50.0									
Qualifiers: BRL Below Reporting Limit	rting Limit		E Value a	Value above quantitation range	ge		H Holdin	g times for pr	reparation or a	Holding times for preparation or analysis exceeded	eq
J Analyte detec	Analyte detected below quantitation limits		ND Not Det	Not Detected at the Reporting Limit	g Limit		R RPD or	RPD outside recovery limits	ry limits		
S Spike Recove	Spike Recovery outside recovery limits									, O	Page A of 33

Analyte detected below quantitation limits Spike Recovery outside recovery limits

Fay, Spofford & Thorndike CLIENT:

0805025 Work Order: WM-046, I.4 Exp Project:

TestCode: 8260B_w

	7 - C	- C - H	111								
Sample in: MB	Sampiype: MBLA	lesicode: 8200B_W	W_BUGS	OURS: hg/L		Prep Date:			KunNo: 23612	612	
Client ID: ZZZZZ	Batch ID: R23612	TestNo:	TestNo: SW8260B		Апа	Analysis Date:	5/8/2008	æ	SeqNo: 232929	2929	
Analyte	Result	PQL S	SPK value	SPK Ref Val	%REC Lo	LowLimit Hi	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Benzane	QN	5.00									
Bromobenzene	ON.	2.00									•
Bromochloromethane	ND	2.00				-					
Bromodichloromethane	ON.	2.00	-	-							
Bromoform	9	2.00									
Bromomethane	QV.	2.00									
Carbon Disulfide	QN	5.00									
Carbon Tetrachloride	Q.	2.00									
Chlorobenzene	QN	5.00			٠						
Chloroethane	QN	5.00				÷					
Chloroform	QN	5.00									
Chloromethane	QN	5.00									
cis-1,2-Dichloroethene	QN	5.00									
cis-1,3-Dichloropropene	QN	0.500									
Dibromochloromethane	QV.	2.00									
Dibromomethane	Ð	5.00									
Dichlorodifluoromethane	QN	5.00									
Ethylbenzene	ND	5.00									
Hexachlorobutadiene	0.6700	0.500									
{sopropy!benzene	QN	5.00									
Methyl Tert-Butyl Ether	QN	5.00				÷					
Methylene Chloride	QN	5.00									
Naphthalene	QN	20.0									
n-Butylbenzene	QN	5.00									
n-Propylbenzene	QN	5.00									
sec-Butylbenzene	ON	5.00									
Styrene	OZ.	5.00									
tert-Butylbenzene	QN	5.00									
Tetrachloroethene	QN	5.00									
Toluene	QN	5,00									
trans-1,2-Dichloroethene	ΩN	5.00									
Oualifiers: BRL Below Reporting Limit	ding Linit		'	Value above quantitation range			H	Holding times for preparation or analysis exceeded	reparation or ar	nalvsis exceede	. Pa
_	Analyte detected below on antitation limits	2	_	Not Detected at the Reporting Uniting	T innit			PPD outeide recovery limits	Transfer		?
and of the contract of		÷ •		Secretary on an appropri	#.d81111.			J D Cumatur I tectric	ay tauns		

Fay, Spofford & Thorndike CLIENT:

0805025 Work Order:

WM-046, 1.4 Exp Project:

1R w	
- 8260R	
TestCode:	
-	

Sample ID: MB	SampType: MBLK	TestCode: 8260B_W	8260B_W	Units: µg/L		Prep Date:	່ ບໍ່		RunNo: 23612	
Client ID: ZZZZZ	Batch ID; R23612	TestNo:	TestNo: SW8260B		7.	Analysis Date:	e: 5/8/2008		SeqNo: 232929	
Analyte	Result	Pal	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit R	RPD Ref Val	%RPD RPDLimit	Qual
trans-1,3-Dichioropropene	QN	0.500		diddid a control of the control of t						
Trichloroethene	QN .	5.00								
Trichlorofluoromethane	QV	5.00								
Vinyl Chloride	ON	2.00						·		
Xylenes, Total	QN	5.00								
Surr: 1,2-Dichloroethane-d4	33.99	0	30	0	113	70	130			
Surr: 4-Bromofluorobenzene	. 29.90	٥	30	0	2.66	70	130			
Surr: Dibromofluoromethane	24.98	0	30	0	83.3	70	130			
Surr: Toluene-d8	28.48	0.	30	. 0	94.9	70	130			
Sample ID: MB	SampType: MBLK	TestCode: 8260B_W	8260B W	Units: µg/L		Prep Date:	e:		RunNo: 23706	
Client ID: ZZZZZ	Batch ID: R23706	TestNo:	TestNo: SW8260B			Analysis Date:	e: 5/14/2008		SeqNo: 233193	
Analyte	Result	POL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Vai	%RPD RPDLimit	Qual
1,1,1,2-Tetrachloroethane	QN	5.00	***************************************							
1,1,1-Trichloroethane	QN	5.00							•	
1,1,2,2-Tetrachloroethane	9	2.00					-			
1,1,2-Trichloroethane	QN	5.00								
1,1-Dichloroethane	QN	5.00								
1,1-Dichloraethene	QV.	5.00								
1,1-Dichloropropene	QV	5.00								-
1,2,3-Trichlorobenzene	QV	5.00								
1,2,3-Trichloropropane	Q	5.00								
1,2,4-Trichlorobenzene	Q	5.00								
1,2,4-Trimethylbenzene	ON	5.00								
1,2-Dibromo-3-Chloropropane	QV	5.00								
1,2-Dibromoethane	QN	2.00								
1,2-Dichlorobenzene	Q.	5.00		~						
1,2-Dichloroethane	CN	2.00								
1,2-Dichloropropane	QN	2.00								
Onalifiers: BRI, Below Reporting Limit	ting Limit		E Value	Value above quantitation range)ge		н но	Iding times for p	Holding times for preparation or analysis exceeded	ded
	Analyte detected below quantitation limits		_	Not Detected at the Reporting Limit	g Limit		R R	RPD outside recovery limits	ery limits	
S Spike Recove	Spike Recovery outside recovery limits								Ĭ	Page 6 of 33

Page 7 of 33

•	
VULLATION STIMMADO	
	こうつく
ANAIVTI	

TestCode: 8260B_w

1.4 Exp
WM-046,
Project:

Fay, Spofford & Thorndike

0805025

Work Order:

CLIENT:

	The second secon										
Sample ID: MB	SampType: MBLK	TestCo	TestCode; 8260B_W	Units: µg/L		Prep Date:	je.		RunNo: 23706	90	
Citent ID: ZZZZ	Batch ID: R23706	Test	TestNo: SW8260B		∢	Analysis Date:	ie: 5/14/2008	90	SeqNo: 233193	193	
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit HighLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
1,3,5-Trimethylbenzene	QN ·	5.00									
1,3-Dichlorobenzene	Q	2.00									
1,3-Dichloropropane	QN	5.00									
1,4-Dichlorobenzene	QN	5,00									
2,2-Dichloropropane	QN	5,00									
2-Butanone	Q	10.0									
2-Chloroethyl Vinyl Elher	QN	5.00									
2-Chlorotoluene	Q	5.00									
2-Hexanone	QN	10.0									
4-Chlorotoluene	QN	5.00									
4-tsopropyltoluene	QN	5.00									
4-Methyl-2-Pentanone	Q	5.00					,				
Acetone	QN .	50.0									
Acrolein	9	50.0									
Acrylonitrile	9	50.0								-	
Benzene	QN	5.00									
Bromobenzene	Q	5.00	,								
Bromochloromethane	Q	2.00									
Bromodichloromethane	Q	2.00									
Bromoform	Q	2.00									
Вгототефале	QN	2.00									
Carbon Disulfide	Q	5.00									
Carbon Tetrachloride	QN	2.00	•								
Chlorobenzene	QN	5.00									
Chloroethane	QN .	5.00						•		•	
Chloroform	Q	5.00									
Chloromethane	QN	5.00									
cis-1,2-Dichloroethene	QN	5.00									
cis-1,3-Dichloropropene	QN	0.500									
Dibromochloromethane	ON	2.00			÷						

T 2220			covery fimits	Spike Recovery outside recovery limits
R RPD outside recovery fimits	ND Not Detected at the Reporting Limit	ND	iantitation limits	J Analyte detected below quantitation limits
H Holding times for preparation or analysis exceeded	B Value above quantitation range	Œ		
		5.00	QN	Dibromomethane
		2.00	S	Dibromochloromethane
		0.500	S	cis-1,3-Dichloropropene
		5.00	QN	cis-1,2-Dichloroethene
		5.00	QN	Chloromethane
		5.00	Q	Chloroform
		5.00	QN .	Chloroethane
		5.00	QN	Chlorobenzene
		2.00	Q	Carbon Tefrachloride
		5.00	Q	Carbon Disulfide
		2.00	QN	Bromomethane
			i	

Page 8 of 33

H Holding times for preparation or analysis exceeded R RPD outside recovery limits

Qual

%RPD RPDLimit

%REC LowLimit HighLimit RPD Ref Val

130

70

108

!	
	¥
	\supset
1	Ξ,
Ì	Y
ď	Y
	$\overline{}$
þ	~
- 6	¥
•	◂
ì	↸
-	≘
,	<u> </u>
ζ	
7	
	\asymp
(_
(_
,	7
(ICAL (
	YIICAL (
	LYTICAL
	ALYTICAL (
	VALYTICAL (
	NALYTICAL
	LYTICAL
	ANALYTICAL
	ANALYTICAL
	ANALYTICAL
	ANALYTICAL

TestCode: 8260B_w

WM-046, 1.4 Exp **Project**:

Fay, Spofford & Thorndike

0805025

Work Order: CLIENT:

tple ID: MB	SampType; MBLK	TestCode: 8260B_W	Units: µg/L		Prep Date:		RunNo: 23706
nt ID: ZZZZZ	Batch ID: R23706	TestNo: SW8260B		*	Analysis Date: 5/14/2008	4/2008	SeqNo: 233193
lyte	Result	PQL SPK value SPK Ref Val	SPK Ref Val	%REC	LowLimit HighLi	%REC LowLimit HighLimit RPD Ref Val	%RPD RPDLim

Sample ID: MB	SampType: MBLK	TestCoc	TestCode: 8260B_W	Units: µg/L		Prep Date:			RunNo: 23706	90	
Client ID: ZZZZ	Batch ID: R23706	Testh	estNo: SW8260B		•	Analysis Date:	5/14/2008		SeqNo: 233193	193	
Analyte	Result	PQL	SPK value	SPK Ref Vai	%REC	LowLimit	HighLimit RF	RPD Ref Val	%RPD	RPDLimit	Qual
Dichlorodifluoromethane	QN	5.00									
Ethylbenzene	ON N	5.00									
Hexachlorobutadiene	QV	0.500									
Isopropylbenzene	QN	5.00									
Methyl Tert-Butyl Ether	QN	5.00									
Methylene Chloride	QN	5.00									
Naphthalene	Q	20.0									
n-Butylbenzene	QN	5.00			•						
n-Propylbenzene	QN	5.00									
sec-Butylbenzene	QN	5.00									
Styrene	QN	5.00									
tert-Butylbenzene	QN	5,00									
Tetrachloroethene	QN	5.00									
Toluene	CIN	5.00									
trans-1,2-Dichloroethene	Ð	5.00							•		
trans-1,3-Dichloropropene	QN	0.500									
Trichloroethene	ON	5.00									
Trichlorofluoromethane	ON	5.00								-	
Vinyl Chloride	QN	2.00									
Xylenes, Total	QN ·	5.00									
Surr: 1,2-Dichloroethane-d4	26.45	0	30	0	88.2	70	130				
Surr: 4-Bromofluorobenzene	24.75	0	30	0	82.5	20	130				
Surr: Dibromofluoromethane	33.39	0	30	0	##	20	130				
Surr: Toluene-d8	30.02	0	30	0	100	70	130		***************************************		
Sample ID: LCS	SampType: LCS	TestCor	TestCode: 8260B_w	Units: µg/L		Prep Date:			RunNo: 23612	112	
Client ID: ZZZZZ	Batch ID: R23612	Test	TestNo: SW8260B		`	Analysis Date: 5/8/2008	5/8/2008		SeqNo: 232927	927	

Analyte			Result	Pal	SPK value	PQL SPK value SPK Ref Val
1,1,1,2-Tetrachloroethane	chloroe	thane	53.76	5.00	50	0
Qualifiers:	BRL	BRL Below Reporting Limit J Analyte detected below quantitation limits	natitation limits	- Parket and the second	E Value	E Value above quantitatio ND Not Detected at the Rep

S pike Recovery outside recovery limits

S Spike Recovery outside recovery limits

Fay,Spofford & Thorndike 0805025 CLIENT:

Work Order:

WM-046, 1.4 Exp

Project:

Took

ż	
ST0078	•
est Code:	
Les	

Sample ID: LCS	SampType: LCS	TestCo	TestCode: 8260B_w	Units: µg/L		Prep Date:	ōi		RunNo: 23612	
Client ID: ZZZZZ	Batch ID: R23612	Test	TestNo: SW8260B			Analysis Date:	e: 5/8/2008	80	SeqNo: 232927	
Analyte	Result	Pal	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD RPDLimit	mit Qual
1,1,1-Trichloroethane	51.40	5.00	50	0	103	70	130	Address of the second s		
1,1,2,2-Tetrachloroethane	49.87	2.00	50	0	99.7	70	130			
1,1,2-Trichloroethane	56.74	5.00	20	0	113	70	130			
1,1-Dichloroethane	99'29	5.00	90	0	115	70	130			
1,1-Dichloroethene	62.50	5.00	50	0	125	70	130			
1,1-Dichloropropene	51.00	5.00	50	0	102	20	130			
1,2,3-Trichlorobenzene	36.89	5.00	50	0	73.8	20	130			
1,2,3-Trichloropropane	54.62	5.00	. 50	0	109	70	130			
1,2,4-Trichlorobenzene	34.62	5.00	50	0	69.2	70	130			S
1,2,4-Trimethylbenzene	49.52	5.00	20	0	0.66	70	130			
1,2-Dibromo-3-Chloropropane	52.54	5.00	50	0	105	70	130			
1,2-Dibromoethane	55.11	2.00	50	0	110	20	130			
1,2-Dichlorobenzene	43.06	5.00	50	0	86.1	20	130			
1,2-Dichloroethane	61.91	2.00	50	0	124	70	130			
1,2-Dichloropropane	48.76	2,00	50	0	97.5	70	130			
1,3,5-Trimethylbenzene	48.58	5.00	50	0	97.2	20	130			
1,3-Dichlorobenzene	40.75	5.00	50	0	81.5	20	130			
1,3-Dichloropropane	57.70	5.00	50	0	115	70	130			
1,4-Dichlorobenzene	43.15	5.00	20	0	86.3	20	130			
2,2-Dichloropropane	54.28	2.00	20	0	109	70	130			
2-Butanone	54.42	10.0	50	0	109	70	130			
2-Chloroethyl Vinyl Ether	52.09	5.00	50	0	104	70	130	•		
2-Chlorotoluene	43.30	5.00	50	0	9.98	70	130			
2-Hexanone	46.57	10.0	50	0	93.1	70	130			
4-Chlorotoluene	46.38	5.00	50	0	92.8	20	130			
4-isopropyitoluene	48.22	5.00	20	0	96.4	70	130			
4-Methyl-2-Pentanone	54.80	5.00	50	0	110	70	130			
Acetone	27.68	50.0	50	0	115	70	130			
Acrylonitrile	111.5	50.0	100	0	112	70	130			
Вепzепе	55.53	5.00	20	0	<u>*-</u>	70	130			
Bromabenzene	42.04	5.00	20	0	84.1	70	130			
Ouglifiers: BRL Below Reporting Limit	ting Limit		E Value a	Value above quantitation range	986	The second secon	H H	Colding times for r	Holding times for preparation or analysis excended	cended
-	Analyse detected halow manifestion limits		_	Not Detected at the Depocitive Unit	o I imit			OD outside second	Apparation of analysis to	ייייייי
values or Cardell C	otes between quantum			CORN at the responsi	E Casana			N. D. Outstue tecovery timits	ay immis	

Spike Recovery outside recovery limits

CLIENT: Fay, Spofford & Thorndike

Work Order: 0805025

Project: WM-046, 1.4 Exp

TestCode: 8260B_w

ANALYTICAL QC SUMMARY REPORT

Control Cont	Sample ID: LCS	SampType: LCS	TestCode	TestCode: 8260B_w	Units; µg/L		Prep Date:	33,	RunNo: 23612	
Result POL SPK value SPK Ref Val SMR PC Low, finit Hight limit RPD Ref Val SMR PD Total Table PM PD Ref Val SMR PD Ref Val		Batch ID: R23612	Test	40: SW8260B			Analysis Da		SeqNo: 232927	
63.65 2.00 50 68.0 77 130 44.02 2.00 50 0 88.7 70 130 45.74 2.00 50 0 177 70 130 41.43 2.00 50 0 142 70 130 52.70 2.00 50 0 102 70 130 47.52 5.00 50 0 147 70 130 56.31 5.00 50 0 147 70 130 56.31 5.00 50 0 141 70 130 56.31 5.00 50 0 141 70 130 56.31 5.00 50 0 141 70 130 56.31 5.00 50 0 141 70 130 56.31 5.00 50 0 141 70 130 56.41 5.00 50 0 141 70 130 56.42 50 0 50 0 142 70 130 64.39 5.00 50 0 140 70 130 41.62 5.00 50 0 140 70 130 41.62 5.00 50 0 140 70 130 41.62 5.00 50 0 141 70 130 65.83 5.00 50 0 141 70 130 41.62 5.00 50 0 141 70 130 65.83 5.00 50 0 140 70 130 41.62 5.00 50 0 141 70 130 66.33 5.00 50 0 141 70 130 41.62 5.00 50 0 141 70 70 130 68.39 5.00 50 0 141 70 70 130 68.39 5.00 50 0 141 70 70 130 68.39 5.00 50 0 141 70 70 130 68.30 5.00 50 0 141 70 70 130 68.31 5.00 50 0 141 70 70 130 68.32 70 130 68.33 5.00 50 0 141 70 70 130 68.33 5.00 50 0 141 70 70 130 68.33 5.00 50 0 141 70 70 130 68.33 5.00 50 0 141 70 70 130 68.33 5.00 50 0 141 70 70 130 68.33 5.00 50 0 141 70 70 130 68.32 70 130 68.33 5.00 50 0 141 70 70 130 68.32 70 130 68.33 5.00 50 0 141 70 70 130 68.33 5.00 50 0 141 70 70 130 68.34 5.00 50 0 141 70 70 130 68.35 5.00 50 0 141 70 70 130 68.37 5.00 50 0 141 70 70 130 68.38 5.00 50 0 141 70 70 130 68.39 5.00 50 0 141 70 70 130 68.30 5.00 6 50 0 141 70 70 130 68.31 5.00 50 0 141 70 70 130 68.32 70 130 68.33 5.00 50 0 141 70 70 130 68.34 5.00 50 0 141 70 70 130 68.35 5.00 50 0 141 70 70 130 68.35 5.00 50 0 141 70 70 130 68.35 5.00 50 0 141 70 70 130 68.35 5.00 50 0 141 70 70 130 68.35 5.00 50 0 141 70 70 130 68.35 5.00 50 0 141 70 70 130 69.31 5.00 50 0 141 70 70 130 69.31 5.00 50 0 141 70 70 130 69.31 5.00 50 0 141 70 70 130 69.31 5.00 50 0 141 70 70 130 69.31 70 70 70 70 70 70 70 70 70 70 70 70 70	Analyte	Result	POL	SPK value	SPK Ref Val	%REC	LowLimit			
63.65 2.00 6.0 127 70 130 45.74 2.00 50 60 147 70 140 444.33 2.00 50 0 1402 70 140 54.06 5.00 50 0 1402 70 140 47.52 5.00 50 0 1402 70 140 47.52 5.00 50 0 140 147 70 140 56.31 5.00 50 0 141 70 140 56.31 5.00 50 0 141 70 140 56.31 5.00 50 0 141 70 140 56.32 50 0 50 0 141 70 140 56.34 5.00 50 0 141 70 140 56.35 50 0 50 0 141 70 140 56.35 50 0 50 0 141 70 140 56.36 50 0 50 0 141 70 140 56.37 5.00 50 0 140 141 70 140 56.38 50 0 50 0 141 70 140 56.39 5.00 50 0 140 70 140 56.31 5.00 50 0 140 70 140 41.32 5.00 50 0 140 70 140 56.31 5.00 50 0 140 70 140 41.62 5.00 50 0 140 70 140 56.31 5.00 50 0 140 70 140 56.31 5.00 50 0 140 70 140 56.31 5.00 50 0 140 70 140 56.31 5.00 50 0 140 70 140 56.31 5.00 50 0 140 70 140 56.31 5.00 50 0 140 70 140 56.31 5.00 50 0 140 70 140 56.31 5.00 50 0 140 70 140 56.31 5.00 50 0 140 70 140 56.31 5.00 50 0 140 70 140 56.31 5.00 50 0 140 70 140 56.31 5.00 50 0 140 70 140 56.31 5.00 50 0 140 70 140 56.32 5.00 50 0 140 70 140 56.33 5.00 50 0 140 70 140 56.34 5.00 50 0 140 70 140 56.35 5.00 50 0 140 70 140 56.35 5.00 50 0 140 70 140 56.31 5.00 50 0 140 70 140 56.31 5.00 50 0 140 70 140 56.32 5.00 50 0 140 70 140 56.33 5.00 50 0 140 70 140 56.34 5.00 50 0 140 70 140 56.34 5.00 50 0 140 70 140 56.34 5.00 50 0 140 70 140 56.35 5.00 50 0 14	Bromochloromethane	44.02	2.00	50	0	88.0	70	130		
44.33 2.00 5.0 6.0 91.5 70 130 44.33 2.00 5.0 0 88.7 70 130 52.70 5.00 5.0 0 105 70 130 47.52 5.00 5.0 0 0 95.3 70 130 47.52 5.00 5.0 0 0 95.3 70 130 58.67 5.00 5.0 0 0 95.3 70 130 58.67 5.00 5.00 0 0 117 70 130 55.82 5.00 5.00 5.0 0 113 70 130 55.82 5.00 5.00 5.0 0 113 70 130 56.57 5.00 5.00 5.0 0 113 70 130 56.43 5.00 5.00 5.0 0 114 70 130 56.43 5.00 5.00 5.0 0 1414 70 130 56.89 5.00 5.0 0 1414 70 130 56.89 5.00 5.0 0 1414 70 130 56.89 5.00 5.0 0 1414 70 130 56.31 5.00 5.0 5.0 0 1414 70 130 56.31 5.00 5.0 5.0 0 1414 70 130 56.32 5.00 5.0 5.0 0 1414 70 130 56.33 5.00 5.0 5.0 0 1414 70 130 56.34 5.00 5.0 5.0 0 1417 70 130 56.35 5.00 5.0 5.0 0 1417 70 130 56.31 5.00 5.0 5.0 0 1417 70 130 56.32 5.00 5.0 5.0 0 1417 70 130 56.33 5.00 5.0 5.0 0 1417 70 130 56.34 5.00 5.0 5.0 0 1417 70 130 56.35 5.00 5.0 5.0 0 1417 70 130 56.35 5.00 5.0 5.0 0 1417 70 130 56.35 5.00 5.00 5.0 0 1417 70 130 56.35 5.00 5.00 5.0 0 1417 70 130 56.35 5.00 5.00 5.0 0 1417 70 130 56.35 5.00 5.00 5.00 6.0 0 1417 70 130 56.35 5.00 5.00 5.00 6.0 0 1417 70 130 56.35 5.00 5.00 5.00 6.0 0 1417 70 130 56.35 5.00 5.00 6.0 0 1417 70 130 56.35 5.00 5.00 6.0 0 1417 70 130 56.35 5.00 5.00 6.0 0 1417 70 130 56.35 5.00 5.00 6.0 0 1417 70 130 56.35 5.00 5.00 6.0 0 1417 70 130 56.35 5.00 5.00 6.0 0 1417 70 130 56.35 5.00 5.00 6.0 0 1417 70 130 56.35 5.00 5.00 6.0 0 1417 70 130 56.35 5.00 5.00 6.0 0 1417 70 130 56.35 5.00 5.00 6.0 0 1417 70 130 56.35 5.00 5.00 6.0 0 1417 70 130 56.35 5.00 5.00 6.0 0 1417 70 130 56.35 5.00 6.0 0 1417 70 130 56.35 5.00 6.0 0 1417 70 130 56.35 5.00 6.0 0 1417 70 130 56.35 5.00 6.0 0 1417 70 130 56.35 5.00 6.0 0 1417 70 130 56.35 5.00 6.0 0 1417 70 130 56.35 5.00 6.0 0 1417 70 130 56.35 5.00 6.0 0 1417 70 130 56.35 5.00 6.0 0 1417 70 130 56.35 5.00 6.0 0 1417 70 130 56.35 5.00 6.0 0 1417 70 130 56.35 5.00 6.0 0 1417 70 130 56.35 5.00 6.0 0 1417 70 1418 56.35 5.00 6.0 0 1417 70 1418 56.35 5.00 6.0 0 1417 70 1418 56.35 5.00 6.0 0 1417 70 1418 56.35 5.00 6.0 0 1417 70 1418 56.35 5.00 6.0 0 1418 70 1418 56.35 5.00 6.0 0 1418 70 1418	Bromodichloromethane	63.65	2.00	50	0	127	70	130		
44.33 2.00 50 88.7 70 130 51.06 5.00 50 0 102 70 130 47.52 5.00 50 0 0 95.0 70 130 47.53 5.00 50 0 0 95.0 70 130 58.57 5.00 50 50 0 95.0 70 130 58.51 5.00 50 50 0 111 70 130 58.52 5.00 50 50 0 111 70 130 58.54 5.00 50 50 0 111 70 70 130 58.54 5.00 50 50 0 111 70 70 130 58.54 5.00 50 50 0 112 70 130 58.53 50 50 50 50 0 112 70 130 47.73 5.00 50 50 0 112 70 130 58.53 50 50 50 50 0 112 70 130 58.54 50 50 50 0 114 70 70 130 58.55 50 50 50 50 0 112 70 130 47.74 5.00 50 50 0 114 70 70 130 58.53 5.00 50 50 0 114 70 70 130 47.75 5.00 50 50 0 114 70 70 130 47.77 5.00 50 50 0 114 70 70 130 58.53 50 50 50 50 0 114 70 70 130 48.54 50 50 50 50 0 114 70 70 130 48.55 50 50 50 50 0 114 70 70 130 58.39 5.00 50 50 0 114 70 70 130 58.39 5.00 50 50 0 117 70 70 130 58.39 5.00 50 50 0 117 70 70 130 58.39 5.00 50 50 0 117 70 70 130 58.39 5.00 50 50 0 117 70 70 130 58.39 5.00 50 50 0 117 70 70 130 58.39 5.00 50 50 0 117 70 70 130 58.39 5.00 50 50 0 117 70 70 130 58.39 5.00 50 50 0 117 70 70 130 58.39 5.00 50 50 0 117 70 70 130 58.39 5.00 50 50 0 117 70 70 130	Bromoform	45.74	2.00	50	0	91.5	70	130		
51.06 5.00 5.0 102 7.0 130 52.70 2.00 5.0 0 105 7.0 130 47.63 5.00 5.0 0 96.3 7.0 130 58.71 5.00 5.0 0 96.3 7.0 130 56.31 5.00 5.0 0 117 7.0 130 56.31 5.00 5.0 0 113 7.0 130 56.27 0.500 5.0 0 113 7.0 130 56.27 0.500 5.0 0 113 7.0 130 56.27 0.500 5.0 0 112 7.0 130 56.27 0.500 5.0 0 101 7.0 130 56.27 0.500 5.0 0 102 7.0 130 56.27 0.500 5.0 0 102 7.0 130 56.29 0.500 </td <td>Bromomethane</td> <td>44,33</td> <td>2.00</td> <td>20</td> <td>0</td> <td>88.7</td> <td>70</td> <td>130</td> <td></td> <td></td>	Bromomethane	44,33	2.00	20	0	88.7	70	130		
52.70 2.00 50 105 70 130 47.63 5.00 5.0 0 95.3 70 130 47.63 5.00 5.0 0 95.0 70 130 58.67 5.00 5.0 0 95.0 70 130 56.31 5.00 5.0 0 117 70 130 56.34 5.00 5.0 0 113 70 130 56.37 2.00 5.0 0 114 70 130 56.87 6.0 5.0 0 113 70 130 56.87 6.0 5.0 0 112 70 130 56.89 5.00 5.0 0 112 70 130 56.89 5.00 5.0 0 114 70 130 56.89 5.00 5.0 0 114 70 130 56.89 5.00 5.0 </td <td>Carbon Disulfide</td> <td>. 90.15</td> <td>5.00</td> <td>50</td> <td>0</td> <td>102</td> <td>70</td> <td>130</td> <td></td> <td></td>	Carbon Disulfide	. 90.15	5.00	50	0	102	70	130		
47.63 5.00 5.0 0 95.3 70 130 47.52 5.00 5.0 0 95.0 70 130 58.67 5.00 5.0 0 96.0 70 141 47.04 5.00 5.00 0 0 1417 70 130 56.51 5.00 5.00 0 0 1414 70 130 56.52 5.00 5.0 0 0 1414 70 130 55.82 5.00 5.0 0 0 1414 70 130 47.64 5.00 5.00 5.0 0 1412 70 130 56.89 5.00 5.00 5.0 0 1414 70 130 47.64 5.00 5.00 5.0 0 1414 70 130 46.29 5.00 5.0 0 95.3 70 130 46.29 5.00 5.0 0 95.3 70 130 46.29 5.00 5.0 0 95.3 70 130 46.29 5.00 5.0 0 95.3 70 130 46.29 5.00 5.0 5.0 0 95.3 70 130 46.29 5.00 5.0 5.0 0 95.3 70 130 46.29 5.00 5.0 5.0 0 95.3 70 130 46.29 5.00 5.0 5.0 0 95.3 70 130 46.29 5.00 5.0 5.0 0 95.3 70 130 46.29 5.00 5.0 5.0 0 95.3 70 130 46.29 5.00 5.0 5.0 0 95.3 70 130 46.28 5.0 5.0 5.0 0 95.3 70 130 46.28 5.0 5.0 5.0 5.0 0 95.3 70 130 46.58 5.0 5.0 5.0 5.0 0 95.3 70 130 46.58 5.0 5.0 5.0 5.0 0 95.3 70 130 46.58 5.0 5.0 5.0 5.0 0 95.3 70 130 46.58 5.0 5.0 5.0 5.0 0 95.3 70 130 46.58 5.0 5.0 5.0 5.0 0 95.3 70 130 46.58 5.0 5.0 5.0 5.0 0 95.3 70 130 46.58 5.0 5.0 5.0 5.0 0 95.3 70 130 46.58 5.0 5.0 5.0 5.0 0 95.3 70 130 46.58 5.0 5.0 5.0 5.0 0 95.3 70 130 46.58 5.0 5.0 5.0 5.0 0 95.3 70 130 46.58 5.0 5.0 5.0 5.0 0 95.3 70 130 46.58 5.0 5.0 5.0 5.0 0 95.3 70 130 46.58 5.0 5.0 5.0 5.0 0 95.3 70 130 46.58 5.0 5.0 5.0 5.0 5.0 5.0 5.0 5.0 5.0 5.0	Carbon Tetrachioride	52.70	2.00	50	0	105	70	130		
47.52 5.00 50 95.0 70 130 58.67 5.00 50 0 117 70 130 40.15 5.00 5.00 0 113 70 130 56.31 5.00 5.00 0 114 70 130 56.57 2.00 50 0 114 70 130 55.82 5.00 50 114 70 130 55.82 5.00 50 112 70 130 55.82 5.00 50 112 70 130 55.82 5.00 50 101 70 130 43.73 0.500 50 0 117 70 130 44.64 5.00 50 0 141 70 130 56.89 5.00 50 0 174 70 130 56.89 5.00 50 0 174 70 130 <td>Chlarobenzene</td> <td>47.63</td> <td>5.00</td> <td>50</td> <td>0</td> <td>95.3</td> <td>70</td> <td>130</td> <td></td> <td></td>	Chlarobenzene	47.63	5.00	50	0	95.3	70	130		
58.67 5.00 50 117 70 130 40.15 5.00 50 0 113 70 130 56.31 5.00 50 0 113 70 130 57.06 0.500 50 0 114 70 130 56.57 2.00 50 0 113 70 130 56.41 5.00 50 0 142 70 130 50.41 5.00 50 0 102 70 130 43.73 0.500 50 0 141 70 130 44.34 5.00 50 0 141 70 130 56.89 5.00 50 0 144 70 130 56.89 5.00 50 0 144 70 130 46.89 5.00 50 0 144 70 130 46.29 5.00 50	Chloroethane	47.52	2.00	50	0	95.0	70	130		
40.15 5.00 50 60.3 70 130 56.31 5.00 50 0 113 70 130 57.06 0.500 50 0 114 70 130 56.57 2.00 50 0 113 70 130 56.41 5.00 50 0 102 70 130 50.41 5.00 50 0 102 70 130 47.64 5.00 50 0 87.5 70 130 64.39 5.00 50 0 141 70 130 56.89 5.00 50 0 141 70 130 56.89 5.00 50 0 77.1 70 130 56.89 5.00 50 0 77.1 70 130 46.49 5.00 50 0 77.1 70 130 46.29 5.00 50	Chloroform	28.67	5.00	. 20	0	117	7.0	130		
56.31 5.00 50 113 70 130 57.06 0.500 50 0 114 70 130 56.57 2.00 50 0 113 70 130 55.82 5.00 50 0 112 70 130 51.11 5.00 50 0 112 70 130 50.41 5.00 50 0 101 70 130 47.64 5.00 50 0 87.5 70 130 64.39 5.00 50 0 114 70 130 56.89 5.00 50 0 144 70 130 56.89 5.00 50 0 144 70 130 46.59 5.00 50 0 144 70 130 46.59 5.00 50 0 9 70 130 50.11 5.00 50 <	Chloromethane	40.15	5.00	50	0	80.3	. 70	130		
57.06 0.500 50 114 70 130 56.57 2.00 50 0 113 70 130 56.82 2.00 50 0 112 70 130 51.11 5.00 50 0 102 70 130 50.41 5.00 50 0 101 70 130 43.73 0.500 50 0 87.5 70 130 43.73 0.500 50 0 87.5 70 130 64.39 5.00 50 0 87.5 70 130 56.89 5.00 50 0 77.1 70 130 56.89 5.00 50 0 77.1 70 130 46.29 5.00 50 0 77.1 70 130 50.11 5.00 50 0 70 130 50.11 5.00 50 0	cis-1,2-Dichloraethene	56.31	5.00	50	0	113	70	130		
56.57 2.00 50 0 113 70 130 55.82 5.00 50 0 112 70 130 51.11 5.00 50 0 102 70 130 50.41 5.00 50 0 101 70 130 47.64 5.00 50 0 87.5 70 130 64.39 5.00 50 0 129 70 130 56.89 5.00 50 0 129 70 130 56.89 5.00 50 0 144 70 130 56.89 5.00 50 0 171 70 130 56.89 5.00 50 0 171 70 130 44.39 5.00 50 0 92.6 70 130 46.29 5.00 50 0 93.2 70 130 50.11 5.00	cis-1,3-Dichloropropene	92.06	0.500	50	0	114	70	130		
55.82 5.00 50 0 112 70 130 51.11 5.00 50 0 102 70 130 50.41 5.00 50 0 101 70 130 43.73 0.500 50 0 101 70 130 47.64 5.00 50 0 129 70 130 56.89 5.00 50 0 129 70 130 56.89 5.00 50 0 114 70 130 56.89 5.00 50 0 114 70 130 56.89 5.00 50 0 104 70 130 45.49 5.00 50 0 104 70 130 46.29 5.00 50 0 92.6 70 130 46.29 5.00 50 0 93.2 70 130 50.11 50 <	Dibromochloromethane	56.57	2.00	50	0	113	70	130		
51.11 5.00 50 102 70 130 50.41 5.00 50 0 101 70 130 43.73 0.500 50 0 47.5 70 130 47.64 5.00 50 0 95.3 70 130 56.89 5.00 50 0 129 70 130 56.89 5.00 50 0 77.1 70 130 56.89 5.00 50 0 77.1 70 130 38.53 20.0 50 0 77.1 70 130 46.29 5.00 50 0 77.1 70 130 46.29 5.00 50 0 83.5 70 130 41.93 5.00 50 0 83.5 70 130 58.39 5.00 50 0 117 70 130 58.39 5.00 50	Dibromomethane	55.82	5.00	20	0	112	70	130		
50.41 5.00 50 101 70 130 43.73 0.500 50 0 87.5 70 130 47.64 5.00 50 0 95.3 70 130 56.89 5.00 50 0 114 70 130 56.89 5.00 50 0 77.1 70 130 38.53 20.0 50 0 77.1 70 130 45.49 5.00 50 0 104 70 130 46.29 5.00 50 0 91.0 70 130 46.29 5.00 50 0 92.6 70 130 46.29 5.00 50 0 83.5 70 130 50.11 5.00 50 0 107 70 130 58.39 5.00 50 0 125 70 130 62.27 0.500 50	Dichlorodifluoromethane	51.11	5.00	50	0	102	70	130		
43.73 0.500 50 0 87.5 70 130 47.64 5.00 50 0 95.3 70 130 64.39 5.00 50 0 129 70 130 56.89 5.00 50 0 114 70 130 38.53 20.0 50 0 77.1 70 130 45.49 5.00 50 0 91.0 70 130 46.29 5.00 50 0 92.6 70 130 46.29 5.00 50 0 92.6 70 130 46.29 5.00 50 0 92.6 70 130 46.29 5.00 50 0 92.6 70 130 56.11 5.00 50 0 100 70 130 58.39 5.00 50 0 125 70 130 62.27 0.500 50 0 93.2 70 130 Akborating Limit 1	Ethylbenzene	50.41	5.00	50	0	101	70	130		
47.64 5.00 50 0 95.3 70 130 64.39 5.00 50 0 129 70 130 56.89 5.00 50 0 114 70 130 38.53 20.0 50 0 77.1 70 130 45.49 5.00 50 0 91.0 70 130 46.29 5.00 50 0 83.5 70 130 41.62 5.00 50 0 83.5 70 130 50.11 5.00 50 0 83.5 70 130 58.39 5.00 50 0 83.5 70 130 58.39 5.00 50 0 83.2 70 130 58.39 5.00 50 0 100 70 130 62.27 0.500 50 0 93.2 70 130 accordance Limit 46.58 5.00 50 0 93.2 70 130 b	Hexachlorobutadiene	43.73	0.500	50	0	87.5	70	130		
64.39 5.00 50 129 70 130 56.89 5.00 50 0 114 70 130 38.53 20.0 50 0 77.1 70 130 51.79 5.00 50 0 77.1 70 130 45.49 5.00 50 0 91.0 70 130 46.29 5.00 50 0 83.5 70 130 41.62 5.00 50 0 83.9 70 130 50.11 5.00 50 0 100 70 130 58.39 5.00 50 0 70 130 58.39 5.00 50 0 70 130 6 62.27 0.500 50 70 130 Akeporting Limit 1 1 1 1 1 Akeporting Limit 1 1 1 1 1 1	Isopropylbenzene	47.64	5.00	50	0	95.3	70	130		
56.89 5.00 50 0 114 70 130 38.53 20.0 50 0 77.1 70 130 51.79 5.00 50 0 104 70 130 45.49 5.00 50 0 91.0 70 130 46.29 5.00 50 0 83.5 70 130 41.62 5.00 50 0 83.9 70 130 50.11 5.00 50 0 83.9 70 130 58.39 5.00 50 0 100 70 130 58.39 5.00 50 0 100 70 130 58.39 5.00 50 0 125 70 130 46.58 5.00 50 0 93.2 70 130 Akeporting Limit E Value above quantitation range H H P P P	Methyl Tert-Butyl Ether	64.39	5.00	50	0	129	70	130	•	
38.53 20.0 50 0 77.1 70 130 51.79 5.00 50 0 104 70 130 45.49 5.00 50 0 91.0 70 130 41.77 5.00 50 0 92.6 70 130 41.33 5.00 50 0 83.9 70 130 41.62 5.00 50 0 83.9 70 130 50.11 5.00 50 0 117 70 130 58.39 5.00 50 0 117 70 130 58.39 5.00 50 0 125 70 130 Ak 58 5.00 50 0 93.2 70 130 Ak 6.58 5.00	Methylene Chloride	56.89	5.00	50	0	114	70	130		
51.79 5.00 50 104 70 130 45.49 5.00 50 0 91.0 70 130 41.77 5.00 50 0 91.0 70 130 46.29 5.00 50 0 92.6 70 130 41.93 5.00 50 0 83.9 70 130 41.62 5.00 50 0 83.9 70 130 50.11 5.00 50 0 100 70 130 58.39 5.00 50 0 117 70 130 6 62.27 0.500 50 0 93.2 70 130 AR Good limit E Value above quantitiation range F F F F F	Naphthalene	38.53	20.0	50	0	77.1	70	130		
45.49 5.00 50 91.0 70 130 41.77 5.00 50 0 83.5 70 130 46.29 5.00 50 0 83.9 70 130 41.93 5.00 50 0 83.9 70 130 41.62 5.00 50 0 83.2 70 130 50.11 5.00 50 0 100 70 130 58.39 5.00 50 0 117 70 130 e 62.27 0.500 50 0 125 70 130 w Reporting Limit E Value above quantitation range H	n-Butylbenzene	51.79	5.00	50	0	104	70	130		
41.77 5.00 50 0 83.5 70 130 46.29 5.00 50 0 92.6 70 130 41.93 5.00 50 0 83.9 70 130 41.62 5.00 50 0 100 70 130 50.11 5.00 50 0 117 70 130 58.39 5.00 50 0 117 70 130 62.27 0.500 50 0 93.2 70 130 A6.58 5.00 50 0 93.2 70 130 Accordant Limit E Value above quantitation range H H P	n-Propylbenzene	45.49	5.00	. 50	0	91.0	20	130		
46.29 5.00 50 0 92.6 70 130 41.93 5.00 50 0 83.9 70 130 41.62 5.00 50 0 83.2 70 130 50.11 5.00 50 0 100 70 130 58.39 5.00 50 0 117 70 130 e 62.27 0.500 50 0 125 70 130 w Reporting Limit E Value above quantitation range H	sec-Butylbenzene	41.77	5.00	50	0	83.5	20	130		
41.93 5.00 50 63.9 70 130 41.62 5.00 50 0 83.2 70 130 50.11 5.00 50 0 100 70 130 58.39 5.00 50 0 117 70 130 e 62.27 0.500 50 0 125 70 130 w Reporting Limit E Value above quantitation range F F H	Styrene	46.29	5.00	50	0	92.6	20	130	-	
41.62 5.00 50 0 83.2 70 130 50.11 5.00 50 0 100 70 130 58.39 5.00 50 0 117 70 130 e 62.27 0.500 50 0 125 70 130 w Reporting Limit E Value above quantitation range H H P P	tert-Butylbenzene	41.93	5.00	50	0	83,9	70	130		
50.11 5.00 50 0 100 70 130 130 58.39 5.00 50 0 117 70 130 50.00 50 0 125 70 130 50.00 50 0 125 70 130 50.00 50 0 93.2 70 130 50.00 50 0 93.2 70 130 50.00 50.00 50 0 50.00 50 130 50.00 50 0 50 0 50 0 50 0 50 0 50 0 5	Tetrachloroethene	41.62	2.00	50	0	83.2	70	130		
58.39 5.00 50 0 117 70 130 62.27 0.500 50 0 125 70 130 46.58 5.00 50 0 93.2 70 130 w Reporting Limit E Value above quantitation range H	Toluene	50.11	5.00	20	0	100	70	130		
ichloropropene 62.27 0.500 50 0 125 70 130 nene 46.58 5.00 50 0 93.2 70 130 BRL Bclow Reporting Limit E Value above quantitation range H H	trans-1,2-Dichloroethene	58.39	5.00	50	0	117	70	130		
130 130	trans-1,3-Dichloropropеле	62.27	0.500	90	0	125	70	130		
BRL Below Reporting Limit E Value above quantitation range H I Analyte detailed halous quantitation limit Described at the Described in the Described of the Described in the Described of the Described in the Described by Describing Describing Described by Describing Describing Described by Describing Describing Described By Described By Describing Described By D	Trichloroethene	46.58	5.00	20	0	93.2	70	130		
1 Anolyte detected below constitution limits NID Not Detected at the Beacedine Limit D	BRL	ting Limit	A /u d d /u		above quantitation ran	98			r preparation or analysis	exceeded
	-	ted below assentiation limits			docted at the Denoctin	o I imit			armer fishing	

1.142.45

Analyte detected below quantitation limits Spike Recovery outside recovery limits

Fay, Spofford & Thorndike CLIENT:

0805025 Work Order: WM-046, 1.4 Exp Project:

TestCode: 8260B_w

Sample ID: LCS	SampType: LCS	TestCoc	TestCode: 8260B_w	Units: µg/L		Prep Date:	fe:	RunN	RunNo: 23612		
Client ID: ZZZZZ	Batch ID: R23612	Testh	TestNo: SW8260B			Analysis Date:	te: 5/8/2008	SeqN	SeqNo: 232927		
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit RPD Ref Val		%RPD RPDLimit	Jmit Qual	<u></u>
Trichlorofluoromethane	42.99	5.00	50	0	86.0	70	130				
Vinyl Chloride	36.44	2.00	50	0	72.9	70	130				
Xylenes, Total	156.4	5.00	150	0	104	70	130				
Surr: 1,2-Dichloroethane-d4	31,20	0	30	0	104	70	130				
Surr: 4-Bromofluorobenzene	35.38	0	30	0	118	70	130				
Surr: Dibromofluoromethane	28.44	0	30	0	94.8	70	130				
Surr: Toluene-d8	29.40	0	30	0	98.0	70	130				
Sample ID: LCS	SampType: LCS	TestCoc	TestCode: 8260B_W	Units: µg/L		Prep Date:	te;	RunN	RunNo: 23706		
Client ID: ZZZZ	Batch ID: R23706	Testh	TestNo: SW8260B			Analysis Date:	te: 5/14/2008	SeqN	SeqNo: 233187		
Analyte	Result	Pal	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit RPD Ref Val		%RPD RPDLimit	imit Qual	
1,1,1,2-Tetrachioroethane	49.57	5.00	50	0	99.1	70	130				1
1,1,1-Trichloroethane	54,94	5.00	20	0	110	70	130				
1,1,2,2-Tetrachloroethane	55.73	2.00	20	0	<u>*-</u>	70	130				
1,1,2-Trichloroethane	51.22	5.00	50	0	102	70	130				
1,1-Dichloroethane	47.68	5.00	50	0	95.4	70	130		-		
1,1-Dichloraethene	46.96	5.00	50	0	93.9	70	130				
1,1-Dichloropropene	43.32	5.00	20	0	9.98	70	130	,			
1,2,3-Trichlorobenzene	52.89	5.00	50	0	106	70	130				
1,2,3-Trichloropropane	50.53	5.00	20	0	101	70	130				
1,2,4-Trichlorobenzene	51.85	2.00	20	0	104	70	130				
1,2,4-Trimethylbenzene	54.98	2,00	20	0	110	70	130				
1,2-Dibromo-3-Chloropropane	37.94	5.00	50	0	75.9	70	130				
1,2-Dibromoethane	51.00	2.00	20	0	102	70	130				
1,2-Dichlorobenzene	53,69	5.00	20	0	107	70	130				
1,2-Dichloroethane	39.48	2.00	90	0.92	77.1	70	130				
1,2-Dichloropropane	48.56	2.00	50	0 .	97.1	70	130				
1,3,5-Trimethylbenzene	51.26	5.00	50	0	103	20	130				
1,3-Dichlorobenzene	49.84	5.00	20	0	99.7	70	130				
	COMMING THE PROPERTY OF THE PR		İ	The second secon	- VAL 200 I N VIII.					The state of the s	
Qualifiers: BRL Below Reporting Limit	ing Limit			Value above quantitation range)ge			Holding times for preparation or analysis exceeded	on or analysis e	popoox	
J Analyte detec	Analyte detected below quantitation limits		ND Not De	Not Detected at the Reporting Limit	g Limit		R RPD outsid	RPD outside recovery limits	so.		

Fay, Spofford & Thorndike CLIENT:

0805025 Work Order:

WM-046, 1.4 Exp Project:

ANALYTICAL QC SUMMARY REPORT

TestCode: 8260B_w

Sample ID: LCS	SampType: LCS	TestCor	TestCode: 8260B_W	Units: µg/L		Prep Date:		RunNo: 23706	
Client ID: ZZZZZ	Batch ID: R23706	Test	TestNo: SW8260B			Analysis Date:	5/14/2008	SeqNo; 233187	
Analyte	Result	POL	SPK value	SPK Ref Vai	%REC	LowLimit	HighLimit RPD Ref Val	Val %RPD RPDLimit Qual	-
1,3-Dichloropropane	45.68	5.00	. 50	0	91.4	70	130		
1,4-Dichlorobenzene	48.43	5.00	50	0	6.96	70	130		
2,2-Dichloropropane	45,14	5.00	90	0	90.3	70	130		
2-Butanone	46.27	10.0	50	0	92.5	70	130		
2-Chloroethyl Vinyl Ether	. 205.8	5.00	50	0	412	20	130	S	
2-Chlorotoluene	47.63	5.00	20	0	95.3	70	130		
2-Hexanone	44.68	10.0	20	0	89.4	70	130		
4-Chlorotoluene	52.19	5,00	50	0	104	70	130		
4-Isopropyftoluene	49.92	5.00	50	0	8'66	70	130		
4-Methyl-2-Pentanone	48.13	5.00	50	0	96.3	70	130		
Acetone	55,46	50.0	. 50	0	111	70	130		
Acrolein	130.0	50,0	100	0	130	70	130		
Acrylonitrile	84.09	50.0	100	0	84.1	70	130		
Benzene	41.48	5.00	50	0	83.0	70	130		
Bromobenzene	47.50	5.00	50	0	95.0	70	130		
Bromochloromethane	50.60	2.00	50	0	101	70	130		
Bromodichloromethane	41.71	2.00	50	0	83.4	70	130		
Bromoform	43,21	2.00	50	0	86.4	70	130		
Bromomethane	63.68	2.00	20	0	127	70	130		
Carbon Disulfide	40.66	5.00	50	0	81.3	20	130		
Carbon Tetrachloride	41.00	2.00	50	0	82.0	70	130		
Chlorobenzene	51.75	5.00	50	0	104	70	130		
Chloroethane	53.68	5.00	50	0	107	70	130		
Chloroform	52.34	5.00	50	0	105	70	130		
Chioromethane	57.47	5.00	50	0	115	70	130		
cis-1,2-Dichloroethene	42.95	5.00	50	0	85.9	70	130		
cis-1,3-Dichloropropene	45.32	0.500	50	0	9.06	70	130		
Dibromochloromethane	45.71	2.00	50	0	91.4	70	130		
Dibromomethane	44.69	5.00	20	0	89.4	70	130		
Dichlorodifluoromethane	42.49	5.00	50	0	85.0	20	130		
Ethylbenzene	44.82	5.00	20	0	9.68	70	130		
Qualifiers: BRL Below Reporting Limit	orting Limit		E Value a	Value above quantitation range	១ភី		H Holding tim	Holding times for preparation or analysis exceeded	Ì
J Analyte dete	Analyte detected below quantitation limits		ND Not De	Not Detected at the Reporting Limit	g Límit		R RPD outsid	RPD outside recovery limits	
S Spike Reeov	Spike Recovery outside recovery limits							Page 12 of 33	of 33

RPD outside recovery limits

H

E Value above quantitation range
ND Not Detected at the Reporting Limit

Analyte detected below quantitation limits Spike Recovery outside recovery limits

BRL Below Reporting Limit

Qualifiers:

Fay, Spofford & Thorndike CLIENT:

0805025 Work Order: WM-046, 1.4 Exp

Project:

TestCode: 8260B_w

Sample ID: LCS	SampType: LCS	TestCo	TestCode: 8260B_W	Units: µg/L		Prep Date:	;e;		RunNo: 23706		
Citent ID: ZZZZZ	Batch ID: R23706	Test	TestNo: SW8260B			Analysis Date:	e: 5/14/2008		SeqNo: 233187	_	
Analyte	Result	Pal	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit R	RPD Ref Val	%RPD R	RPDLimit Q	Qual
Hexachlorobutadiene	56.03	0.500	50	0	112	70	130				
isopropyibenzene	47.23	5.00	50	Ö	94.5	70	130				
Methyl Tert-Butyl Ether	43.02	5.00	50	0	86.0	20	130				
Methylene Chloride	40,34	5.00	50	0	80.7	20	130				
Naphthalene	55.23	20.0	20	2.56	105	70	130				
n-Butyfbenzene	50.22	5.00	50	0	100	22	130				
n-Propylbenzene	43.12	5.00	90	0	86.2	70	130				
sec-Butylbenzene	48.61	2.00	50	0	97.2	70	130				
Styrene	44.94	5.00	20	0	6.68	70	130				
tert-Butylbenzene	49.39	5.00	20	0	98.8	20	130				
Tetrachloroethene	47.10	5.00	20	0	94.2	70	130				
Toluene	47.15	5.00	50	0	94.3	70	130				
trans-1,2-Dichloroethene	51.03	5.00	50	0	102	70	130				
trans-1,3-Dichloropropene	40.36	0.500	50	0	80.7	70	130				
Trichloroethene	43.11	2.00	50	0	86.2	70	130				
Trichlorofluoromethane	63.40	2.00	20	0	127	70	130				
Vinyl Chloride	45.23	2.00	50	0	90.5	20	130				
Xylenes, Totał	136.9	5,00	150	0	91.3	70	130				
Surr: 1,2-Dichloroethane-d4	29.96	0	30	0	6.66	70	130				
Surr: 4-Bromofluorobenzene	27.47	0	30	. 0	91.6	70	130				
Surr: Dibromofluoromethane	31.61	0	30	0	105	70	130				
Surr: Toluene-d8	29.65	0	30	0	98.8	70	130				

Fay, Spofford & Thorndike CLIENT:

0805025 Work Order:

Project:

WM-046, 1.4 Exp

	≯
C	∍
ľ	~
i	0/78
	×
۱	~
	lestCode:
۰	3
	Ξ
,	٦
۱	J
	_
	e.
	v
ŀ	_

Sum id-1, MB-1, Lord Marker Same Sam												
Result POL SPR PRIOR (SPR PRIOR) Arealysis Date SPT PRIOR SPR PRIOR PRIOR SPR PRIOR SPR PRIOR PRIOR SPR PRIOR SPR PRIOR PRIOR PRIOR SPR PRIOR PRIOR <th< th=""><th>Sample ID: MB-100</th><th>920</th><th>SampType: MBLK</th><th>TestCode</th><th>8270 W</th><th>Units: µg/L</th><th>Prep</th><th></th><th>80</th><th>RunNo: 235</th><th>56</th><th></th></th<>	Sample ID: MB-100	920	SampType: MBLK	TestCode	8270 W	Units: µg/L	Prep		80	RunNo: 235	56	
Result POL SPK value SPK Fed Val SREC Lond-inth Hightlinit RPD Ref Ved SRPD RPDLinit RPD Ref Ved SRPD Ref Ved Ved SRPD Ref Ved Ved Ved Ved Ved Ved Ved Ved Ved Ved			Batch ID; 10076	TestNo	SW8270C		Analysis		80	SeqNo: 231	370	
ND 1.00 1.	Analyte		Result	PQL	SPK value	SPK Ref Val		ſ		%RPD	RPDLimit	Qual
ND 100	1,2,4-Trichlorobenze	ene	QN	1.00								
ND 100	1,2-Dichlorobenzene	Œ.	QN	1.00								
ND 1.00 1.	1,2-Dinitrobenzene		QN	1.00								
ND 1.00 1.	1,3-Dichlorobenzens	ø	ON.	1.00								
ND 1.00 ND	1,3-Dinítrobenzene		QN	1.00								
end ND 1 00 ND 1 00 Reserved everantilation imits Reserved was added excovery limits ND 1 00 Reserved was added recovery limits Reserved was added recovery limits Reserved was added recovery limits	1,4-Dichlorobenzen	o	ON .	1.00								
enol ND 100 ND 1	1,4-Dinitrobenzene		QN	1.00								
ND 1.00 1.00 1.00 ND ND ND ND ND ND ND	2,3,4,6-Tetrachlorop	phenoi	Q	1.00								
ND 1,00 1,00 1,00 ND	2,4,5-Trichloropheno	10	N N	1.00								
ND 1.00 1.00 1.00 ND	2,4,6-Trichloropheno	0	ON.	1.00								
ND 1,00 ND 5,00 ND 1,00 ND 1,00 ND 1,00 ND 1,00 ND 1,00 Plan 1,00 Plan 1,00 Plan 1,00 Plan 1,00 Plan 1,00 Plan 1,00 Analyte detected below quantitation limits ND 1,00 ND 1,00 1,00 ND <t< td=""><td>2,4-Dichlorophenol</td><td></td><td>ON</td><td>1.00</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></t<>	2,4-Dichlorophenol		ON	1.00								
nne ND 5.00 ND 1.00 1.00 nne ND 1.00 nne ND 1.00 nne ND 1.00 dine 1.00 1.00 Methyphenol ND 1.00 Aphenol ND 1.00 phenol ND 1.00 nD 1.00 1.00 ND	2,4-Dimethylphenol		QZ	1.00				٠				
ND 1,00 ND 1,00 ND 1,00 ND 1,00 ND 1,00 Methylphenol ND 1,00 Methylphenol ND 1,00 Methylphenol ND 1,00 Methylphenol ND 1,00 phenol ND 1,00 phenol ND 1,00 phenol ND 1,00 phenol ND 1,00 ND 1,00 1,00 Analyte detected below quantitation limits ND NOA Detected at the Reporting Limit R RPD outside recovery limits Spike Recovery outside recovery limits ND ND ND ND ND	2,4-Dinitrophenol		<u>0</u> 2	5.00								
ND 1.00 ND 1.00 ND 1.00 Mb 1.00 Mb 1.00 Methylphenol ND ND 1.00 Methylphenol ND ND 1.00 Phenol ND ND 1.00 Phenol ND ND 1.00	2,4-Dinitrotoluene		<u>Q</u>	1.00								
ND 1.00 ND Not Detected at the Reporting Limit R RPD outside recovery limits	2,6-Dinitrotoluene		Q	1.00								
ND 1.00 ND 1.00 ND 1.00 ND 1.00 ND 5.00 ND 1.00 ND Not Detected at the Reporting Limit R RPD outside recovery limits	2-Chloronaphthalen	je e	Q	1.00								
ND 1.00 ND 1.00 ND 1.00 ND 1.00 ND 1.00 ND 1.00 ND 1.00 ND 1.00 ND 1.00 ND 1.00 ND 1.00 ND 1.00 ND 1.00 ND 1.00 ND 1.00 ND 1.00 ND 1.00 ND 1.00 ND Not Detected at the Reporting Limit R PD outside recovery limits RPD outside recovery limits	2-Chloropheriol		QN	1.00								
ND 1.00 ND 1.00 ND 1.00 ND 1.00 ND 1.00 ND 1.00 ND 1.00 ND 1.00 ND 1.00 ND 1.00 ND 1.00 ND 1.00 ND 1.00 ND 1.00 ND Not Detected at the Reporting Limit R RPD outside recovery limits very outside recovery limits R RPD outside recovery limits	2-Methylnaphthalen	9		1.00								
ND 1.00 ND 1.00 ND 1.00 ND 5.00 ND 1.00 ND Not Detected at the Reporting Limit R Protected by quantitation limits ND Not Detected at the Reporting Limit R Protected by Quantitation limits	2-Methylphenol		QN	1.00								
ND 1.00 ND 1.00 ND 1.00 ND 1.00 ND 1.00 ND 1.00 ND 1.00 ND 1.00 ND 1.00 ND 1.00 ND 1.00 ND 1.00 ND 1.00 ND 1.00 ND 1.00 ND Not Detected at the Reporting Limit R RPD outside recovery limits	2-Nitroaniline		Ð	1.00								
ND 1.00 ND 1.00 ND 5.00 ND 1.00 ND Not Detected at the Reporting Limit Holding times for preparation or analysis executed below quantitation limits very outside recovery limits ND Not Detected at the Reporting Limit RPD outside recovery limits	2-Nitrophenol		QN	1.00								
ND 1.00 ND 5.00 ND 1.00 ND Not Detected at the Reporting Limit R Produing times for preparation or analysis exercited below quantitation limits very outside recovery limits R RPD outside recovery limits	3,3'-Dichlorobenzidi	ine	ON	1.00		•						
ND 5.00 ND 1.00 ND 1.00 1.00 1.00 1.00 ND 1.00 1.00 1.00 1.00 1.00 ND 1.00	3-Methylphenol/4-M	lethytphenol	QN.	1.00								
ND 5.00 ND 1.00 Accepted below quantitation limits E Value above quantitation range H Holding times for preparation or analysis expected below quantitation limits Accepted below quantitation limits ND Not Detected at the Reporting Limit R RPD outside recovery limits	3-Nitroaniline		QV	1.00								
ND 1.00 ND 1.00 ND 1.00 ND 1.00 ND 1.00 ND 1.00 Accreted below quantitation limits E Value above quantitation range H Holding times for preparation or analysis expected below quantitation limits According Limit B Not Detected at the Reporting Limit R RPD outside recovery limits	4,6-Dinitro-2-Methyl	lphenol	QN	5.00								
ND 1.00 ND 1.00 ND 1.00 ND 1.00 ND 1.00 ND 1.00 ND 1.00 ND 1.00 ND 1.00 ND 1.00 ND 1.00 ND 1.00 ND 1.00 ND 1.00 ND 1.00 ND 1.00 ND 1.00 ND 1.00 ND Not Detected at the Reporting Limit RPD outside recovery limits	4-Bromophenyl Phe	anyl Ether	<u>Q</u>	1.00								
ND 1.00 ND 1.00 ND 1.00 ND 1.00 ND 1.00 ND 1.00 ND 1.00 ND 1.00 ND 1.00 E Value above quantitation range H Holding times for preparation or analysis excepted below quantitation limits E Value above quantitation limits M Not Detected at the Reporting Limit R RPD outside recovery limits	4-Chloro-3-Methylpt	henol	Q	1.00								
ND 1.00 ND 1.00 ND 1.00 ND 1.00 ND 1.00 ND 1.00 ND 1.00 ND 1.00 E Value above quantitation range H Holding times for preparation or analysis excepted below quantitation limits E Value above quantitation range M RPD outside recovery limits E Value above quantitation range H Holding times for preparation or analysis excepted below quantitation limits E Value above quantitation range H Holding times for preparation or analysis excepted below quantitation limits E Value above quantitation range H Holding times for preparation or analysis excepted below quantitation limits E Value above quantitation range H Holding times for preparation or analysis excepted below quantitation limits E Value above quantitation range H Holding times for preparation or analysis excepted below quantitation limits E Value above quantitation limits E Value above quantitation range H Holding times for preparation or analysis excepted below quantitation limits E Value above quantitation limits E Value above quantitation range H Holding times for preparation or analysis excepted below quantitation limits E Value above quantitation limits H Holding times for preparation or analysis excepted at the Reporting Limit R RPD outside recovery limits	4-Chloroaniline		QN	1.00								
ND 1.00 ND 1.00 ND 1.00 BRL Below Reporting Limit J Analyte detected below quantitation limits S Spike Recovery outside recovery limits ND Not Detected at the Reporting Limit R RPD outside recovery limits R RPD outside recovery limits	4-Chlorophenyl Phe.	enyl Ether	Q	1.00								-
BRL Below Reporting Limit J. Analyte detected below quantitation limits S. Spike Recovery outside recovery limits ND Not Detected at the Reporting Limit RPD outside recovery limits RPD outside recovery limits	4-Nitroaniline		QN	1,00								
BRL Below Reporting Limit J Analyte detected below quantitation limits Spike Recovery outside recovery limits Spike Recovery outside recovery limits	4-Nitrophenol	!	ON	1.00				A COLOR BRIDA				
Analyte detected below quantitation limits ND Not Detected at the Reporting Limit Recovery outside recovery limits			ting Limit			above quantitation rang	25	H	Holding times for p	reparation or a	nalysis exceed	Þ
Spike Recovery outside recovery limits	ſ	Analyte detec	cted below quantitation limits			etected at the Reporting	, Limit	~	RPD outside recovi	ery limits		
	20	Spike Recove	ery outside recovery limits								Pag	e 14 of 3

Fay, Spofford & Thorndike CLIENT:

0805025 Work Order: WM-046, 1.4 Exp Project:

TestCode: 8270_w

0.000	+ · · ·	ŀ		:		1		**************************************	
Sample ID: MB-10070	Sampilype: MBLN	l estro	estCode: 82/0_W	Units: µg/L	Prep Date:	te: 5/6/2008	RunNo: 23556	556	
Client ID: ZZZZZ	Batch ID: 10076	Test	estNo: SW8270C	(SW3510)	Analysis Date:	te: 5/7/2008	SeqNo: 231370	11370	***************************************
Analyte	Result	POL	SPK value	SPK Ref Val	"REC LowLimit	HighLimit RPD Ref Val	Val %RPD	RPDLimit	Qual
Acenaphthene	QV	1.00							
Acenaphthylene	QN	1.00							
Acetophenone	QN	1.00							
Aniline	Q	5.00							
Anthracene	QN	1.00							
Azobenzene	QN	5.00							
Benz(a)Anthracene	Q	0.100							
Benzidine	QV	5.00							
Benzo(a)Pyrene	Q	0.100							
Benzo(b)Fluoranthene	ON.	0.500							
Benzo(g,h,i)Perylene	2	1.00							
Benzo(k)Fluoranthene	Q N	0.500							
Benzyi Alcohoi	Q.	1.00							
Bis(2-Chtoroethoxy)Methane	g	1.00							
Bis(2-Chloroethyl)Ether	QN	1,00							
Bis(2-Chloroisopropyl)Ether	QN	1.00							
Bis(2-Ethylhexyl)Phthalate	QV	1.00							
Butyl Benzyl Phthalate	QN	1,00							
Carbazole	QN	1.00							
Chrysene	QN	1.00							
Dibenz(a,h)Anthracene	QN	0.100							
Dibenzofuran	Ð	1.00							
Diethyl Phthalate	QN	1.00							
Dimethyl Phthalate	QN	1.00			٠				
Di-n-Butyl Phthalate	QN	1,00							
Di-n-Octyl Phthalate	ON	1.00							
Fluoranthene	QN	1.00							
Fluorene	QN.	1.00							
Hexachlorobenzene	QN	0.100							
Hexachlorobutadiene	ON	0.100							
Hexachtorocyclopentadiene	QN	5.00							
Qualifiers: BRL Below Reporting Limit	ting Limit	-	E Value al	Value above quantitation range	The state of the s	H Holding time	Holding times for preparation or analysis exceeded	malysis exceeded	5
J Analyte detec	Analyte detected below quantitation limits		ND Not Det	Not Detected at the Reporting Limit	Limit	R RPD outside	RPD outside recovery limits		
S Spike Recove	Spike Recovery outside recovery limits							Dog I	Page 15 of 33

Fay, Spofford & Thorndike 0805025 CLIENT:

Work Order:

WM-046, 1.4 Exp **Project:**

TestCode: 8270_w

Cample ID: MB-40078	SampTyne, BBIK	Tectorda	TectOrde: 9270 W	Hoiter net!		Pron Date:	. E/8/2000	BunNo: 22556	2	Γ
		-		1 2		2		Training Post	•	
Client ID: ZZZZ	Batch ID: 10076	TestNo	TestNo: SW8270C	(SW3510)		Analysis Date:	: 5/7/2008	SeqNo: 231370	02	
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit RPD Ref Val	%RPD	RPDLimit Qual	
Hexachloroethane	QN	1.00							-]
Indeno(1,2,3-cd)Pyrene	QN	0.100								
Isophorone	QN	1.00								
Naphthalene	QN	1.00								
Nitrobenzene	QN	1.00								
N-Nitrosodimethylamine	QN	5.00								
N-Nitrosodi-n-Propylamine	QN	1.00								
N-Nitrosodiphenylamine	QN	5,00				٠.				
Pentachlorophenol	QN	1.00		*						
Phenanthrene	QV	1.00								
Phenof	QN	1.00								
Pyrene	ON.	1.00								
Pyridine	QN	5.00								
Surr: 2,4,6-Tribromophenol	40.84	0	75	0	54.4	15	150			
Surr; 2-Fluorobiphenyl	39.44	0	50	0	78.9	30	130			
Surr: 2-Fluorophenol	34.66	0	75	0	46.2	15	110			
Surr; Nitrobenzene-d5	50.51	0	50	0	101	30	130			
Surr: Phenol-d6	33.45	0	75	0 .	44.6	15	110			
Surr: Terphenyl-d14	23.86	0	50	O	47.7	30	130			
Sample ID: LCS-10076	SampType: LCS	TestCode	TestCode: 8270_w	Units: µg/L		Prep Date:	5/6/2008	RunNo: 23556	9	
Client ID: ZZZZZ	Batch ID: 10076	TestNo	TestNo: SW8270C	(SW3510)		Analysis Date:	: 5/7/2008	SeqNo: 231371	7.1	
Analyte	Result	POL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimít RPD Ref Val	%RPD F	RPDLimit Qual	
1,2,4-Trichlorobenzene	15.74	1.00	25	0	62.9	40	140			1
1,2-Dichlorobenzene	16.48	1.00	25	0	62.9	40	140			
1,2-Dinitrobenzene	21.39	1.00	25	0	85.6	40	140			
1,3-Dichlorobenzene	16.06	1.00	25	0	64.2	40	140			
1,3-Dinitrobenzene	17.94	1.00	25	0	71.8	40	140			
1,4-Dichlorobenzene	16.80	1.00	25	0	67.2	40	140			
Qualifiers; BRL Below Reporting Limit	rting Limit	***************************************	E Value a	Value above quantitation range	- afi	PROPERTY OF THE PROPERTY OF TH	H Holding times f	Holding times for preparation or analysis exceeded	lysis exceeded	
	Analyte detected below quantitation limits		ND Not Det	Not Detected at the Reporting Limit	g Limit		R RPD outside recovery limits	overy limits		
S Spike Recov	Spike Recovery outside recovery limits								Page 16 of 33	133

Fay, Spotford & Thorndike CLIENT:

0805025 Work Order: WM-046, 1.4 Exp Project:

TestCode: 8270_w

Sample ID: LCS-10076	SampType: LCS	TestCode: 8270_w	8270_w	Units: µg/L		Prep Date:	te: 5/6/2008	RunNo: 23556	9	
Client ID: ZZZZZ	Batch ID: 10076	TestNo:	TestNo: SW8270C	(SW3510)		Analysis Date:	te: 5/7/2008	SeqNa: 231371	Σ	
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit RPD Ref Val	%RPD R	RPDLimit Q	Qual
1,4-Dinitrobenzene	19,22	1.00	25	0	76.9	40	140			
2,3,4,6.Tetrachlorophenol	12.97	1.00	25	0	51.9	30	130			
2,4,5-Trichlorophenol	15.13	1.00	25	0	60.5	30	130			
2,4,6-Trichlorophenol	14.99	1.00	25	0	0'09	30	130			
2,4-Dichlorophenol	14.86	1.00	22	0	59.4	30	130			
2,4-Dimethylphenol	18.10	1.00	25	0	72.4	30	130			
2,4-Dinitrophenol	<u>Q</u>	5.00	25	0	18.4	30	130			S
2,4-Dinitrotoluene	19.47	1.00	25	0	77.9	40	140			
2,6-Dínitrotoluene	18.52	1.00	22	0	74.1	40	140			
2-Chloronaphthalene	20.10	1.00	25	0	80.4	40	140			
2-Chlorophenol	15.81	1.00	22	0	63.2	30	130			
2-Methylnaphthalene	19.45	1.00	25	0	77.8	40	140			
2-Methyiphenoi	16.62	1.00	25	0	66.5	30	130			
2-Nitroaniline	19.58	1.00	25	0	78.3	40	140			
2-Nitrophenol	15,67	1.00	25	0	62.7	30	130			
3,3'-Dichlorobenzidine	23.56	1.00	25	0	94.2	40	140			
3-Methylphenol/4-Methylphenol	16.23	1.00	25	0	64.9	30	130			
3-Nitroaniline	20.07	1.00	25	0	80.3	40	140			
4,6-Dinitro-2-Methyiphenol	8.905	5.00	25	0	35.6	30	130			
4-Bromophenyi Phenyi Ether	19.52	1.00	25	0	78.1	40	140			
4-Chloro-3-Methylphenol	17.42	1.00	25	0	2.69	30	130			
4-Chloroaniline	26,31	1.00	25	0	105	40	140			
4-Chlorophenyi Phenyi Ether	20.33	1.00	25	0	81.3	40	140			
4-Nitroaniline	20.07	1.00	25	0	80.3	40	140			
4-Nitrophenol	9,775	1,00	25	0	39.1	30	130			
Acenaphthene	20.18	1.00	25	0	80.7	40	140			
Acenaphthylene	24.10	1.00	25	0	96.4	40	140			
Acetophenone	18.04	1.00	25	0	72.2	40	140			
Aniline	30.50	5.00	25	0	122	40	140			
Anthracene	24.30	1.00	25	0	97.2	40	140			
Azobenzene	26.56	5.00	25	0	106	40	140			
Qualifiers: BRL Below Reporting Limit	ting Limit		E Value	Value above quantitation range	ာရိ		H Holding times for p	Holding times for preparation or analysis exceeded	ysis exceeded	İ
	Analyte detected below quantitation limits	Kan	ND Not Do	Not Detected at the Reporting Limit	g Linuit		R RPD outside recovery limits	ery limits		
S Spike Recove	Spike Recovery outside recovery limits								Page 17 of 33	7 of 33
									0	

Spike Recovery outside recovery limits

~ ~

Fay, Spofford & Thorndike CLIENT:

0805025 Work Order:

WM-046, 1.4 Exp **Project:**

TestCode: 8270_w

Another Line (17.10) Result (1) Circle (1) SexPort SWEZTOG SWEZTOG SWEZTOG SWEZTOG SWEZTOG Convinint Highland Rep (14.10) SWEZTOG Convinint Highland Rep (14.10) SWEZTOG Convinint Highland Rep (14.10)	Sample ID: LCS-10076	SampType: LCS	TestCoc	TestCode: 8270_w	Units: µg/L		Prep Date:	(e: 5/6/2008	HUNNO: 23256	
Page 14 Page		Batch ID: 10076	Test	lo: SW8270C	(SW3510)		Analysis Da		SeqNo: 231371	
26.02 0.100 25 0 104 40 140 22.08 5.00 25 0 93.1 40 140 22.08 0.100 25 0 86.3 40 140 21.34 0.500 25 0 86.2 40 140 23.201 1.00 25 0 86.2 40 140 17.40 1.00 25 0 86.2 40 140 17.41 1.00 25 0 86.2 40 140 17.40 1.00 25 0 86.2 40 140 17.40 1.00 25 0 86.7 40 140 18.1 1.00 25 0 86.7 40 140 21.5 1.00 25 0 86.7 40 140 22.10 1.00 25 0 86.4 40 140 22.10 1.00 <th>Analyte</th> <th>Result</th> <th>PQL</th> <th>SPK value</th> <th>SPK Ref Val</th> <th>%REC</th> <th>LowLimit</th> <th></th> <th></th> <th></th>	Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit			
10 10 331 40 140 21,34 0,100 25 0 88,3 40 140 21,34 0,100 25 0 88,4 40 140 22,01 1,00 25 0 88,0 40 140 17,40 1,00 25 0 86,2 40 140 17,40 1,00 25 0 88,2 40 140 17,54 1,00 25 0 88,2 40 140 1,00 25 0 88,2 40 140 1,00 25 0 83,7 40 140 2,343 1,00 25 0 83,7 40 140 2,48 1,00 25 0 88,7 40 140 2,548 1,00 25 0 88,4 40 140 2,548 1,00 25 0 26 0 <t< td=""><td>Benz(a)Anthracene</td><td>26.02</td><td>0.100</td><td>25</td><td>0</td><td>104</td><td>40</td><td>140</td><td></td><td></td></t<>	Benz(a)Anthracene	26.02	0.100	25	0	104	40	140		
22.08 0.100 25 0 0 88.3 40 140 21.34 0.500 25 0 85.4 40 140 22.01 1.00 25 0 85.4 40 140 22.01 1.00 25 0 85.2 40 17.40 1.00 25 0 85.2 40 17.54 1.00 25 0 85.2 40 17.54 1.00 25 0 89.7 40 17.54 1.00 25 0 89.7 40 17.54 1.00 25 0 89.7 40 17.54 1.00 25 0 89.7 40 17.54 1.00 25 0 89.7 40 17.54 1.00 25 0 89.7 40 17.54 1.00 25 0 89.7 40 17.54 1.00 25 0 89.7 40 17.54 1.00 25 0 89.7 40 17.54 1.00 25 0 89.7 40 17.54 1.00 25 0 89.7 40 17.54 1.00 25 0 89.7 40 17.54 1.00 25 0 89.8 40 17.55 1.00 25	Benzidine	82.76	5.00	25	0	331	40	140		S
1,134 0,500 25 0 86.4 40 410	Benzo(a)Pyrene	22.08	0.100	25	0	88.3	40	140		
22.01 1.00 25 0 68.0 40 40 140 12.380 0.500 25 0 68.5 40 140 17.40 1.00 25 0 77.1 40 140 17.54 1.00 25 0 77.2 40 140 17.54 1.00 25 0 83.7 40 140 22.43 1.00 25 0 83.7 40 140 22.48 1.00 25 0 83.7 40 140 22.48 1.00 25 0 83.5 40 140 22.50 1.00 25 0 83.5 40 140 22.10 1.00 25 0 83.5 40 140 22.20 1.00 25 0 83.5 40 140 22.20 1.00 25 0 83.5 40 140 22.20 1.00 25 0 83.5 40 140 22.20 1.00 25 0 83.5 40 140 22.20 1.00 25 0 98.8 40 140 22.20 1.00 25 0 98.8 40 140 22.20 1.00 25 0 98.8 40 140 22.20 1.00 25 0 9 83.5 40 140 22.20 1.00 25 0 9 83.5 40 140 22.20 1.00 25 0 9 83.5 40 140 23.378 1.00 25 0 9 87.9 40 140 23.378 1.00 25 0 9 87.9 40 140 23.378 1.00 25 0 9 87.9 40 140 23.378 1.00 25 0 9 87.9 40 140 23.378 1.00 25 0 9 87.9 40 140 23.378 1.00 25 0 9 87.9 40 140 24.40 14.42 1.00 25 0 9 87.9 40 140 24.40 14.42 1.00 25 0 9 87.9 40 140 24.40 14.42 1.00 25 0 9 87.9 40 140 24.40 14.42 1.00 25 0 9 87.9 40 140 24.40 14.42 1.00 25 0 9 87.9 40 140 24.40 14.42 1.00 25 0 9 87.9 40 140 24.40 14.40 14.40 20 140 24.40 14.40 14.40 20 140 24.40 14.40 14.40 20 140 25.40 14.	Benzo(b)Fluoranthene	21.34	0.500	25	0	85.4	40	140		
14.0	Benzo(g,h,i)Perylene	22.01	1.00	25	0	88.0	40	140		
17.40 1.00 25 0 69.6 40 140 140 140 154 140 154 140 155 140 155 140 155 140 155 154 160 155 160 150	Benzo(k)Fluoranthene	23.80	0.500	25	0	95.2	40	140		
re 19.26 1.00 25 0 77.1 40 140 140 140 17.54 1.00 25 0 70.2 40 140 140 17.54 1.00 25 0 84.2 40 140 140 140 140 140 140 140 140 140	Benzyl Alcohol	17.40	1.00	25	0	9.69	40	140		
r 21.06 1.00 25 0 70.2 40 140 140 140 123.43 1.00 25 0 84.2 40 140 140 140 140 140 140 140 140 140	Bis(2-Chloroethoxy)Methane	19.26	1.00	25	0	77.1	40	140		
c 21.06 1.00 25 0 84.2 40 140 23.43 1.00 25 0 83.7 40 140 22.43 1.00 25 0 86.2 40 140 21.54 1.00 25 0 86.2 40 140 25.48 1.00 25 0 86.2 40 140 25.48 1.00 25 0 102 40 140 20.86 0.100 25 0 60.6 40 140 15.16 1.00 25 0 60.6 40 140 26.24 1.00 25 0 60.6 40 140 26.24 1.00 25 0 88.2 40 140 21.99 1.00 25 0 88.2 40 140 15.28 0.100 25 0 60.6 40 140 21.97	Bis(2-Chloraethyl)Ether	17.54	1.00	25	0	70.2	40	140		
23.43 1.00 25 0 93.7 40 140 22.43 1.00 25 0 88.7 40 140 21.54 1.00 25 0 86.2 40 140 25.48 1.00 25 0 86.2 40 140 20.86 0.100 25 0 83.5 40 140 20.86 0.100 25 0 88.4 40 140 18.87 1.00 25 0 88.4 40 140 18.87 1.00 25 0 88.4 40 140 26.24 1.00 25 0 105 40 140 26.24 1.00 25 0 105 40 140 27.05 1.00 25 0 88.0 40 140 16.28 0.10 25 0 87.9 40 140 23.22 1.00 25 0 135 40 140 19.19 1.00 <td< td=""><td>Bis(2-Chloroisapropyl)Ether</td><td>21.06</td><td>1.00</td><td>25</td><td>0</td><td>84.2</td><td>40</td><td>140</td><td></td><td></td></td<>	Bis(2-Chloroisapropyl)Ether	21.06	1.00	25	0	84.2	40	140		
22.43 1,00 25 0 89.7 40 140 21.54 1,00 25 0 86.2 40 140 25.48 1,00 25 0 102 40 140 20.86 0,100 25 0 83.5 40 140 22.10 1,00 25 0 88.4 40 140 18.87 1,00 25 0 88.4 40 140 18.87 1,00 25 0 60.6 40 140 26.24 1,00 25 0 60.6 40 140 26.29 1,00 25 0 60.6 40 140 27.99 1,00 25 0 61.1 40 140 16.28 0.10 25 0 61.1 40 140 16.29 1,00 25 0 87.9 40 140 23.20 1,00 25 0 62.9 40 140 19.19 10	Bis(2-Ethylhexyl)Phthalate	23.43	1.00	25	0	93.7	40	140		٠
21.54 1,00 25 0 86.2 40 140 25.48 1,00 25 0 102 40 140 20.86 0,100 25 0 83.5 40 140 22.10 1,00 25 0 88.4 40 140 18.87 1,00 25 0 60.6 40 140 22.10 1,00 25 0 60.6 40 140 26.24 1,00 25 0 60.6 40 140 21.99 1,00 25 0 88.0 40 140 22.05 1,00 25 0 88.0 40 140 14.26 1,00 25 0 88.0 40 140 14.26 1,00 25 0 61.1 40 140 21.37 0,10 25 0 87.9 40 140 23.22 1,00 25 0 135 40 140 19.19 1,00 <td< td=""><td>Butyl Benzyl Phthalate</td><td>22.43</td><td>1.00</td><td>25</td><td>0</td><td>89.7</td><td>40</td><td>140</td><td></td><td></td></td<>	Butyl Benzyl Phthalate	22.43	1.00	25	0	89.7	40	140		
25.48 1.00 25 0 102 40 140 20.86 0.100 25 0 83.5 40 140 22.10 1.00 25 0 88.4 40 140 18.87 1.00 25 0 75.5 40 140 16.16 1.00 25 0 60.6 40 140 26.24 1.00 25 0 60.6 40 140 24.69 1.00 25 0 98.8 40 140 21.99 1.00 25 0 88.0 40 140 18.25 0.100 25 0 88.0 40 140 19.28 0.100 25 0 61.1 40 140 21.97 0.100 25 0 87.9 40 140 23.22 1.00 25 0 76.8 40 140 19.19 1.00<	Carbazole	21.54	1.00	25	0	86.2	40	140		
20.86 0.100 25 0 63.5 40 140 22.10 1.00 25 0 68.4 40 140 18.87 1.00 25 0 75.5 40 140 15.16 1.00 25 0 60.6 40 140 26.24 1.00 25 0 60.6 40 140 26.24 1.00 25 0 98.8 40 140 21.99 1.00 25 0 88.0 40 140 22.05 1.00 25 0 88.0 40 140 15.28 0.100 25 0 88.2 40 140 14.26 1.00 25 0 88.2 40 140 21.97 0.100 25 0 87.9 40 140 23.22 1.00 25 0 87.9 40 140 19.78 1.00 25 0 135 40 140 11.44 5.00	Chrysene	25.48	1.00	25	0	102	40	140		
22.10 1.00 25 0 88.4 40 140 1887 1.00 25 0 75.5 40 140 26.24 1.00 25 0 60.6 40 140 26.24 1.00 25 0 60.6 40 140 24.69 1.00 25 0 98.8 40 140 21.99 1.00 25 0 88.0 40 140 22.05 1.00 25 0 88.0 40 140 16.28 0.100 25 0 88.0 40 140 16.28 0.100 25 0 61.1 40 140 14.26 1.00 25 0 61.1 40 140 21.97 0.100 25 0 87.9 40 140 23.22 1.00 25 0 87.9 40 140 23.22 1.00 25 0 87.9 40 140 19.19 1.00 25 0 45.8 40 140 19.78 1.00 25 0 78.1 40 140 19.78 <t< td=""><td>Dibenz(a,h)Anthracene</td><td>20.86</td><td>0.100</td><td>25</td><td>0</td><td>83.5</td><td>40</td><td>140</td><td></td><td></td></t<>	Dibenz(a,h)Anthracene	20.86	0.100	25	0	83.5	40	140		
18.87 1.00 25 0 75.5 40 140 15.16 1.00 25 0 60.6 40 140 26.24 1.00 25 0 60.6 40 140 24.69 1.00 25 0 98.8 40 140 21.99 1.00 25 0 88.0 40 140 18.25 0.100 25 0 88.2 40 140 18.25 0.100 25 0 61.1 40 140 14.26 1.00 25 0 61.1 40 140 21.97 0.100 25 0 87.9 40 140 23.22 1.00 25 0 87.9 40 140 19.19 1.00 25 0 87.9 40 140 19.78 1.00 25 0 75.8 40 140 19.78 1.00 25 0 45.8 40 140 19.78 1.00	Dibenzofuran	22.10	1.00	25	0	88,4	40	140		
15.16 1.00 25 0 60.6 40 140 26.24 1.00 25 0 105 40 140 24.69 1.00 25 0 98.8 40 140 21.99 1.00 25 0 88.0 40 140 18.25 0.100 25 0 88.2 40 140 18.25 0.100 25 0 73.0 40 140 14.26 1.00 25 0 61.1 40 140 21.97 0.100 25 0 87.9 40 140 23.28 1.00 25 0 87.9 40 140 23.22 1.00 25 0 76.8 40 140 19.19 1.00 25 0 76.8 40 140 19.78 1.00 25 0 75.8 40 140 19.78 1.00 </td <td>Diethyl Phthalate</td> <td>18.87</td> <td>1.00</td> <td>25</td> <td>0</td> <td>75.5</td> <td>40</td> <td>140</td> <td></td> <td></td>	Diethyl Phthalate	18.87	1.00	25	0	75.5	40	140		
26.24 1.00 25 0 105 40 140 24.69 1.00 25 0 98.8 40 140 21.99 1.00 25 0 88.0 40 140 22.05 1.00 25 0 88.2 40 140 18.25 0.100 25 0 73.0 40 140 14.26 1.00 25 0 61.1 40 140 21.97 0.100 25 0 87.9 40 140 23.22 1.00 25 0 87.9 40 140 19.19 1.00 25 0 82.9 40 140 19.19 1.00 25 0 76.8 40 140 19.17 1.00 25 0 76.8 40 140 19.18 1.00 25 0 75.8 40 140 19.78 1.00 25 0 75.8 40 140 19.78 1.00 <	Dimethyl Phthalate	15.16	1.00	25	0	9.09	40	140		
24,69 1,00 25 0 98.8 40 140 21,99 1,00 25 0 88.0 40 140 22,05 1,00 25 0 88.2 40 140 18,25 0,100 25 0 61.1 40 140 15,28 0,100 25 0 61.1 40 140 21,97 0,100 25 0 87.9 40 140 23,22 1,00 25 0 135 40 140 19,19 1,00 25 0 76.8 40 140 11,44 5,00 25 0 76.8 40 140 19,78 1,00 25 0 76.8 40 140 19,78 1,00 25 0 76.8 40 140 19,78 1,00 25 0 76.8 40 140 19,78 1,00 25 0 79.1 40 140 10,78 25 0 79.1 40 140 10,78 25 0 79.1 40 140 10,00 25 0 79.	Di-n-Butyl Phthalate	26.24	1.00	25	0	105	40	140		
21.99 1.00 25 0 88.0 40 140 22.05 1.00 25 0 88.2 40 140 18.25 0.100 25 0 73.0 40 140 15.28 0.100 25 0 61.1 40 140 14.26 1.00 25 0 87.9 40 140 21.97 0.100 25 0 87.9 40 140 33.78 1.00 25 0 92.9 40 140 19.19 1.00 25 0 76.8 40 140 11.44 5.00 25 0 76.8 40 140 19.78 1.00 25 0 76.8 40 140 19.78 1.00 25 0 79.1 40 140 According Limit E. Value above quantitation range H H 140	Di-n-Octyl Phthalate	24.69	1.00	25	0	98.8	40	140		
22.05 1.00 25 0 88.2 40 140 18.25 0.100 25 0 73.0 40 140 15.28 0.100 25 0 61.1 40 140 14.26 1.00 25 0 67.0 40 140 21.97 0.100 25 0 87.9 40 140 33.78 1.00 25 0 135 40 140 23.22 1.00 25 0 76.8 40 140 19.19 1.00 25 0 76.8 40 140 19.78 1.00 25 0 76.8 40 140 19.78 1.00 25 0 79.1 40 140 Reporting Limit 1.00 25 0 79.1 40 140	Fluoranthene	21.99	1.00	25	. 0	88,0	40	140		
18.25 0.100 25 0 73.0 40 140 15.28 0.100 25 0 61.1 40 140 14.26 1.00 25 0 57.0 40 140 21.97 0.100 25 0 87.9 40 140 33.78 1.00 25 0 135 40 140 23.22 1.00 25 0 76.8 40 140 19.19 1.00 25 0 76.8 40 140 19.78 1.00 25 0 76.8 40 140 19.78 1.00 25 0 79.1 40 140 According Limit E. Value above quantitation range B H 140 140	Fluorene	22.05	1.00	25	0	88.2	40	140		
15.28 0.100 25 0 61.1 40 140 14.26 1.00 25 0 57.0 40 140 21.97 0.100 25 0 87.9 40 140 23.22 1.00 25 0 92.9 40 140 19.19 1.00 25 0 76.8 40 140 11.44 5.00 25 0 45.8 40 140 Reporting Limit E Value above quantitation range H	Hexachiorobenzene	18.25	0.100	25.	0	73.0	40	140		
14.26 1.00 25 0 57.0 40 140 21.97 0.100 25 0 87.9 40 140 33.78 1.00 25 0 135 40 140 23.22 1.00 25 0 92.9 40 140 19.19 1.00 25 0 76.8 40 140 Reporting Limit 1.00 25 0 79.1 40 140 Reporting Limit E Value above quantitation range B H 140	Hexachtorobutadiene	15,28	0.100	25	0	61.1	40	140		
21.97 0.100 25 0 87.9 40 140 33.78 1.00 25 0 135 40 140 23.22 1.00 25 0 92.9 40 140 19.19 1.00 25 0 76.8 40 140 140 25 0 76.8 40 140 140 25 0 76.8 40 140 140 25 0 79.1 40 140 140 25 0 79.1 40 140 140 140 140 140 140 140 140 140	Hexachloroethane	14.26	1.00	25	0	57.0	40	140		
33.78 1.00 25 0 135 40 140 23.22 1.00 25 0 92.9 40 140 19.19 1.00 25 0 76.8 40 140 11.44 5.00 25 0 76.8 40 140 19.78 1.00 25 0 79.1 40 140 Reporting Limit E Value above quantitation range H	Indeno(1,2,3-cd)Pyrene	21.97	0.100	25	0	87.9	40	140		
23.22 1.00 25 0 92.9 40 140 19.19 1.00 25 0 76.8 40 140 140 11.44 5.00 25 0 75.8 40 140 140 19.78 1.00 25 0 79.1 40 140 140 140 15.00 25 0 79.1 40 140 140 140 15.00 25 0 79.1 40 140 140 140 15.00 15	(sophorone	33.78	1.00	25	0	135	40	140		
19.19 1.00 25 0 76.8 40 140 140 11.44 5.00 25 0 45.8 40 140 140 19.78 1.00 25 0 79.1 40 140 140 140 140 140 140 140 140 140	Naphthalene	23,22	1,00	25	0	92.9	40	140		
11.44 5.00 25 0 45.8 40 140 140 19.78 1.00 25 0 79.1 40 140	Nitrobenzene	19.19	1.00	25	0	76.8	40	140		
Reporting Limit E Value above quantitation range H H	N.Nitrosodimethylamine	11.44	5.00	25	0	45.8	40	140		
BRL Below Reporting Limit E Value above quantitation range H	N-Nitrosodi-n-Propylamine	19.78	1.00	25	0	79.1	40	140		
T And the American Electron Propies NOT New Debases of the Depast of the	BRL	ding Limit			above quantitation ran				preparation or analysis ex	ceeded
		and the land and another fine lives to			tacted at the Denortin	, time;			reary liverides	

Fay, Spofford & Thorndike CLIENT:

0805025 Work Order: WM-046, 1.4 Exp

Project:

TestCode: 8270_w

ANALYTICAL QC SUMMARY REPORT

Sample ID: LCS-10076	SampType: LCS	TestCo	TestCode: 8270_w	Units: µg/L		Prep Date:	e: 5/6/2008	RunNo: 23556	
Client ID: ZZZZZ	Batch ID: 10076	Test	estNo: SW8270C	(SW3510)		Analysis Dat	Analysis Date: 5/7/2008	SeqNo: 231371	
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	%REC LowLimit HighLimit RPD Ref Val	%RPD RPDLimit	Qual
N-Nitrosodiphenylamine	24.01	5.00	25	0	96.0	40	140		
Pentachlorophenol	9.235	1.00	25	0	36.9	30	130		
Phenanthrene	24.02	1.00	25	0	96.1	40	140		
Phenol	10.02	1.00	25		40.1	30	130		
Pyrene	28.18	1.00	. 25	0	113	40	140		
Pyridine	11.34	5.00	25	0	45.3	40	140		
Surr: 2,4,6-Tribromophenol	42.18	0	75	0	56.2	5	110		
Surr: 2-Fluorabiphenyl	41,68	0	50	0	83.4	30	130		
Surr: 2-Fluorophenol	32.01	0	75	0	42.7	15	110		
Surr: Nitrobenzene-d5	35.67	0	90	. 0	71.3	30	130		
Surr: Phenol-d6	24.74	0	75	0	33.0	15	110		
Surr: Terphenyl-d14	49.71	0	50	0	99.4	30	130		

щS Analyte detected below quantitation limits BRL Below Reporting Limit

Qualifiers:

Spike Recovery outside recovery limits

Not Detected at the Reporting Limit Value above quantitation range

Holding times for preparation or analysis exceeded RPD outside recovery limits H ×

RPD outside recovery limits

E Value above quantitation range ND Not Detected at the Reporting Limit

Analyte detected below quantitation limits Spike Recovery outside recovery limits

BRL Below Reporting Limit

Qualifiers:

Fay, Spofford & Thomdike CLIENT:

0805025 Work Order: WM-046, 1.4 Exp

Project:

TestCode: ag_w

Sample ID: MB-10051	SampType: MBLK	TestCod	TestCode: ag_w	Units: mg/L		Prep Date: 5/2/2008	2/2008	RunNo: 23480		
Client ID: ZZZZZ	Batch ID: 10051	TestA	estNo: 200.7	(SW3010A)	*	Analysis Date: 5/5/2008	5/2008	SeqNo: 230662		
Analyte	Result	PaL	SPK value	SPK value SPK Ref Val	%REC	LowLimit Highl	"REC LowLimit HighLimit RPD Ref Val	%RPD RPDLimit	imit	Qual
Silver	ON	0.00700				A TAXABLE TO PARTY OF THE PARTY				
Sample ID: LCS-10051	SampType: LCS Batch ID: 10051	TestCoc	TestCode: ag_w TestNo: 200.7	Units: mg/L (SW3010A)	,	Prep Date: 5/2/2008 Analysis Date: 5/5/2008	2/2008 5/2008	RunNo: 23480 SeqNo: 230663		
Analyte	Result	POL	SPK value	SPK value SPK Ref Val	%REC	LowLimit Highl	%REC LowLimit HighLimit RPD Ref Val	%RPD RPDLimit	1	Qual
Silver	0.3990	0.00700	0.425	0	93.9	80	120			

RPD outside recovery limits

H N

E Value above quantitation range
ND Not Detected at the Reporting Limit

Analyte detected below quantitation limits Spike Recovery outside recovery limits

BRL Below Reporting Limit

Qualifiers:

Fay, Spofford & Thorndike CLIENT:

0805025 Work Order:

Project:

WM-046, 1.4 Exp

TestCode: CN_W_SM

Sample ID: MB-R23624	SampType: MBLK	TestCo	TestCode: CN_W_SM	Units: mg/L		Prep Date:	THE PROPERTY OF THE PROPERTY O		RunNo: 23624	24	
Client ID: ZZZZ	Batch ID: R23624	Test	TestNo: SM 4500-CN-	<u>.</u>	-	Analysis Date: 5/12/2008	5/12/2008	J,	SeqNo: 232074	074	
Analyte	Result	Pal	SPK value SPK Ref Val	SPK Ref Val	%REC	LowLimit	%REC LowLimit HighLimit RPD Ref Val	r Val	%RPD	%RPD RPDLimit Qual	Qual
Cyanide, Total	QN	0.0197									
Sample ID: LCS-R23624	SampType: LCS	TestCo	TestCode: CN_W_SM	Units: mg/L		Prep Date:	11	<u>.</u>	RunNo: 23624	24	
Client ID: ZZZZ	Batch ID: R23624	Test	TestNo: SM 4500-CN-	4	7	Analysis Date: 5/12/2008	:: 5/12/2008	5,	SeqNo: 232075	376	
Analyte	Result	PQL	SPK value SPK Ref Val	SPK Ref Val	%REC	LowLimit	"REC LowLimit HighLimit RPD Ref Val	(Val	%RPD	%RPD RPDLimit Qual	Qual
Cyanide, Total	0.1726	0.0197	0.183	0	94.3	85	115		T		

RPD outside recovery limits

E Value above quantitation range
ND Not Detected at the Reporting Limit Value above quantitation range

> Analyte detected below quantitation limits Spike Recovery outside recovery limits

BRL Below Reporting Limit

Qualifiers:

Fay, Spofford & Thorndike 0805025 Work Order: CLIENT:

WM-046, 1.4 Exp

Project:

TestCode: Cr6_WW

Sample ID: MB-R23495	SampType; MBLK	TestCode	TestCode: Cr6_WW	Units: mg/L		Prep Date:	.ie		RunNo: 23495	95	
Client ID: ZZZZ	Batch ID: R23495	TestNc	estNo: M3500.Cr D	C .	∢	malysis Dat	Analysis Date: 5/6/2008		SeqNo: 230862	1862	
Anafyte	Result	POL	SPK value	SPK value SPK Ref Val	%REC	LowLimit	%REC LowLimit HighLimit RPD Ref Val	'D Ref Val	%RPD	%RPD RPDLimit Qual	Qual
Chromium, Hexavalent	ON	0.0500									
Sample ID: LCS-R23495	SampType: LCS	TestCode	TestCode: Cr6_WW	Units: mg/L		Prep Date:	(a)	***************************************	RunNo: 23495	95	

Sample ID: LCS-R23495	SampType: LCS	TestCoc	TestCode: Cr6_WW	Units: mg/L		Prep Date:	6	RunNo: 23495	195	
Client ID: ZZZZ	Batch ID; R23495	Test	TestNo: M3500.Cr D		*	Analysis Date: 5/	e: 5/6/2008	SeqNo: 230863	3863	
Analyte	Result	Pal	SPK value SPK Ref Val	SPK Ref Vai	%REC	LowLimit	%REC LowLimit HighLimit RPD Ref Val	%RPD	%RPD RPDLimit Qual	Quai
Chromium, Hexavalent	0,4610	0.0500	0.5	0	92.2	85	115			

Page 23 of 33

Analyte detected below quantitation limits Spike Recovery outside recovery limits

- 2
_
$-\delta$
<u>-</u>
,
\simeq
~
5
\mathbf{z}
=
SUN
V 2
7)
\mathbf{x}
AL
73
\rightarrow
7
-
A
7

TestCode: EPHP_W

-046, 1.4 Exp	
roject: WM-	

Fay, Spofford & Thorndike 0805025

Work Order: CLIENT:

.4 Exp	
WM-046, I	
••	

Sample ID: MB-10060	SampType: MBLK	TestCo	estCode: EPHP_W	Units: µg/L		Prep Dat	Prep Date: 5/5/2008		RunNo: 23489	189	
Client ID: ZZZZZ	Batch ID: 10060	Test	TestNo: MADEP EPH_ (eph_Wpr)	H_ (eph_Wpr)		Analysis Dat	Analysis Date: 5/5/2008		SeqNo: 230812	1812	
Analyte	Result	Pal	SPK value	SPK Ref Vai	%REC	LowLimit	LowLimit HighLimit RPD Ref Val	J Ref Val	%RPD	RPDLimit	Qual
Naphthalene	QN.	1.00	-								
2-Methylnaphthalene	QN	1.00									
Acenaphthene	Q.	1.00								0.2	
Phenanthrene	QN	1.00							٠		
Acenaphthylene	QN	1.00									
Fluorene	QN	1.00									
Anthracene	QN	1.00						•			
Fluoranthene	Q	1.00									
Pyrene	QN	1.00									
Benzo(a)Anthracene	Q	0.400	÷								
Chrysene	QN	1.00									
Benzo(b)Fluoranthene	DN.	1.00									
Benzo(k)Fluoranthene	ND ND	1.00									
Benzo(a)Pyrene	ND	0.200	٠								
Inderio(1,2,3-cd)Pyrene	<u>N</u>	0.400									
Dibenz(a,h)Anthracene	QN	0.400									
Benzo(g,h,i)Perylene	QN	1.00									
Total PAH Target Concentration	- ND	0					٠				
Surr: 2,2'-Difluorobiphenyl	25.19	0	25	0	101	40	140				
Surr: 2-Fluorobiphenyl	23.20	0	25	0	92.8	40	140				

Analyte Result PQL SPK value SPK Ref Val %REC LowLimit HighLimit RPD Ref Val %RPD RPDLimit Qual Naphthalene 26.86 1.00 50 0 59.7 40 140 A A A A A A B A B A B	Sample ID: LCS-10060 Client ID: ZZZZZ	SampType: LCS Batch ID: 10060	TestCod TestN	TestCode: EPHP_W TestNo: MADEP EP	iCode: EPHP_W Units: µg/L estNo: MADEP EPH_ (eph_Wpr)	1	Prep Dat Analysis Dat	Prep Date: 5/5/2008 Analysis Date: 5/5/2008	RunNo: 23489 SeqNo: 230813	489 0813	
26.86 1.00 50 0 53.7 40 29.85 1.00 50 0 59.7 40 32.40 1.00 50 0 64.8 40 36.47 1.00 50 0 72.9 40 9 31.79 1.00 50 0 63.6 40	Analyte	Result	POL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit RPD Ref Val	%RPD	RPDLimit	Qual
aslene 29.85 1.00 50 0 59.7 40 32.40 1.00 50 0 64.8 40 36.47 1.00 50 0 72.9 40 9 31.79 1.00 50 0 63.6 40	Naphthalene	26.86	1.00	50	0	53.7	40	140			
32.40 1.00 50 0 64.8 40 36.47 1.00 50 0 72.9 40 9 31.79 1.00 50 0 63.6 40	2-Methylnaphthalene	29.85	1.00	50	0	59.7	40	140			
36.47 1.00 50 0 72.9 40 e 31.79 1.00 50 0 63.6 40	Acenaphthene	32.40	1.00	50	0	64.8	40	140		•	
31.79 1.00 50 0 63.6 40	Phenanthrene	36.47	1.00	50	0	72.9	40	140			
	Acenaphthylene	31.79	1.00	20	0	63.6	40	140			
	l Analyte detect	Analyte detected below anantitation limits		NID Mot Die	NO Not Distorted at the Beneather I imit	,		manage and the same of the same of		and make	3

Fay, Spofford & Thorndike CLIENT:

0805025 Work Order: WM-046, 1.4 Exp

Project:

TestCode: EPHP_W

ANALYTICAL QC SUMMARY REPORT

Sample ID: LCS-10060	SampType: LCS	TestCo	TestCode: EPHP_W	Units: µg/L		Prep Date:	Prep Date: 5/5/2008	RunNo: 23489
Client ID: ZZZZZ	Batch ID: 10060	Test	[estNo: MADEP EPH_ (eph_Wpr)	ا_ (eph_Wpr)		Analysis Date: 5/5/2008	5/5/2008	SeqNo: 230813
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	LowLimit HighLimit RPD Ref Val	Val %RPD RPDLimit Qual
Fluorene	39.49	1,00	50	0	79.0	40	140	
Anthracene	37.42	1.00	50	0	74.8	40	140	
Fluoranthene	40.18	1.00	50	0	80.4	40	140	
Pyrene	40.38	1.00	50	0	80.8	40	140	•
Benzo(a)Anthracene	39.36	0.400	. 50	0	78.7	40	140	
Сhrysene	38.67	1.00	50	0	77.3	40	140	
Benzo(b)Fiuoranthene	33.58	1.00	20	0	67.2	40	140	
Benzo(k)Fiuoranthene	49.30	1.00	90	0	98.6	40	140	
Benzo(a)Pyrene	44.37	0.200	90	0	88.7	40	140	
Indeno(1,2,3-cd)Pyrene	41.81	0.400	20	0	83.6	40	140	
Dibenz(a,h)Anthracene	42.73	0.400	20	0	85.5	40	140	
Benzo(g,h,i)РегуІеле	40.33	1.00	50	0	80.7	40	140	
Total PAH Target Concentration	645.0	0						
Surr: 2,2'-Difluorobiphenyl	20.53	0	25	0	82.1	40	140	
Surr: 2-Fluorobiphenyl	17.17	0	25	0	68.7	40	140	

E Value above quantitation range

ND Not Detected at the Reporting Limit Analyte detected below quantitation limits Spike Recovery outside recovery limits

BRL Below Reporting Limit

Qualifiers:

H Holding times for preparation or analysis exceeded R RPD outside recovery limite RPD outside recovery limits

RPD outside recovery limits

Value above quantitation range Not Detected at the Reporting Limit

J Analyte detected below quantitation limits S Spike Recovery outside recovery limits

BRL Below Reporting Limit

Qualifiers:

CLIENT: Fay, Spofford & Thorndike

Work Order: 0805025

WM-046, 1.4 Exp

Project:

TestCode: epht_w

Sample ID: MB-10060	SampType: MBLK	TestCoc	TestCode: epht_w	Units: µg/L		Prep Dat	Prep Date: 5/5/2008	RunNo: 23545	
Client ID: ZZZZZ	Batch ID: 10060	Testh	lo: MADEP EF	TestNo: MADEP EPH (eph_Wpr)		Analysis Dat	Analysis Date: 5/6/2008	SeqNo: 231284	
Analyte	Result	PQL	SPK value	SPK value SPK Ref Val	%REC	LowLimit	%REC LowLimit HighLimit RPD Ref Val	%RPD RPDLimit	Qual
Adjusted C11-C22 Aromatics	ON	100							
C09-C18 Aliphatics	QN	100							
C19-C36 Aliphatics	QN QN	100							
Unadjusted C11-C22 Aromatics	QN	100							
Surr: 1-Chlorooctadecane	00'99	0	100	0	0.99	40	140		
Surr: o-Terphenyl	73.00	0	100	0	73.0	40	140		
Sample ID: LCS-10060	SampType: LCS	TestCod	TestCode; epht_w	Units: µg/L	THE PERSON NAMED IN COLUMN NAM	Prep Date	Prep Date: 5/5/2008	RunNo; 23545	
Client ID: ZZZZ	Batch ID: 10060	TestN	o: MADEP EF	TestNo: MADEP EPH (eph_Wpr)	-	Analysis Date: 5/6/2008	a; 5/6/2008	SeqNo: 231285	
Analyte	Result	Pal	SPK value	SPK value SPK Ref Val	%REC	LowLimit	%REC LowLimit HighLimit RPD Ref Val	%RPD RPDLimit	Qual
C09-C18 Aliphatics	QN	100	100	0	48.0	40	140		
C19-C36 Aliphatics	ON.	100	100	0	64.0	40	140		
Unadjusted C11-C22 Aromatics	ON.	100	100	0	86.9	40	140		
Surr: 1-Chlorooctadecane	52.00	0	100	0	52.0	40	140		
Surr; o-Terphenyl	73.00	0	100	0	73.0	40	140		

H Holding times for preparation or analysis exceeded R RPD outside recovery limits

Not Detected at the Reporting Limit Value above quantitation range

ш Q

Analyte detected below quantitation limits Spike Recovery outside recovery limits

BRL Below Reporting Limit

Qualifiers:

Fay, Spofford & Thorndike CLIENT:

Work Order:

WM-046, 1.4 Exp

Project:

TestCode: hg-245.1_w

				The second secon	-			The second secon		
Sample ID: MB-10071	SampType: MBLK	TestCod	Code: hg-245.1_w	Units: mg/L		Prep Date:	Prep Date: 5/5/2008	RunNo: 23475		
Client ID: ZZZZZ	Batch ID: 10071	Testh	TestNo: E245.1	(SW7470A)E2	ν.	Analysis Date: 5/5/2008	5/5/2008	SeqNo: 230595		
Analyte	Result	PQL	SPK value SPK Ref Val	SPK Ref Vai	%REC	LowLimit	"REC LowLimit HighLimit RPD Ref Val	%RPD RPDLimit Qual	Jimit	nal
Mercury	QN	0.000500								
Sample ID: LCS-10071	SampType: LCS Batch ID: 10071	TestCor	TestCode: hg-245.1_w TestNo: E245.1	Units: mg/L (SW7470A/E2	1	Prep Date: 5/5/2008 Analysis Date: 5/5/2008	Prep Date: 5/5/2008 Alysis Date: 5/5/2008	RunNo: 23475 SeqNo: 230596		
Analyte	Result	Pal	SPK value	SPK Ref Val	%REC	LowLimit	%REC LowLimit HighLimit RPD Ref Val	%RPD RPD	RPDLimit Q	Qual
Mercury	0.005060	0.000500	0.005	0	101	80	120			

Page 27 of 33

Holding times for preparation or analysis exceeded

RPD outside recovery limits

H H

E Value above quantitation range ND Not Detected at the Reporting Limit

> Analyte detected below quantitation limits Spike Recovery outside recovery limits

~ s

BRL Below Reporting Limit

Qualifiers:

40

68.5 74.0

100

0.200

1.369

Total Petroleum Hydrocarbons Surr: o-Terphenyl

CLIENT: Fay, Spofford & Ti Work Order: 0805025 Project: WM-046 1 4 Fyra	Fay,Spofford & Thorndike 0805025	To the state of th			ANALYTICAL QC SUMMARY REPORT	MMARY REPORT
					Y CALCOURS.	,
Sample ID: WB1-10059 Client ID: ZZZZZ	SampType: MBLK Batch ID: 10059	TestCode: tph_w TestNo: 8100M	Units: mg/L (8100M)		Prep Date: 5/5/2008 Analysis Date: 5/5/2008	RunNo: 23505 SeqNo: 230939
Analyte	Result	PQL SPK value	e SPK Ref Val	%REC	LowLimit HighLimit RPD Ref Val	%RPD RPDLimit Qual
Total Petroleum Hydrocarbons Surr: o-Terphenyl	00.96	0.200 0 100	. 0 0	96.0	40 140	
Sample ID: MB-10088 Client ID: ZZZZZ	SampType: MBLK Batch ID: 10088	TestCode: tph_w TestNo: 8100M	Units: mg/L (8100M)		Prep Date: 5/7/2008 Analysis Date: 5/7/2008	RunNo: 23549 SeqNo: 231311
Analyte	Result	PQL SPK value	e SPK Ref Val	%REC	LowLimit HighLimit RPD Ref Val	%RPD RPDLimit Qual
Total Petroleum Hydrocarbons Sur: o-Terphenyl	ND 94.00	0.200	0 0	94.0	40 140	- Andread Control of the Control of
Sample ID: LW1-10059 Client ID: ZZZZZ	SampType: LCS Batch ID: 10059	TestCode: tph_w TestNo: 8100M	Units: mg/L (8100M)	. The commence of the commence	Prep Date: 5/5/2008 Analysis Date: 5/5/2008	RunNo: 23505 SeqNo: 230937
Analyte	Result	PQL SPK value	e SPK Ref Val	%REC	LowLimit HighLimit RPD Ref Val	%RPD RPDLimit Qual
Total Petroleum Hydrocarbons Surr: o-Terphenyl	1.576 74.00	0.200 2 0 100	2 0 0 0	78.8 74.0	4 0 140 40 140	
Sample ID: LW2-10059 Client ID: ZZZZZ	SampType: LCS Batch ID: 10059	TestCode: tph_w TestNo: 8100M	Units: mg/L (8100M)		Prep Date: 5/5/2008 Analysis Date: 5/5/2008	RunNo: 23505 SeqNo: 230938
Analyte	Result	PQL SPK value	e SPK Ref Val	%REC	LowLimit HighLimit RPD Ref Val	%RPD RPDLimit Qual
Total Petroleum Hydrocarbons Surr: o-Terphenyl	1.276 66.00	0.200 2 0 100	2 0 0 0	63.8 66.0	40 140 40 140	
Sample ID: LCS-10088 Client ID: ZZZZ	SampType: LCS Batch ID: 10088	TestCode: tph_w TestNo: 8100M	Units: mg/L (8100M)		Prep Date: 5/7/2008 Analysis Date: 5/7/2008	RunNo: 23549 SeqNo: 231312
Analyte	Result	PQL SPK value	SPK Ref Vai	%REC	LowLimit HighLimit RPD Ref Val	%RPD RPDLimit Qual

Holding times for preparation or analysis exceeded RPD outside recovery limits

H Z

E Value above quantitation range
ND Not Detected at the Reporting Limit

Analyte detected below quantitation limits Spike Recovery outside recovery limits

BRL Below Reporting Limit

Qualifiers:

Fay, Spofford & Thorndike CLIENT:

0805025 Work Order: WM-046, 1.4 Exp

Project:

ANALYTICAL QC SUMMARY REPORT

TestCode: tph_w

Sample ID: LCS2-10088 Client ID: ZZZZ	SampType: LCS Batch ID: 10088	TestCo	TestCode: tph_w TestNo: 8100M	Units: mg/L (8100M)	,	Prep Dat Analysis Dat	Prep Date: 5/7/2008 Analysis Date: 5/7/2008	RunNo: 23549 SeqNo: 231315	
Analyte	Result	PQL	SPK value	SPK value SPK Ref Val	%REC	LowLimit	WREC LowLimit HighLimit RPD Ref Val	%RPD RPDLimit Qual	Qual
Total Petroleum Hydrocarbons	1.840	0.200	2	0	92.0	40	140	A CONTRACTOR OF THE PROPERTY O	
Surr: o-Terphenyl	104.0	0	100	0	104	40	140		

Fay, Spofford & Thorndike 0805025 Work Order: CLIENT:

WM-046, 1.4 Exp

Project:

ANALYTICAL QC SUMMARY REPORT TestCode: TRC_W

Sample ID: MB-R23484	SampType; MBLK	TestCo	tCode; TRC_W	Units: mg/L		Prep Date:	***************************************	RunNo: 23484	
Client ID: ZZZZ	Batch ID: R23484	Test	estNo: Hach 8167			Analysis Date: 5/5/2008	5/2008	SeqNo: 230752	
Analyte	Result	Pal	SPK value	SPK value SPK Ref Val	%REC	LowLimit HighL	%REC LowLimit HighLimit RPD Ref Val	%RPD RPDLimit Qual	it Qual
Total Residual Chlorine	GN	0.162		Additional and a second state of the second st	**************************************				
Sample ID: LCS-R23484	SampType: LCS	TestCoo	TestCode: TRC_W	Units: mg/L		Prep Date:		RunNo: 23484	
Client ID.	Batch ID: K23484		estivo: Hach 816/		-	Analysis Date: 5/5/2008	5/2008	SeqNo: 230753	-
Analyte	Kesult	Pal	SPK value	SPK value SPK Ref Val	%REC	LowLimit HighL	%REC LowLimit HighLimit RPD Ref Val	%RPD RPDLimit Qual	it Qual
Total Residual Chlorine	1.040	0.162	_	0	104	85	115	The state of the s	

		PART () WHIRE WAS AN AN AN AN AN AN AN AN AN AN AN AN AN
Below Reporting Limit	Щ	Value above quantitation range
Analyte detected below quantitation limits	S	ND Not Detected at the Reporting Limit
Spike Recovery outside recovery limits		

BRL Below Reporting Limit

Qualifiers:

H Holding times for preparation or analysis exceeded R RPD outside recovery limits RPD outside recovery limits

RPD outside recovery limits

H Z

E Value above quantitation range ND Not Detected at the Reporting Limit

> Analyte detected below quantitation limits Spike Recovery outside recovery limits

BRL Below Reporting Limit

Qualifiers:

CLIENT: Fay, Spofford & Thorndike

Work Order: 0805025

Project: WM-046, 1.4 Exp

TestCode: TSS

Sample ID: MB-R23464	SampType: MBLK	TestCode: TSS	e: TSS	Units: mg/L		Prep Date;	;e;	RunNo: 23464	164	
Client ID: ZZZZ	Batch ID: R23464	TestN	FestNo: E160.2			Analysis Dal	Analysis Date: 5/5/2008	SeqNo: 230464	1464	
Analyte	Result	PQL	SPK value	SPK value SPK Ref Val	%REC	LowLimit	%REC LowLimit HighLimit RPD Ref Val	%RPD	%RPD RPDLimit Qual	Qual
Total Suspended Solids	QN	4.00								
Sample ID: LCS-R23464	SampType: LCS	TestCode: TSS	e. TSS	Units: mg/L		Prep Date:		RunNo: 23464	164	
Client ID: ZZZZZ	Batch ID: R23464	TestN	TestNo: E160.2			Analysis Dat	Analysis Date: 5/5/2008	SeqNo: 230465	1465	
Analyte	Result	PaL	SPK value	SPK Ref Val	%REC	LowLimit	%REC LowLimit HighLimit RPD Ref Val	%RPD	%RPD RPDLimit	Quai
Total Suspended Solids	74.00	4.00	66.5	0	141	80	120			

Quai

%RPD RPDLimit

%REC LowLimit HighLimit RPD Ref Val

SPK value SPK Ref Val

PQ

Result

75.0 75.0

Unadjusted C9-C12 Aliphatic Hydrocarb Unadjusted C5-C8 Aliphatic Hydrocarbo

Methyl Tert-Butyl Ether

Ethylbenzene

Toluene Benzene

m,p-Xyiene

o-Xylene

C9-C10 Aromatic Hydrocarbons

Analyte

5.00 5.00 5.00 5.00 5.00

5.00 20.0

Adjusted C5-C8 Aliphatic Hydrocarbons

Qualifiers:

Naphthalene

CLIENT:	Fay, Spofford & Thorndike
Work Order:	0805025

ANALYTICAL QC SUMMARY REPORT

TestCode: VPH W2

WM-046, 1.4 Exp

Project:

Sample ID: MBLK	SampType: MBLK	MBLK	TestCod	TestCode: VPH_W2	Units: pg/L		Prep Date:	:e		RunNo: 23623	23	
Client ID: ZZZZ	Batch ID: R23623	R23623	TestN	FestNo; VPH		~	Analysis Datı	Analysis Date: 5/9/2008		SeqNo: 232073	573	
Analyte		Result	PQL	SPK value	SPK value SPK Ref Val	%REC	LowLimit	"REC LowLimit HighLimit RPD Ref Val	PD Ref Val	%RPD	RPDLimit	Qual
C9-C10 Aromatic Hydrocarboris	(0	ND	75.0		The state of the s		***************************************	To the state of th		- Anna Anna Anna Anna Anna Anna Anna Ann		
Unadjusted C5-C8 Aliphatic Hydrocarbo	drocarbo	QN	75.0									
Unadjusted C9-C12 Aliphatic Hydrocarb	ydrocarb	QN	75.0									
Methyl Tert-Butyl Ether		Q.	5.00									-
Benzene		S	5,00									
Toluene		Ü	5.00									
Ethylbenzene		N Q N	5.00									
m,p-Xylene		Q.	5.00									
o-Xylene		Q	5.00									
Naphthalene		Q	20.0									
Adjusted C5-C8 Aliphatic Hydrocarbons	carbons	2	75.0									
Adjusted C9-C12 Aliphatic Hydrocarbon	ocarbon	QN	75.0									
Surr: 2,5-Dibromotoluene FID	_	72.73	0	100	0	72.7	70	130				
Surr: 2,5-Dibromotoluene PID	(71.59	0	100	0	71.6	70	130				c
Sample ID: MBLK	SampType: MBLK	WBLK	TestCode	TestCode: VPH_W2	Units: µg/L	Minimum Market and Company of the Co	Prep Date:	1		RunNo: 23658	8:	
Cilent ID: ZZZZZ	Batch ID: R23658	423658	TestNo	estNo: VPH		Q	\nalysis Date	Analysis Date: 5/13/2008		SeqNo: 232577	11	
												-

-					TOTAL CONTRACTOR OF THE PROPERTY OF THE PROPER	
58	L. Below Reporting Limit	ш	Value above quantitation range	H	Holding times for preparation or analysis exceeded	_
-	Analyte detected below quantitation limits	Ð	Not Detected at the Reporting Limit	~	RPD outside recovery limits	
S	Spike Recovery outside recovery limits				i	

REPO
F-1
\simeq
\rightarrow
_
< €
>
=
·
(C)
()
_
\simeq
OC SUMMARY REPO
_
_
_
_
_
_
_
_
_
_
_
_
NALYTICAL
NALYTICAL
ANALYTICAL OC
NALYTICAL
NALYTICAL
NALYTICAL

TestCode: VPH_W2

10	6, 1.4 Exp
0805025	WM-046, I
Work Order:	Project:

Fay, Spofford & Thorndike 0805025

CLIENT:

l.4 Exp
7.
46,
WM-046,
≶

Exp	
4.	
WM-046,	

Sample ID: MBLK Samp	SampType: MBLK	TestCod	TestCode: VPH_W2	Units: µg/L		Prep Date:	es:		RunNo: 23658	
Client ID: ZZZZZ Bate	Batch ID: R23658	Testh	TestNo: VPH			Analysis Date:	e: 5/13/2008	308	SeqNo: 232577	
Analyte	Result	Pal	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD RPDLimit	Qual
Adjusted C9-C12 Aliphatic Hydrocarbon Surr; 2,5-Dibromotoluene FID Surr; 2,5-Dibromotoluene PID	ND 79.01 73.17	75.0 0 0	100	0	79.0 73.2	70 70	130 130			
Sample ID: LCS Samp	SampType: LCS	TestCoo	TestCode: VPH_W2	Units: µg/L		Prep Date:			RunNo: 23623	
23	Batch ID: R23623	Test	TestNo: VPH			Analysis Date:	e: 5/9/2008	80	SeqNo: 232071	
Analyte	Result	Pal	SPK value	SPK Ref Val	%REC	LowLimít	HighLímit	RPD Ref Val	%RPD RPDLimit	Qual
C9-C10 Aromatic Hydrocarbons	79.77	75.0	100	5.648	74.1	70	130			
Unadjus(ed C5-C8 Aliphatic Hydrocarbo	523.6	75.0	600	51.05	78.8	70	130			
Unadjusted C9-C12 Aliphatic Hydrocarb	483.6	75.0	909	20.12	77.3	20	130			
Methyl Tert-Butyl Ether	73.67	5,00	100	0	73.7	20	130			
Benzene	70.61	5.00	100	0	9.07	20	130			
Toluene	74.21	5.00	100	0	74.2	20	130			
Ethylbenzene	79.34	5.00	100	0	79.3	70	130			
m,p-Xylene	168.0	5.00	200	0	84.0	70	130			
o-Xylene	75.59	5.00	100	0	75.6	20	130			
Naphthalene	40.07	20.0	100	0	70.1	20	130			
Surr: 2,5-Dibromotoluene FID	76.08	0	100	0	76,1	70	130			
Surr: 2,5-Dibromotoluene PID	70.11	0	100	0	70.1	70	130		And the state of t	
Sample ID: LCS Samp	SampType: LCS	TestCo	TestCode: VPH_W2	Units: µg/L		Prep Date:	.;		RunNo: 23658	
Client ID: ZZZZ Bate	Batch ID: R23658	Test	TestNo: VPH			Analysis Date:	ie: 5/13/2008	900	SeqNo: 232575	
Analyte	Result	POL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD RPDLimit	Qual
C9-C10 Aromatic Hydrocarbons	91.84	75.0	100	4.97	86.9	70	130			
Unadjusted C5-C8 Aliphatic Hydrocarbo	573.3	75.0	900	18.73	92.4	70	130			
Unadjusted C9-C12 Aliphatic Hydrocarb	519.2	75.0	900	18.75	83.4	70	130			
Methyl Tert-Butyl Ether	76.66	5.00	100	0	7.97	70	130			
Вепzепе	72.19	5.00	100	0	72.2	20	130			
Qualifiers: BRL Below Reporting Limit	iít	CACAMINET TO STATE OF THE STATE	E Value	Value above quantitation range	ngc		H	Holding times for	Holding times for preparation or analysis exceeded	
J Analyte detected below quantitation limits	w quantitation limits		ND Not D	Not Detected at the Reporting Limit	ng Limit		×	RPD outside recovery limits	·сту limits	
S Spike Recovery outside recovery limits	de recovery limits								Page	Page 32 of 33

Holding times for preparation or analysis exceeded R RPD outside recovery limits

RPD outside recovery limits

E Value above quantitation range
ND Not Detected at the Reporting Limit

Analyte detected below quantitation limits Spike Recovery outside recovery limits

BRL Below Reporting Limit

Qualifiers:

Fay, Spofford & Thorndike CLIENT:

0805025 Work Order: WM-046, 1.4 Exp

Project:

TestCode: VPH_W2

Sample ID: LCS	SampType: LCS	TestCo	TestCode: VPH_W2	Units: µg/L		Prep Date:	.9	RunNo: 23658
Client ID: ZZZZZ	Batch ID: R23658	Test	TestNo: VPH		7	Analysis Dat	Analysis Date: 5/13/2008	SeqNo: 232575
Analyte	Result	PaL	SPK value	POL SPK value SPK Ref Val	%REC	LowLimit	%REC LowLimit HighLimit RPD Ref Val	%RPD RPDLimit Qual
Toluene	81.79	5.00	100	0	81.8	70	130	
Ethylbenzene	82.20	5.00	100	0	82.2	20	130	
m,p-Xylene	183.0	5.00	200	0	91.5	70	130	
o-Xylene	72.69	5.00	100	0	72.7	70	130	
Naphthalene	81.03	20.0	100	0	81.0	20	130	
Surr: 2,5-Dibromotoluene FID	96.83	0	100	0	96.8	20	130	
Surr: 2,5-Dibromotokene PID	75.44	0	100	0	75.4	70	130	

とうのは 7007 5, SEE ATT ACHED ₹ 3 LITE25 木 かいなる Page BO SAMPLE Filter 13 il Special Instructions 10, 00, NO, 00. 1 Requirements: circle choice (s) 35 800 011 61.2 | Sample Handling: circle effects
| Sample Handling: circle effects
| Sample Handling: circle effects
| Sample Handling: circle effects
| Sample Handling: circle effects
| Sample Handling: circle effects
| Not Mended | 859 Not Meeded 559 Preservation Data Delivery: circle choice (s) CHAIN OF CUSTODY RECORD GeoLabs, Inc. Environmental Laboratories 45 Johnson Lane, Brainfree, MA 02184 p 781.848.7844 • f 781.848.7811 www.geolabs.com GeoLabs, Inc.

5

_ < @ 0 = Other C) * TEMPERATURE NH (2508) NJ (MA-009) RI (LA000252) ألمها しっちれい 175 /TR > 4 B = Bag P = Plastic V = Voa CT RCP (Reasonable Confidence Profocols) CHZONY HEXVN 7 4 Analysis Request 0% 9 101 m 24 4 WM-046 1 4 Date / Tanyé A = Amber G = Glass S = Summa Containers しんで行う 1 1 =01 MA K) MA (MA - 015) PA (68-03417) をひつく State / Fed Program - Criteria L L 7 = 0ther Q 7d 1 4 + invoice to *:_ Project PO: 10278 Project: . 1 CT (PH-0148) NY(11796) 4 Ļ 1 4 5 ≈ Na0H 6 = MEOHHON? Preserative: 005 600 800 400 Geolabs SAMPLE NUMBER アット ころい てのろ $\frac{1}{8}$ 4 = Na2S203Payment due within 30 days unless other arrangaments are made. Past due balances subject to interest and collection cast. Note: Hemcownors and Law Firms must pay when dropping off samples. We accept cash, check and credit cards. MCP Methods 3 = H2S04Other Preservatives Spass Received by 100 2 = HN031 = Hcl 77 DU RICIN क स ब ख GW-1 S-1 OC 1255 PAI Received on Ice 4.40% ಲ≎ ೬ 181-3 7 ---= مدون حدم CONTAINER d **ロコベスート**> 1 لا د email PDF Phone: email: Fax: - - a u 7 0) < 5 Date / Time OT = Other A = AirBLANK SAMPLE LOCATION / ID Format: Excel) S == Soil 0 = 0Eax DURKIN るころ 100 1500 るに S DW = Drinking Water i, $\bar{\omega}$ By Rehingto いなり 5 / 7-days SL = Sludge Turnaround: circle one 4 しなり いよし ⊀ങ മെപ്പളമു⊳ര 3-day Contact: LATCIEN 280265.J&P.C of CR.03/07/08 7 COLLECTION 1c 55 P 1000 と077 9016 1140 GW = Ground Water WW = Waste Water しついる Refinquished by: Matrix Codes: 1-day 2-day Address: K, E 子も 14130 かあこと Client: 0 4 1- 11 11

FST 6905 Groundwater RGP Appendix VI Methods

- 1. Volatile Organics (8260)
- 2. VPH
- 3. Semi-Volatile Organics (8270)
- 4. EPH
- 5. TPH
- 6. PCBs
- 7. Cyanide
- 8. RCRA 8 Metals, plus Iron, Copper, Antimony, Nickel
- 9. Hexavalent Chrome
- 10. Total Suspended Solids
- 11. Total Residual Chlorine

Appendix B Stephen's Associates Geotechnical Report



Certified W/DBE in MA, ME, NH and VT www.stephensengineers.com

60 Northrup Dr Brentwood, NH 03833 Phone: (603) 772-1417 Fax: (603) 772-1418 668 Main Street, Suite 250 Wilmington, MA 01887 Phone: (978) 988-2115 Fax: (978) 988-2117



GEOTECHNICAL ENGINEERING REPORT MWRA CONTRACT NO. 6905 LYNNFIELD/SAUGUS PIPELINES SAUGUS, MASSACHUSETTS

SA Project No. 026-08-007 October 6, 2008

Prepared for:

FAY, SPOFFORD & THORNDIKE, LLC.

5 Burlington Woods Burlington, Massachusetts 01803

ENGINEERS



Prepared by:

Stephens Associates Consulting Engineers, LLC

James E. Turner, PE

Project Engineer

Junes Zunen

Robert S. Stephens, PE

Principal Engineer



Certified W/DBE in MA, ME, NH and VT

www.stephensengineers.com

60 Northrup Dr Brentwood, NH 03833 Phone: (603) 772-1417 Fax: (603) 772-1418 668 Main Street, Suite 250 Wilmington, MA 01887 Phone: (978) 988-2115 Fax: (978) 988-2117



October 6, 2008

Fay, Spofford & Thorndike, LLC 5 Burlington Woods
Burlington, MA 01803
Attention, Mr. Donnie Boucher

Attention: Mr. Dennis Boucher

Re: Geotechnical Report MWRA Contract No. 6905

Lynnfield/Saugus Pipelines Saugus, Massachusetts SA Project No. 026-08-007

Ladies and gentlemen:

The attached Report presents the results of geotechnical engineering evaluation provided by Stephens Associates Consulting Engineers, LLC (SA) for the Subject Project. This Report has generally been prepared in accordance with our Agreement for these services, and is subject to the limitations presented throughout the Report, including Tables, Figures and Appendices.

We have enclosed one unbound original, 5 bound copies, 7 unbound copies and one CD-RW disk with pdf file of our Report, as requested.

We trust that this Report meets your current needs, and appreciate the opportunity to assist you on this Project. Please contact us if you have any questions.

Sincerely,

Stephens Associates Consulting Engineers, LLC

James E. Turner, PE Project Engineer

Robert S. Stephens, PE, PG

Principal

RSS:tgbg

GEOTECHNICAL REPORT MWRA CONTRACT NO. 6905, LYNNFIELD/SAUGUS PIPELINES SAUGUS, MASSACHUSETTS

SUMMARY

This Report ("Report") provides the results of geotechnical engineering evaluation performed by Stephens Associates Consulting Engineers, LLC ("SA," "we," "our," or "us") for Fay, Spofford & Thorndike, LLC ("FST," "Client," "you," "your," etc.) for the proposed Lynnfield/Saugus Pipelines ("Pipelines," or "Project"), Massachusetts Water Resource Authority ("MWRA" or "Owner") Contract No. 6905 in Saugus, Massachusetts. This Report is subject to the limitations presented herein, including Figures, Tables and Appendices, (e.g. Appendix A – Limitations, etc.). SA performed these services for FST in general accordance with our Agreement dated January 28, 2008. The purpose of our services was to evaluate geotechnical conditions and provide geotechnical recommendations for design and construction of the proposed pipeline.

The Site is located on U.S. Rte. 1 (aka Broadway), extending south from the Saugus-Lynnfield town line about 6,400 ft. The Project consists of installation of about 2,560 ft. of 36-in. diameter MWRA water main, 4,240 ft. of 24-in. diameter MWRA water main, and 6,000 ft. of 12-in. water main for the Town of Saugus, parallel to the MWRA main. At the southern end, the proposed route will follow the eastern shoulder of the northbound lane, cross Rte. 1 to the western shoulder of the southbound lane and extend to about Sta. 48+40SB (Stationing is described in Section 1.1, extends south to north from Sta 0+00 to 64+00). North of this station, the MWRA is considering routes following either the northbound shoulder or the southbound shoulder, to be determined.

SA reconnoitered the Site for readily visible surficial signs of geologic conditions. We noted significant rock outcrops west of Rte. 1 from about Sta. 18+00SB to 23+00SB and about Sta. 61+00SB to 64+00SB, and east of Rte. 1 from about Sta. 51+00NB to 64+00NB. Published geologic information generally indicates soils in the Site vicinity to consist of glacial till, and in some locations overlying shallow bedrock consisting of granite, granodiorite, or diorite.

The MWRA engaged Green International Affiliates, Inc. who engaged Hager GeoScience, Inc. ("Hager," or "GPR Consultant") to perform geophysical surveys of the northbound and southbound shoulders of Rte. 1 using ground penetrating radar ("GPR") to attempt to identify the depth of bedrock and buried obstructions prior to excavation. Hager provided the results in a report titled, "Geophysical Subsurface Characterization, MWRA Lynnfield/Saugus Pipeline Project, Route 1, Saugus, MA," dated June 2008, prepared for Green International Affiliates, Inc. ("GPR Report"). The GPR Report indicates variable fractured bedrock surface elevations of about 3.5 to 45 ft. below ground surface. The GPR Report also identifies numerous subsurface obstructions and possible buried utilities, and areas of possible reinforced concrete located below the existing asphalt pavement. SA included the bedrock profile interpreted by Hager and the above features, as interpreted by Hager, on our subsurface profiles shown in Figures 5 through 7. Figure 4 shows the baseline locations of SA's subsurface profiles, which are based on the GPR traverses.

FST engaged GeoLogic Earth Exploration, Inc., of Norfolk, Massachusetts ("GeoLogic" or "Drillers"), to drill 27 borings and install 9 groundwater observation wells at locations selected by FST along the proposed pipeline alignment between March 30 and April 25, 2008 using a truck-mounted drill rig. The purpose of the borings was to evaluate geotechnical conditions (by SA) and to obtain samples for environmental and corrosion testing (by others). Figure 4 shows the boring locations, Appendix B contains SA's boring logs, and Figures 5 to 7 show generalized subsurface profiles.

Stephens Associates
Consulting Engineers
Insightful, Costsaving Solutions
for Buildings and
Infrastructure
Hydrology & Hydraulics

026-08-007 S-i 10/6/08

The subsurface explorations generally encountered Asphalt overlying subbase and Fill consisting of mostly dense to very dense fine to coarse sand with varying proportions of silt and gravel (USCS classification SM, SW, GP) extending about 3 to 12 ft. below ground surface. Underlying the Fill, the Drillers generally encountered medium dense to very dense Sand with varying proportions of silt and gravel (SW, SP, SM, GP), or bedrock consisting of granitic, dioritic, or granodioritic rock. Where encountered, bedrock depths ranged from about 3 to 15 ft. below ground surface. Water levels measured by FST in observation wells installed in the borings were about 4.1 to 13.7 ft. below ground surface.

SA performed 48 grain-size distribution analyses, 11 hydrometer analyses, and 2 Atterberg limits tests on samples obtained from the borings. The purposes of the geotechnical laboratory testing were to assist in soil classification and preparation of boring logs, to evaluate re-use of existing soils, and to assist in permeability evaluation. Geotechnical laboratory test results are summarized in Table 2 and are presented in detail in Appendix C. Based on the laboratory data, SA estimated vertical permeability using the Kozeny-Carmen Formula to range from about 3.6×10^{-2} to 5.9×10^{-7} cm/s. The references indicate that measured values of hydraulic conductivity usually range from 1/3 to 3 times the estimated value. FST performed field permeability tests ("slug tests") in the observation wells installed in selected borings. FST estimated permeabilities from the slug tests to range between 1×10^{-2} and 4.7×10^{-4} cm/s, which are summarized in Table 3. Refer to Section 2.5.

Pipe trench bottom depths are anticipated to be about 8 to 9 ft. below ground surface. The subsurface conditions identified at these depths in the borings generally consist of medium dense to very dense Sand, Sand and Gravel, or Bedrock and are generally suitable for foundation support of the proposed pipes with proper trench excavation and pipe bedding. Buried utilities, including gas mains, sewer/drain lines, telecommunications, etc. are located in close proximity to the proposed pipelines. In our opinion, the subsurface conditions will significantly affect pipeline design and construction in several ways, including the following:

- Shallow bedrock We anticipate up to 7 ft. of bedrock excavation, and typically 1 to 5 ft., may be needed to reach proposed trench bottom depths where shallow bedrock was encountered in the borings and GPR results. Table 3.3.2 summarizes anticipated rock excavation depths and locations.
- Shallow groundwater Groundwater was generally measured between 4.1 and 9 ft. below ground surface. Excavation will require dewatering. Refer to Section 4.5.
- Highly permeable soils Large quantities of water may be pumped during dewatering and the influence of groundwater drawdown could extend a significant distance from excavation. Refer to Sections 2.5 and 4.5.
- Buried utilities Close proximity of buried utilities will affect methods for rock removal and will likely require shoring of excavations. Refer to Sections 3.5, 4.3 and 4.4.
- Subsurface obstructions The GPR results indicate numerous subsurface obstructions (e.g. boulders), and SA's borings, particularly those performed near Hawke's Pond, encountered boulders on the order of 1 to 3 ft. diameter. Excavation of boulders could be difficult and could increase trench sizes. Boulders could also hinder excavation support installation.
- Pipeline route selection north of Sta. 48+40SB Based on the subsurface explorations, GPR data, and SA's review of plans from MassHighway, we anticipate that the northbound route may require less bedrock excavation and fewer boulders, but possibly shallower groundwater. Refer to Section 3.2.

Section 3.3 discusses pipe support factors. Where shallow rock is encountered, the trench should be excavated at least one foot below the proposed pipe bottom elevation. Pipe bedding should consist of crushed stone,



026-08-007 S-ii 10/6/08

MassHighway material M2.01.5 and should be wrapped with geotextile filter fabric, meeting the requirements of MassHighway (1995) M9.50.0 Type I – Separation, to reduce risk of migration of fines, and potential ground deformations resulting from such migration of fines into the crushed stone. Backfill placed over the pipe and pipe bedding should consist of Ordinary Borrow, MassHighway M1.01.0, with a maximum particle size of 3 in., placed in 8-in. maximum loose lifts and compacted to at least 92 percent maximum dry density as measured by ASTM D1557. Within two feet of proposed ground surface, but beneath the pavement section, backfill should consist of Gravel Borrow, MassHighway M1.03.0 placed in 8-in. maximum loose lifts and compacted to at least 95 percent of maximum dry density as measured by ASTM D1557. The pavement section should be designed and constructed in accordance with MassHighway standards. Based on the grain-size analyses, we anticipate that most excavated soils from the trench can generally be reused as Ordinary Borrow after screening for particles larger than 3 in.

Sections 3.5 and 4.3 discuss lateral earth pressures, trench design factors, and excavation support. The presence of structures, including buildings, bridges, culverts, utilities, drainage structures (e.g. catch basins, etc.), pavements, etc., in close proximity to the proposed pipelines will affect trench design and construction. Excessive lateral ground movements (rotation or translation) of excavation support systems, if not properly designed and executed, could result in nearby structural deformations and settlement. Likewise, dewatering and ground loss at the excavation support system into the trench could result in vertical and lateral ground deformations, even at potentially much greater distances. Trenches should be shored to limit lateral ground movements to 1 inch or less. The excavation support system should be designed by a registered professional engineer engaged by the Contractor.

Up to 7 ft. of bedrock excavation may be required. The proximity of the Walnut St. Bridge and buried utilities, and especially buried gas mains within several feet of the proposed pipeline, should be carefully considered in the selection of rock removal technique. Bedrock elevations vary significantly near the Walnut St. Bridge and rock removal should be anticipated under or near Bridge. The selection of a rock removal technique should strive to balance risk to adjacent utilities and structures with opposing factors such as excavation cost and production rate. Rock can typically be excavated by explosive or non-explosive methods, such as mechanical excavation (e.g. hydraulic rams, etc.), trenching, chemical splitting, or other, proprietary methods. The primary factors affecting selection of method include cost, risk of damage to adjacent structures from vibrations, airblast, flyrock, etc., and permissions from regulating authorities. Section 4.4 discusses rock removal.

The detailed evaluation, recommendations, and assumptions on which they are based, described in the body of this Report, should be read in entirety, reviewed and understood.



026-08-007 S-iii 10/6/08

GEOTECHNICAL REPORT MWRA CONTRACT NO. 6905, LYNNFIELD/SAUGUS PIPELINES SAUGUS, MASSACHUSETTS

TABLE OF CONTENTS

SU	SUMMARY	S-:
TA	TABLE OF CONTENTS	TOC-
1.	1. INTRODUCTION	
	1.2 Site Location and Description1.3 Project Understanding and Background	
2.	2. SITE AND SUBSURFACE INFORMAT	ION
	 2.2 Available Geologic Information	
3.	3. EVALUATION AND RECOMMENDA	TIONS10
	3.2 Pipeline Route Considerations 3.2.1 Bedrock 3.2.2 Boulders 3.2.3 Groundwater 3.3 Pipe Support Factors 3.3.1 Pipe Foundations 3.3.2 Pipe Bedding and Backfill	10 10 11 12 12 12 12 12 12 15 16 17 Factors 17
4.	4. ADDITIONAL RECOMMENDATIONS	AND CONSTRUCTION CONSIDERATIONS 18
	4.2 Reuse of Existing Site Soils	
5	5 REFERENCES	24



FIGURE	Figure 1 – Site Location Map	Attached
	Figure 2 – Site Aerial Photo	Attached
	Figure 3 – Excerpt of Massachusetts Bedrock Geologic Map	Attached
	Figures 4-1 to 4-7 – Boring Location Plans	Attached
	Figure 5 – Subsurface Profile Legend and Notes	Attached
	Figures 6-1 to 6-6 – Southbound Subsurface Profiles	Attached
	Figures 7-1 to 7-6 – Northbound Subsurface Profiles	Attached
	Figure 8 – Factors Affecting Pipeline Design	
TABLES	Table 3.2.1 – Bedrock Depths in Northern Borings	12
	Table 3.3.2 – Estimated Bedrock Excavation from GPR Data	
	Table 3.3.2.1 – Pipe Bedding Gradation	16
	Table 1 – Summary of Groundwater Observation Well Measurements	Attached
	Table 2 – Summary of Geotechnical Laboratory Test Results	
	Table 3 – Field Permeability Test Results	
APPENDICES	Appendix A – Limitations	
	Appendix B – Boring Logs	
	Appendix C – Geotechnical Laboratory Test Results	
	Appendix D – Excavations	

GEOTECHNICAL REPORT MWRA CONTRACT NO. 6905, LYNNFIELD/SAUGUS PIPELINES SAUGUS, MASSACHUSETTS

1. INTRODUCTION

This Report ("Report") provides the results of geotechnical engineering evaluation performed by Stephens Associates Consulting Engineers, LLC ("SA," "we," "our," or "us") for Fay, Spofford & Thorndike, LLC ("FST," "Client," "you," "your," etc.) for the proposed Lynnfield/Saugus Pipelines ("Pipelines," or "Project"), Massachusetts Water Resource Authority ("MWRA" or "Owner") Contract No. 6905 in Saugus, Massachusetts. This Report is subject to the limitations presented herein, including Figures, Tables and Appendices, (e.g. Appendix A – Limitations, etc.). SA performed these services for FST in general accordance with our Agreement dated January 28, 2008.

This Report first describes the Site and its location, our Project understanding, background, and purpose and scope of services. Section 1 presents our Site reconnaissance observations, available geologic data, results of current subsurface explorations, and summary of geotechnical laboratory testing. Section 3 describes our evaluation and recommendations of subsurface conditions, pipeline route selection considerations, and design recommendations. Section 4 provides additional recommendations and construction considerations. References are listed in Section 5.

1.1 Stationing and Datum

FST provided SA with the drawing titled, "Existing Conditions Plan", January 30, 2008, prepared by Bryant Associates, Inc. ("Existing Conditions Plan"). The Existing Conditions Plan indicates the vertical datum as the Boston City Base, which is 5.65 ft. below the National Geodetic Vertical Datum of 1929, and the horizontal datum as the Massachusetts State Plane Coordinate System NAD 1983. Elevations cited herein are with respect to this datum.

FST indicated that Project stationing along the proposed pipeline will be established later in the design process. For the purpose of presenting subsurface profiles, interpreted ground penetrating radar ("GPR") data provided by others, and this Report, two baselines with stationing were established by coordination and consent between SA, FST, MWRA and the GPR Consultant. The baselines were set following GPR traverses on the northbound and southbound shoulders of Rte. 1, with station 0+00 at the southern end. Stationing referenced herein is therefore denoted as 0+00SB or 0+00NB where SB and NB refer to the southbound or northbound baseline, respectively, and are in units of feet. In general, stations on the two baselines are similar at the southern end and differ by about 30 ft. near the northern end because they follow curvature of Rte. 1. The Existing Conditions Plan also shows a baseline and stationing for the Rte. 1 roadway, which is substantially similar to baselines and stationing shown on previous plans since 1926, as discussed below.

1.2 Site Location and Description

Site location is shown on Figure 1 – Site Location Map and Figure 2 – Site Aerial Photo. The Site is located on U.S. Rte. 1 (aka Broadway), extending south from the Saugus-Lynnfield town line about 6,400 ft. Rte. 1 is a historic, major three-lane thoroughfare with commercial and industrial businesses located just off the shoulders. Uncontrolled access and egress to commercial and industrial property is prevalent on Rte. 1. USGS topographic maps of the Boston Quadrangle (USGS 1903) and Lawrence Quadrangle (USGS 1893) show a road in similar location and geometry as the present day road. An interchange with Rte. 129 (Walnut Street) is located near Sta. 15+50NB, where the Walnut Street Bridge crosses over and connects with Rte. 1



026-08-007 Page 1 of 26 10/6/08

via on- and off-ramps. Hawkes Pond, retained by Hawkes Pond Dam, is located immediately west of Rte. 1, approximately between stations 51+50NB and 60+00NB. According to the National Inventory of Dams database (NID 2008), Hawkes Pond Dam (NID ID No. MA00245) is owned by the Lynn Water and Sewer Department and was constructed in 1895. The Lynnfield Water District Pump Station is the Site northern terminus, on the eastern side of Rte. 1 near Sta. 64+00NB.

In general, ground surface elevations increase from south to north along Rte. 1 at the Site. According to the Existing Conditions Plan and our Site observations, south of the Walnut St. Bridge (approx. Sta. 0+00 to 15+50NB), the Site slopes gently upward from about El. 48 to El. 53. Northward from the Walnut St. Bridge, the Site slopes moderately upward to a peak of about El. 69.7 near Sta. 28+00NB, and then slopes gently downward to a relatively level section of about El. 63 to 66 between Sta. 31+00NB and 45+00NB. From Sta. 45+00, the Site slopes relatively steeply upward to about El. 115 ft. near Sta. 63+00NB, and then gently downward to about El. 113 near the Pump Station.

1.3 Project Understanding and Background

Our understanding of the Project is described in our Agreement dated January 28, 2008 and is further described throughout this Report. Our understanding of the Project is based on the following:

- Our email correspondence with Messrs. John Krawczyk and Dennis Boucher, and Ms. Erica Lotz of FST between December 13, 2006 and January 8, 2008;
- Meetings with Mr. Krawczyk on March 26, 2007, and with Mr. Boucher on July 5, 2007;
- Email correspondence and meetings with Mr. Larry Durkin and Dennis Boucher between January 8 and July 14, 2008.
- The document titled, "Massachusetts Water Resources Authority, Request for Qualifications Statements/Proposals, Lynnfield/Saugus Pipelines Design/CA/RI, Contract 6905," dated November 29, 2006 ("RFQ/P").
- The document titled, "Field Testing Work Plan, Lynnfield/Saugus Pipelines Project, MWRA Contract No. 6905," March 18, 2008, prepared by FST.
- Drawing titled, "Rte. 1, Saugus, MA, Existing Conditions Plan," January 30, 3008, prepared by Bryant Associates, Inc. ("Existing Conditions Plan")
- Sketches titled, "Typical Trench Section MWRA 36" Main Only," "– Saugus 12" Main Only," and "– Common Pipe Trench," provided by FST on June 8, 2008, referred to herein as "Trench Sketches."

The RFQ/P indicates that the MWRA intends to construct about 2,560 ft. of 36-in. diameter water main, 4,240 ft. of 24-in. diameter water main, and 6,000 ft. of 12-in. water main and 6-in. diameter blow-off piping along Rte. 1 in Saugus, Massachusetts. The 12-in. water main is being constructed for the Town of Saugus (referred to herein as "Saugus 12-in. main") and will generally parallel the MWRA 24/36-in. main. FST indicated that the MWRA main at the southern end will be 36-in. diameter and will transition to 24-in pipe near Sta. 19+00SB just north of the Walnut St. Bridge, which will continue to the northern terminus. The Field Testing Work Plan indicates that the southern project limit has been moved northward since the RFQ/P, reducing the length of 36-in. diameter pipeline because of recent development at the Shops at Saugus site where a MWRA water main extension was installed.

At the southern end, the proposed route will follow the eastern shoulder of the northbound lane (referred to herein as "northbound shoulder" or "northbound side") from about Sta. 0+00 to 10+50NB, where it will cross the road to the western shoulder of the southbound lane (referred to herein as "southbound shoulder" or "southbound side") and extend to about Sta. 48+40SB (48+80NB). North of this station, FST indicated that

Stephens Associates
Consulting Engineers

Insightful. Costsaving Solutions
for Buildings and
Infrastructure
Hydrology & Hydraulics

the MWRA is considering routes following either the northbound shoulder or the southbound shoulder, to be determined after MWRA's review of subsurface conditions presented herein and other factors such as utility conflicts, coordination with the Town of Saugus, etc. At the northern end, the pipeline will tie into the existing Lynnfield Water District Pump Station just north of the Lynnfield/Saugus town line, east of the northbound shoulder. The route following the southbound shoulder, if selected, would cross to the northbound shoulder near Sta. 62+70NB and then connect to the Pump Station near Sta. 64+00NB. The Field Testing Work Plan indicates that the Saugus 12-in. main will begin at the southern end and terminate just south of Hawkes Pond near Sta. 52+00NB, tying into the existing Town of Saugus water main at Walden Avenue.

The Trench Sketches provided by FST show a horizontal spacing of 6 ft. between inside edges of the MWRA 24/36 in. main and the Saugus 12-in. main. The Trench Sketches also show the pipe crowns located 5 ft. below ground surface. Where the pipes will be installed in a common trench, the Trench Sketches show a trench width of 14 ft. and depth of about 9 ft. Where installed in separate trenches, the trenches for the MWRA 36-in. and Saugus 12-in. pipes are shown as about 9 ft. deep by 9 ft. and 3 ft. wide, respectively. FST indicated that where the MWRA pipe will be 24-in. diameter, the trench depth will be about 8 ft. below ground surface. The proposed pipes may need to be placed deeper to pass beneath existing utilities where the pipes cross over Rte. 1 (northern and southern cross-overs) and at several other locations including a stone culvert crossing Rte. 1 near Sta. 36+00SB and the Lynn Raw Water Pump Station Main near Sta. 57+00SB (57+50NB). FST anticipates that the trench bottom depth at these locations might be 10 ft. below ground surface, but will not be decided until utility locations are confirmed during design. We assume the finished ground surface will be similar to, if not the same as, the existing ground surface.

FST indicated that the MWRA prefers to use Class 52 (ANSI thickness classification) ductile iron for the 24 and 36-in. pipes, though FST may also consider steel pipe in their preliminary design report. FST is assuming the Saugus 12-in. main will likely be Class 52 ductile iron pipe, and indicated that ANSI/AWWA C600 "Installation of Ductile-Iron Water Mains and Their Appurtenances" will be used as a design guide.

1.4 Purpose and Scope of Services

The purpose of our services was to evaluate geotechnical conditions and provide geotechnical recommendations for design and construction of the proposed pipeline. Our scope of services is summarized as follows:

- 1. Assist in Development of Field Testing Program (FTP)
- 2. Review Available Geotechnical Information
- 3. Assist in Preparation of Draft FTP Technical Memorandum
- 4. Meet with MWRA and FST
- 5. Respond to MWRA Comments on draft FTP Technical Memorandum
- 6. Assist in Finalization of FTP Technical Memorandum
- 7. Exploration Program Work Plan
- 8. Exploration Program Implementation
- 9. Geotechnical Laboratory Testing
- 10. Geotechnical Evaluation and Preparation of this Report



026-08-007 Page 3 of 26 10/6/08

SA's scope of services does not include an environmental assessment of any kind, including but not limited to assessments for the presence or absence of wetlands or hazardous or toxic materials or organisms (e.g., fungi, flora, fauna, microorganisms, etc.) in the soil, surface water, groundwater, or air, on or below or around this site. Any observations of odors, colors, or unusual or suspicious items or conditions noted by SA were incidental to our services, and any statements regarding such observations are strictly for the information of the Client.

2. SITE AND SUBSURFACE INFORMATION

2.1 Site Reconnaissance

SA reconnoitered the Site for readily visible surficial signs of geologic conditions. We noted significant rock outcrops north of the Walnut St. Bridge, on the western side of Rte. 1, from about Sta. 18+00SB to 23+00SB. The ground surface in this area slopes steeply upward to near vertical west of Rte. 1, suggesting that the rock was excavated for construction of Rte. 1. SA also noted large surface boulders placed in landscaped areas between Sta. 27+00SB and 31+00SB on the western side of Rte. 1. From about Sta. 47+00SB to 59SB+00, in the vicinity of Hawkes Pond, SA noted that the ground surface sloped downward west of Rte. 1, indicating fill was placed to create the Rte. 1 embankment. Based on topography shown on the Existing Conditions Plan, the embankment is on the order of 11 ft. high. SA noted exposed bedrock over relatively large areas on the shore of Hawkes Pond at the embankment bottom. West of Rte. 1 from about Sta. 61+00SB to 64+00SB, the ground surface slopes upward and SA observed rock outcrops in the sidewalk. The sidewalk was also constructed sloping steeply upward westerly, suggesting shallow rock left in place instead of excavation to create a level sidewalk. On the eastern side of Rte. 1 from about Sta. 51+00NB to 64+00NB, the ground surface generally slopes steeply upward to the east, and SA noted numerous rock outcrops.

2.2 Available Geologic Information

2.2.1 Published Data

The Surficial Geologic Map of the Reading Quadrangle (Oldale 1962) shows the Site vicinity north of Hawkes Pond to consist of Ground moraine, described as, "till with minor amounts of stratified drift". The Map further describes till as "poorly sorted to unsorted mixture of gravel, sand, silt and clay deposited directly by glacial ice. Deposition of the till was by lodgement (plastering beneath the moving ice) or by ablation of the ice." The Map describes a younger, or upper till and older, or lower till. Younger till is indicated as more extensive geographically, however, the older till may have greater volume due to greater thickness. Younger till is described as "loose, unsorted and unstratified mixture of sand and gravel with varying amounts of silt and clay. Boulders in the younger till vary greatly in number and size... Lenses of zones of stratified sand and gravel occur within the deposits." The upper 1 to 1.5 ft. is generally "yellowish brown or brown and contains somewhat more silt and clay than the unoxidized light gray till below it... In most places it (the younger till) is only a few feet to 15 feet thick, but in some places it can be considerable thicker." The Map also indicates, "the loose sandy texture of younger till makes it easy to excavate, fairly permeable, and useful as fill material. Slope stability in the sand till is good: in most places the till will stand on a 2:1 slope. The numerous large boulders in younger till at some places might make excavation of the till difficult."



026-08-007 Page 4 of 26 10/6/08

The Map describes the older till as, "in most places is a very compact, unsorted and unstratified mixture of gravel, sand, silt and clay. It appears to have a somewhat higher silt and clay content than the younger till. Older till is plastic when wet and is indurated to varying degrees when dry. Permeability is low in the older till... Older till is found in drumlins and in most places where the ground moraine is thick. It is rarely less than 15 feet thick and may be as much as 250 feet thick." The upper 10 to 25 feet is reddish brown or olive brown, whereas at greater depths the older till is light to dark gray. The Map also indicates that, "the compactness and induration of the older till makes excavation difficult to very difficult...Older till is very unstable in cuts, and careful planning as to the degree of slope and amount of drainage is necessary to insure a successful cut slope."

A smaller scale Surficial Geologic Map of the Boston Area (Kaye 1977) shows surficial soils to consist of Rocky Terrain, described as, "many bedrock outcrops, thin, spotty drift," and Stratified Drift, described as, "sand, gravel, and clay, minor till; in places overlain by swamp." These data are generally consistent with that shown on the Surficial Geologic Map of the Reading Quadrangle.

Figure 3 shows an excerpt of the Bedrock Geologic Map of Massachusetts (Zen et al. 1983). Based on Figure 3, bedrock in the site vicinity generally consists of gray granite to granodiorite. At the northern end of the Site, the Bedrock Map shows Peabody Granite, described as alkalic granite containing ferro-hornblende, middle Devonian age, intruding diorite and granodiorite. South of Hawkes Pond, the Bedrock Map shows gray granite to granodiorite, indicated as intruding the Westboro Formation of quartzite and argillite further south.

The Tectonic Map of Massachusetts (inset on the Bedrock Geologic Map) shows the Site vicinity to be part of the Milford-Dedham Zone, in an area shown as Brittlely Deformed Terraine and the Peabody Pluton, located within the Brittlely Deformed Terraine. The Brittlely Deformed Terraine is located between the northeast-southwest trending Bloody Bluff Fault to the northwest and the similar trending Northern Border Fault bordering the Boston Basin to the southeast.

According to the Metamorphic Map of Massachusetts (also inset on the Bedrock Map), except for the Peabody Pluton which is not metamorphosed, the Map indicates Low grade metamorphism consisting of, "Predominately greenschist, greenstone, felsite, and quartzite, commonly enveloped in granite."

Another preliminary bedrock map (Barosh et al. 1977) shows bedrock in the Site vicinity to consist of Dedham Granodiorite, Peabody Granite, Hybrid Dedham and Middlesex Fells Volcanic Rock, and quartzites and gneissoid metavolcanics. These descriptions are generally consistent with that shown on the Bedrock Geologic Map of Massachusetts.

2.2.2 Previous Subsurface Explorations

The Field Testing Work Plan contains an appendix of existing geotechnical data obtained by FST from the MWRA and Massachusetts Highway Department ("MassHighway"). The data included:

- A Geotechnical Letter Report, August 31, 2006, prepared for a new 120-ft. long MWRA water main in the northbound shoulder of Rte. 1 at the Lynnfield pumping station. This letter report presented results of two subsurface explorations, IB-1 and IB-2.
- Logs of borings BB-1A, BB-2 and BB-3 performed at the Walnut St. Bridge, July 1997 and provided by MassHighway



026-08-007 Page 5 of 26 10/6/08

• A Geotechnical Report titled, "Geotechnical Investigation, Shops at Saugus, Saugus, Massachusetts," January 10, 2007, prepared by JGI Eastern, Inc. for the Shops at Saugus commercial development near the southern end of the proposed alignment.

The borings performed near the Lynnfield Pumping Station generally encountered about 4 to 5 ft. of fine to coarse sand overlying bedrock consisting of light gray, hard, fine to coarse grained, fresh to moderately weathered Granite. Rock quality designation (RQD) values were 68 and 78 percent. The boring logs indicate that drill water was lost when coring rock, and groundwater was not encountered.

The borings performed at the Walnut St. Bridge generally encountered medium dense to very dense fine to coarse sand overlying granitic bedrock at depths of about 42 to 66 ft. below ground surface (bgs). Groundwater was noted in borings BB-1A and BB-2, performed behind the abutments of Walnut St. Bridge and about 12 ft. higher than Rte. 1, at boring completion at about 25 ft. below ground surface. In boring BB-2, performed on Rte. 1, groundwater was noted as about 9 ft. bgs.

The Geotechnical Report for the Shops at Saugus provides boring and test pit logs for 49 explorations, however, a boring location plan was not provided. The site location plan included in the report shows the general area of construction. The report summarizes the subsurface conditions at the northern portion of the site as granular fill overlying organic silt and wood debris, overlying glacial soils. In the southern and eastern portions of the site, the report summarizes subsurface conditions as blast rock fill overlying boulders or bedrock. Thirty nine of the 49 explorations encountered bedrock or boulders at depths from exposure at the ground surface to 23.5 ft. below the ground surface at the time of the explorations. Groundwater was noted at about 4 to 7 ft. below ground surface. Surface elevations may have changed since the explorations were made, thus changing bedrock and groundwater correlations with depth. The report recommends supporting the proposed buildings on shallow foundations bearing on structural fill, existing fill, glaciofluvial soil, glacial till or intact bedrock with a maximum net allowable bearing pressure of 6,000 pounds per square foot.

2.2.3 Ground Penetrating Radar

The MWRA engaged Green International Affiliates, Inc. who engaged Hager GeoScience, Inc. ("Hager," or "GPR Consultant") to perform geophysical surveys of the northbound and southbound shoulders of Rte. 1 using ground penetrating radar ("GPR"), supplemented by seismic refraction of the southbound shoulder from about Sta. 7+70 to 11+80. Hager performed the survey between April 15 and May 15, 2008, reduced and intepreted the data, and provided the results in a report titled, "Geophysical Subsurface Characterization, MWRA Lynnfield/Saugus Pipeline Project, Route 1, Saugus, MA," dated June 2008, prepared for Green International Affiliates, Inc. ("GPR Report"). The GPR Report indicates that, "the objective of the investigation was to identify the depth of bedrock and buried obstructions prior to excavation, with the specific goal to map areas along the proposed alignment with bedrock at depths of 10 feet or less."

In the GPR Report, Hager indicates, "GPR records showed two apparent unique reflective boundaries, which we interpret as fractured (weathered) bedrock overlying more competent (harder) rock." Inasmuch as this is a quote of the Hager GPR Report, the "we" in the quote refers exclusively to Hager. In correspondence between Hager and SA, Hager indicated that the degree of fracturing or weathering of the upper layer cannot be evaluated from the GPR data, and their interpretation was based on comparison between the GPR data and SA's draft boring logs provided to Hager by the MWRA. The GPR Report indicates variable fractured bedrock surface elevations of about 5 to 108 ft. (depths about 3 to 45 feet below ground surface) on the southbound shoulder, and about 14 to 109 ft. (depths about 3.5 to 38 ft. below ground surface) on the northbound shoulder. The GPR Report also identifies numerous subsurface obstructions and possible buried

Stephens Associates
Consulting Engineers

Insightful, Costsaving Solutions
for Buildings and
Infrastructure
Hydrology & Hydraulics

026-08-007 Page 6 of 26 10/6/08

utilities, and areas of possible reinforced concrete located below the existing asphalt pavement. Further discussion of the GPR results is presented in following sections.

As noted in Section 1.1, the GPR traverses were established as baselines for subsurface profiles with stationing beginning with 0+00 at the southern end through coordination and consent between SA, FST, MWRA and the GPR Consultant. Hager provided SA with the GPR traverses plotted on the Existing Conditions Plan in electronic AutoCAD format. Figure 4 shows the baselines. Hager also provided SA with subsurface profiles of the interpreted GPR results showing bedrock elevations, subsurface obstructions, possible buried utilities, and possible reinforced concrete under the asphalt in electronic AutoCAD format on June 23, 2008. SA included these features, as interpreted by Hager, on our subsurface profiles shown in Figures 5 through 7.

2.3 Current Subsurface Explorations

FST engaged GeoLogic Earth Exploration, Inc., of Norfolk, Massachusetts ("GeoLogic" or "Drillers"), to drill the borings and install groundwater observation wells along the proposed pipeline alignment between March 30 and April 25, 2008 using a truck-mounted drill rig. A total of 27 borings were drilled and 9 wells installed. The purpose of the borings was to evaluate geotechnical conditions (by SA) and to obtain samples for environmental and corrosion testing (by others). FST selected the boring and observation well locations and depths, and the Drillers marked the locations in the field and notified DigSafe System Inc. for utility clearance prior to drilling, as required by law. SA observed and logged the borings in the field, screened the samples using a photoionization detector (PID), measured ties to each boring from existing Site features, and jarred portions of the split spoon samples in environmental containers as requested by FST.

The boring logs are attached in Appendix B. FST provided ground surface elevations at the boring locations as noted on the boring logs. Figure 4 shows the exploration locations and Figures 5 to 7 show subsurface profiles. At the request of FST, SA used the Existing Conditions Plan and photogrammetric topographic data provided by FST to generate a ground surface profile along the baselines from which to plot the subsurface profiles showing the GPR data and boring results. The surface profiles generally follows the contours shown on the Existing Conditions Plan, but show localized variations, generally less than 0.5 ft. from a 'smooth' surface line. The variations result from the surface modeling routine used by AutoCAD Civil3D 2008 with the provided topographic data.

The Drillers advanced the borings to depths of about 12 to 21 ft. below ground surface ("bgs") using wash boring techniques. These techniques were selected over other methods (e.g. hollow stem auger drilling) because of the significant presence of boulders and bedrock, and sand below the water table, for which wash boring techniques were judged to be better suited. The Drillers performed Standard Penetration Tests ("SPT") and obtained split spoon samples continuously within the top 12 to 13 ft., where not impeded by boulders, and at 5-ft. intervals at greater depths, in general accordance with ASTM D-1586. The Drillers generally used soil cuttings to backfill the borings, except at borings B-3 and B-19 where PID readings exceeded 50 parts per million (ppm), the cuttings were drummed for disposal. The 50 ppm PID criterion was selected by FST. At boring B-19, it was later found that the PID had mis-read, and readings of the soil samples with a new PID indicated zero ppm.

The borings were spaced at approximately 300 ft. and subsurface conditions could vary significantly between boring locations. The generalized subsurface descriptions presented below and on Figures 6 and 7 are interpretations intended to highlight the major subsurface strata based on available data. Bedrock elevations shown on the subsurface profiles were provided by Hager based on their interpreted GPR data, as described

Stephens Associates
Consulting Engineers

Insightful, Costsaving Solutions
Geotechnical
Intrastructure
Hydrology & Hydraulics

026-08-007 Page 7 of 26 10/6/08

above. More detailed descriptions of subsurface conditions are presented in the logs of the individual explorations. Interested parties should review the exploration logs presented in Appendix B for specific information at individual boring locations. The strata and groundwater shown on the logs and Figures 6 and 7 approximate conditions at the exploration locations at the time of drilling. Variations may occur and should be expected between exploration locations and over time. The strata and groundwater delineations represent interpretations of the approximate boundaries between subsurface materials. The actual transition may be gradual. Our generalized description of subsurface conditions is as follows:

<u>Asphalt</u> – The Drillers generally encountered about 6 to 8 inches of asphalt at the ground surface of the borings. Many borings encountered either 4 to 6 inches of concrete or about 6 inches of cobbles beneath the asphalt.

<u>Subbase</u> – Underlying the Asphalt and concrete or cobbles, the Drillers generally encountered 2 to 6 inches of gray to gray and black medium to coarse Sand (Unified Soil Classification System (USCS) SP soil), with varying proportions of gravel, and crushed asphalt in some locations.

<u>Fill</u> – The Drillers generally encountered Fill consisting of gray-brown to brown fine to coarse sand with varying proportions of silt and gravel (SM,SW,GP) below the asphalt subbase and extending to depths of about 3 to 12 ft. below ground surface. Boulders on the order of one to two feet from top to bottom were encountered in borings B-1, -12, -17, -20, -23, -25, -26 and -27. Many samples penetrated less than 6 inches after 50 blows, or less than 12 inches after 100 blows, which is defined as sampler refusal. For samples that penetrated 12 in., Standard Penetration Test ("SPT") N-values ranged from 6 to 131 bpf, with most values greater than 22 bpf, generally indicating dense to very dense consistency.

<u>Sand</u> – In most borings, the Drillers encountered light brown, brown, or gray fine, fine to medium, or fine to coarse Sand (SW,SP,SM,GP), with varying proportions of gravel and non-plastic silt, underlying the Fill. In general, south of the Walnut St. Bridge, the sand was finer with more silt and less gravel. In the northern portion of the route, the sand was not encountered or was difficult to distinguish from the overlying Fill. Where bedrock was not encountered underlying the Sand, the Sand generally extended to depths of about 9 to 16 ft. bgs, in many cases the exploration bottom depth. In borings B-12, B-21 and B-23, a few inches of sand with trace organics were encountered at the top of this layer, suggesting possible former topsoil over which fill was placed. SPT N-values ranged from 6 to 109 bpf, with most values greater than 20 bpf, indicating mostly medium dense to very dense consistency.

<u>Silt</u> – Non-plastic to slightly plastic Silt was encountered in borings B-4, B-5 and B-17. In boring B-4, the Drillers encountered slightly plastic Silty Clay to Clayey Silt (CL/ML), trace to 'and' fine Sand at about 10 ft. bgs, extending to about 19 ft. bgs, and overlying fine to coarse sand and gravel (SW) extending to the boring bottom at about 21 ft. bgs. In boring B-5, non-plastic Silt was encountered from about 5.5 ft. bgs to the exploration bottom at about 21 ft. bgs. Boring B-17 likely encountered non-plastic Silt, some fine Sand from about 8 to 16 ft. bgs. The top few inches of Silt in borings B-5 and B-17 contained trace organics, suggesting former topsoil over which fill was placed. SPT N-values in the Silt ranged from 6 to 28 bpf, indicating medium stiff to very stiff consistency.



<u>Bedrock</u> – In borings B-7, -8, -10 and -11, the Drillers encountered bedrock at depths of about 3 to 4 ft. bgs. In borings B-18 through B-27, the Drillers encountered bedrock at depths of about 5 to 15 ft. bgs, with most depths less than 9 ft. bgs. The bedrock generally consisted of very hard, gray and black to pink and black, fresh to slightly weathered, medium grained, Granitic rock; very hard, gray and black, fresh to slightly weathered, fine to medium grained Granodioritic rock; or very hard, black, fresh to moderately weathered, fine grained Dioritic rock. Joints were generally closely spaced, dipping near horizontal to near vertical. Healed joints with veins of mineral infilling were generally observed in the Dioritic rock. Rock Quality Designations (RQD) ranged from 0 to 100 percent with most values between 30 and 83 percent. In general, rock coring was difficult because drill water generally did not return to the ground surface and the rock core barrel jammed frequently.

<u>Water</u> – In borings where monitoring wells were installed, SA measured water levels after each well was installed, and 2 hours to 4 days after installation at wells that could be accessed within the Driller's traffic control setup. FST measured water levels in the observation wells between April 27 and May 1, 2008, about 9 to 21 days after well installations. Table 1 summarizes measurements of groundwater levels in observation wells by SA and FST. Based on the observation well measurements, groundwater levels generally varied from about 4.1 to 13.7 ft. bgs, with most values between 5.3 and 9 ft. bgs. SA also measured water levels of about 1.6 to 10.9 ft. bgs at the end of drilling in borings where monitoring wells were not installed. The drilling technique, however, added water to the borings and SA's measured water levels may not depict natural groundwater levels. Groundwater levels will likely fluctuate seasonally, and depths at the time of construction differ from those indicated above.

In general, the Site soils and bedrock encountered in the borings are consistent with the surficial materials noted in the published geologic references and previous subsurface explorations described above.

2.4 Geotechnical Laboratory Test Results

Geotechnical laboratory test results are summarized in Table 2 and are presented in detail in Appendix C. SA performed 48 grain-size distribution analyses, 11 hydrometer analyses, and 2 Atterberg limits tests on samples obtained from the borings. The purposes of the geotechnical laboratory testing were to assist in soil classification and preparation of boring logs, to evaluate re-use of existing soils, and to assist in permeability evaluation.

2.5 Estimated Permeability

SA estimated hydraulic conductivity (permeability) of subsurface materials based on the gradation results. FST performed field permeability tests ("slug tests") in observation wells B-3-OW, B-4-OW, B-5-OW, B-9-OW, B-13-OW, and B-18-OW installed in the borings. The permeability data estimated from gradation analyses and field permeability tests contained in this Report should be used in conjunction with engineering analysis and engineering judgment in the design of dewatering and earth support systems for the Project.

SA estimated hydraulic conductivity based on the Kozeny-Carman Formula (Carrier 2003, Aubertin et al. 2005, Chapuis and Aubertin 2003). The Kozeny-Carman Formula estimates hydraulic conductivity based on fluid properties (i.e. water), void spaces (i.e. void ratio), and solid grain surface characteristics (i.e. specific surface area or SSA). Various authors present methods for estimating SSA based on grain-size distribution. Hydraulic conductivity is particularly affected by the estimate of SSA, which is largely dependant on the smallest particle size (D_0) in the grain-size distribution. SA estimated SSA using methods described by Chapuis and Aubertin (2003), which includes a method for estimating D_0 in the absence of hydrometer data.

Stephens Associates
Consulting Engineers

Insightful, Costsaving Solutions
for Buildings and
Infrastructure
Hydrology & Hydraulics

Carrier (2003) notes that the formula applies to non-plastic silt, but is not appropriate for clayey soils where interpartical forces affect flow. For larger particles, Carrier notes that the formula applies to gravely sands, but tends to overpredict permeability in gravels. SA therefore did not estimate permeability of clayey soils or gravels using the Kozeny-Carmen formula, or of near-surface soils that are above the groundwater table.

Based on the Kozeny-Carmen formula and the gradation data, we estimate *vertical* hydraulic conductivity of the soils tested to range from about 3.6×10^{-2} to 5.9×10^{-7} cm/s. Aubertin, et al. (2005) indicate that measured values of hydraulic conductivity usually range from 1/3 to 3 times the estimated value. Table 2 shows our estimates of hydraulic conductivity based on the grain-size test results.

SA *did not measure permeability*. The references note that values estimated with the Kozeny-Carman Formula are usually within the range of 1/3 to 3 times measured values. The estimated values are within the typical range of values for silty Sand to Silt and are generally considered to be low to high permeability. SA estimated permeability only of soils recovered from the split-spoon sampler. The samples therefore did not include large gravel, cobbles or boulders that could not be sampled. Permeability of soil containing such materials can vary significantly from soils containing purely smaller particles, and such permeabilities are not easily estimated without direct field measurement. The references note that nearly all laboratory measurements used to validate the Kozeny-Carman Formula were based on *vertical* hydraulic conductivity. The composition and permeability of existing Fill likely varies, and horizontal and vertical permeability could differ substantially depending on materials used and locations placed.

FST performed field permeability (slug) tests in selected observation wells indicated above and interpreted the data. Table 3 presents FST's summary of field permeability values. The values range from $1x10^{-2}$ cm/s to $4.7x10^{-4}$ cm/s. In interpreting the results, FST indicated the following:

The results generally agree in that low permeabilities calculated by one method correspond to low results by the other methods, such as at B-5. Variations in the results illustrate issues present in these methods. How completely the wells were developed and the limited displaced volume affect slug tests. Estimates from grain size distribution are dependent on the how representative the sample is, particularly in its relationship to the entire length of the entire screened interval. This method has difficulty accounting for layering in sediments not seen in bulk samples used for sieving. The results plus the boring logs should allow for preliminary evaluation of dewatering requirements.

3. EVALUATION AND RECOMMENDATIONS

The following sections present our recommendations regarding significant geotechnical design and construction-related issues for the subject Project based on information provided by FST and on our subsurface explorations described above. Recommendations in Section 4, Additional Recommendations and Construction Considerations, are integral to the design recommendations presented herein.

3.1 General Impacts of Subsurface Conditions

As indicated above, trench bottom depths are anticipated to be about 9 ft. below ground surface for stations 0 to 19+00, and about 8 ft. below ground surface for stations north of 19+00. The subsurface conditions identified at these depths in the borings generally consist of medium dense to very dense Sand, Sand and Gravel, or Bedrock and are generally suitable for foundation support of the proposed pipes with proper trench excavation and pipe bedding. Materials to be excavated generally consist of Sand or Sand and Gravel, or

Stephens Associates
Consulting Engineers

Insightful, Costsaving Solutions
for Buildings and
Infrastructure
Hydrology & Hydraulics

026-08-007 Page 10 of 26 10/6/08

Sand, Gravel and Boulders. Buried utilities, including gas mains, sewer/drain lines, telecommunications, etc. are located in close proximity to the proposed pipelines. In our opinion, the subsurface conditions will significantly affect pipeline design and construction in several ways, including the following:

- Shallow bedrock We anticipate up to 7 ft. of bedrock excavation, and typically 1 to 5 ft., may be needed to reach proposed trench bottom depths where shallow bedrock was encountered in the borings and GPR results. The GPR Report indicates bedrock shallower than proposed excavation bottom depths from about Sta. 15+30SB to 23+80SB; Sta. 25+20SB to 28+50SB; and frequently north of Sta 49+50SB.
- Shallow groundwater Groundwater was generally measured between 4.1 and 9 ft. below ground surface. Excavation will require dewatering.
- Highly permeable soils Large quantities of water may be pumped during dewatering and the influence of groundwater drawdown could extend a significant distance from excavation.
- Buried utilities Close proximity of buried utilities will affect methods for rock removal and will likely require shoring of excavations.
- Subsurface obstructions The GPR results indicate numerous subsurface obstructions (e.g. boulders), and SA's borings, particularly those performed near Hawke's Pond, encountered boulders on the order of 1 to 3 ft. diameter. Excavation of boulders could be difficult and could increase trench sizes. Boulders could also hinder excavation support installation.

The following sections further discuss these and other factors affecting pipeline design and construction, and should be reviewed in detail and understood.

3.2 Pipeline Route Considerations

As discussed above, north of Sta. 48+40SB, the MWRA is considering installing the 24-in. pipe following a route along either the northbound or southbound shoulder (also referred to as "northbound route" or "southbound route"). Factors affecting the selection of northbound versus southbound route include subsurface conditions, utility conflicts, coordination with the Town of Saugus, and possibly others. To assist in the evaluation of subsurface conditions, FST selected boring locations on each side of Rte. 1 to be approximately opposite each other, and the MWRA engaged the GPR Consultant to perform GPR surveys on each side of Rte. 1.

Subsurface conditions potentially affecting route selection include shallow bedrock, boulders, and groundwater. These factors are discussed in detail in the following subsections. In general:

- The GPR results and SA's borings performed north of Sta. 49+50SB on both sides of Rte. 1 encountered bedrock shallower than the proposed excavation depth of 8 ft. Although the borings encountered bedrock at similar depths on both sides of Rte. 1, the GPR results suggest that the route following the northbound shoulder may require less bedrock excavation than the southbound shoulder.
- Historic plans obtained from MassHighway by SA suggest that bedrock along the northbound lanes/shoulder and the northern portion of the southbound lanes/shoulder (north of Sta. 61+20SB) was likely over-excavated during previous construction for installation of utilities.
- The GPR results and SA's borings indicate subsurface obstructions on both sides of Rte. 1. Based on the borings and our Site reconnaissance, the route following the northbound shoulder may encounter fewer boulders than the southbound shoulder.



• Groundwater levels measured in observation wells at borings B-17-OW and B-18-OW suggest that water levels on the southbound shoulder may be deeper than on the northbound shoulder north of Sta. 49+50SB. Ground surface topography decreases relatively steeply south and west in this area towards Hawke's Pond, suggesting that groundwater may follow a similar trend.

3.2.1 Bedrock

The borings performed for evaluation of route selection approximately north of Sta. 48+00 generally encountered bedrock at depths and rock quality designation values shown in Table 3.1.1 below.

TABLE 3.2.1 – BEDROCK DEPTHS IN NORTHERN BORINGS								
Southbound Route			Northbound Route					
Boring No.	Depth to Bedrock (ft.)	RQD ^a	Boring No.	Depth to Bedrock (ft.)	RQD ^a			
17	>21	N/A	18	15	71			
20	8	100	19	8.5	0			
21	9	0	22	7.5	98			
23	12	58	24	8	54			
25 ^b	7	42	26	7	50			
27	5	30	IB-1 ^c	4.3	78			
			IB-2 ^c	4.9	68			

^a Rock quality designation (RQD) values shown are for rock core taken within about 1 to 5 ft. of bedrock surface, which may need excavation.

The borings on the southbound side generally encountered bedrock at depths of about 5 to 12 ft. bgs, and the northbound side generally encountered bedrock at depths of about 4.3 to 8.5 ft. bgs. For a proposed trench bottom depth of 8 ft. below ground surface, the borings on both sides generally indicate little bedrock excavation except for the northern-most area (borings B-25 to B-27, IB-1 and IB-2), where we expect the amount of bedrock excavation to be greater. Rock quality designation values on both sides are comparable, indicating that bedrock will likely be difficult to excavate on both sides. The GPR data, however, indicate shallower bedrock between boring locations on the southbound side.

As indicated above Figures 6-5, 6-6, 7-3 and 7-4 show subsurface profiles of the GPR data and bedrock surface interpreted by Hager. For a proposed trench depth of 8 ft. below ground surface, SA compared the plotted GPR data with the trench bottom shown in Figures 6-5, 6-6, 7-3 and 7-4. From Sta. 50+00 to 60+00, we estimate that about 60 percent of the southbound route has bedrock shallower than 8 ft. bgs, compared to about 20 percent on the northbound side. The thickness of bedrock excavation on the southbound side is estimated to be on the order of 1 to 2 ft. typical, whereas the northbound bedrock excavation thickness is likely to be on the order of 1 ft. typical between these stations. North of Sta. 60+00, we estimate that most, if not all, of the profile on both sides would require bedrock excavation on the order of 2 to 3 ft. typical. These data suggest that the northbound route may require less bedrock excavation than the southbound route. The above estimates are based solely on the GPR data provided by others and actual conditions could vary.

026-08-007 Page 12 of 26 10/6/08

^b In boring B-25, the Drillers advanced the roller bit about 1.5 ft. into rock before coring.

^c Borings IB-1 and IB-2 performed in 2006. See Section 2.2.2.

Based on SA's Site reconnaissance, where we observed significant rock outcrops east and west of Rte. 1 and existing topography sloping relatively steeply downward from east to west, we would expect the depth to bedrock on the northbound route (i.e. eastern side of Rte. 1) to be shallower than indicated by the borings and GPR, and to be shallower than depths to bedrock along the southbound route (i.e. western side of Rte. 1), contrary to what the data indicate. Based on the boring and GPR results and our observations, we hypothesize that bedrock was over-excavated along the northbound lanes/shoulder, and north of B-25 on the southbound lanes/shoulder, during past construction/widening of Rte. 1 to allow for below-grade utility installation. We also hypothesize that the soil overlying bedrock in these locations was likely placed as fill after the bedrock was removed.

To assist us in evaluating our hypotheses, SA contacted MassHighway, requesting plans, profiles, sections and boring logs from past Rte. 1 construction. MassHighway found no previous boring logs in this area, but provided plan and profile drawings from 1926 to 1966. We understand that FST and MWRA also requested MassHighway boring information and received only three borings performed at the Walnut St. Bridge. FST also reviewed drawing files from the Town of Saugus, but only found a few sewer profiles that do not show bedrock.

SA compared MassHighway plan Nos. RP 656 0017 and RP 656 0018, showing as-built conditions from 1927-1928 ("1928 Plans") with plan Nos. RP 657 0017 and RP 657 0018, showing as-built conditions from 1935-1936 ("1926 Plans") after Rte. 1 was widened from one to multiple lanes (in each direction) and a center median was added. Both sets of plans show a baseline with stations, the Hawkes Pond Dam spillway and the Lynnfield pump house on the western side of Rte. 1, and the Saugus-Lynnfield Town line. Comparing the stations and baselines with these landmarks, SA concluded that the baselines and stations for the two sets of plans were substantially similar, if not the same. In comparison to the current Existing Conditions Plan using the same methods, the Rte. 1 baseline and stationing shown on the Existing Conditions Plan is substantially similar to, or nearly the same as, the previous baselines and stationing. Comparing these three sets of plans, SA noted the following over the area north of Sta. 48+80:

- Rte. 1 was widened circa 1935-36 by adding about 75 ft. to the eastern side while maintaining a similar western edge location;
- An additional 25 ft. was added to the eastern side between 1936 and 2008 while the western side was maintained in a similar location, or widened slightly.
- The 1928 Plans show "ledge" outcrops on the eastern side of Rte. 1 near Sta. 49+20SB to 50+20SB, Sta. 58+20SB, and from about Sta. 62+20SB to 63+70SB. On the 1928 western side of Rte. 1, "ledge" outcrops are shown near Sta. 61+20SB and about 62+70SB to 63+70SB (stations indicated on current southbound baseline referenced in this Report).
- The 1936 Plans do not show (legible) bedrock or ledge outcrops;
- Since Rte. 1 was widened easterly after 1928, we presume the ledge noted on the 1928 Plans was removed/excavated during the corresponding widening;
- The 1936 Plans show construction of catch basins and drain pipe not shown on the 1928 Plans. The catch basin bottom elevations are shown on the order of 4 to 6 ft. below the 1936 finished ground surface, suggesting that bedrock was either excavated along a trench for each pipe, or, more likely, over excavated during grading for the corresponding widening.
- SA could not reconcile ground surface elevations shown on profile views on the 1928 Plans and 1936 Plans because of apparent differences in datum. The plans do not indicate a datum.



Based on these plans, the boring and GPR results, and our Site observations, we conclude that bedrock along the northbound lanes/shoulder and the northern portion of the southbound lanes/shoulder was likely over-excavated during previous construction for installation of utilities. The data above also suggest that less bedrock excavation may be required along the northbound route.

3.2.2 Boulders

Boulders could be difficult to excavate during construction, resulting in larger/wider trenches, undermining of adjacent utilities, greater backfill quantities, and higher costs. Borings B-17, 20, 23, 25 and 27, performed on the southbound side encountered fill containing significant boulders overlying the bedrock. Boulders were also encountered on the northbound side in boring B-26. Based on our Site reconnaissance and review of historic plans indicated above, we suspect that boulder fill was placed for the original construction of Rte. 1, or possibly construction of Hawkes Pond Dam, at the southbound shoulder/embankment. Although we suspect that the soil overlying bedrock on the northbound shoulder is also fill, the borings did not encounter as many boulders as at the southbound shoulder. The GPR data indicate similar numbers of subsurface obstructions on each side. Based on the boring results, the boulders may be on the order of 1 to 3-ft. diameter. Based on these data, the northbound side may have fewer boulders overlying bedrock.

3.2.3 Groundwater

As noted in Section 2.3, groundwater levels measured in the borings at the end of drilling varied significantly, and are not likely indicative of the actual groundwater level because of water added during drilling. FST measured water levels in observation wells installed in borings B-17 and B-18, performed on the southbound and northbound sides, respectively, of about 13.7 and 6.9 ft. below ground surface. These data suggest that trench excavation along the northbound side may encounter groundwater and dewatering might be needed, whereas excavation along the southbound side may not encounter groundwater. The topography, however, slopes steeply to the north and east from both of these wells, and groundwater depths in the vicinity could differ significantly.

3.3 Pipe Support Factors

Figure 8 shows factors affecting pipeline design. Pipelines are typically designed based on experience, by standardized design methods (e.g. AWWA C150 2002, DIPRA 2006), or by analytical methods such as the Marston-Spangler Load Theory (Spangler and Handy, 1982). Loads on buried pipes include surface loads (e.g. traffic), earth load, and internal pressure. Load carrying capacity of the pipe is dependant on the structural characteristics of the pipe, bedding characteristics and shape around the pipe bottom (i.e. bedding angle), compaction of backfill at pipe sides. The load carrying capacity of the pipe is also affected by trench width and ability of native soils to confine the bedding/backfill and provide horizontal resistance.

AWWA Standard C150 presents a method for designing the thickness of ductile iron pipe. In this method the pipe thickness is designed separately for internal pressure and trench load (earth plus surface loads). The larger thickness from the two designs is selected, and pipe deflection is checked. For 24 and 36-in. diameter pipes, a casting allowance of 0.07 in. is added to the calculated thickness.



026-08-007 Page 14 of 26 10/6/08

Traffic loads are tabulated in AWWA C150 for a single AASHTO H-20 truck, 16 kip wheel load placed over the pipe with an effective pipe length of 3 ft. and a 1.5 impact factor. For 24- and 36-in. pipes with 5 ft. of cover over the pipe crown, AWWA C150 Table 1 indicates traffic loads acting on the pipe of 1.1 psi. Trench backfill unit weight, γ should be taken as 120 lb/ft³. Design parameters including modulus of soil reaction, E', bending moment coefficient, K_b and deflection coefficient, K_x depend on the depth and type of pipe bedding. As noted above, FST provided a typical pipe detail showing bedding placed to the pipe midpoint with 6 inches of bedding below the pipe. This bedding configuration is considered Type 5 in the Standard, and values of E', K_b , and K_x should be taken as 700 psi, 0.128 and 0.085, respectively. Other bedding configurations with less bedding thickness below or beside the pipe (Types 1 through 4) will result in larger trench loads, and correspondingly lower values of E' and higher values of K_b and K_x should be selected in accordance with AWWA C150. If other methods are used to design the proposed pipeline, SA should be consulted on the applicability of the above values before their use in design.

3.3.1 Pipe Foundations

The borings indicate that pipe foundation soils at proposed trench depths of 8 to 9 ft. generally consist of medium dense to very dense Sand, Sand and Gravel, or Bedrock. Medium stiff to hard, non-plastic to slightly plastic, sandy Silt was encountered in borings B-4, B-5, and B-17 at depths similar to the proposed trench bottom depths and will likely be encountered at the trench bottom in localized areas. The Sand, Sand and Gravel, Bedrock, and Silt are suitable for foundation support of the proposed pipe. Trench bottoms/foundation subgrades should be prepared as described in Section 4. Disturbed subgrades should be remedied in accordance with this Report.

Several inches of dark brown Sand or Silt with traces of organics, likely a former topsoil over which Fill was placed, were encountered in borings B-5, -12, -17, -21, -23 at depths of about 5 to 8 ft. below ground surface. Soils containing organics are unsuitable for foundation support of the proposed pipe. Where encountered at the trench bottom, these materials should be removed and replaced with compacted granular soil or crushed stone. Thickness of such materials could vary significantly between borings.

For trench bottom depths of 9 ft. below ground surface south of Sta. 19+00SB, and 8 ft. below ground surface north of Sta. 19+00SB, the GPR data indicate that bedrock excavation will likely be required as follows:

Table 3.3.2 – Estimated Bedrock Excavation from GPR Data					
Stations	Route	Approximate Bedrock Excavation Thickness			
15+30SB to 23+80SB	Southbound	4 to 7 ft. typical			
25+20SB to 28+50SB	Southbound	2 to 5 ft. typical			
49+50SB to 60+00SB	Southbound	1 to 2 ft. typical over 60 percent			
55+00NB to 60+00NB	Northbound	~1 ft. typical over 20 percent			
60+00SB to Northern End	Southbound	2 to 3 ft. typical			
60+00NB to Northern End	Northbound	2 to 3 ft. typical			

The above estimates are based solely on the GPR data provided by others and actual conditions could vary. These estimates are not intended to be a quantity estimate.



026-08-007 Page 15 of 26 10/6/08

The bedrock surface shown in the GPR Report generally agrees with the top of bedrock encountered in the borings within one to two feet, except at boring B-9, where the boring was advanced through a boulder (or boulders) from about 8.5 ft. to 12.5 ft. bgs and underlying soil whereas the GPR Report shows bedrock at about 9 ft below ground surface. Though we cannot reconcile this discrepancy, the boulders and/or bedrock at this location is deeper than the proposed trench bottom and will not likely impact pipeline construction. Variations in the actual bedrock surface from that estimated by the GPR data should be expected.

The GPR Report also shows a second, lower bedrock surface, interpreted by the GPR Consultant to be "more competent (harder) rock" underlying "fractured (weathered) bedrock." We generally find this delineation between possible fractured bedrock and more competent rock difficult to correlate with the rock core RQD values obtained in the borings.

Bedrock generally consists of very hard Dioritic, Granitic, and/or Granodioritic rock. Over the anticipated depth of excavation, Rock Quality Designation values ranged from 0 to 100, with most values between 42 and 78, indicating slightly to moderately fractured bedrock. We recommend excavating bedrock to at least one foot below the proposed pipe bottom elevation. We anticipate that such bedrock will generally be difficult to excavate. Section 4.4 describes further considerations about bedrock excavation.

3.3.2 Pipe Bedding and Backfill

As noted above, FST indicated that excavation depths for the 24-in. and 36-in. pipes will likely extend about 1-ft. below the pipe bottom, to about 8 and 9 ft. below ground surface, respectively, and pipes will therefore have about 5 ft. of cover. Typical details of pipe trench construction provided by FST, however, show 6 in. of pipe bedding stone placed beneath the pipe and up to the pipe centerline. We recommend placing at least 6 in. of crushed stone as pipe bedding beneath the pipe. The depth of proposed trench excavation and bedding thickness may be reconciled by reducing excavation below pipe bottom elevation to 6 inches, increasing thickness of bedding to 1 ft., or placing 6 inches of Gravel Borrow at the trench bottom prior to placing 6 inches of bedding. Where bedrock removal is required to establish the proposed trench bottom elevation, bedrock should be excavated at least one foot below the pipe bottom, and a minimum of one-foot of pipe bedding should be placed over the bedrock surface.

AWWA C600 indicates that Type 5 bedding should consist of granular material (sand, gravel, or crushed stone). The typical detail provided by FST shows crushed stone pipe bedding. Crushed stone pipe bedding may be imported or processed on-Site from excavated rock. Crushed stone pipe bedding should conform to MassHighway Crushed Stone M2.01.5 (1/2" nominal crushed stone) which, among other requirements, has the following gradation specification:

TABLE 3.3.2.1 - PIPE BEDDING GRADATION		
Sieve Size	Percent Finer By Weight	
5/8 in.	100	
1/2 in.	85-100	
3/8 in.	15-45	
No. 4	0-15	
No. 8	0-5	



026-08-007 Page 16 of 26 10/6/08

Geotextile filter fabric, meeting the requirements of MassHighway (1995) M9.50.0 Type I – Separation, should be placed over the trench bottom and wrapped around the crushed stone to reduce risk of migration of fines, and potential ground deformations resulting from such migration of fines into the crushed stone.

Backfill placed over the pipe and pipe bedding should consist of Ordinary Borrow, MassHighway M1.01.0, with a maximum particle size of 3 in., placed in 8-in. maximum loose lifts and compacted to at least 92 percent maximum dry density as measured by ASTM D1557. Within two feet of proposed ground surface, but beneath the pavement section, backfill should consist of Gravel Borrow, MassHighway M1.03.0 placed in 8-in. maximum loose lifts and compacted to at least 95 percent of maximum dry density as measured by ASTM D1557. The pavement section should be designed and constructed in accordance with MassHighway standards. Based on the grain-size analyses, we anticipate that most excavated soils from the trench can generally be reused as Ordinary Borrow after screening for particles larger than 3 in.

3.4 Lateral Earth Pressures and Trench Design Factors

The presence of structures, including buildings, bridges, culverts, utilities, drainage structures (e.g. catch basins, etc.), pavements, etc., in close proximity to the proposed pipelines will affect trench design and construction. Excessive lateral ground movements (rotation or translation) of excavation support systems, if not properly designed and executed, could result in nearby structural deformations and settlement. Such ground deformations could damage adjacent structures within a distance of about 3 times the trench depth away from the excavation. Structures located within the active earth wedge, defined by a line extending from the trench bottom, outward and upward at an angle of about 60 degrees, may be particularly affected, as we would expect the most ground deformation within this zone. Likewise, dewatering and ground loss at the excavation support system into the trench could result in vertical and lateral ground deformations, even at potentially much greater distances.

Based on a trench depth of 9 ft., we estimate that rotation or translation of the trench wall of about 0.1 inches would be needed to mobilize active lateral earth pressures. Additional movements should be expected from ground loss and dewatering, depending on the types of trench support and dewatering systems implemented. For example, ground loss at the trench walls is typical when trench box earth support is used, due to raveling, collapse and seepage into irregularities in the space between the trench box and the trench walls. Other construction-related factors may cause ground movements as well, and should be evaluated and addressed by the Contractor's Professional Engineer in submittals before construction. Additional construction considerations of specific earth support techniques are discussed in Section 4.3.

Where movements required to develop active earth pressures risk damage to adjacent utilities, excavation support can be designed using at-rest pressures with an equivalent fluid unit weight of 65 pcf for soils above the groundwater level during excavation. This unit weight is based on a coefficient of at-rest earth pressure, K_0 , of 0.5, multiplied by a soil unit weight of 130 pcf for Sand, Sand and Gravel, or Sand and Gravel Fill. For soils below the groundwater level during excavation, use an equivalent fluid unit weight of 34 pcf plus hydrostatic forces. Where movements required to develop active earth pressures are acceptable, excavation support can be designed using an equivalent fluid unit weight of 43 pcf for soils above the groundwater level during excavation. This unit weight is based on a coefficient of active earth pressure, K_a , of 0.33, multiplied by a soil unit weight of 130 pcf for Sand, Sand and Gravel, or Sand and Gravel Fill. For soils below the groundwater level during excavation, use an equivalent fluid unit weight of 22 pcf plus hydrostatic forces.



026-08-007 Page 17 of 26 10/6/08

Loads from construction equipment and traffic, if located within a distance 1.5 times the excavation depth from the excavation top, should be applied uniformly over the excavation support height on the side of the active loading. These loads should be evaluated and used by the Contractor's Professional Engineer, however, at a minimum, a surcharge load equal to placement of 3 ft. of additional fill should be included.

The excavation support designer (Contractor's Professional Engineer) should consider the location and depth of adjacent buried structures (e.g. catch basins, manholes, etc.) in comparison with the trench bottom depth to check that adjacent structures will not be undermined by excavation. Where risks of undermining adjacent structures are identified in the Construction Contract, the Contractor should design and construct earth support or underpinning at these locations.

4. ADDITIONAL RECOMMENDATIONS AND CONSTRUCTION CONSIDERATIONS

The following sections represent our recommendations regarding significant geotechnical construction-related issues for the subject Project.

4.1 Site Preparation and Earthwork

Earthwork should conform to local, state and federal regulations, including but not limited to environmental regulations regarding mitigation of runoff impacts to drainage systems and wetlands. Prior to earthwork, measures should be taken to direct surface runoff away from the construction area. Drainage should be directed to minimize sedimentation of lower portions of the Site. Earthwork should further conform to MassHighway Standard Specifications. A registered design professional or his representative should be on the Project at all times while fill is being placed and compacted.

Trench excavations will extend below the water table and will require dewatering, discussed later. Water will influence construction since subgrade support capacities will deteriorate when the soil becomes wet, frozen and/or disturbed. Wet or freezing conditions will significantly reduce the workability of Site soils. The Contractor should keep exposed subgrades properly drained and free of ponded water. This may be achieved by sloping the Site topography adjacent to the construction to direct the water away from the excavation, or by trenching and berming to collect the excess run-off, or by other means.

The Contractor should not place pipe bedding on wet or disturbed subgrades. Disturbed subgrades should be evaluated by the engineer and remedied in accordance with this Report. Pipe bedding should be placed over undisturbed subgrades consisting of existing Sand, Sand and Gravel, Silt, or bedrock after placing geotextile filter fabric, as described above. Where bedrock excavation is required to reach design subgrade elevation, loose soil and rock should be removed from the trench bottom after rock blasting or breaking.

We recommend completing final excavations to desired subgrades immediately before the placement of pipe bedding. The Contractor should take care during excavation to minimize disturbance of the subgrade and should provide a subgrade at the excavation bottom smooth enough to support the geotextile without damaging it during backfilling. We recommend performing final excavation using a smooth-edged excavator bucket or by finishing the excavation with hand tools. Disturbed subgrades should be recompacted smooth. A qualified geotechnical engineer should observe the excavation and subgrade finishing, and make recommendations on modifications to the excavation/compaction based on the subgrades and their response to the excavation/compaction. If the on-Site geotechnical engineer observes that compaction/smoothing disturbs the



026-08-007 Page 18 of 26 10/6/08

subgrade, these activities should be terminated and alternative means should be evaluated. Compaction of soils with significant fines, such as those encountered in the borings south of the Walnut St. Bridge, will be difficult when wet. Where compaction causes excessively deep disturbance of these soils, disturbed subgrades should be removed and replaced with crushed stone pipe bedding or Gravel Borrow, as recommended by the on-Site geotechnical engineer. Any loose or soft zones observed during excavation, smoothing/compaction, or placement of pipe bedding should be recompacted to natural density. If this cannot be accomplished, the disturbed soils should be excavated and replaced with compacted crushed stone. Voids created in the subgrade by removing boulders or loose broken bedrock should be filled with Gravel Borrow or crushed stone to match the subgrade elevation, in a manner consistent with the recommendations of this Report for those materials.

4.2 Reuse of Existing Site Soils

Exclusive of materials affected by environmental restrictions, and subject to the provisions of this Report, clean native soils and existing fills (exclusive of construction debris) that meet the requirements of the MassHighway Standard Specifications for Ordinary Borrow may be reused on Site as backfill over the pipe providing that they can be adequately placed and compacted. Based on the grain-size analysis results, we anticipate that most excavated soils meet the gradation requirements of Ordinary Borrow and can be reused as backfill after screening for particles larger than 3 inches. Samples that did *not* meet the criteria for Ordinary Borrow included B-5, -18, -20, and -23 (7 to 9 ft. bgs), B-17 (8 to 10 ft. bgs), and B-24 (5 to 7 ft. bgs). Grain-size analyses of select, near-surface samples (~1 to 3 ft. bgs) from borings B-8 and B-11 through B-16 indicate gradations that generally meet the criteria for Gravel Borrow after screening for particles larger than 3 inches. Samples taken from greater depths in borings B-4 (~6-8 ft. bgs), B-16 (~7-9 ft. bgs) and B-19 (~3-5 ft. bgs) meet the grain-size criteria for Gravel Borrow. If the Contractor plans to reuse these materials when encountered during trench excavation, these materials should be stockpiled separately from material not meeting the gradation for Gravel Borrow. A qualified environmental consultant should evaluate the environmental impacts of the reuse of contaminated on-site soils for the Project, if such soils are encountered. Imported materials such as Pipe Bedding and Gravel Borrow should be free of environmental contaminants.

4.3 Excavation Support

All excavations should be supported in accordance with current Occupational Safety and Health Administration (OSHA) requirements. Refer to Appendix D for additional information. Structures, including but not limited to buildings, bridges, culverts, utilities, drainage structures, and pavements, etc., in close proximity to the proposed pipelines will affect, and be affected by, trench excavation. Trenches should be shored to limit movements to tolerable levels. The Contractor should be required to submit deformation-based earth support designs prepared and stamped by a professional civil engineer registered in the Commonwealth of Massachusetts (Contractor's PE). The Contractor should be allowed to use commonly accepted means and methods for excavation support, with movement tolerances and daily monitoring of movement-sensitive structures specified in the earthwork or other specification sections.

The Contractor may prefer to support excavations with a trench box. Trench boxes, however, generally result in greater movements of surrounding earth than other excavation support techniques, and may not be suitable where adjacent structures are in close proximity. Excavation with a trench box generally proceeds below the box bottom, leaving soil unsupported, and the excavation sides do not typically conform closely to the box dimensions, often leaving voids between the excavation walls and box sides. These factors can cause vertical and lateral soil movements that could damage adjacent structures. The Contractor's excavation support plan may include the use of trench boxes where soil movement will not jeopardize adjacent structures. Alternative excavation support methods, such as driven sheeting, might be considered where structures are in close



proximity to the proposed trench. Installation of sheeting, however, may be difficult where subsurface obstructions, such as boulders are present. The Contractor's excavation support plan should include contingencies for difficulties encountered in installing the designed earth support system.

Poor construction practices will cause excessive settlement of nearby structures. As deflections occur in excavation walls or bottom, these deflections are manifest in nearby ground movements and surface settlements. The Contractor should limit the deflections of the trench walls and bottom, especially where the trench is deepest, to 1 inch. Additionally, risks of ground deformations and instability from wall and bottom deflections, consolidation, ground loss, creep, etc., increase significantly with time. The longer the excavations are open, the greater the risk. It should be noted that, as is typical for such excavation and construction, some ground deformation will occur in the vicinity of the construction. Proper care taken during design and construction can manage such deformations to acceptable levels.

The Contractor's excavation support design should consider the location and depth of adjacent structures in comparison with the trench bottom depth, and include measures to support these structures and underlying soil without undermining.

4.4 Bedrock Excavation

The feasibility of bedrock excavation techniques depends, to a large extent, on the rock hardness and quality (e.g. spacing, frequency, and orientation of fractures). Selection of a bedrock excavation technique will be significantly affected by the existing structures, particularly the gas main, within several feet of the proposed pipeline, and the Walnut St. Bridge. The GPR data noted in Section 3.3.1 shows shallow bedrock under the Walnut St. Bridge, however, the MassHighway borings performed at the Bridge in 1997 encountered bedrock at much greater depths. The GPR data and borings indicate that bedrock elevations vary significantly in this area, and bedrock excavation near, if not under, the Walnut St. Bridge should be anticipated. As summarized in Table 3.3.2, we generally anticipate 2 to 7 ft. of bedrock excavation north of the Walnut St. Bridge, and 1 to 3 ft. of bedrock excavation over the northern portion of the proposed alignment. In the following sections, we describe our observations of bedrock quality based on the borings and GPR data, followed by bedrock excavation methods, and bedrock blasting risks and criteria.

4.4.1 Bedrock Quality

Section 3.3.1 summarizes GPR data interpreted to show likely stations and depths (i.e. thickness) of bedrock excavation. Based on the borings, the bedrock generally consists of Dioritic, Granodioritic, and Granitic rock, which are common igneous rocks. The bedrock is generally very hard. Joints and fractures are slightly weathered to fresh without a well-defined zone of increased surficial weathering at the top of the bedrock.

As noted above, the GPR Report also shows a second, lower bedrock surface, interpreted by the GPR Consultant to be "more competent (harder) rock" underlying "fractured (weathered) bedrock." We generally find this delineation between possible fractured bedrock and more competent rock difficult to correlate with the rock core RQD values obtained in the borings. Based on the borings, the bedrock surface did not appear to be significantly more weathered or fractured than bedrock at greater depths. In some borings, RQD values were higher at the bedrock surface and decreased with depth where localized fracture zones were encountered.



026-08-007 Page 20 of 26 10/6/08

Over the proposed depth of bedrock excavation, the RQD values range from 0 to 100, with most values between 42 and 78, indicating moderately fractured rock. Orientation of joints varied from near horizontal to near vertical. Based on the boring results and Site observations, we hypothesize that over-blast from previous bedrock blasting to construct Rte. 1, particularly north of the Walnut St. Bridge from about Sta. 15+30SB to 28+50SB, may have fractured or loosened the rock.

4.4.2 Rock Excavation Methods

The proximity of the Walnut St. Bridge and buried utilities, and especially buried gas mains within several feet of the proposed pipeline, should be carefully considered in the selection of rock removal technique. As noted above, bedrock elevations vary significantly near the Walnut St. Bridge and rock removal should be anticipated under or near the Bridge. The selection of a rock removal technique should strive to balance risk to adjacent utilities and structures with opposing factors such as excavation cost and production rate.

FST indicated that for construction of the interim connection at the Lynnfield Water District Pump Station, the contractor encountered very hard bedrock and was not allowed to blast because of close proximity to a buried gas pipeline. We understand that mechanical excavation by hoe-ram was used for the Interim Connection at the Lynnfield Water District Pumping Station, and that the bedrock hardness presented significant challenges and slow progress.

Rock can typically be excavated by explosive or non-explosive methods, such as mechanical excavation (e.g. hydraulic rams, etc.), trenching, chemical splitting, or other, proprietary methods. The primary factors affecting selection of method include cost, risk of damage to adjacent structures from vibrations, airblast, flyrock, etc., and permissions from regulating authorities. Factors affecting cost include, but are not limited to, the following:

- Method production rate
- Rock hardness
- Rock fractures
- Special measures such as reinforcement of adjacent bedrock by drilling and grouting steel dowels
- Size of excavated material that could requiring further breaking or crushing
- Control of trench size, which affects quantity of backfill
- Permitting
- Method-specific restrictions on working hours
- Traffic stoppages
- Monitoring and mitigation measures for damage to adjacent structures

Blasting is typically more cost effective than non-explosive methods, however, for this Project, controlled blasting needed to reduce risks to nearby buried and above ground structures as well as permitting and safety measures would increases costs, and non-explosive methods might be viable. Furthermore, as described below, blasting requires cooperation and permission from adjacent buried utility owners as well as the Town of Saugus Fire Marshal and MassHighway, and may not be permitted. Alternatively, in our opinion, mechanical excavation is feasible, though excavation progress will likely be slow because of the bedrock hardness and, where high RQD values were encountered, the limited fracture frequency.



026-08-007 Page 21 of 26 10/6/08

4.4.3 Rock Blasting

Rock blasting should conform to local and federal regulations, as well as State Board of Fire Prevention Section 527 CMR 13 – Explosives ("State Blasting Regulations"), which describes State regulations regarding explosives. We recommend that the Owner or general Contractor engage a well-qualified licensed blasting contractor with experience in trench blasting near existing buried utilities, and that the contract specifications require the blaster to submit their qualifications to the Owner and Engineer for review prior to blasting.

SA contacted Captain Daniel McNeil at the Saugus Fire Department who provided a copy of the blasting permit application and the Saugus Fire Department Blasting Regulations, which reference the State Blasting Regulations. Cpt. McNeil indicated that where the proposed blast is in close proximity to existing buried utilities, the Town requires the Owner/Applicant to involve the existing utility owner in the blast planning and seek and receive approval from the utility owner. If the existing utility owner does not agree to blasting, the Town will not generally permit blasting. Cpt. McNeil also indicated that blasting has previously been performed in Saugus in close proximity to a buried gas pipeline owned by Tennessee Gas. He was unsure as to why blasting was not allowed at the Lynnfield Water District Pump Station Interim Connector, but speculated that perhaps the gas pipeline owner would not agree to blasting.

Some risks associated with rock blasting are damage to adjacent structures from vibrations, and airblast; risks to nearby sensitive electronic equipment; safety concerns with flyrock and handling explosives on a state highway; and potential noise complaints from nearby residents and businesses.

Risks to adjacent structures can be mitigated by performing pre-blast condition surveys of adjacent structures and requiring the blasting contractor to prepare, submit, and adhere to a blasting plan to control vibrations, airblast, and noise levels within allowable limits. Where blasting is performed in close proximity to existing structures, the distance to such structures should be checked and compared to the proposed rock fracture zone. Movement of rock blocks within the proposed fracture zone could damage such structures. Methods to mitigate such risks include reinforcing the rock near existing utilities by drilling and grouting steel dowels into the rock, or designing the blasting plan to produce less energy. Section 527 CMR 13 requires the blasting contractor to performed a blast analysis and prepare a blasting plan considering structures, buildings, building foundations, utilities, septic systems, swimming pools and area geology within 250 ft. of the center of the blast site.

Section 527 CMR 13.09 (9) and (10) require the Owner/blaster to offer preblast surveys to owners of any structure within 250 ft. of the blast, unless waived by the local fire department head or if the blaster uses charges per delay less than the limits specified in Tables 1 and 2 of Section 527 CMR 13.09 (9) and (10) for scaled distance. Regardless of blasting charges used, we recommend that the Owner engage a qualified engineer to perform pre-blast surveys of adjacent structures (e.g., houses, wells) prior to construction to document the structures' existing conditions. The blasting contractor or engineer should also research the location and type of electronic equipment in the Site vicinity that may be susceptible to vibrations. Such surveys reduce risk to the Owner and Contractor of fraudulent damage claims.

4.4.3.1 <u>Vibration and Airblast Criteria</u>

527 CMR 13.09 Tables 1 and 2 and Figures (a) and (b) specify ground vibration limits at adjacent *inhabited* buildings or structures. 527 CMR 13.09 Tables 1 and 2 indirectly set vibration criteria by restricting charge weight per delay as a function of scaled distance and distance to the nearest structure. Alternatively, through petition to the State Fire Marshal or local fire department head, 527 CMR 13.09 Figures (a) and (b) set allowable vibration criteria that are a function of peak particle velocity (PPV) and frequency. Blasting should be controlled to maintain vibrations at nearby structures within these limits.

527 CMR 13.09 Table 3 specifies limits for airblast at adjacent inhabited buildings or structures. The limits are set as a function of the lower frequency limit of the measuring system and range from 105 to 134 peak decibels. The Regulations also indicate that for pipeline construction where the specified vibration limits or airblast limits would be overly restrictive, higher vibration and/or airblast levels are allowable when authorized in writing by the owners of adjacent inhabited buildings or structures within the blast area.

The Regulations note that the vibration and airblast criteria apply to inhabited structures, but no limits are given for other structures such as buried utilities and bridges. Being the owner of the Walnut St. Bridge, MassHighway will likely specify allowable vibration criteria for blasting in the vicinity of the Bridge.

Siskind et al. (2000, 1994a,b) summarize studies performed by the US Bureau of Mines ("USBM") on vibration effects on buried, pressurized steel and PVC pipelines with diameters of 6 to 20 in. and a distance of 48 ft. The study found no damage to the pipelines with PPV values between 0.5 and 25 in./s, and recommended a conservative safe vibration level of 5 in./s. Oriard (1994, as reported by Siskind 2000) summarizes studies performed for blasting a new pipeline trench adjacent to an existing pipeline in the same right-of-way. He reports a blast within 2 to 3 ft. of the existing pipeline that generated 50 to 150 in./s and caused no damage. Based on his research, Oriard recommended the following for blasting near pipelines (as reported by Siskind 2000):

- A general limit of 12 in/s vibration
- A limit of one hole per delay when existing pipes are within 20 ft. of the blast hole
- A limited hole diameter of 2.5 in.

These criteria are guidelines and should *not* relieve the blasting contractor of designing and executing safe blasts that do not damage existing structures. The blasting contractor should carefully evaluate locations, geology, and structure types and materials, and design appropriate blasts that protect them.

Every blast should be monitored by seismographs placed, at a minimum, at adjacent structures. The seismograph data should be monitored and interpreted by qualified personnel after each blast to check that vibrations remain within specified values. Where vibrations exceed specified limits, the blaster should be notified immediately, should cease blasting and modify the blasting plan to achieve vibrations within specified limits.

Some rock blasting safety risks result from handling explosives on a state highway and potential for flyrock striking vehicles, structures, or people. The blasting contractor should maintain close security of the Site and blast vicinity to maintain public safety during blasting. Traffic on Rte. 1 and potentially on feeder

Stephens Associates
Consulting Engineers

Insightful, Costsaving Solutions
Geotechnical
Intrastructure
Hydrology & Hydraulics

routes would need to be stopped prior to and during each blast. 527 CMR 13.09 (1)(n) indicates that no blasts shall be fired between sunset or sunrise unless otherwise authorized in writing by the State Fire Marshal or the head of the local fire department. Since traffic would need to be stopped during blasting, blasting might occur at night (as was required for the subsurface explorations) and special permission would be needed. Blasting mats should be used on every blast to reduce risks of flyrock. Flyrock that escapes blasting mats should be immediately recovered and steps taken to reduce flyrock.

4.5 Groundwater Control and Dewatering

Measurements of groundwater levels in observation wells by SA and FST generally indicate groundwater levels about 4.1 to 13.7 ft. below ground surface. Pipe excavation will extend to 8 to 9 ft. below ground surface and will require dewatering. An important element of construction will be dewatering and its affect on stability of trench walls and bottom, as well as its potential to cause settlement of nearby structures

The change (increase) in effective stresses in the soil will be significant where water elevations are lowered by dewatering. If adjacent structures are founded on loose or soft soils, increases in soil effective stress resulting from groundwater table lowering could cause settlement and potentially damage nearby structures. Risks of adjacent structures settling increase where structures are closer to the area of dewatering and the depth of drawdown is greater. Based on the subsurface explorations and our Site reconnaissance, we would expect areas of greater risk to be where rock outcrops were not observed in the Site vicinity.

Water levels should be maintained a minimum of 1 foot below the trench bottom at all times while the trench is open. Away from the trench, groundwater should be maintained at or near ambient levels. We strongly recommend that the Contractor measure the actual groundwater levels at the time of construction to assess groundwater impact on the construction and the impact of the construction on groundwater. Placement of pipe and pipe bedding in a wet excavation or on a wet subgrade should not be permitted. The Contractor should maintain the groundwater level below the excavation, and maintain a dry excavation during wet weather. The Contractor should be permitted to employ whatever commonly accepted means and practices are necessary to accomplish this. The dewatering system designer should design the dewatering system with appropriate filters to be compatible with, and prevent loss of, the existing Silt and Sand.

Based on the estimated permeability data indicated in Section 2.5, and that observation wells responded rapidly during FST's field permeability testing, we expect that dewatering will likely generate large volumes of water. Pumped water can be used in recharge wells, if needed to maintain water levels away from the excavation, subject to regulations and environmental considerations/restrictions. Otherwise, pumped water should be properly disposed of in accordance with all applicable regulations.

For evaluating buoyancy of the empty pipe during construction, the pipeline designer should consider a design groundwater elevation at the ground surface. For design of temporary earth support and dewatering, the Contractor's Professional Engineer should interpret a design groundwater elevation based on the well and boring water levels and time of year. The Contractor's Professional Engineer should submit a design groundwater level for each section in the shoring and dewatering submittal(s). In no case should the design groundwater depth be greater than one-half the measured depth to groundwater indicated in Table 1 for the corresponding well and nearby portion of the pipeline.



026-08-007 Page 24 of 26 10/6/08

5. REFERENCES

American Water Works Association (AWWA)/American National Standards Institute (ANSI) (2002) "Thickness Design of Ductile-Iron Pipe", Standard C150/A21.50-02.

Aubertin, M. et al. (2005) "Discussion of Goodbye, Hazen; Hello, Kozeny-Carman," *Journal of Geotechnical and Geoenvironmental Engineering*, August 2005, Vol. 131, No. 8, ASCE.

Barosh, P.J., Fahey, R.J., and Pease, M.H. Jr. (1977), "Preliminary Compilation of the Bedrock Geology of the Land Area of the Boston 2° sheet, Massachusetts, Connecticut, Rhode Island and New Hampshire," Open-File Report OF-77-285, United States Geological Survey.

Carrier III, W.D. (2003) "Goodbye, Hazen; Hello, Kozeny-Carman," *Journal of Geotechnical and Geoenvironmental Engineering*, November 2003, Vol. 129, No. 11, ASCE.

Chapuis, R.P., and Aubertin, M. (2003) "Evaluation of the Kozeny-Carman's Equation to Predict the Hydraulic Conductivity of a Soil," Canadian Geotechnical Journal, 40(3), 616-628.

Ductile Iron Pipe Research Association, DIPRA (2006) "Ductile Iron Pipe Design," published December 1991, revised July 2006, 245 Riverchase Parkway East, Suite O, Birmingham, Alabama 35244-1856

Kaye, C.A. (1977), "Surficial Geologic Map of the Boston Area, Massachusetts," Open-File Report OF-78-111, United States Geological Survey, scale 1:100,000

Massachusetts Highway Department (MassHighway) (1995) <u>Standard Specifications for Highways and Bridges</u>

National Inventory of Dams, http://crunch.tec.army.mil/nidpublic/webpages/nid.cfm, accessed May 8, 2008.

Oldale, R.N. (1962) "Geologic Map of the Reading Quadrangle, Massachusetts, Surficial Geology", United States Geological Survey, in cooperation with the Commonwealth of Massachusetts Department of Public Works, scale 1:24,000

Oriard, L.L (1994), "Vibration and Ground Rupture Criteria for Buried Pipelines", Proc. 20th Annual Converence on Explosives and Blasting Techniques, International Society of Explosives Engineers (ISEE), Austin, TX, pp. 243-254, as cited in Siskind, D.E. (2000), Vibrations From Blasting, ISEE.

Siskind, D.E., (2000), <u>Vibrations From Blasting</u>, International Society of Explosives Engineers, Cleveland, OH

Siskind, D.E., Stagg, M.S., Wiegand, J.E., Schulz, D.L. (1994a), Surface Mine Blasting Near Pressurized Transmission Pipelines, U.S. Bureau of Mines RI 9523, 51 pp.

Siskind, D.E. and Stagg, M.S., (1994b), Surface Mine Blasting Near Transmission Pipelines, *Mining Engineering*, December 1994, pp. 1357-1360.

Spangler, M.G. and Handy, R.L (1982), <u>Soil Engineering</u>, Fourth Edition, Harper & Row Publishers, New York.

Stephens Associates
Consulting Engineers

Insightful, Costsaving Solutions
for Buildings and
Infrastructure
Hydrology & Hydraulics

United States Geologic Survey (USGS) (1903) 15-minute topographic map, Boston Quadrangle, accessed at University of New Hampshire, Diamond Library, Documents Department and Data Center, http://docs.unh.edu/nhtopos/Boston.htm, May 8, 2008.

United States Geologic Survey (USGS) (1893) 15-minute topographic map, Lawrence Quadrangle, accessed at University of New Hampshire, Diamond Library, Documents Department and Data Center, http://docs.unh.edu/nhtopos/Lawrence.htm, May 8, 2008.

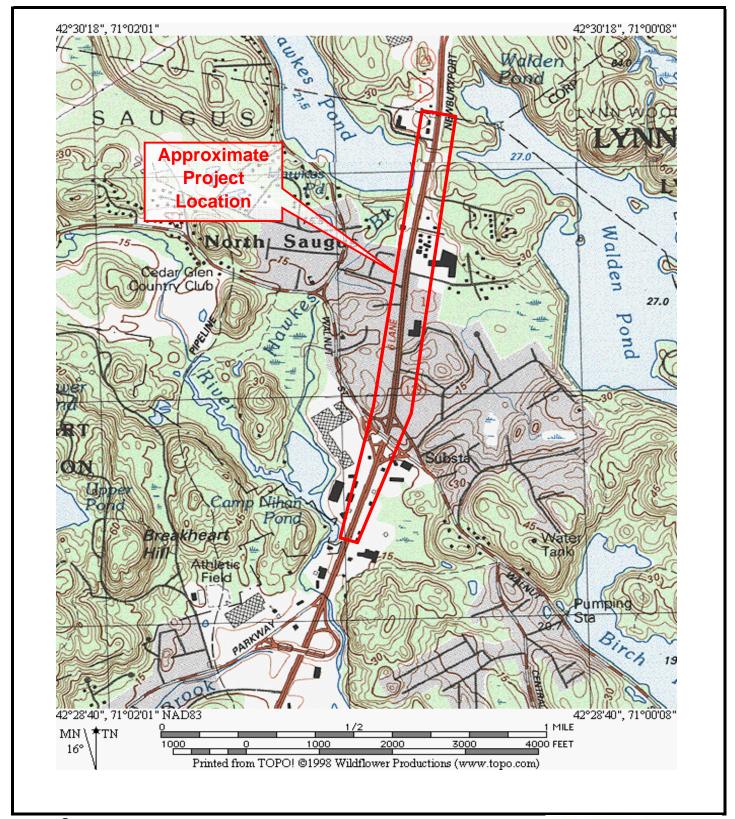
Zen, E-an, Goldsmith, Richard, Ratcliffe, N.M., Robinson, Peter, Stanley, R.S., Hatch, N.L., Shride, A.F., Weed, G.A., and Wones, D.R. (1983), <u>Bedrock Geologic Map of Massachusetts</u>, U.S. Geological Survey, scale 1:250000.

FIGURES

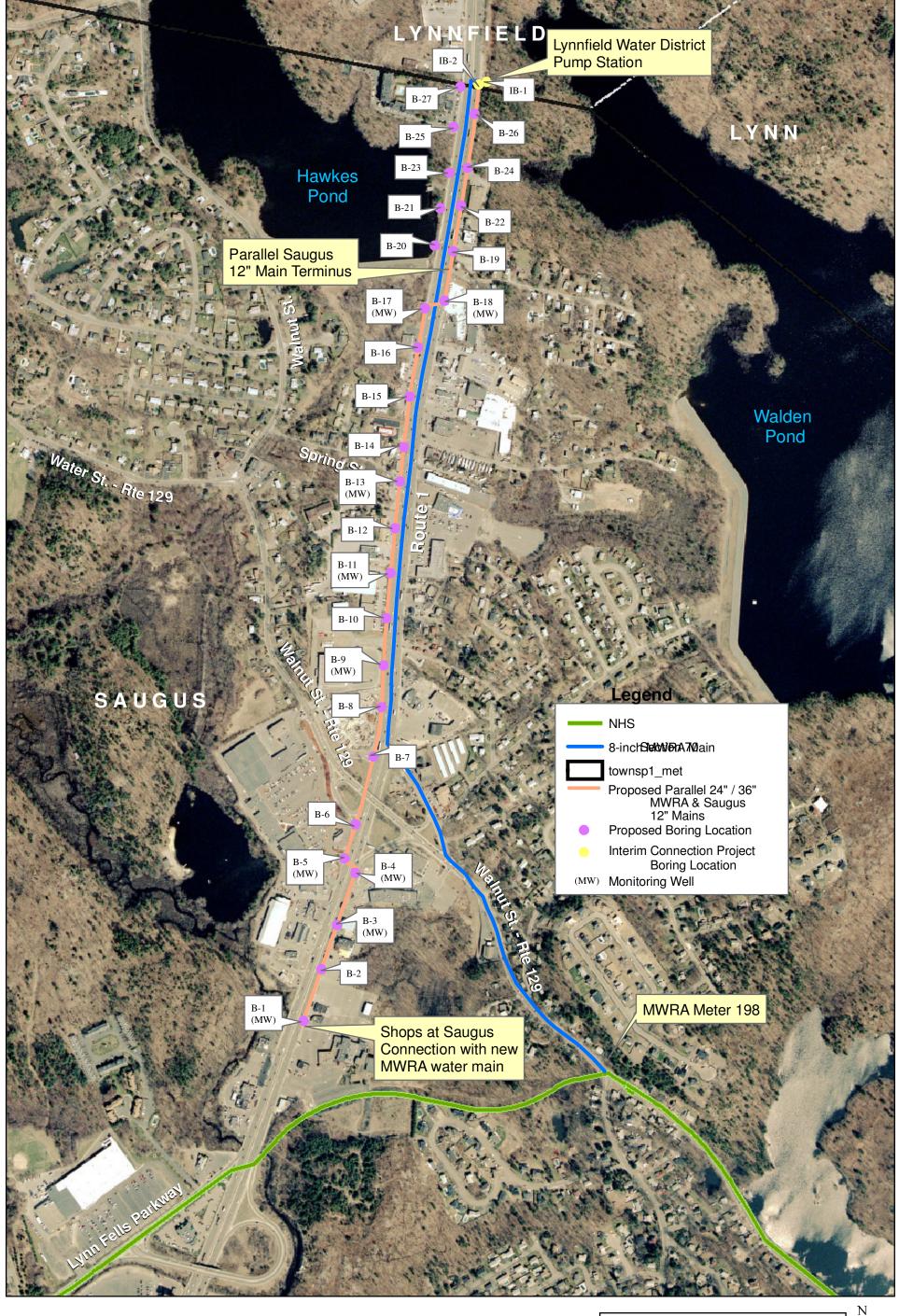


Project: Number: 026-08-007 Sheet 1 of Proposed Pipeline, MWRA Contract No. 6905 Name: Route 1, Saugus, Massachusetts

Original Work: FIGURE 1 - Site Location Map Ву: J. Turner Date: June 30, 2008 Subject: Checked By: Date:



Copyright © 2007 Stephens A Revisions:	Associates Consult	ing Engineers, LLC	Ohens Associates Consulting Engineers
By:	Date:	saving	attul, Cost- g Solutions Structural Geotechnical
By:	Date:	for Bull	tructure Hydrology & Hydraulics
SACE 00-1 (v. 1) 1/00		www.stephensengineers.com 668 Main Street, Wilmington, MA 018	887 (978) 988-2115



LYNNFIELD/SAUGUS PIPELINES PROJECT

500 250 0 500 1,000 1,500 Feet

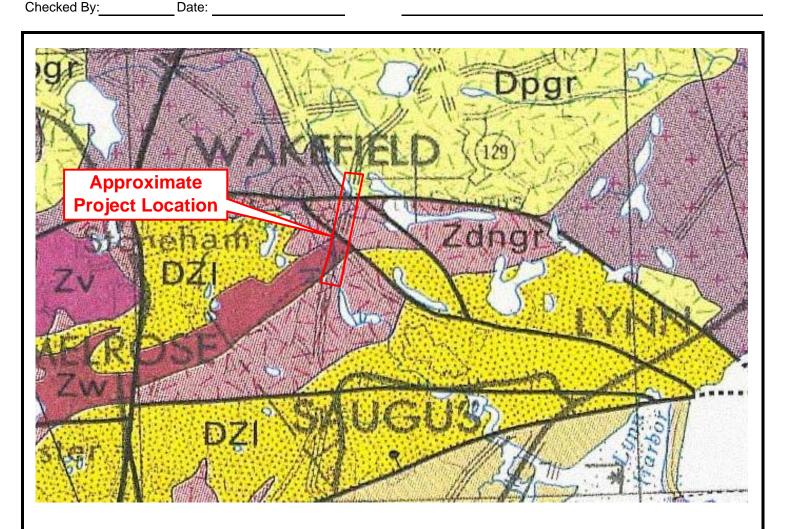
Stephens Associates Consulting Engineers, LLC Project 026-08-007
Figure 2 - Site Aerial Photo
Provided by FST, Inc.



 Project:
 Number:
 026-08-007
 Sheet
 1
 of
 1

 Proposed Pipeline, MWRA Contract No. 6905
 Proposed Pipeline, MWRA Contract No. 6905
 Route 1, Saugus, Massachusetts

 By:
 J. Turner
 Date:
 May 13, 2008
 Subject:
 FIGURE 3 - Excerpt of Bedrock Geologic Map



Symbol descriptions from Bedrock Geologic Map:

SACE 00-1 (v. 1) 1/00

Dpgr - Peabody Granite (Middle Devonian) - Alkalic granite containing ferro-hornblend. Intrudes Zgb, Zdngr.

Zdngr - Gray granite to granodiorite, more mafic than Zdgr (Dedham Granite) North of Boston. Intrudes Zw, Zv.

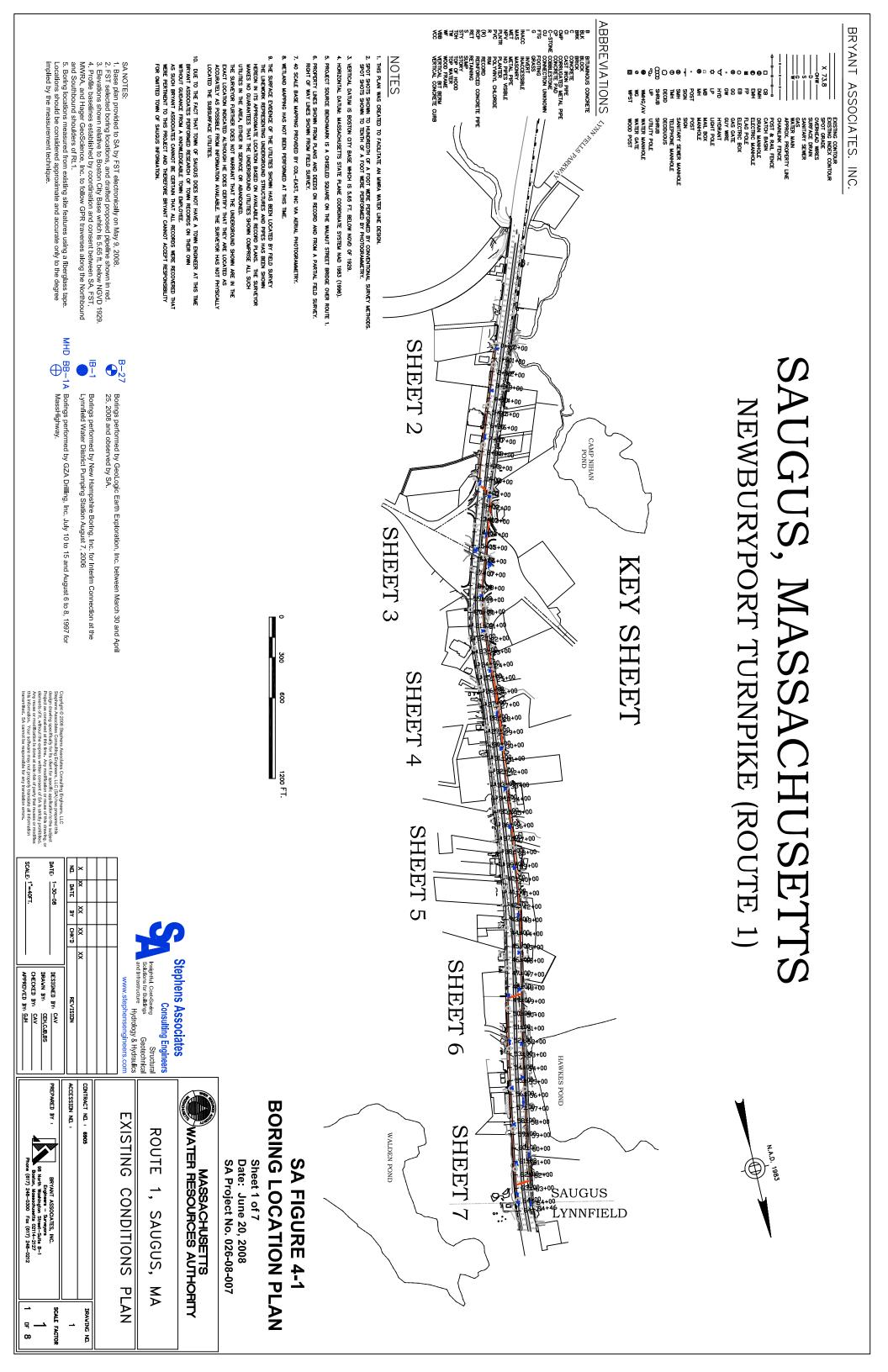
Zdigb - Diorite and Gabbro (Proterozoic Z) - Complex of diorite and gabbro, subordinate metavolcanic rock, and intrusive granite and granodiorite.

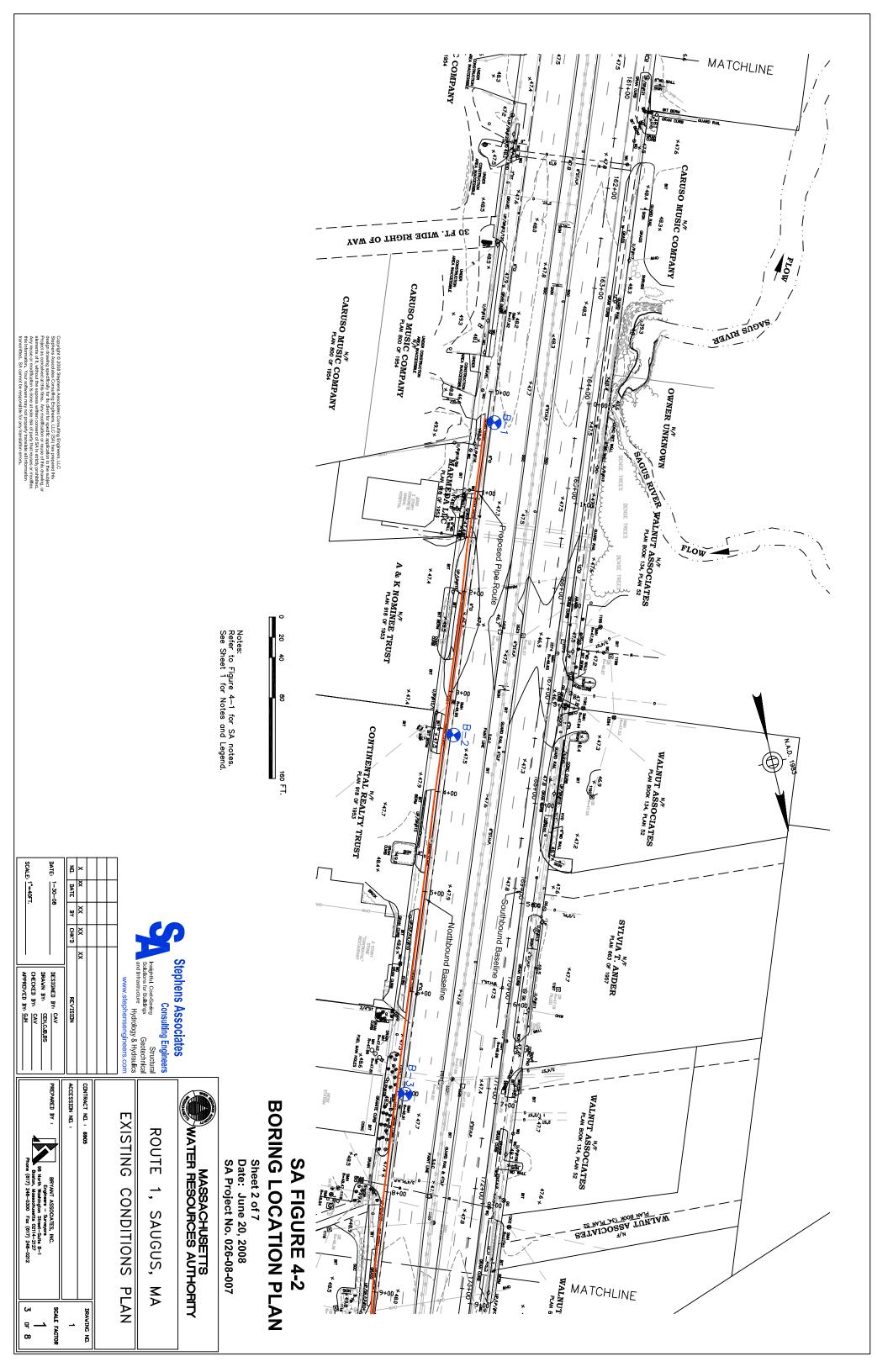
Zw - Westboro Formation (Proterozoic Z) - Quartzite, schist calc-silicate quartzite and amphibolite. Consists of quartzite and argillite in Lynnfield and Saugus area.

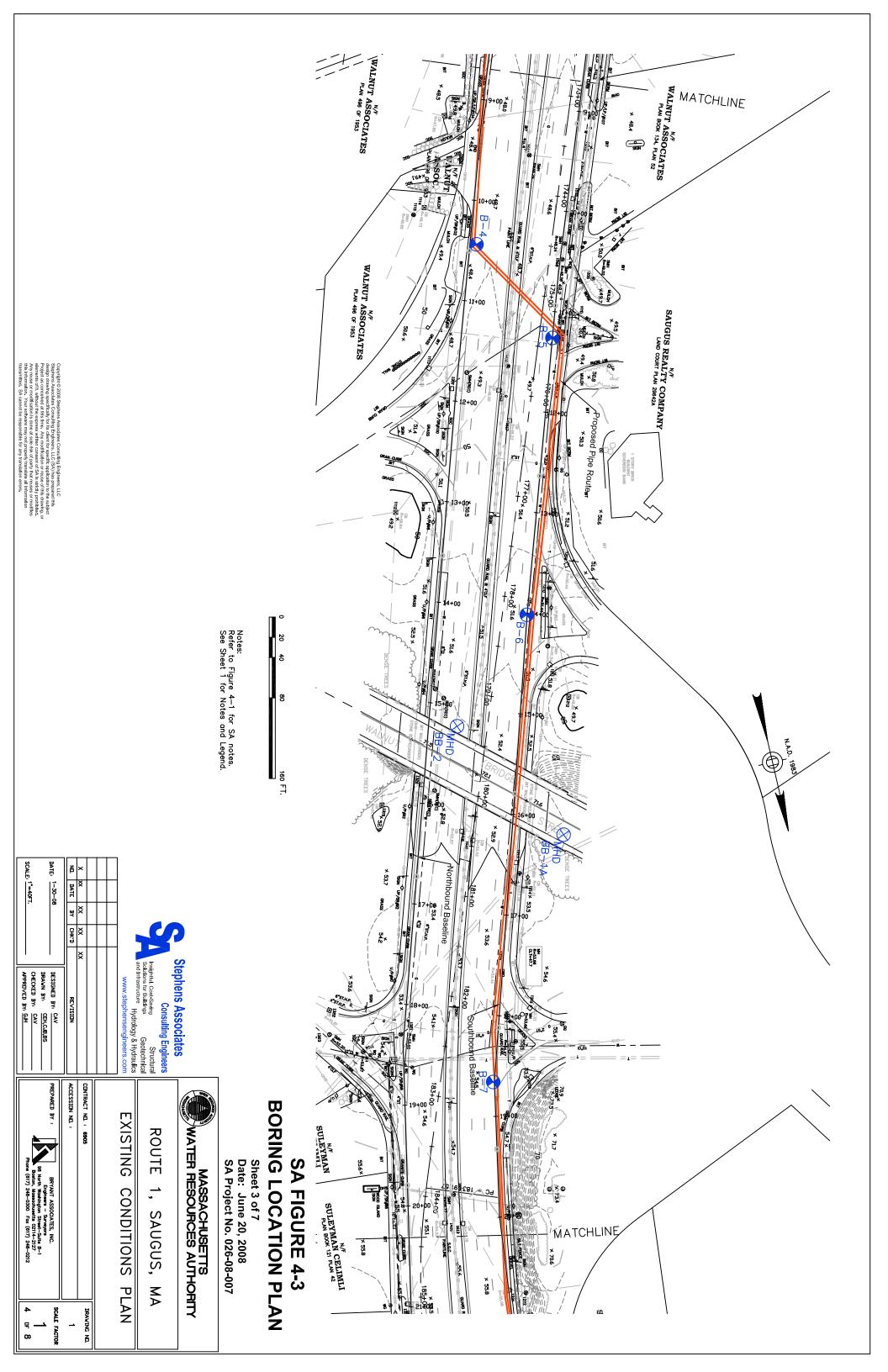
0	5 Miles

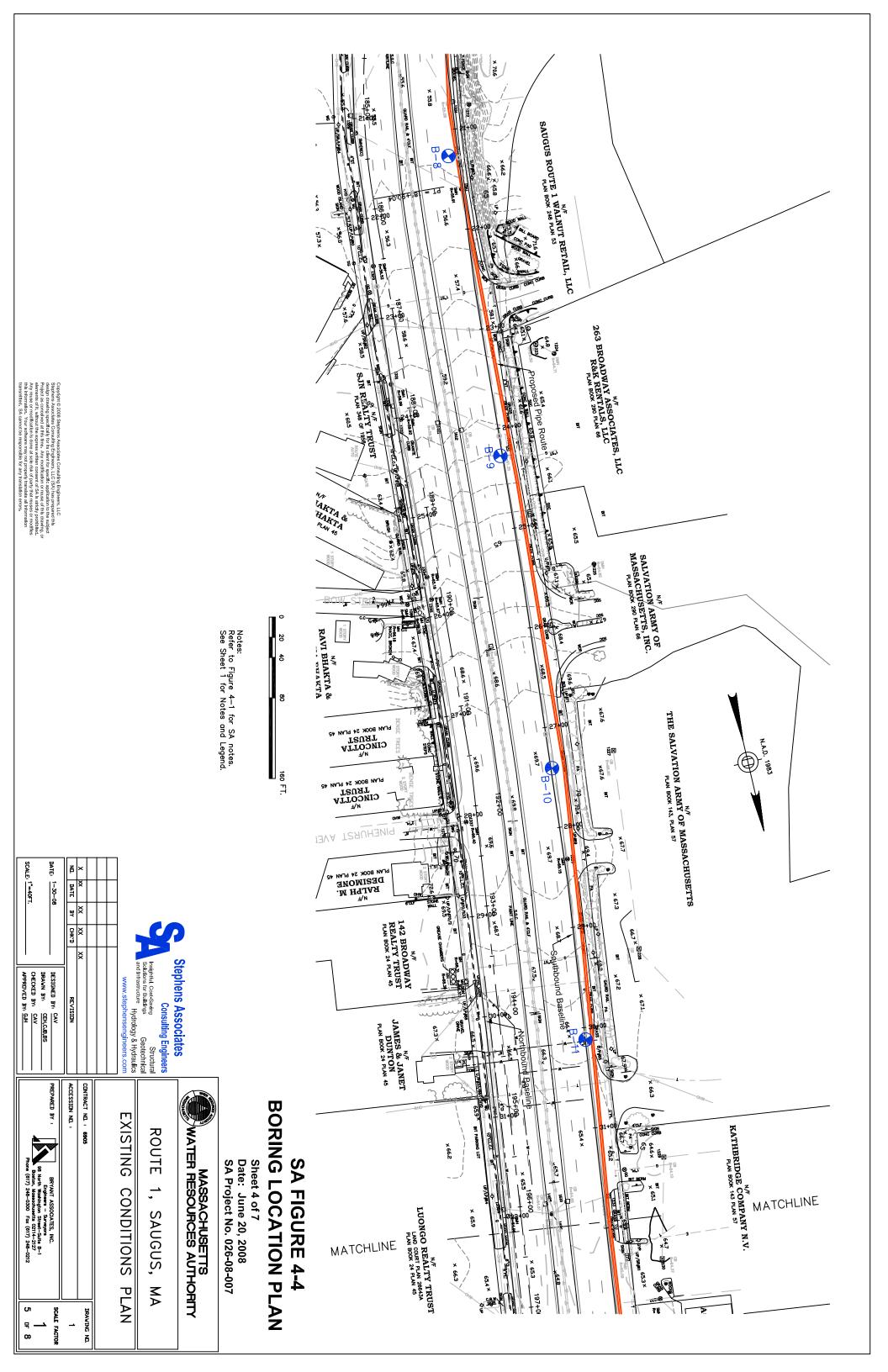
Map excerpt from: Zen, E-an, Goldsmith, Richard, Ratcliffe, N.M., Robinson, Peter, Stanley, R.S., Hatch, N.L., Shride, A.F., Weed, E.G.A., and Wones, D.R. (1983) Bedrock Geologic Map of Massachusetts, U.S. Geological Survey, scale 1:250000.

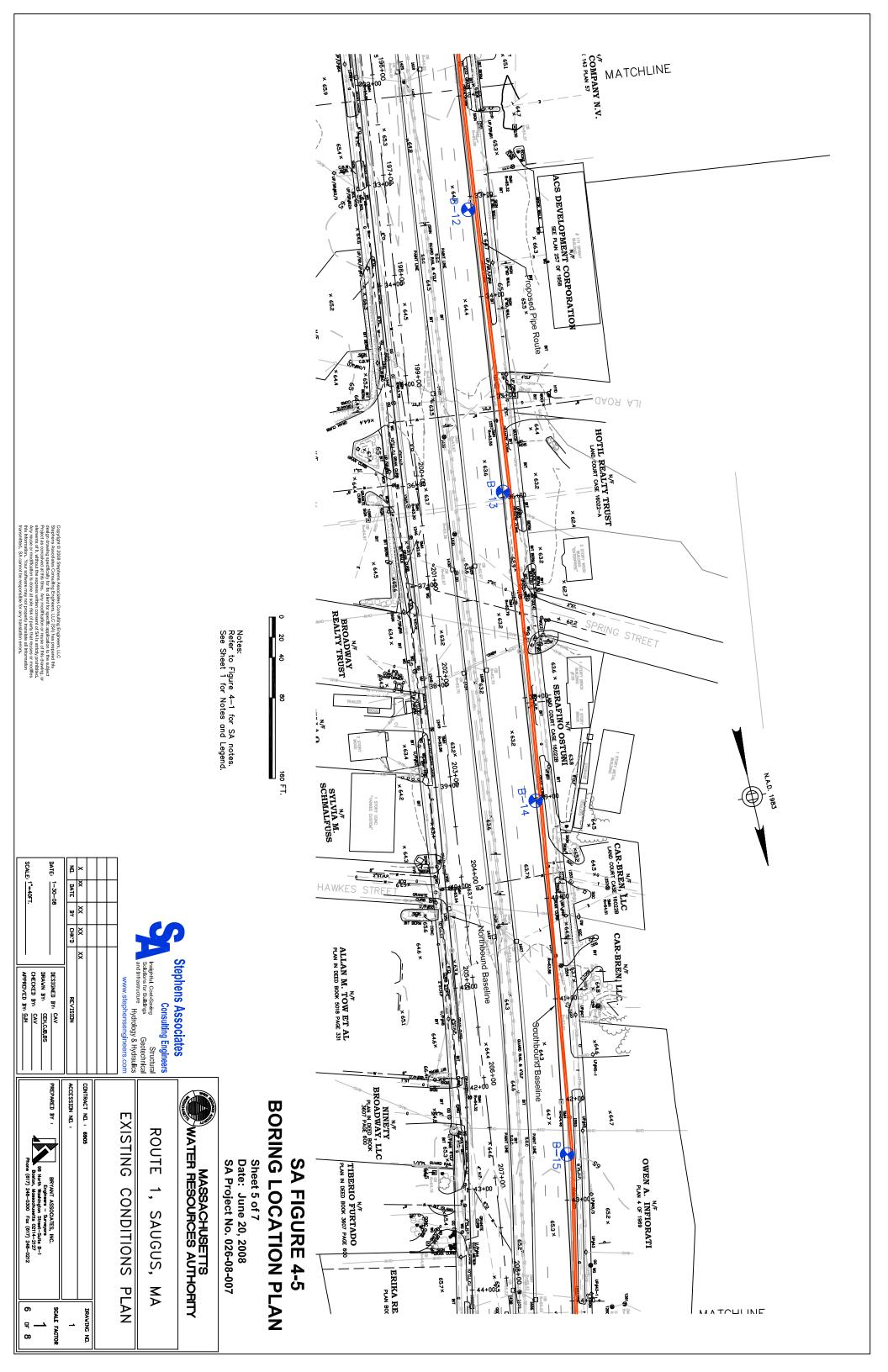
Copyright © 2008 Steph	nens Associates Consulting Engineers, LLC	C	Stephens Assoc Consulting	iates Engineers
By:	Date:		Insightful, Cost- saving Solutions	Structural Geotechnical
By:	Date:		for Buildings and	& Hydraulics

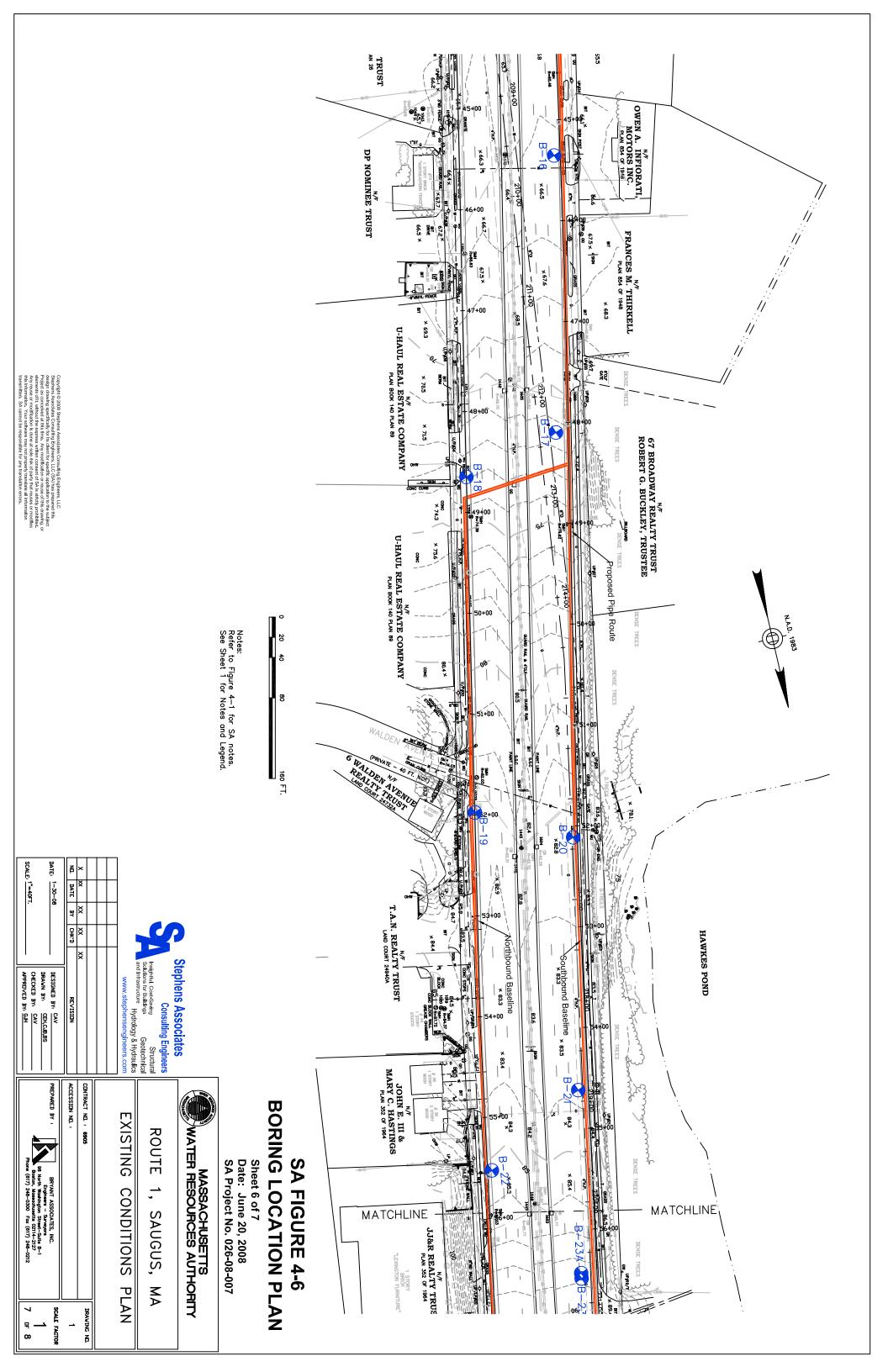


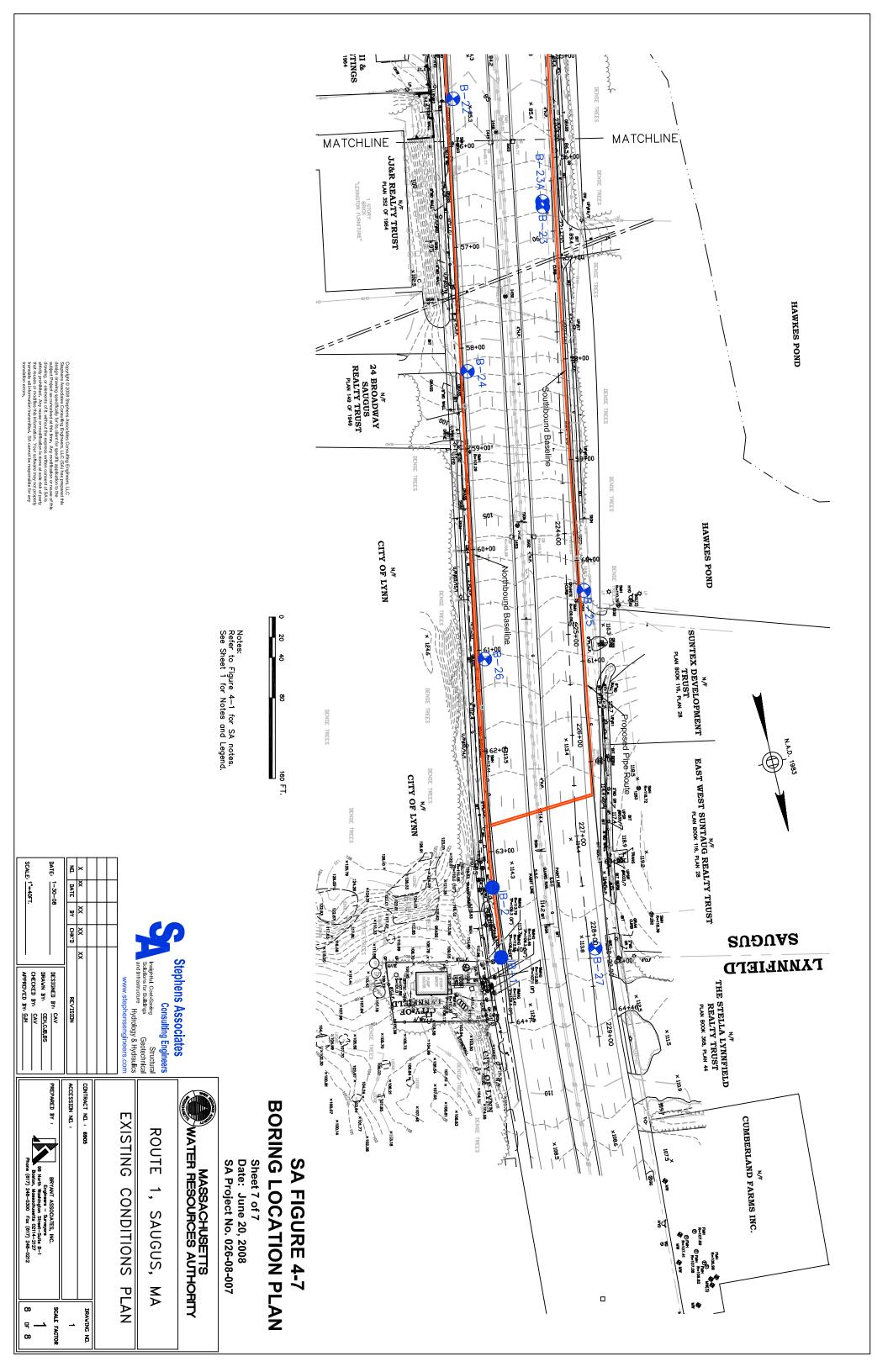


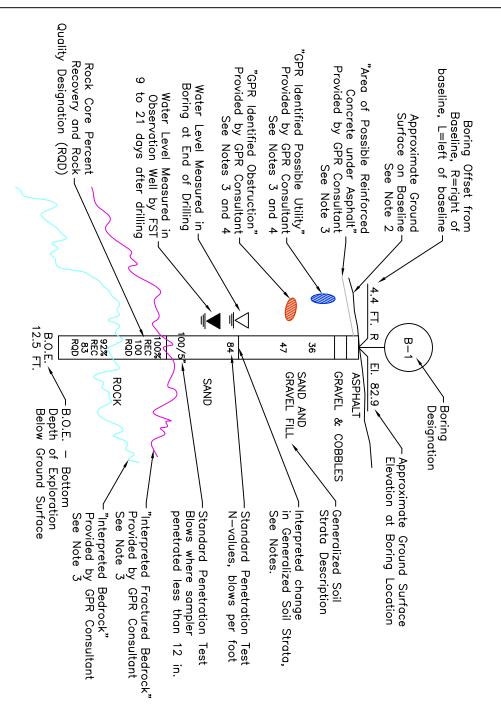










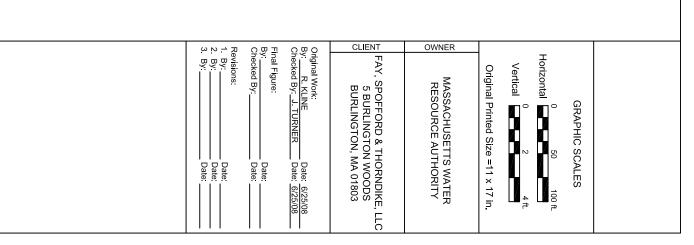


- 1. Profile baselines established by coordination and consent between SA, FST, MWRA, and Hager GeoScience, Inc. to follow GPR traverses along the Northbound and Southbound shoulders of Rt.1. SA's Profiles are therefore denoted as "Northbound Profile" and "Southbound Profile". Refer to Figures 4-1 to 4-7 for locations and stationing of baselines.
- June 23, 2008, which SA inserted into the profiles in Figures 6 and 7. SA did not review surface model and generate 'smooth' surface profiles was beyond SA's scope of services with the provided topographic data. Modification of the provided data to manipulate the Plan, but show localized variations, generally less than 0.5 ft. from a 'smooth' surface line. 2008. The surface profile generally follows the contours shown on June 2008, prepared by Hager GeoScience, Inc., for further information. Characterization, MWRA Lynnfield/Saugus Pipeline Project, Route 1, Saugus MA," dated this information for accuracy. Refer to the Report titled, "Geophysical SubSurface Asphalt", "GPR Identified Possible Utilities", and "GPR Identified Obstructions" shown on ("GPR Consultant") to evaluate subsurface conditions by ground penetrating radar The MWRA engaged Green International Affiliates, Inc. and Hager GeoScience, Inc. The variations result from the surface modeling routine used by AUTOCAD Civil 3D 2008 SA generated the ground surface profile along the baselines using the profiles. The GPR consultant provided these plotted features to SA electronically on Fractured Bedrock", "Interpreted Bedrock", "Areas of Possible Reinforced Concrete under (Figures 4-1 to 4-7) and additional topographic data provided to S*I* Approximate ground surface profile on baselines obtained from Thorndike, LLC electronically on May 9, and 21, 2008, respectively. At the request of FST "GPR"). The GPR consultant interpreted the GPR data and plotted the "Interpreted \ by Fay, Spofford & **Existing Conditions Plan** the Existing Conditions **AUTOCAD Civil 3D**
- 4. Hager GeoScience, Inc. Notes:
- "Possible utilities have been depicted with an exaggerated diameter for visualization purposes, and do not represent their true size. However, the depth and station location have been adjusted to show their proper location."
- "Obstructions depicted on the plates (i.e. Profiles) represent their shallowest component; however, they may extend to greater depths."
- 5. Pipe location shown schematically with 5 ft. of cover at boring locations and varying linearly between borings.
- 6. Elevations shown relative to Boston City Base Datum, which is 5.65 ft. below NGVD 1929.
- Boring locations selected by FST.
- 8. Borings performed by GeoLogic Earth Exploration, Inc. between March 30 and April 25, 2008 and observed by SA. Borings IB-1 and IB-2 performed by New Hampshire Boring, Inc., August 8, 2006 for Interim Connection at Lynnfield Water District Pump Station. Borings MHD BB-1A and MHD BB-2 performed by GZA Drilling, Inc. July and August 1997 for MassHighway.
- Boring locations measured from existing site features using a fiberglass tape. Locations should be considered approximate and accurate only to the degree implied by the measurement technique.
- 10. The soil/rock strata and groundwater surface presented in this Drawing and the Geotechnical Report for the Project are generalized interpretations from widely spaced data and represent the approximate boundaries between subsurface materials. The actual transition between strata may be gradual. Explorations (e.g. boring and/or test pit logs) should be reviewed for specific information at respective locations. The data shown on the logs prepared by SA represent the conditions only at the actual exploration locations at the time the explorations were undertaken. Variations in subsurface conditions may occur and should be expected between exploration locations and over time. Seasonal fluctuation of water and groundwater depths should be anticipated.

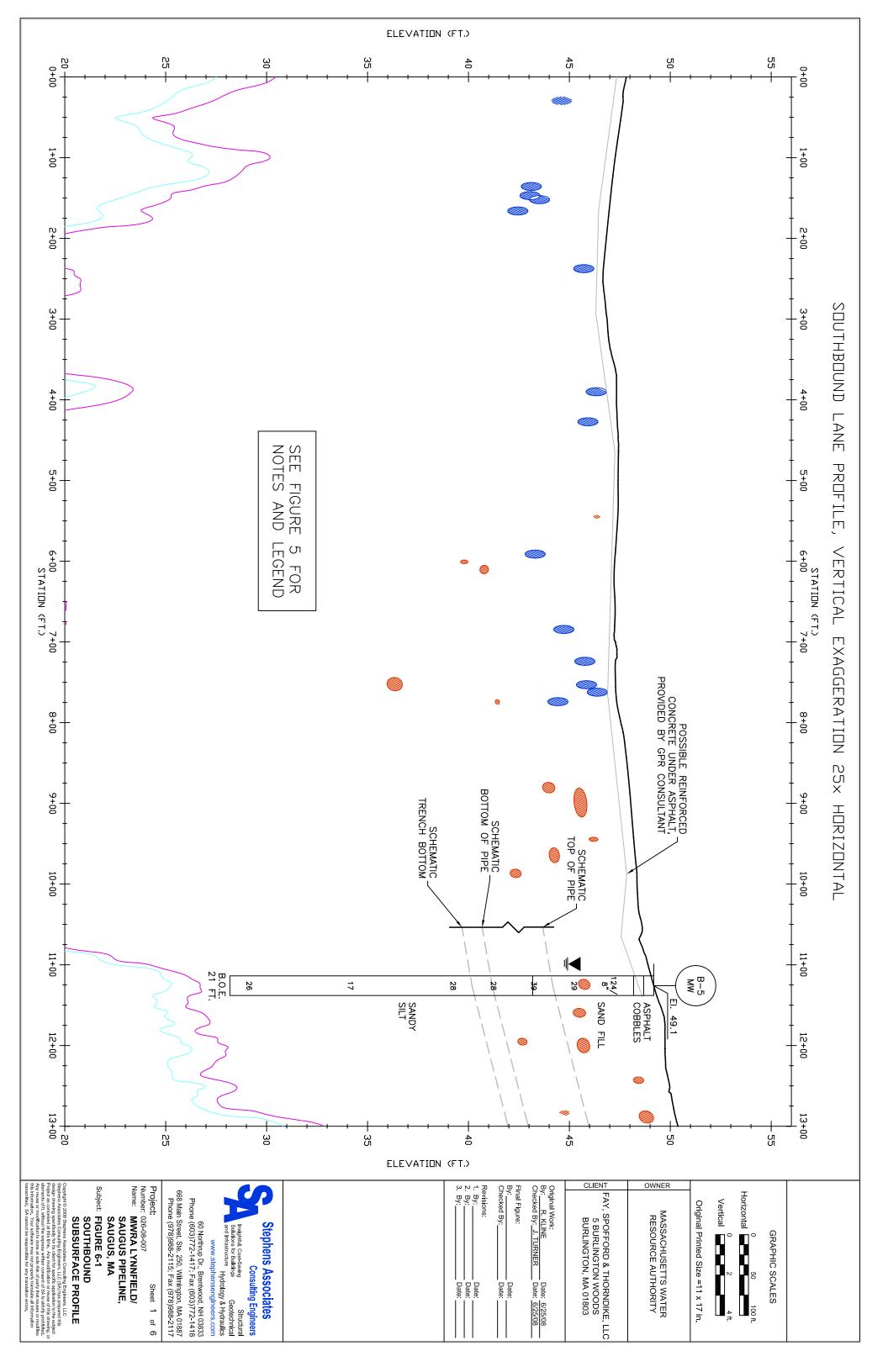
Subject: FIGURE 5

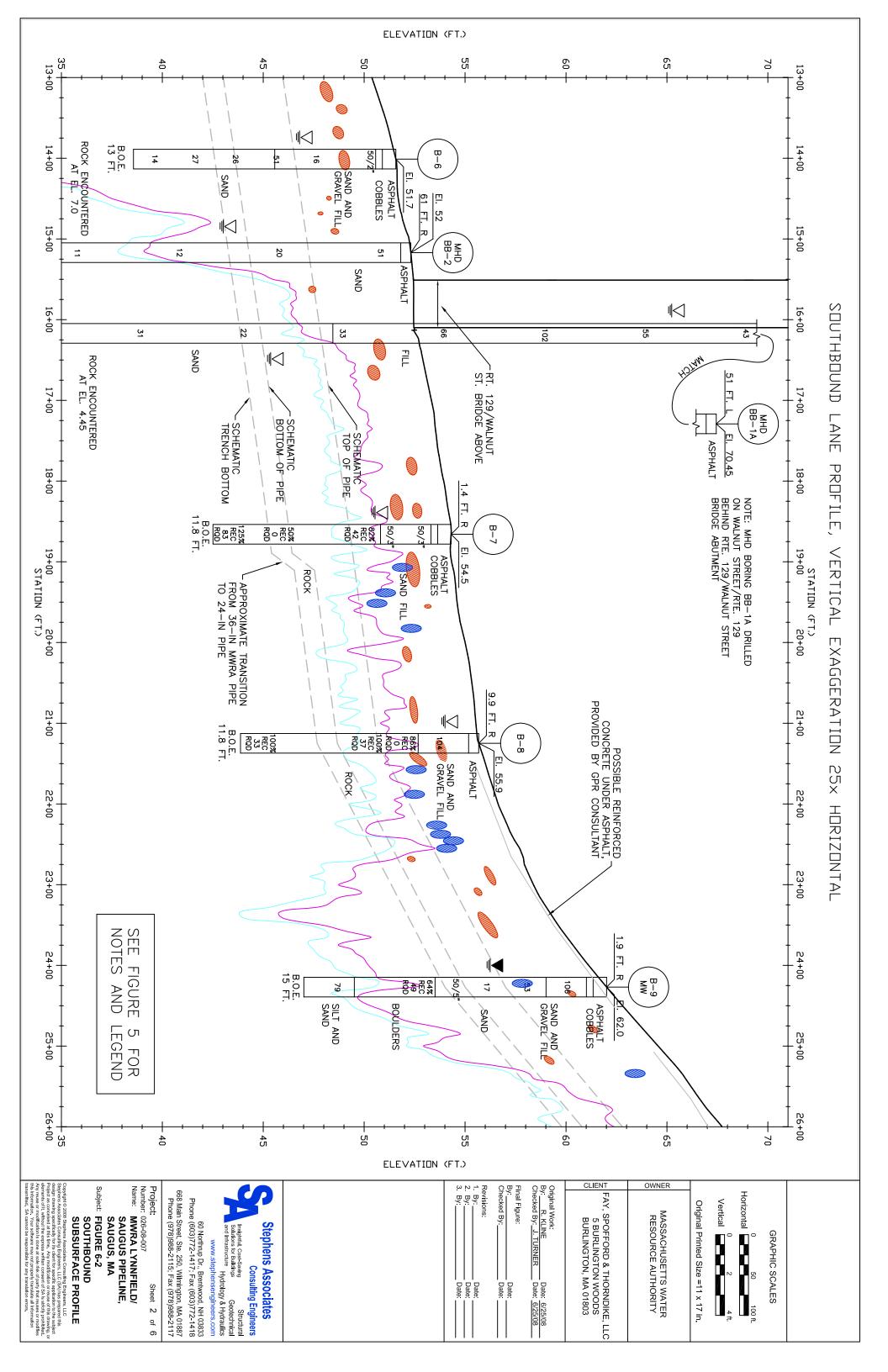
LEGEND AND NOTES

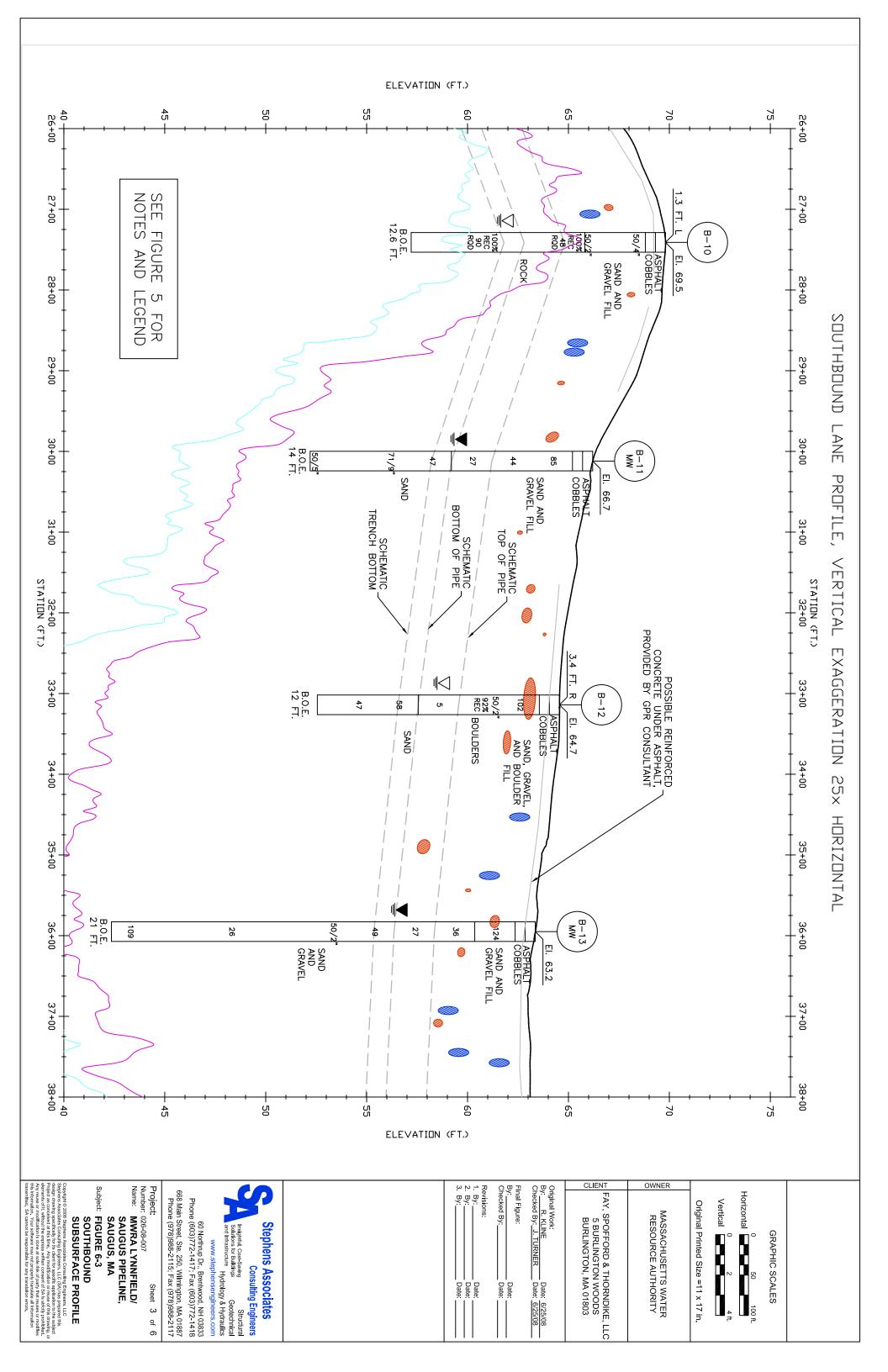
SUBSURFACE PROFILE

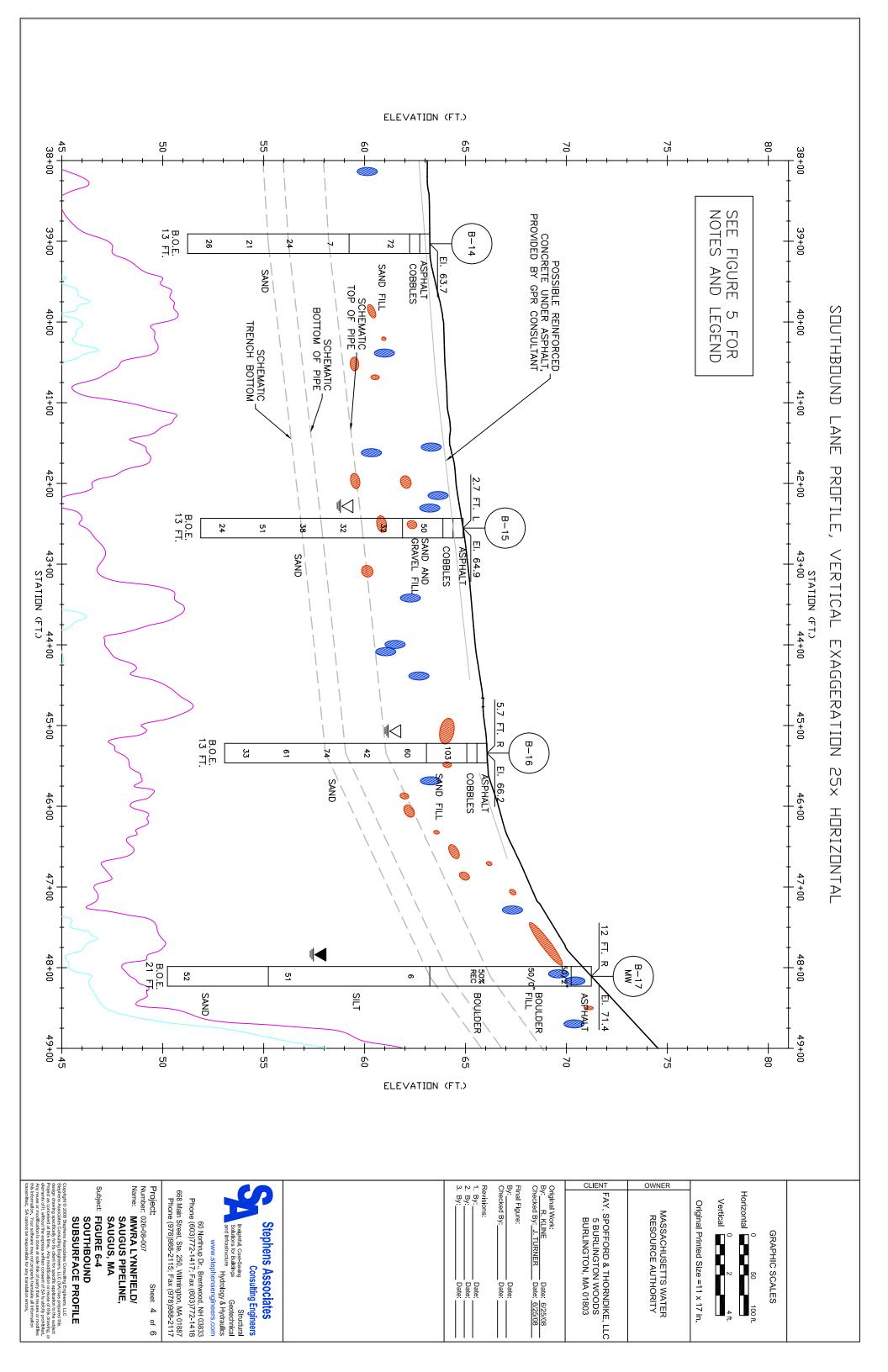


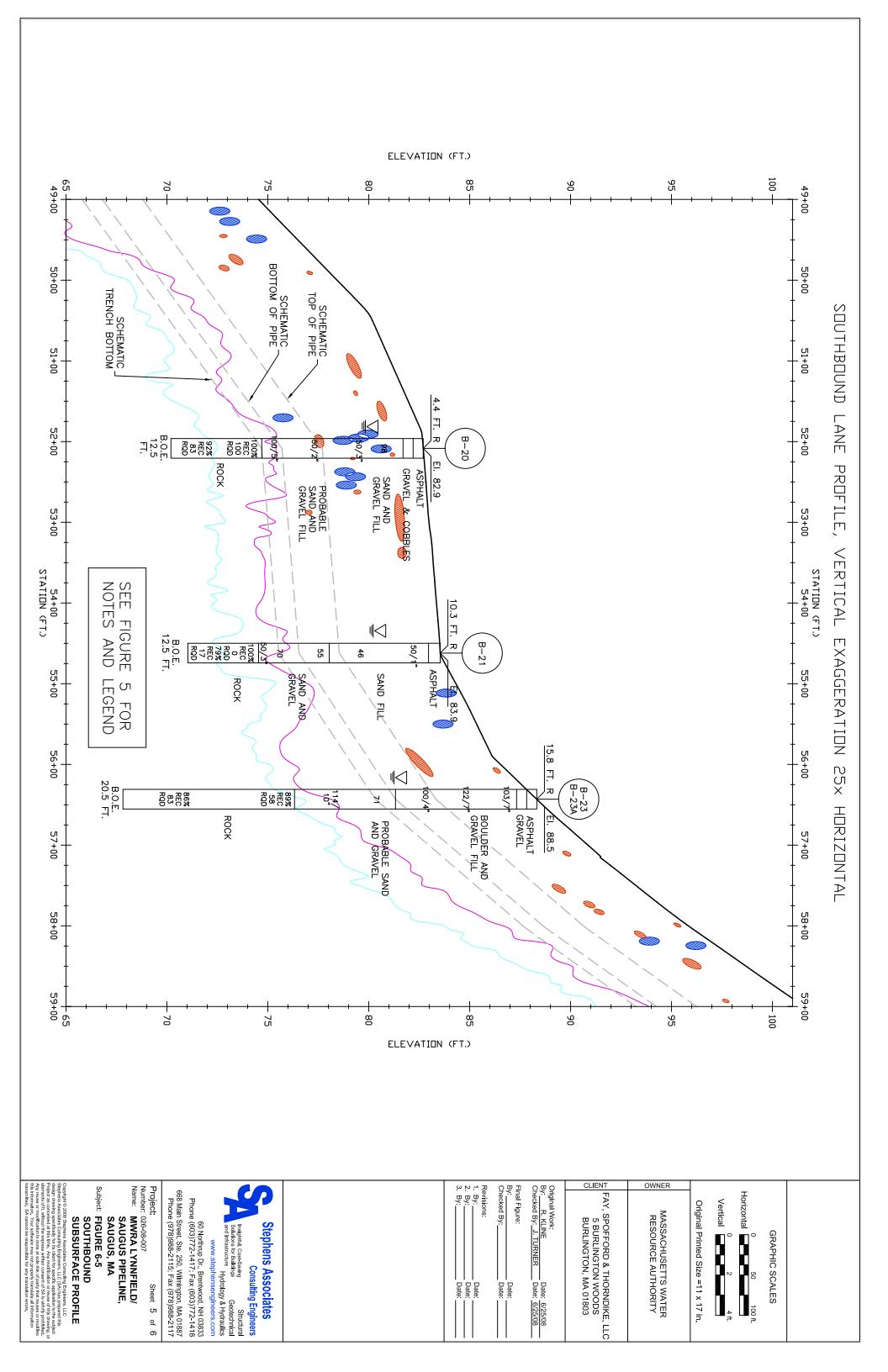
Stephens Associates Consulting Engineers Insightut, Cost-Saving Structural Solutions for Buildings Aand Infrastructure Hydrology & Hydraulics www.stephensengineers.com

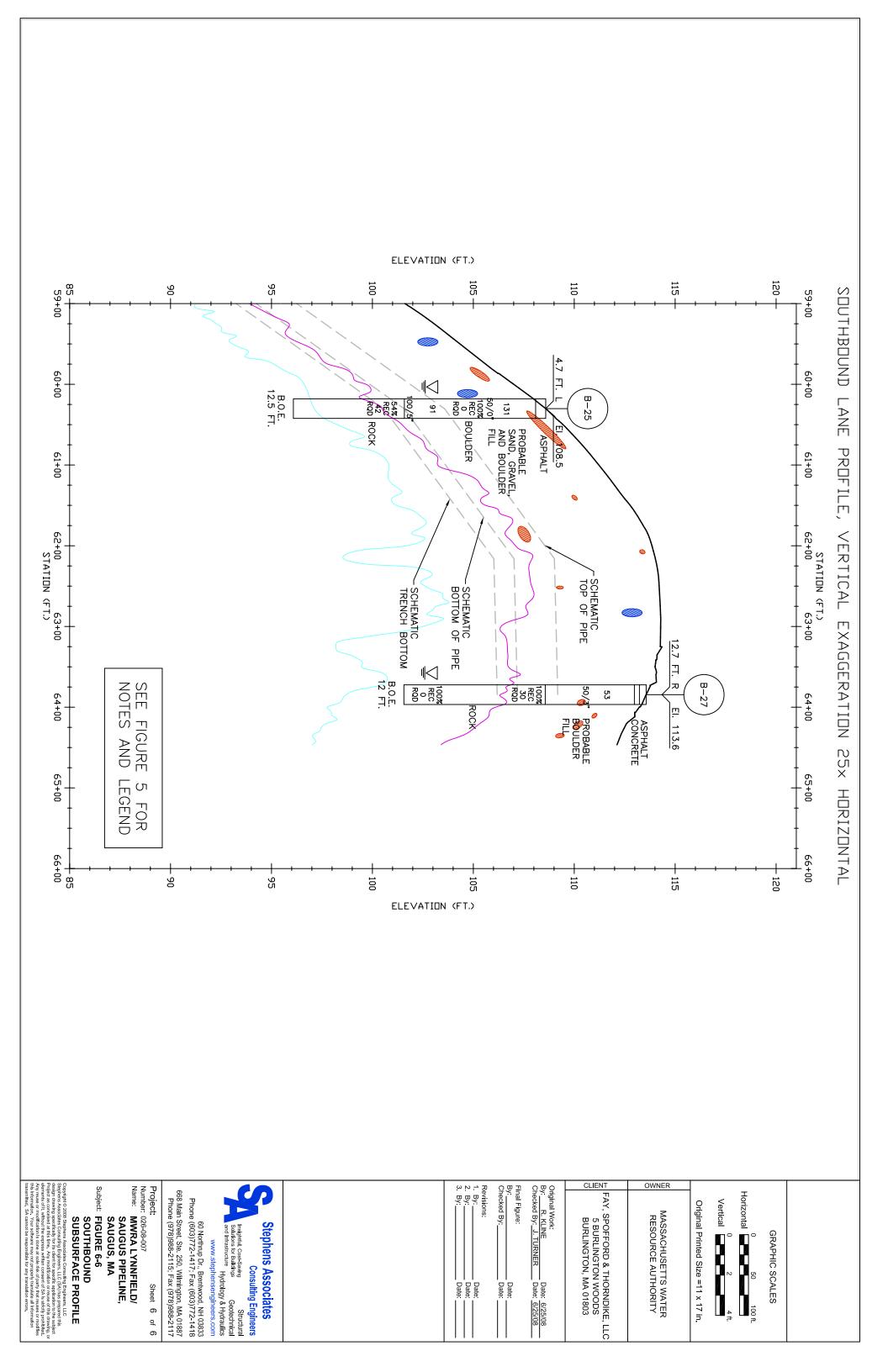


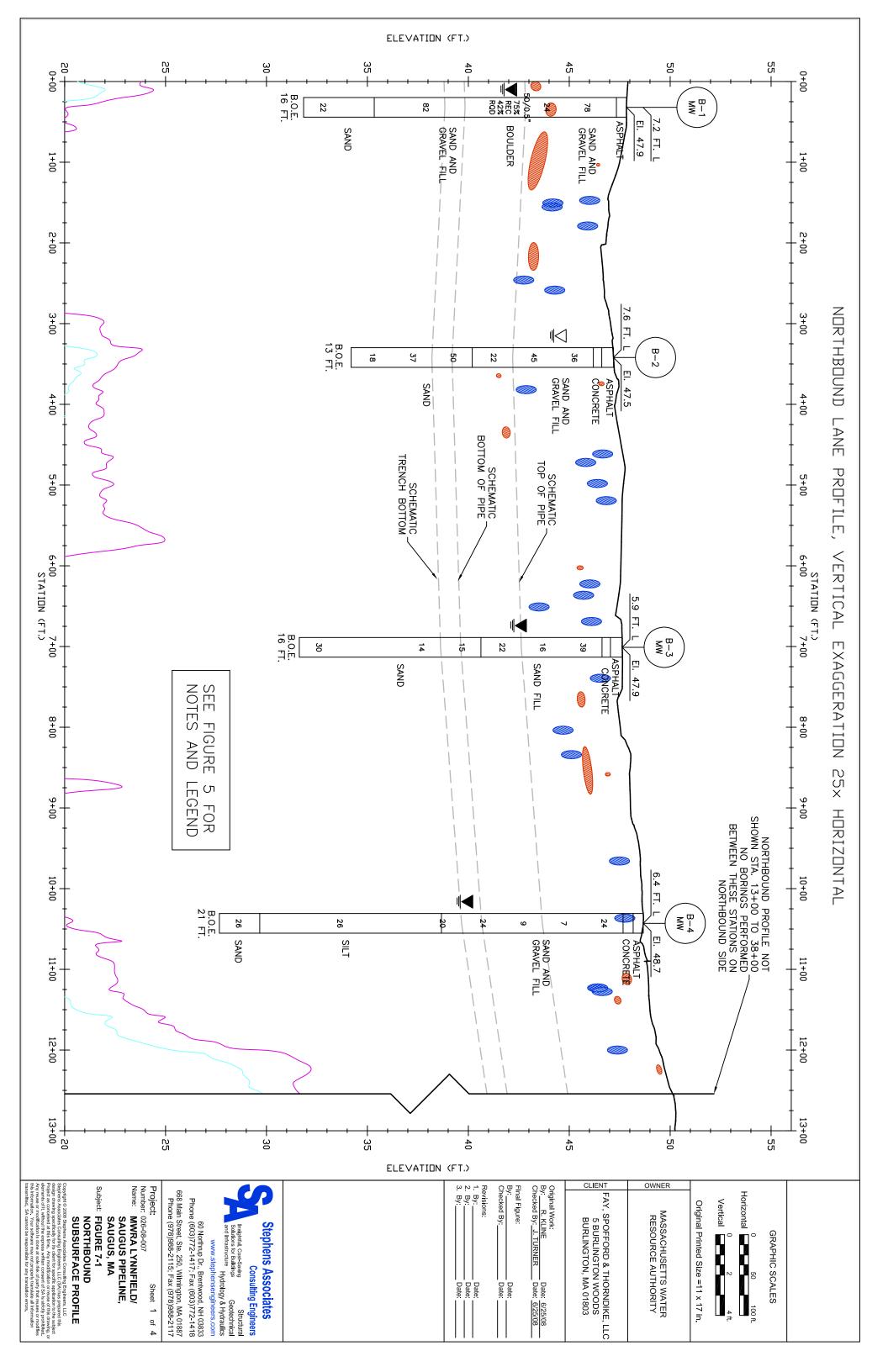


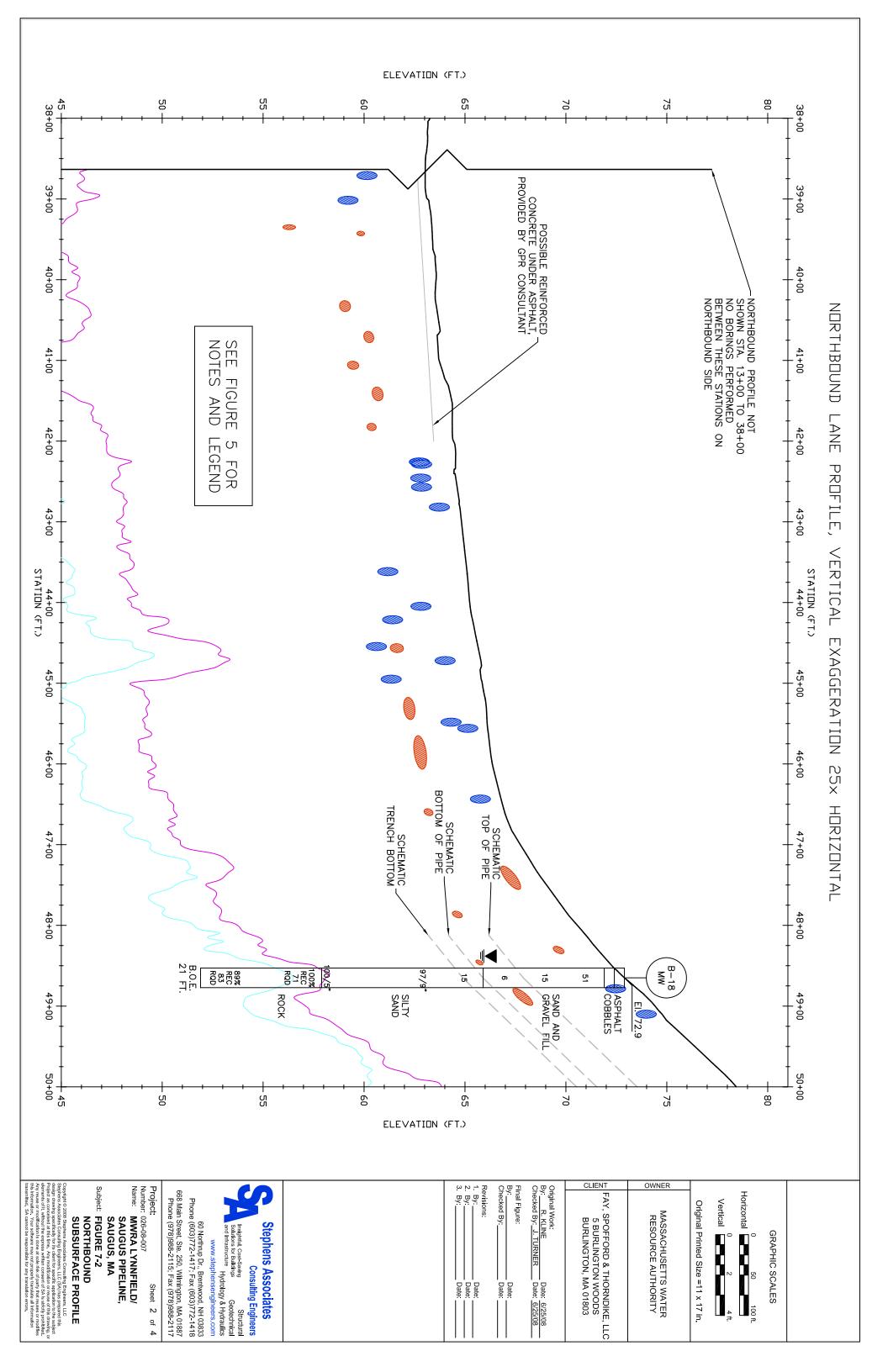


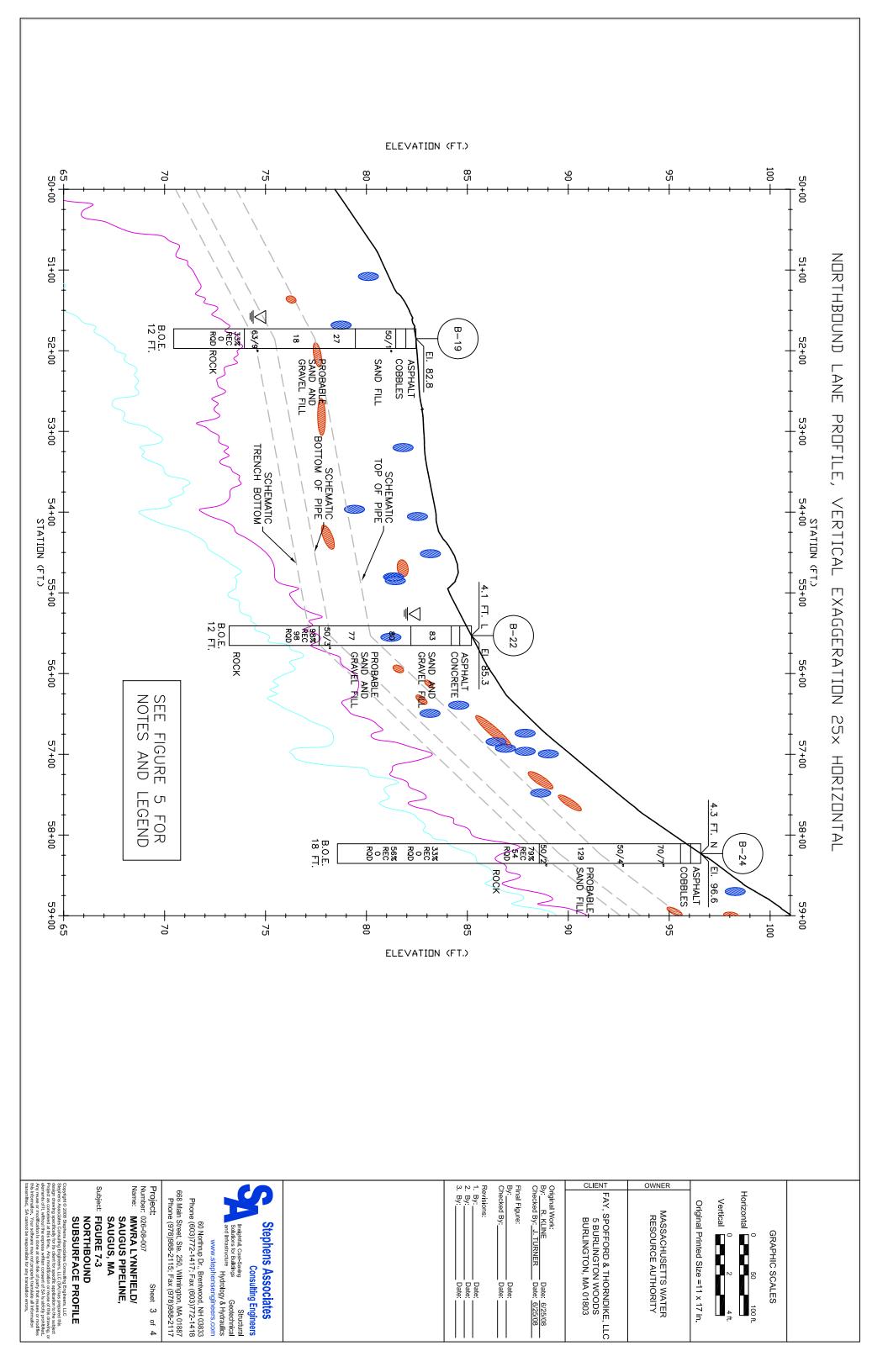


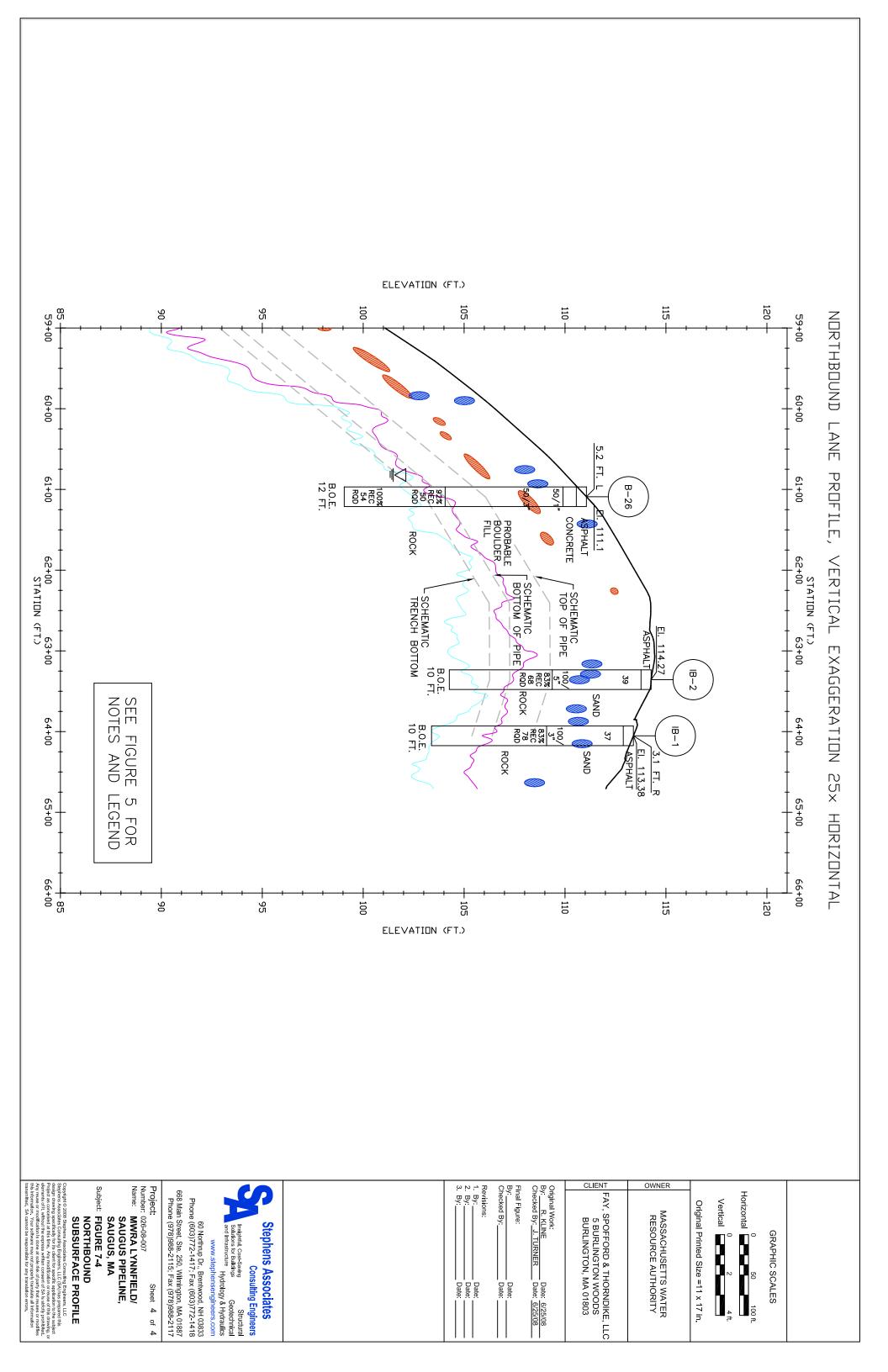












Project: Number: <u>026-08-007</u> .Sheet <u>1 of 1</u>

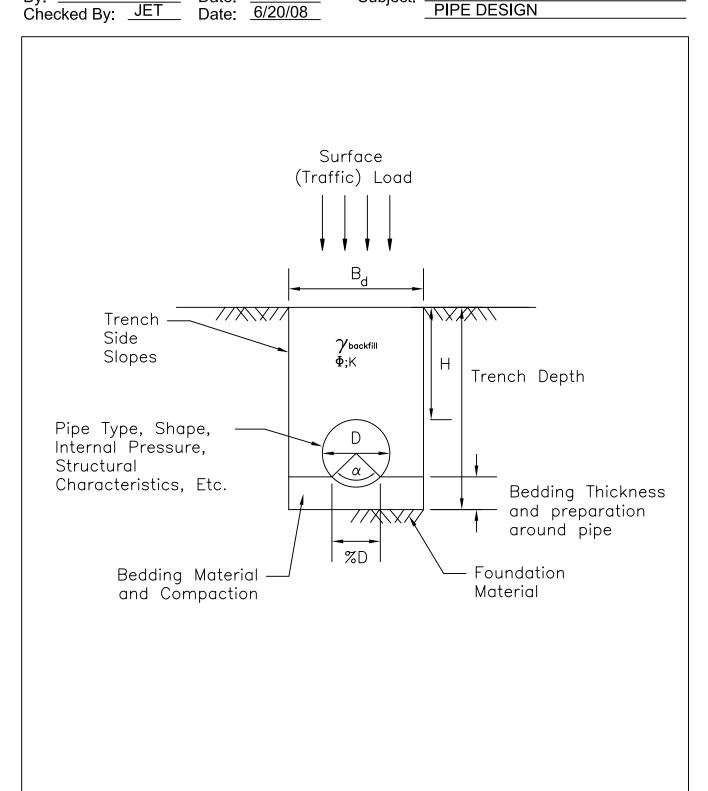
Name: -

MWRA Lynnfield/Saugus

Pipeline, Saugus, MA Original Work: By: R. Kline Date: 6/20/08 Subject: -

FIGURE 8 - FACTORS AFFECTING

PIPE DESIGN



Revisions:	
By:	Date:
By:	Date:



TABLES



 Project:
 Number:
 026-08-007
 Sheet
 1
 of
 1

 Name:
 Proposed Pipeline, MWRA Contract No. 6905
 Proposed Pipeline, MWRA Contract No. 6905
 Route 1, Saugus, Massachusetts

 By:
 J. Turner
 Date:
 July 25, 2008
 Subject:
 TABLE 1

Summary of Observation Well Measurements

SUMMARY OF OBSERVATION WELL READINGS

Date:

Checked By:

Observation Well No.	Well Installation Date	Date of Reading	Water Depth (ft.)	Comments
B-1-MW	4/17/08	4/17/08	5.4	Reading 1.6 hrs. after installation
D-1-10100	4/17/00	4/27/08	6.0	Reading by FST
B-3-MW	4/17/08	4/17/08	4.1	Reading 3.5 hrs. after installation
D-2-1616A	4/17/06	4/27/08	5.3	Reading by FST
B-4-MW	4/18/08	4/18/08	8.4	Reading after well installed and backfilled
D-4-IVIVV	4/10/00	4/27/08	9.0	Reading by FST
B-5-MW	4/16/08	4/16/08	4.1	Reading after well installed and backfilled
D-2-1414A	4/10/00	5/1/08	4.2	Reading by FST
		4/13/08	5.5	Reading after well installed and backfilled
B-9-MW	4/13/08	4/14/08	5.6	Reading ~22 hrs. after installation
		5/1/08	5.7	Reading by FST
		4/10/08	4.7	Reading ~20 min. after well inst. and backfill
B-11-MW	4/10/08	4/10/08	6.8	Reading ~18 hrs. after installation
D-11-WW	4/10/00	4/14/08	6.8	
		4/30/08	6.8	Reading by FST
B-13-MW	4/9/08	4/9/08	6.9	Reading ~20 hours after installation
D-12-10100	4/9/00	4/30/08	6.9	Reading by FST
B-17-MW	4/7/08	4/7/08	7.6	Reading after well installed and backfilled
D-17-IVIVV	4/1/00	4/30/08	13.7	Reading by FST
B-18-MW	3/31/08	4/1/08	7.0	
D-10-1014	3/3/1/06	4/28/08	6.9	Reading by FST

Depths are measured from the ground (pavement) surface.

Copyright © 2008 Stephens Associates Consulting Engineers, LLC Revisions:

By: Date: Date:



TABLE 2 - SUMMARY OF GEOTECHNICAL LABORATORY TEST RESULTS

		Grain-Siz	e Analyses	Estimated Hydraulic Conductivity				
Boring	Sample	¹ Depth (ft.)	² Percent Gravel	³ Percent Sand	⁴ Percent Fines	5,6Probable lower bound of measured k = 1/3 of estimated k (cm/s)	^{5,6} Estimated k (cm/s)	5,6Probable upper bound of measured k = 3 times estimated k (cm/s)
B-1	SS-1	1-3	72.2	27.1	0.7			
B-1	SS-4	9-11	59.3	36.6	4.1	2.8E-03	8.4E-03	2.5E-02
B-2	SS-1	1-3	61.5	32.6	5.9			
B-2	SS-2	3-5	33.9	52.2	13.9	5.7E-04	1.7E-03	5.1E-03
B-2	SS-4	7-9	1.7	88.3	10	1.8E-04	5.4E-04	1.6E-03
B-2	SS-5	9-11	6.1	87.4	6.5	1.4E-03	4.1E-03	1.2E-02
B-2	SS-6	11-13	0.0	70.9	29.1	7.6E-04	2.3E-03	6.8E-03
B-4	SS-1	1-3	18.0	56.5	25.5			
B-4	SS-4	7-9	30.9	56.4	12.7	1.9E-03	5.7E-03	1.7E-02
B-4	SS-5	9-11	0.0	2.9	97.1			
B-5	SS-4	7-9	0.0	40.8	59.2	3.9E-05	1.2E-04	3.5E-04
B-5	SS-5	9-11	0.7	7.2	92.1	5.5E-06	1.6E-05	4.9E-05
B-6	SS-4	7-9	14.3	82.2	3.5	1.0E-02	3.1E-02	9.3E-02
B-6	SS-5	9-11	4.7	78.1	17.2	8.6E-04	2.6E-03	7.8E-03
B-8	¹ SS-1	1-3	19.8	79.9	0.3			
B-8	¹ SS-1	1-3	37.7	56	6.3			
B-9	SS-2	3-5	23.3	65.8	10.9	3.5E-04	1.0E-03	3.1E-03
B-11	SS-1	1-3	44.3	45	10.7			
B-11	SS-4	7-9	29.5	41.8	28.7	2.2E-04	6.7E-04	2.0E-03
B-12	SS-1	1-3	54.4	40.6	5			
B-12	SS-5	10-12	0.0	43.1	56.9	2.8E-07	8.4E-07	2.5E-06
B-13	SS-1	1-3	46.6	44.4	9			
B-13	SS-2	3-5	30.4	54.3	15.3			
B-13	SS-3 & SS-4	3-7	66.1	29.1	4.8	1.2E-02	3.5E-02	1.1E-01
B-13	SS-6	14-16	33.1	64.2	2.7	2.3E-02	7.0E-02	2.1E-01
B-14	SS-3	6-8	30.8	65.7	3.5	1.0E-02	3.1E-02	9.4E-02
B-15	SS-1	1-3	32.4	60.8	6.8			
B-15	SS-2 & SS-3	3-7	19.0	74.5	6.5	1.6E-03	4.8E-03	1.4E-02
B-15	SS-4	7-9	62.4	33.1	4.5	1.2E-02	3.6E-02	1.1E-01
B-16	¹ SS-1	1-3	25.6	74	0.4			
B-16	¹ SS-1	1-3	10.3	77	12.7			
B-16	SS-3	5-7	11.1	80	8.9	8.9E-04	2.7E-03	8.0E-03
B-16	SS-4	7-9	49.0	45.4	5.6	1.4E-03	4.1E-03	1.2E-02
B-17	SS-4	8-10	3.2	27.8	69	6.5E-05	1.9E-04	5.8E-04

026-08-007 T-3 of 4 7/25/08

Stephens Associates
Consulting Engineers

Insightful, Costsaving Solutions
for Buildings and
Infrastructure

Hydrology & Hydraulics

TABLE 2 (CONTINUED)

		Grain-Siz	e Analyses			Estimate	d Hydraulic Cor	ductivity
Boring	Sample	¹ Depth (ft.)	² Percent Gravel	³ Percent Sand	⁴ Percent Fines	5,6Probable lower bound of measured k = 1/3 of estimated k (cm/s)	^{5,6} Estimated k (cm/s)	5,6Probable upper bound of measured k=3 times estimated k (cm/s)
B-18	SS-1	1-3	13.9	62.4	23.7			
B-18	SS-2	3-5	33.9	47.7	18.4			
B-18	SS-4	7-9	8.8	38	53.2	1.3E-05	3.8E-05	1.2E-04
B-18	SS-5	9-11	20.5	50.7	28.8	2.3E-07	6.8E-07	2.0E-06
B-19	SS-2	3-5	48.8	42.9	8.3			
B-20	SS-4	7-9	6.8	46.5	46.7	3.0E-07	9.1E-07	2.7E-06
B-21	SS-2	3-5	17.1	53.6	29.3			
B-22	SS-1	1-3	23.9	58.1	18			
B-22	SS-3	5-7	49.3	36.5	14.2	2.1E-04	6.3E-04	1.9E-03
B-23	SS-2	3-5	25.9	62.6	11.5			
B-23	SS-4	7-9	17.5	31.3	51.2	7.9E-07	2.4E-06	7.1E-06
B-24	SS-3	5-7	3.5	51.1	45.4	2.0E-07	5.9E-07	1.8E-06
B-25	SS-1	1-3	12.3	76.5	11.2			
B-25	SS-3	5-7	14.9	54.5	30.6	2.5E-05	7.6E-05	2.3E-04

		At	tterberg Limits and	Natural Wa	ater Content Ana	alyses	
Doring	Sample	Donth	Natural Water	Liquid	Plastic Limit	Plasticity Index	Classification
Boring	Sample	Depth	Content (%)	Limit (%)	(%)	Plasticity flidex	Classification
B-4	S-5	9-11'	37	30	19	11	CL
B-12	S-5	10-12'		I	Non-plastic, see A	tterberg Limits da	ta sheet

NOTES:

- 1. Depth values are depths over which split spoon was driven. A representative sample for lab testing taken from the depth indicated. Refer to individual lab data sheets and boring logs for further information on sample location from within split spoon.
- 2. Gravel is defined as particles 0.187" (No. 4 seive) to 3" in diameter. Percent gravel is the percent of material by weight within this range of particles sizes.
- 3. Sand is defined as particles 0.187" (No. 4 sieve) to 0.003" (No. 200 sieve) in diameter. Percent sand is the percent of material by weight within this range of particles sizes.
- 4. Fines are defined as particles smaller than 0.003" (No. 200 sieve) in diameter. Percent fines is the percent of material by weight smaller than this particle size.
- 5. See List of References Appendix C
- 6. The references note that this method may overpredict permeability in gravel, but the results likely present an upper bound. The references further note that the Kozeny-Carmen method is not applicable to clay soils and would overpredict permeability.



026-08-007 T-4 of 4 7/25/08

TABLE 3 - FIELD PERMEABILITY TEST RESULTS

(after Fay, Spofford & Thorndike, September 24, 2008)

	Field Per	meability (Slug)) Test Results		Perm	eability Estim	ated by SA fron	n Laboratory Da	ata
Well ID B-3 B-4** B-5**	Bouwer & R	ice Analysis sult¹	Hvorslev	/ Result ²	Sample No. Sample Depth		k=1/3 of estimated k	Estimated k	k=3 times estimated k
Well ID	feet/min	cm/s	feet/min	cm/s	-	(ft.)	cm/s	cm/s	cm/s
B-3	0.0067	0.003	0.0093	0.005	-	-	-	-	-
B-4**	0.039	0.02	0.054	0.03	SS-4	7-9	0.0019	0.0057	0.017
B-5**	0.00066	0.00034	0.00092	0.00047	SS-4	7-9	0.000035	0.00012	0.00035
					SS-5	9-11	0.0000055	0.000016	0.000049
B-9*	-	-	-	-	SS-2	3-5	0.00035	0.001	0.0031
B-13	0.03	0.02	0.041	0.02	SS-3&4	3-7	0.012	0.035	0.11
B-13	0.019	0.0096**	0.026	0.0133	SS-3&4	3-7	0.012	0.035	0.11
B-13	0.019	0.01	0.027	0.01	SS-4	7-9	0.023	0.070	0.21
B-18**	0.0039	0.00196	0.0053	0.00271	SS-4	7-9	0.000013	0.000038	0.00012
					SS-5	9-11	0.00000023	0.00000068	0.0000020

FST Notes:

SA Notes:

Slug tests performed, data interpreted and provided to SA by FST.

¹ Freeware used to analyze the data was written by Karl DeBisschop and obtained from http://sourceforge.net/projects/hydrotools ² Freeware used to analyze the data was written by Karl DeBisschop and obtained from http://sourceforge.net/projects/hydrotools



^{*}The data did not have enough variance to analyze the slug test **Off by 1 or more orders of magnitude

APPENDIX A LIMITATIONS



APPENDIX A – REPORT LIMITATIONS

Stephens Associates Consulting Engineers, LLC (SA) has prepared this Report based on the information available to us at this time, including preliminary design information furnished through the Client, the Owner and their representatives for the proposed Project. If any of the noted information is incorrect or has changed (e.g., revisions to the design; subsurface conditions encountered during excavation for construction are different from those noted in this report, etc.), SA should be notified and retained to review the corrections and changes and amend this report. If SA is not retained for these purposes, we cannot be responsible for the impact of those conditions on the performance of the Project. Upon completion of plans and specifications, SA should be retained to review the final design documents before issuance for construction bid. This review will allow us to check that our engineering recommendations have been interpreted and implemented properly in the design. At that time, it may be necessary to submit supplementary recommendations, which SA will do on a time and expense basis according to our Agreement for the Project.

The subsurface descriptions contained in this report are generalized to highlight the major soil strata as interpreted from readily available data. The soil/rock strata and groundwater surface are interpretations from widely spaced data and represent the approximate boundaries between subsurface materials. The actual transition between strata may be gradual. Explorations (e.g., boring and/or test pit logs) should be reviewed for specific information at respective locations. The data shown on the logs prepared by SA represent the conditions only at the actual exploration locations at the time the explorations were undertaken. Further, variations in subsurface conditions may occur and should be expected between exploration locations and over time. Seasonal fluctuation of groundwater depths should be anticipated. We recommend that the contractor measure the actual groundwater levels at the time of construction and evaluate groundwater impact on the construction procedure, and the impact of the construction on groundwater levels.

SA's scope of services does not include an environmental assessment of any kind, including but not limited to assessments for the presence or absence of wetlands or hazardous or toxic materials or organisms (e.g., fungi, flora, fauna, bacteria, viruses, etc.) in the soil, surface water, groundwater, or air, on or below or around this site. Any observations of odors, colors, or unusual or suspicious items or conditions noted by SA were incidental to our services, and any statements regarding such observations are strictly for the information of the Client. We recommend that the Project Owner engage a qualified environmental professional to provide environmental services for this Project.

SA's services were performed using data generated by others (e.g. GPR data interpreted and provided by Hager GeoScience, Inc., field permeability tests data and interpretation provided by FST, etc.). SA relied on these data for cost savings to Client and Owner in lieu of generating these data at higher cost.

We recommend that SA be retained to provide services during design and construction including analysis and engineering of design options, assistance with shop drawing/submittal review and engineering observation of construction. These services will assist the Owner with quality assurance through observation of compliance with design concepts, specifications and recommendations and will allow for the implementation of design changes where necessary due to conditions that differ from those anticipated.

This report has been prepared by SA for the exclusive use of the Client and for the specific application to the subject Project, as conceived at this time. The report is for conceptual design only, and by itself is not sufficient to prepare an accurate cost estimate or construction "bid." Subject to the limitations inherent in the agreed scope of services as to the degree of care, amount of time and expenses to be incurred, and subject to any other limitations contained in the Agreement for SA's services, SA has performed its services with the degree of care and skill ordinarily exercised by other professional engineers under similar circumstances at the time the services were performed. No warranties are implied or expressed.



026-08-007 Page A- 2 of 2 7/25/08

APPENDIX B BORING LOGS



Ī			Gro	undwa	ter:			Project: MWRA Pipeline Project, Contract No. 6905	Borin	g No	. B-1-	MW
	Depth	ո։	5.3 ft.		5.4 ft				-007 S h		1 of	
	Time:		Well inst	alled	1.6 h	rs. after	inst.		on ID 1.3	75" (DD 2"	
								Foreman: John Galvin Hammer Wt.: 140 lb	Fall:	_	30"	
		"				_		Start Date: 4/16/2008 Drill Technique: Drive&Wa	sh ID 4	." (DD 4.5'	'
	t.)	Š	2	_	_	ue u	<u>-</u>	Finish Date: 4/17/2008 Rig Type: Mobile Dr				1 1
	Depth (ft.)	Blows	Sample No.	Pen. (in.)	Rec. (in.)	Blows/6" or Core Time	PID (ppm)	SACE Staff: J. Turner Northing: 3002111.3 Ea	sting:	7859	960.0	emarks
	ptł	S.	E	Ľ.	S	e š	3) (Surface El.: + 47.9 ft Datum: Vert: BCB; Horiz.	NAD83	Eqι	iipment	ıμ
0	De	Cas.	Sa	Ре	Re	ခြဲ ပိ	Ы	Description & Classification	Stratum	Ins	stalled	Re
0 —		146						6" Asphalt Driller adv. Roller bit to 1ft	Asphalt			
		140						Cobbles	Cobbles		je j	
	1	89	SS-1	24	11	14		10" Dense, black medium SAND, little coarse Sand,		Sand	▝░	
						28		little Gravel, little Asphalt, trace brick (SP), wet		Š		
		56				50		1" Very dense, black and brown GRAVEL, little fine		ite	o C	
	2		00.0	24	2	39	_	to coarse SAND (GP), wet.		Bentonite	2" ID PVC Well riser	
	3	16	SS-2	24	2	11 15	0	Medium dense, gray-brown, fine to coarse SAND and GRAVEL, trace silt (SW), wet.		Ber	² 0	
						9		*Driller advanced 5" casing to 4 ft., then telescoped			ft of	1
_		297*				52		4" casing to 5 ft.			2	
5 —	5		SS-3	0.5	0.5	50/0.5"	0	Piece of gravel.	$\overline{}$		_	├ ╢
	5.5		R-1	24		6 min/ft		Boulder - very hard, white, yellow and black, fresh				
								medium to coarse grained Granitic rock, top 14"			tive Casin	
						3 min/ft		one joint near horizontal, bottom 4" gravel			<u>= </u>	
								RQD = 10/24" = 42%			reen	
								Driller advanced roller bit through boulders and had	FILL		Pre	
			ļ					difficulty advancing casing. Repeated roller bit and	Щ	_	Slotted PVC Well screen Protec	
	9		SS-4	24	10	30	0	casing advancement. Very dense, brown, GRAVEL and fine to medium SAND,		Sand backfill	×	
	9	*_	33-4	24	10	37	U	GRAVEL (GW), wet.		bac	M	
10 —		Push*				45		GIVIVEE (GVV), WGL		and	pe	
		ш				47		*Driller advanced roller bit ahead of casing to 14 ft		S	Slott	
		16*										
		10									10	
		46*						Change occurred between samples			<u> </u> ≡	
		43*									≡	
	14		SS-5	24	5	19	0	Medium dense, brown, fine SAND, trace non-plastic				
	17		00-0	24	3	11	0	silt (SP), wet.	0		V	
15 —						11			SAND		•	
						16			SA		5.5"	
								Boring terminated at about 16 ft.		dia	ameter	
											ehole to	
											ft., 4.5"	
											ameter ehole to	
											16 ft.	\parallel
												\parallel
20 —												├ ╣
												$\ \cdot\ $
												$\ \cdot\ $
25 —												} ∦
								Drilling technique added water to boring. Water levels may				
								not be indicative of natural groundwater level.				
			<u> </u>		<u> </u>							
	(S								Steph	ens l	Associat	es
	Remarks										sulting En	
	em	Soil/ro	ck strata ar	ıd groui	ndwate	r surface,	where i	indicated, are approximate. Transitions may be gradual.	Insightful, saving So	lutions		Structural
	œ	Variati	ons betwee	n explo	ration I	ocations a	nd ove	er time should be expected.	for Buildin Infrastruct	ure H	lydrology & H	

		Gro	undwa	ter:			Project: MWRA Pipeline Project, Contract No. 6905	Boring	g No. B-
Deptl	า:	2.9 ft.					Location: Saugus, MA Project Number: 026-08	-007 Sh	
Time		End of d	Irilling,	inside	casing			oon ID 1.3	75" OD 2"
							Foreman: John Galvin Hammer Wt.: 140 lb	Fall:	30"
					_			ash ID 4	
£.	Blows	Sample No.	_	_	Blows/6" or Core Time	2		ill Truck-m	
L (f	8	<u>e</u>	<u>:</u>	.⊑	Zi.	ď	SACE Staff: J. Turner Northing: 3002405.9 Ea		786063.9
bt	'n.	dμ	٠.	, i	ĕ ĕ	ತಿ	Surface El.: + 47.5 ft Datum: Vert: BCB; Horiz		Equipment
Depth (ft.)	Cas.	Sar	Pen. (in.)	Rec. (in.)	음 당	PID (ppm)	Description & Classification	Stratum	Installed
-		•	_	_			7" Asphalt Driller adv. Roller bit to 1ft	Asphalt	motanea
	push						5" Concrete	Concrete	
1	40	SS-1	24	11	17	0	4" Medium dense, gray medium to coarse SAND (SP) wet.	.001.010.0	
	18				19		7" Medium dense, brown GRAVEL and fine to coarse		
	47				17		SAND (GW), trace silt, wet.	$\overline{}$	
	47				15			-	
3	10	SS-2	24	5	20	0	Dense, brown fine to coarse SAND, some Gravel (SM).		
	10				24		little Silt, wet.		
	27				21			FILL	
	۷1				18			正	
5	36	SS-3	24	1	19	0	Similar to SS-2, except medium dense.		
					14				
<u> </u>	18				8				
		CC 4	0.4		12		Donne grow fine to meditive CAND to the	 	
7	36	SS-4	24	9	23	0	Dense, gray fine to medium SAND, trace		
<u> </u>					24 26		non-plastic silt (SP-SM), wet.		
<u> </u>	56			-	28				
9	(h	SS-5	24	14	19	0	Medium dense, gray fine SAND, trace silt (SP-SM),	SAND	
	Hole	000	27	17	15		grading to fine to medium SAND, trace silt (SP-SM)	δ	
	Open I				22		wet.		
	o				23				
11		SS-6	24	12	10	0	Medium dense, gray fine to medium SAND, some		
					9		non-plastic Silt (SM), wet		
					9				
					12				
							Boring terminated at about 13 ft.		
1									
	•								
<u> </u>									
<u> </u>	•								
<u> </u>									
-									
<u> </u>				-					
H	•								
	•								
	•		1						
			<u> </u>						2-1-27
Remarks	1. Drilli	ng techniq	ue adde	ea water	to boring	. wate	er levels may not be indicative of natural groundwater level.	Steph	ens Associat Consulting Eng
ma	Soil/ro	ck strata ar	nd groui	ndwater	surface. v	where i	ndicated, are approximate. Transitions may be gradual.	Insightful, 0	
O.			•				r time should be expected.	saving Solution for Building Infrastructure	s and
~							See Exploration Location Plan 668 Main Street, Wilmingt		10 0050 00

[Gra	undwa	tor.			Project: MWRA Pipeline Project, Contract No. 6905	Rorin	g No. B-	-3-MW			
	Depti	h:	5.4 ft.	unuwa 	ter: 4.1 ft.				-007 Sh		of 1			
	Time		EOD in (cas		rs. after	inst		oon ID 1.3		2"			
	111110	<u>.</u>	LODIII	<i>5</i> 43.	0.0 111	S. artor	11131.	Foreman: John Galvin Hammer Wt.: 140 lb	Fall:	30"	_			
									Fall. ash ID 4		5"			
		٧S	<u> </u>			or e	_							
	Depth (ft.)	Blows	Sample No.	Pen. (in.)	n.)	Blows/6" or Core Time	PID (ppm)	Finish Date: 4/17/2008 Rig Type: Mobile Dr SACE Staff: J. Turner Northing: 3002744.0 Ea		786184.9	P TE			
	ŧ	ω.	d	i) ·	. (i	/S/ e T	g)				Jar			
	eb	Cas.	aπ	en	Rec. (in.)	<u> </u>	₽			Equipme	ent e			
0 —			S	_	8	В	4	Description & Classification	Stratum	Installe	a &			
		push						7" Asphalt Driller adv. Roller bit to 1ft	Asphalt					
	_	10	00.4	0.4	40	00	007	5" Concrete	Concrete	8				
	1	26	SS-1	24	13	23	237	4" Dense, gray and black, medium to coarse SAND,		Sentonite VC Well ri				
						19		crushed asphalt (SP), wet.	FILL	ntor Ķ				
		24				20 15		9" Dense, gray fine to medium SAND, trace gravel,	Щ	SC Be				
	3		SS-2	24	9	6	265	trace silt (SP), wet. Petroleum odor (tested with PID) 5" loose, brown f-m SAND, some Gravel, little Silt (SP)		┡═				
	3	8	33-2	24	9	4	200	3" Medium dense, medium SAND, trace fine sand,	abla	5 ft of 2" ID	- te			
						12		trace coarse sand (SP), wet. See Note 1.		t of	Concrete			
		18				14		1" Brown fine SAND, some non-plastic Silt (SM), wet		5 1	00			
5 —	5		SS-3	24	12	12	8	Medium dense, brown fine SAND, trace non-plastic						
	ا ا	24	30.3		14	10		silt, trace medium sand (SP), wet.		<u> = .5</u>				
						12		S, trado modiam dana (or), wot.		= ,	ğ 🖂			
		12				17					2			
	7	push	SS-4	24	12	8	6	Medium dense, brown fine SAND, little non-plastic		<u>-</u> [5			
		8		<u> </u>		6		Silt, (SM), wet.		reen				
						9								
		18				11				Sand backfill Slotted PVC Well screen				
	9		SS-5	24	12	7	11	Medium dense, brown fine SAND, trace non-plastic		Sand backfill				
10 —		Ī				7		silt (SP), wet.		g d				
10						7				San				
		Hole				9								
		Ī								انے				
		Open I								10 ft.				
		ŏ							□	≡				
		ļ •							SAND	≡				
		<u> </u>							S					
	4.4		00.0	0.4	40	40	_	Madium dance brown fine CANID and non-plantic		≘				
	14	ļ	SS-6	24	12	10	0	ledium dense, brown fine SAND and non-plastic						
15 —						16 14		SILT (SM), wet.		▼				
						14				4.5"	(00000000000000000000000000000000000000			
						14		Boring terminated at about 16 ft.		4.5" diameter				
								Bonng terminated at about 10 h.		borehole				
		ŀ												
		İ												
20 —		Ī												
20 —											[]			
		ļ												
		ļ												
		ļ												
25 —											├ ┤			
	-	}												
		 						Drilling technique added water to having. Water levels may						
								Drilling technique added water to boring. Water levels may not be indicative of natural groundwater level.						
		t						not so maiodire of natural groundwater level.						
ļ		1 90~	nla SS 2 4	rentach	cample	from ton	5" \/0	A vial from mid 5", environmental jar from mid 5" and	C1 1		lates			
	1 2 1			-	•	э пош юр	J , VU	via nom miu 5 , environmentar jar nom miu 5 anu	Steph	ens Assoc Consulting	Engineers			
	nar		ottom 1". Petroleum odor.						Insightful, Cost- Structural					
	en	Soil/rock strata and groundwater surface, where indicated, are approximate. Transitions may be gradual.							saving So for Buildin	olutions nos and	Geotechnical			
	œ	Variations between exploration locations and over time should be expected.							Infrastruct	ture Hydrology	& Hydraulics			

44		Grou	undwa	ter:			Project: MWRA Pipeline Project, Contract No. 6905	Borin	g No). E	3-4-N
Depth	ո։	8.4 ft.					Location: Saugus, MA Project Number: 026-08	-007 Sh		1	
Time:		Well inst	talled				Contractor: GeoLogic Sampler Type: Split spo	oon ID 1.3	75" (OD	2"
							Foreman: John Galvin Hammer Wt.: 140 lb	Fall:		30"	
	"				_		Start Date: 4/18/2008 Drill Technique: Drive&Wa	ash ID 4	" (OD -	4.5"
t.	Blows	Sample No.	_		ne "	<u>_</u>	Finish Date: 4/18/2008 Rig Type: Mobile Dr	ill Truck-m	noun	ted	
(f	쯢	e le	غ.	<u>ء</u> .	s/6 Tir	nd	SACE Staff: J. Turner Northing: 3003068.3 Ea	sting:	7862	291.	7
Depth (ft.)	S.	ш	Pen. (in.)	Rec. (in.)	ž ē	PID (ppm)	Surface El.: + 48.7 ft Datum: Vert: BCB; Horiz.		Εqι	ıipm	ent
De	Cas.	Sal	Pe	Re	Blows/6" or Core Time	吕	Description & Classification	Stratum		stall	
							6" Asphalt Driller adv. Roller bit to 1ft	Asphalt			
	push						6" Concrete	Concrete			1
1	_	SS-1	24	11	10	0	2" Medium dense, gray and black, medium SAND,			5 ft of 2" ID PVC Well riser	
	8				13		trace crushed asphalt (SP), wet.		Bentonite	Vell	
	23				11		9" Medum dense, gray, fine to coarse SAND, some		ent	ο̈	
	20				9		Silt, little Gravel (SM), wet.	_	В	ď	Ш
3	5	SS-2	24	1	6	0	Loose, gray fine to medium SAND, little Silt, little	FILL		₽	
					4		Gravel (SM), wet.			of 2	rete
	8				3					£ (Concrete
		00.0	0.4		3		0: 11			"	၂၁
5	5	SS-3	24	2	7	0	Similar to SS-2.				ng
					6					≣	Sasi
 	9				3					$ \equiv $	e C
7		SC 4	24	10	2 12	0	Madium dance, gray fine to madium SAND, same			=	€cti
7	5	SS-4	24	10	9	0	Medium dense, gray fine to medium SAND, some Gravel, little Silt (SM) grading to GRAVEL and fine			ee	Protective Casing
\vdash					15		to medium SAND (GP).			SCre	Δ.
\vdash	36				21				_	le/	
9		SS-5	24	9	18	0	5" Medium dense, gray-brown GRAVEL and fine to		Sand backfill	≶	
	18				8		medium SAND, little Silt (GM), grading to		1 ba	§	
	00				12		4" very stiff, brown, slightly plastic Silty CLAY, trace	 	and	ted	
	20				10		fine Sand (CL), wet.		S	Slotted PVC Well screen	
	26						` ''				
	26										
	31									$ \equiv $	
	JΙ							SILT		≡	
igsqcut	27							S		≡	
		00 -	<u> </u>							≡	
14		SS-6	24	19	12	0	Very stiff, brown, very slightly plastic Clayey SILT, little fine				
 					13		Sand (ML), wet.			▼	
\vdash	ம				13					4	
	Hole				14				٦i	4.5" amete	⊇r
	en F									oreho	
\vdash	Ope										-
\vdash	O										
							Driller noted change near 19 ft. when adv. roller bit				
19		SS-7	24	4	6	0	Medium dense, brown fine to coarse SAND and				
					12		GRAVEL (SW), wet.	Ω			
					14		, , ,	SAND			
					14			Ŝ			
							Boring terminated at about 21 ft.				
l T	_										
╙											
					ļ						
				1							
									Ī		
	4 Daily	ng test "	100 cdd		rto house	. \\/	valence may not be indicating of natural arguments to be a local section.				
ıks	1. Drilli	ng techniqu	ue adde	ed wate	r to boring	ı. Wate	er levels may not be indicative of natural groundwater level.	Steph	iens /	Asso nsultir	ciate
ark							er levels may not be indicative of natural groundwater level. Indicated, are approximate. Transitions may be gradual.	Steph	Co	Asso nsultir	ciate

ſ			Gro	undwa	ater.			Project: MWRA Pipeline Project, Contract No. 6905	Borin	a Na). B-5-	MM		
	Deptl	ո։	4.7 ft.	unuwa 	4.1 ft.	.			-007 Sh		7. <u>6-5-</u> 1 of			
	Time		EOD in	cas.		installed			oon ID 1.3					
								Foreman: John Galvin Hammer Wt.: 140 lb	Fall:		30"			
		"				_			ash ID 4	" (OD 4.5'	•		
	ť.)	Blows	Sample No.	·	·	ne ne	(L	Finish Date: 4/16/2008 Rig Type: Mobile Dr	ill Truck-m	noun	ted	S		
	h (f	품	e Se	j.	(i.	s/6 Tir	udc	SACE Staff: J. Turner Northing: 3003174.7 Ea	sting:	7862	237.5] x		
	Depth (ft.)	vi.	Ē	Pen. (in.)	Rec. (in.)	ow	PID (ppm)	Surface El.: <u>+</u> 49.1 ft Datum: Vert: BCB; Horiz.	NAD83	Εqι	uipment	Remarks		
0 —	De	Ĉ	Sa	Pe	Re	Blows/6" or Core Time	Ы	Description & Classification	Stratum	Ins	stalled	Re		
0 —		push						6" Asphalt Driller adv. Roller bit to 1ft	Asphalt					
		pusii						Cobbles	Cobbles		5 ft of 2" ID PVC Well riser			
	1	1*	SS-1	14	2	17	0	4" Dense, black medium to coarse SAND (SP), wet.		ţe.		1		
						74		10" Very dense, gray-brown, fine to coarse SAND,	FILL	Bentonite				
		57*				50/2"		little Gravel (SW), wet, slight petroleum odor	Щ	Ben	D PVC			
	3		SS-2	24	3	25	0	*Driller advanced roller bit to 3 ft., then drove casing Medium dense, brown, fine to medium SAND, little			 Const			
	3	51	00-2	27	3	19	0	Silt, trace organics, trace wood fibers (SM), wet,	∇		o 5			
						10		slight petroleum odor.	-		#			
_		54				7			_		"			
5 —	5	13	SS-3	24	11	7	0	8" Medium dense, brown fine to medium SAND, trace						
		13				15		coarse sand, little Silt, trace organics (SM), wet			<u> </u> asi			
		31				24		3" Medium dense, gray-brown fine SAND, little						
	7		CC 4	0.4	40	30	0	non-plastic Silt (SM), wet			= i∳			
	7	*	SS-4	24	18	18 12	0	Very stiff, light brown, non-plastic SILT and fine SAND (ML), wet.			reen			
						16		*Driller pulled 4" casing to 4 ft. to change sections. Casing			SCr	-		
		*				12		skewed when redriving. Pull casing, drive 5" cas. to 9 ft		 	Slotted PVC Well screen			
	9		SS-5	24	8	11	0	Very stiff, light brown, non-plastic SILT, trace fine		Sand backfill	်ၘ	(
10 —		•				14		Sand (ML), wet.		q p	₫			
10 —						14				San	tted			
						14		Driller advanced boring open hole using 5" roller bit.		0,				
									⊢		10 ft.			
									SANDY SILT		<u> - </u>			
		•							> -		≣			
		<u>e</u>							Ω		≡			
		Hole							SA		≡			
	14	en	SS-6	24	11	9	0	Similar to SS-5.						
15 —		Open				8					lacktriangle			
13						9								
						12				di	5.5" ameter			
											orehole			
	19		SS-7	24	16	9	0	Very stiff, gray, slightly plastic SILT, little fine						
20 —						10		Sand (ML), wet.						
						16								
						16		Poring terminated at about 24 ft						
								Boring terminated at about 21 ft.						
								1						
		•												
		· 												
25 —												 		
_~								1						
								1						
ļ		1. Drilli	ina technia	ue adde	ed wate	r to boring	ı. Wate	er levels may not be indicative of natural groundwater level.	Storb	one	Accoriat	000		
	rks	Soil/rock strata and groundwater surface, where indicated, are approximate. Transitions may be gradual. Variations between exploration locations and over time should be expected.							Stephens Associates Consulting Enginee					
	ma								Insightful, Cost- Structu					
	Re								saving Solutions for Bulldings and Intrastructure Hydrology & Hydraulics					
						·								

		Gro	undwa	iter:			Project: MWRA Pipeline Project, Contract No. 6905	Borin	q No. B
Depth	ո։	4.7 ft.					Location: Saugus, MA Project Number: 026-08		eet 1 of
Time:		End of d	Irilling,	inside	e casing			oon ID 1.3	
			J,				Foreman: John Galvin Hammer Wt.: 140 lb	Fall:	30"
		_			_			ash ID 4	
$\overline{}$	Blows	Sample No.	_	_	Blows/6" or Core Time	_		ill Truck-m	
#)	<u>6</u>	e P	ı.	n.)	.9/ .jm	E	SACE Staff: J. Turner Northing: 3003437.8 Ea		786319.4
듚		ldι	Ë		ws e T	<u>a</u>			
Depth (ft.)	Cas.	an	Pen. (in.)	Rec. (in.)	o io	PID (ppm)			Equipmen
	O	S		œ	шО	<u> </u>	Description & Classification	Stratum	Installed
							8" Asphalt Driller adv. Roller bit to 1ft	Asphalt	
	push	00.4		_	E0/0"		Cobbles	Cobbles	
1		SS-1	2	2	50/2"	0	Very dense, dark gray medium SAND, little fine		
							Sand (SP), wet.		
	24*						*Driller advanced roller bit to 3 ft. then drove casing		
2		SS-2	24	3	21	0	Madium dance dark brown fine to coorse SAND little	FILL	
3	24	33-2	24	3	7	U	Medium dense, dark brown fine to coarse SAND, little Gravel (SW), wet.	☶	
					9		Graver (Svv), wet.	$\overline{}$	
	27				24				
5		SS-3	24	8	16	0	7" Dense brown fine to coarse SAND, trace non-plastic		
J	38	JJ-3	24	0	26	U	silt (SP-SM), wet. Sampled for corrosion analysis.		
					25		1" Dense, light brown fine SAND, some non-plastic	 	
	37				23		silt (SM), wet. Sampled for record and geotech.		
7		SS-4	24	14	23	0	4" Medium dense, brown, fine to coarse SAND, little		
 -	29	55-4	<u> </u>	'	14	U	non-plastic Silt (SM), wet See Note 1.		
					12		6" Medium dense, brown, f-c SAND, little Gravel (SP).		
	22				17		4" Medium dense, brown fine SAND, some non-plastic		
9		SS-5	24	12	15	0	Silt (SM), wet.	SAND	
	Open				11		SS-5: Medium dense, brown fine to medium SAND,	√S	
	Hole				16		little non-plastic Silt, trace gravel (SM), wet		
					19		and their places only states graver (only, were		
11		SS-6	24	6	6	0	Similar to SS-5.		
				Ť	7				
					7				
					7				
							Boring terminated at about 13 ft.		
<u> </u>									
							Drilling technique added water to boring. Water levels may not		
11							be indicative of natural groundwater level.		
\vdash									

Variations between exploration locations and over time should be expected. B-6 Location:

See Exploration Location Plan

Soil/rock strata and groundwater surface, where indicated, are approximate. Transitions may be gradual.

Depth	i :	3.7 ft.					•	-
Time:		End of d	Irilling,	in ca	sing		Contractor: GeoLogic Sampler Type: Split spoon ID 1.375" OD	2
							Foreman: John Galvin Hammer Wt.: 140 lb Fall: 30"	
	Ø	o.			, o		Start Date: 4/14/2008 Drill Technique: Drive&Wash ID 4" OD 4	1.5
ft.)	Cas. Blows	Sample No.	Ŀ	Ţ	Blows/6" or Core Time	Ē	Finish Date: 4/15/2008 Rig Type: Mobile Drill Truck-mounted	
Depth (ft.)	B	ple	Pen. (in.)	Rec. (in.)	's⁄. ∐	PID (ppm)	SACE Staff: J. Turner Northing: 3003883.9 Easting: 786488.2	
) pt	JS.	<u>ו</u>	Ĕ.	<u>က</u>	ow ore	٥	Surface El.: <u>+</u> 54.5 ft Datum: Vert: BCB; Horiz. NAD83 Equipme	
۵	ပၱ	Š	Pe	Re	шç		Description & Classification Stratum Installe)d
							8" Asphalt Driller adv. Roller bit to 1ft Asphalt	
	push						Cobbles Cobbles	
1		SS-1	9	3	23	0	2" Dense, gray medium to coarse SAND, trace	
					50/3"		gravel (SP), wet.	
							1" Very dense, brown fine to coarse SAND, trace gravel (SW), wet. Roller bit to 3 ft. 교	
2		000	2	4	E0/2"	0		
3.8		SS-2 R-1	3 60	1 49	50/3" 4 min/ft	0	No recovery. Very hard, gray and black, slightly weathered, medium	
3.6		N-1	00	49	4 111111/11		grained Granitic rock, moderately fractured, rust	
					4 min/ft		staining in joints, thin silty sand seam in one joint near	
					1		mid run, iginte near harizontal to vertical come	
					4 min/ft		healed joints with minear infilling RQD = 25/60" = 42%	
							RQD = 25/60" = 42%	
					6 min/ft]	
		_]	
					5 min/ft]	
8.8		R-2	24	12	1 min/ft		Similar to R-1, except highly fractured	
					4 min/ft		RQD =0%	
					4 min/ft		-	
10.8		R-3	12	15	6 min/ft		Similar to R-1, except top 5" highly fractured, bottom	
10.0		11-5	12	10	O IIIIII/IC		10" intact.	
							RQD = 10/12" = 83%	
							1 1	
							Boring terminated at about 11.8 ft.	
							-	
							1	
]	
]	
]	
							1 1	
 								
							1 1	
\vdash							1 1	
							1	
					1		1 1	
			1				1 1	
							1 1	
]	
]	
							1 1	
							1 1	
 								
-								
\vdash							1 1	
	4.5			-41-1	<u> </u>	a :	I and the state of	_
arphi						•	west of boring and shoulder. Stephens Assoc Consulting	įį
ar					r to boring		rieveis may not be indicative of natural groundwater level.	, .
							indicated, are approximate. Transitions may be gradual.	

-7 Location:

	·I		undwa	ater:	1			-8
Dep		1.6 ft.	Juillie -			, o -l	Location: Saugus, MA Project Number: 026-08-007 Sheet 1 of	
Time	9:	End of c	drilling,	, casır	ig remov	/ed	Contractor: GeoLogic Sampler Type: Split spoon ID 1.375" OD 2"	4
							Foreman: John Galvin Hammer Wt.: 140 lb Fall: 30"	
_	S)	o.			o o		Start Date: 4/14/2008 Drill Technique: Drive&Wash ID 4" OD 4.5"	"-
Depth (ft.)	Blows	Sample No.	<u>-</u>	<u>-</u>	Blows/6" or Core Time	PID (ppm)	Finish Date: 4/14/2008 Rig Type: Mobile Drill Truck-mounted	S S
∃	<u>m</u>	a d	Pen. (in.)	Rec. (in.)	/s/	dd)	SACE Staff: J. Turner Northing: 3004140.8 Easting: 786490.4	Remarks
ebi	as.	an l	en.	ec.	<u> </u>	<u> </u>	Surface El.: + 55.9 ft Datum: Vert: BCB; Horiz. NAD83 Equipment	t E
Ď	Ça	ű	Ā	Ř	m O	Ы	Description & Classification Stratum Installed	Ř
	push						6" Asphalt Driller adv. Roller bit to 1ft Asphalt	
L_	P 4.5			40				1
1	4	SS-1	20	16	22	0	5" Very dense, gray medium to coarse SAND,	2
	-		-		52		(SP) little gravel, wet	
	4				52 50/2"		11" Very dense, brown, fine to coarse SAND and GRAVEL (SP-SM), trace silt, moist. Roller bit to 3 ft.	
3		R-1	22	19	50/2 5 min/ft		GRAVEL (SP-SM), trace silt, moist. Roller bit to 3 ft. 正 Very hard, black and gray, slight pink, slightly	
3	+	K-1	22	19	5 11111/11		weathered, fine to medium grained Granodioritic rock,	
-			1		8 min/1	O"	highly fractured, fragments <3", rust stained. RQD=0%	
4.8	†	R-2	60	60	4 min/ft			
7.0		11, 2	30	30	7 11111/10		Similar to R-1, except more pink near bottom of run, and fragments up to 12 in., healed joints with minearal infilling.	}
	†				3 min/ft		minearal infilling.	
							RQD = 22/60" = 37%	
	†		†		4 min/ft		1	
							1	
	1		1		4 min/ft]	
	1]	
					4 min/ft]	
	↓						1	
9.8		R-3	24	24	3 min/ft		Similar to R-1. Top 16" highly fractured, fragments <1"	
	4						bottom 8" intact.	
	-				6 min/ft		RQD = 8/24" = 33%	
	4		1					ļ
		-	-		-		Poring terminated at about 44.9.4	
	+	<u> </u>	-		-		Boring terminated at about 11.8 ft.	
	1		+		-		1 1	
	†		+		 		1 1	
	1	<u> </u>	†		<u> </u>		1 1	
	†		<u> </u>				1	
		1			1		1 1	ļ
	L]	
]	
]	
	4						1 1	
			1		<u> </u>			
<u> </u>	4	-	1		-		1 1	
			1		 		1 1	ļ
 	+		+		-		1 1	***************************************
					 		1 1	}
	†		 				1 1	-
					1		1 1	
	†		1				1	
		1			1		1 1	
	1						1 1	
]	
]	
							1 1	ļ
	4		<u> </u>]	
-			1		<u> </u>			
	4		-		-		1 1	
		-	-		-		1 1	
	+	<u> </u>	-		-			
	4.5	li sud (Di	<u> </u>	-41- I-	<u> </u>	-1: ·		<u> </u>
ķs						•	west of boring and shoulder. Stephens Associat Consulting En	gineers
Jar							er levels may not be indicative of natural groundwater level.	Structural
Remarks			•				indicated, are approximate. Transitions may be gradual.	technical
_							er time snould be expected. Hydrology & H	
Bori	ng No.:		B-8		Locatio	n:	See Exploration Location Plan 668 Main Street, Wilmington, MA 01887 (978) 988	8-211

			ındwa	-			Project: MWRA Pipeline Project, Contract No. 6905		g No. B-9-
Deptl	า:	5.5 ft.			. (+22 hr			-007 Sh	
Time	:	Well inst	alled	4/14/	08 9:04	PM	Contractor: GeoLogic Sampler Type: Split spe	oon ID 1.3	375" OD 2'
							Foreman: John Galvin Hammer Wt.: 140 lb	Fall:	30"
					_			ash ID 4	
·	Blows	Sample No.	_	_	o e	_	Finish Date: 4/13/2008 Rig Type: Mobile Dr		
Depth (ft.)	Ó	e	Pen. (in.)	Rec. (in.)	/6" irr	PID (ppm)			
표		ā	i.	Ξ.	VS/	ď			786501.9
de	as.	me .	Ę.	ပ္စ	ov ore	٥	Surface El.: <u>+</u> 62.0 ft Datum: Vert: BCB; Horiz		Equipmen
Ď	Ca	Š	Ь	R	Blows/6" or Core Time	Ы	Description & Classification	Stratum	Installed
							8" Asphalt Driller adv. Roller bit to 1ft	Asphalt	i i i
							Cobbles		Bentonite Bentonite Concrete
1	push	SS-1	24	14	36	0	3" Very dense gray medium to coarse SAND (SP), wet.	FILL	5 1
•					52		11" Very dense, brown fine to coarse SAND, some	正	Bentonite
					54		Gravel (SW), wet.	1	[후 근 년
	21				45				Bent Concrete
_		00.0	0.4	_		_	Driller advanced roller bit to 3 ft. then drove casing		─ ─∃⊟€
3	30	SS-2	24	8	23	0	Very dense, brown fine to coarse SAND, some	_	≡ 8
					25		Gravel (SW-SM), little (-) silt, wet	\exists	1 ≡
	63				28			SAND	
	00				21			(O)	
5		SS-3	24	0	17	0	No recovery.		Sand backfill VC Well scre ve Casing —
					6		•		sin ell
					11			'	S ≤ Ind
					9			ļ	Sa VC
7		SS-4	11	4	10	0	Very dense, brown and black GRAVEL, some fine to	ļ	d P
- '-		50.4	- ' '	-	50/5"		coarse Sand, trace non-plastic silt (GP), wet	ļ	Sand backfill Slotted PVC Well screen Protective Casing
				1	50/5		Coarse Sand, trace non-plastic siit (GF), wet		
8.5		R-1	45	29	Note 1		Driller cored ~2 in rock core jammed. Set 3" casing	∤ [!]	±
0.0		lV-1	40	29	Note 1		and wash out. No water return during coring.	,	
					7			(0	
				-	7 min/ft	•	14" Very hard, black, fresh, fine grained Dioritic rock, one	85	
							drilling fracture dipping ~60 deg., rust staining at bot.	BOULDERS	▼
					2 min/ft		15" Very hard, pink and black (5") to gray and]	1
							black (10"), fresh, medium grained Granitic rock, rust	7	4.5"
					4 min/ft		staining at joints. RQD = 22/45" = 49%	ĕ	diameter
							Driller washed out to 13 ft. with roller bit. Could not adv.	l	borehole
							casing because of boulders. Attempted split spoon		1
13		SS-5	24	24	35	3	13" Very dense, gray medium to coarse SAND (SP), wet.	SILT AND SAND	1
					43	0	11" Very dense, gray-brown, non-plastic SILT and fine	S/S	1
					36		SAND (ML), wet.	₽	1
					64		Driller drove spoon through ~1.5 ft. of blow-in	\ ∀	1
					, , ,		3.0.0 Spoon anough 110 ta of 510 m in	<u> </u>	1
				<u> </u>	 		Boring terminated about 15 ft.	<u> </u>	1
				-	 		Borning terminated about 10 It.	ارن	1
				-	 		At and of haring halo stayed open to 10 ft houses	•	1
				1	!		At end of boring hole stayed open to 12 ft., however,	ļ	1
				1	<u> </u>		well could only be installed to 10.5 ft more blow-in	ļ	1
					ļ		occurred.	ļ	1
								•	1
								•	1
				\perp				•	1
								ļ	1
								•	1
								•	1
								•	1
								ļ	1
								ļ	1
				-	 			•	1
				-	-			•	1
				1	—			•	1
					ļ			ļ	1
								ļ	1
								•	1
									1
								·	1
								ļ	1
							Drilling technique added water to boring. Water levels may	ļ	1
							not be indicative of natural groundwater level.	ļ	1
							23diodate of flatarai groundwater level.		1
	4 ^		<u> </u>	L	<u> </u>	,	<u> </u>	(E) 12	<u></u>
Remarks		•		Driller a	idvanced r	ock co	re, paused, pulled back, and removed to clear barrel. Time	Steph	iens Associat
r.	for first	foot unclea	ar.						Consulting En
***	_	ak atrata an	nd arou	ndwate	r surface.	where	ndicated, are approximate. Transitions may be gradual.	Insightful, saving So	Cost- olutions Ger

D			undwa	ter:			Project: MWRA Pipeline Project, Contract No. 6905 Boring No. B
Depth		8.1 ft.	willia	95.		رم دا	Location: Saugus, MA Project Number: 026-08-007 Sheet 1 c
Time:		End of d	rilling,	casın	g remov	ed	Contractor: GeoLogic Sampler Type: Split spoon ID 1.375" OD 2
							Foreman: John Galvin Hammer Wt.: 140 lb Fall: 30"
_	Ś	o.			5 4		Start Date: 4/10/2008 Drill Technique: Drive&Wash ID 4" OD 4.5
Depth (ft.)	Blows	Sample No.	<u>:</u>	<u>.</u>	Blows/6" or Core Time	Ē	Finish Date: 4/11/2008 Rig Type: Mobile Drill Truck-mounted
)	<u> </u>	be	Pen. (in.)	Rec. (in.)	/s/	PID (ppm)	SACE Staff: J. Turner Northing: 3004755.8 Easting: 786516.2
∍pt	Cas.	E	ď.	èC.	o o	۵(Surface El.: <u>+</u> 69.5 ft Datum: Vert: BCB; Horiz. NAD83 Equipmen
ď	ပိ	2S	Pe	Re	m ö	Б	Description & Classification Stratum Installed
							6" Asphalt Driller adv. Roller bit to 1ft Asphalt
							Cobbles
1	push	SS-1	10	4	13	0	2" Dense, gray medium to coarse SAND (SP), wet.
	pusii				50/4"		2" Dense, brown fine to coarse SAND and GRAVEL (SW), wet.
							*Driller adv. roller bit ahead of casing and through
	87*						boulder ~2-3.7 ft.
		00.0			FO/0"		Disco of annual in an annual
4		SS-2	2	1	50/2"	0	Piece of gravel in spoon tip
4.4		R-1	50	50	6 min		48" Very hard, black and gray, fresh to slightly weathered
					7 m:-		Granodioritic rock, joints spaced 2-16", dipping
					7 min		~30-45 deg. 2" Very hard, pink and black , fresh to slightly weathered,
					8 min		medium grained Granitic rock.
					O IIIIII		RQD = 24/50" = 48%
					14 min		No water return when rock coring
							\ <u>\</u>
8.6		R-2	48	48	10 min		Very hard, black and gray, fresh, medium grained,
							Granodioritic rock, joints spaced 4-21 in., dipping
					7 min		about 30-50 deg., slight rust staining in joints near
							core run hottom, healed joints with nink veins of
					7 min		mineral infilling. RQD = 43/48" = 90%
							RQD = 43/48'' = 90%
					8 min		No water return when rock coring
							Design to reciprote diet elecut 40.0%
							Boring terminated at about 12.6 ft.
							1
							1
							1
							1 1
							1
							1
Remarks	1. Drilli	ng techniq	ue adde	ed wate	r to boring	. Wate	er levels may not be indicative of natural groundwater level. Stephens Association
							Consulting

			Grou	undwa	iter:			Project: MWRA Pipeline Project, Contract No. 6905	Borin	a No	b. B-	11-MV
	Depti	h:	4.7		-	. (+18 hr	s)		-007 S h			of 1
	Time	:	Well inst	alled	4/10/	08 9 PM		<u></u> · · · <u></u>	oon ID 1.3	75 " (OD	2"
								Foreman: John Galvin Hammer Wt.: 140 lb	Fall:		30"	
	_	S.	o.			Blows/6" or Core Time			ash ID 4		OD 4	.5"
	Depth (ft.)	Blows	Sample No.	<u>.</u>	<u>-</u>	<u>"</u> 6"	Ē		ill Truck-n			<u> </u>
	ţ.	<u> </u>	ם	Pen. (in.)	Rec. (in.)	/sv Le	PID (ppm)	SACE Staff: J. Turner Northing: 3005025.8 Ea			539.6	
	eb	Cas.	am	eu	ec	o o	⊇	Surface El.: + 66.7 ft Datum: Vert: BCB; Horiz		-	uipmo	ent E
		ပ	S	_	~	a c	Δ	Description & Classification	Stratum	ın	stalle	d r
		push						6" Asphalt Driller adv. Roller bit to 1ft Cobbles	Asphalt	И		\prod_{1}
	1		SS-1	24	13	9	2	2" Loose, gray medium SAND (SP), wet.			2" ID PVC Well	1 2
	-	29*	- 00 1	27	10	36		11" Very dense, brown fine to coarse SAND and		Bentonite	ĺςĺ	
		F0*				49		GRAVEL, little non-plastic silt (SW-SM), wet		ento	Q	
		53*				48		*Driller advanced roller bit to 3 ft. before driving casing.		æ		
	3	14	SS-2	24	2	21	2	Gravel.	Ⅱ) j	
		17				18			l <u>"</u>		4 #	
		39				26					≡	
	5		SS-3	24	1	26 22	2	Medium dense, brown fine to coarse SAND, little			≣	
) 	40	<u> </u>	∠4	1	15	2	non-plastic Silt, trace gravel (SM), wet			≡	ing
						12		Driller noted mostly gravel in wash			<u> </u> ≣	Cas —
		25				3		2 Hotel Hoody graver in wall				Protective Casing
	7	20	SS-4	24	12	22	2	Dense, brown fine to medium SAND, some (+) non-plastic				tect
		36				17		Silt, some Gravel (SM), wet.			iee	Pro
		75				30					🚆	
	<u> </u>		00.5	4-	4.0	39		Dance having fine to good to CAND 1991 (1)		Ĕ	Slotted PVC Well screen 4 ft of	
	9	Roller bit ahead of casing	SS-5	15	10	30	2	Dense, brown fine to medium SAND, little (-) non-plastic		Sand backfill	8	
) —		ahi				21 50/3"		Silt, trace coarse sand (SM), wet.		pur	물	
		r bit ahe casing				30/3		Driller advanced rollerbit ahead of casing and		တိ	otte	
		of of						through boulder about 10.5 to 12 ft.				
		Ä						J			101	
		47							Ω		10 ft.	
		71							SAND		≣	
		204							Ŋ		$\overline{\mathbf{T}}$	
	14		SS-6	5	0	50/5"		No recovery.			▼	
	14		33-6	3	U	30/3						
_								Boring terminated at about 14 ft.				}
											4.5"	(neconecone
											amete	
										bo	orehole	
												omoonoon.
												
			ļ									
		ł										
		<u> </u>										
					-			Drilling technique added water to boring. Water levels may				
		}						not be indicative of natural groundwater level.				
		1 Pos	kground PII	D rood:	nge 2 r	nm			62 .		Acc	int -
	rks		kgrouna Pii ad box well		•		ored in	asphalt	Steph	Co	ASSOC Insulting	iates Enginee
	Remarks							indicated, are approximate. Transitions may be gradual.	Insightful,	Cost-		Structu
	Re			•				or time should be expected.	saving So for Buildin Infrastruct	os and	Hydrology	Geotechni & Hydrau
				- 1-10							,	,,

		Gro	undwa	ter:			Project: MWRA Pipeline Project, Contract No. 6905	Borin	g No . B-1
Depth	ո։	6 ft.						-007 Sh	
Time:		End of D	rilling	in cas	sing		Contractor: GeoLogic Sampler Type: Split spe	oon ID 1.3	75" OD 2"
							Foreman: John Galvin Hammer Wt.: 140 lb	Fall:	30"
	"				_			sh ID 4	" OD 4.5"
ı 🛈	Blows	Sample No.	_	(Blows/6" or Core Time	(-	Finish Date: 4/9/2008 Rig Type: Mobile Dr		
Depth (ft.)	36	<u>e</u>	Pen. (in.)	Rec. (in.)	3/6 Tir	PID (ppm)	SACE Staff: J. Turner Northing: 3005325.1 Ea	sting:	786572.5
ᄫ	S.	ш	<u>ا</u>	c. (e Š	d) (Surface El.: + 64.7 ft Datum: Vert: BCB; Horiz		Equipment
	Cas.	Sal	Pel	Re	S 8	Ы	Description & Classification	Stratum	Installed
			_	_		_	~6 in. Asphalt Driller adv. Roller bit to 1ft	Asphalt	motanoa
	push						Cobbles		
1		SS-1	24	16	32	1	5" Very dense, gray medium to coarse SAND (SP), wet.	SAND GRAVEL AND BOULDER FILL	
 	18				56	•	11" Very dense, brown GRAVEL and fine to coarse	ND GRAVEL AI BOULDER FILL	
					46		SAND, trace non-plastic Silt (GP-GM), trace brick,	Æ.	
	32				39		moist.	ΑÄ	
3		SS-2	2	1	50/2"	1	Gravel - possible remaining from casing washout	89.7	
3.5		R-1	12	11	4 min		Boulders - 2 granitic pieces, 5" and 6"	$\frac{1}{2}$	
							3 ,,	ΑM	
								Ś	
5		SS-3	24	0	7	2	No recovery.		
	4				3		Driller telescoped 3" casing and drove to 7 ft	$ \ \ \ $	
	2				2				
	3				2				_
7		SS-4	24	3	5	2	Dense, gray fine to medium SAND, some (-) non-plastic	_	-
					17		Silt, little Gravel (SM), trace organics including	Ν	
					41		roots and organic odor.	SAND	
					33		Driller indicated wash appeared to be gray sand	0,	
							Driller advanced roller bit through boulder from ~9-10 ft		
10		SS-5	24	11	10	2	Dense, gray grading to olive-brown SILT and fine SAND		
					20		(ML), very slight cohesion, wet.		
					27				
					26				
							Boring terminated at about 12 ft.		
 									
 									
$\vdash \vdash \vdash$									
╟─┼									
\parallel									
 									
\parallel									

B-12

Variations between exploration locations and over time should be expected. See Exploration Location Plan Location:

Soil/rock strata and groundwater surface, where indicated, are approximate. Transitions may be gradual.

_			undwa				Project: MWRA Pipeline Project, Contract No. 6905		g No.	
Deptl		7.5 ft.			(+20 hr			-007 S h		1 o
Time		End of D	Prilling	4/9/08	3 11:31	PM	· · · · <u></u>	on ID 1.3		
							Foreman: John Galvin Hammer Wt.: 140 lb	Fall:	30	
_	NS.	ō.			o e		Start Date: 4/8/2008 Drill Technique: Drive&Wa Finish Date: 4/9/2008 Rig Type: Mobile Dr	ill Truck n		4.5
Depth (ft.)	Blows	Sample No.	Pen. (in.)	Rec. (in.)	Blows/6" or Core Time	PID (ppm)	SACE Staff: J. Turner Northing: 3005605.8 Ea		78659	
oth	S. El	ldu	j.). (i	ws Le	<u>a</u>	Surface El.: + 63.2 ft Datum: Vert: BCB; Horiz.		Equip	
Эек	Cas	Sar	er.	Sec	8 50	9	Description & Classification	Stratum		
		0,		ш.	ш О		6" Asphalt Driller adv. Roller bit to 1ft	Asphalt	_	ca
	·						Cobbles	, roprian		
1	Push	SS-1	24	14	39	3	Very dense, brown, fine to coarse SAND and GRAVEL,		Sand	Í 🕈
	•				57		trace silt (SP-SM), moist, possible fill	_	Sa	
	15*				67		*Driller advanced roller bit to 3 ft. before driving casing.	FILL	te C	3
	10				57				Bentonite Sand Sand	[2
3	25	SS-2	24	11	26	2	Dense, brown, fine to coarse SAND, some Gravel,		3en	1
					20 16		little silt (SM), wet			<u> </u>
	41				19				4)
5		SS-3	24	3	16	2	Medium dense, brown GRAVEL, some fine to coarse		=	=
	20				14		SAND, trace silt (GW), wet.		=	sing
	20				13		,	$\overline{}$	=	ğ <u>=</u>
	28				10				=	Protective Casing
7	26	SS-4	24	5	22	2	Dense, brown GRAVEL, some medium to coarse SAND		=	
	20				30		(GW), wet.		9	[] H
	37				19				_ 5	3
9		SS-5	8	1	15 27	5	Very dense GRAVEL (GP) - likey remaining from		Kfill /	<u> </u>
9	73	JJ-5	0	'	50/2"	ວ	casing washout.	E	bac	?
					JUIZ		odonig washout.	AVI	Sand backfill	;
	111							38.	S #	
	56							SAND AND GRAVEL		
	50							A	#	5
	57							9	#04	=
								Ä	=	=
	35							(,	=	=
14	00	SS-6	24	7	16	5	Medium dense, gray-brown, medium to coarse			
	20				13		SAND, some Gravel, trace fine sand (SP), wet		1	7
	27				13				l	.,
					12				4.5 diam	
	34								borel	
	58									
	112									
	113									
19		SS-7	24	6	68	5	Very dense, gray-brown fine to coarse SAND, some			
					55		Gravel, trace silt (SW), wet.			
					54 45					
					45		Boring terminated at about 21 ft.			
							25.mg tommictod at about 21 ft.			
	· 									
			<u> </u>							
							Drilling technique added water to boring. Water levels may			
							not be indicative of natural groundwater level.			
									<u></u>	
emarks	1. Roa	d box well	cover fit	tightly	in hole bo	red in a	asphalt.	Steph	iens As	socia
		hackgound	d readin	as 2 to	3 ppm for	SS-1 t	o SS-5, and 5 ppm for SS-5 to SS-7.		Consu	ting Er

Deptl Time		Note 2 End of D	rilling	Cacir	na remov	vod.		-007 Sh	
ııme	•	⊏na of L	חווווק l	, casil	ig remov	vea		oon ID 1.3 Fall:	
								Fail: ish ID 4	30" " OD 4.
•	٧S	<u> </u>			Blows/6" or Core Time		Finish Date: 4/9/2008 Rig Type: Mobile Dr		
Depth (ft.)	Cas. Blows	Sample No.	Pen. (in.)	Rec. (in.)	"e"	PID (ppm)	SACE Staff: J. Turner Northing: 3005912.0 Ea		786628.9
ţ	ω.	ď	. (i	<u>:</u>	ws.	d)	Ţ.		
ер	as	an	en	၁ဓ	o io	₽			Equipme
	0	S	_	œ	шО	Д	Description & Classification	Stratum	Installe
	push						~6 in. Asphalt Driller adv. Roller bit to 1ft	Asphalt	
1	•	SS-1	24	1	11	2	Cobbles Dense, gray medium SAND, trace fine sand (SP), wet.		
1	24	33-1	24	I	11 46		Derise, gray medium SAND, trace line sand (SP), wet.		
					26				
	21				16		1	FILL	
					10		*Driller drove casing to 3 ft., and casing sank to 4	匝	
	*						when washing out		
4		SS-2	24	2	15	5	Loose, brown fine to medium SAND (SP), wet.		
	4				4		1 '		
	11				3		1		
	11				4			_	
6	push	SS-3	24	8	9	2	Medium dense, brown, fine to coarse SAND, some	SAND	
	5				8		Gravel (SP), wet.	SA	
	24				16				
_					19				
8	19	SS-4	24	1	15	1	Piece of gravel in spoon tip		
					11		-		
	21				10 12		1		
10		SS-5	24	7	18	1	Medium dense, red-brown fine SAND, trace		
10		33-3	24		15	- 1	silt (SP), wet.		
					11		311 (Or), wet.		
					8		1		
							Boring terminated at about 12 ft.		
							1		
							1		
							1		
							1		
							1		
							1		
							1		
			1				1		
							1		
]		
]		
							-		
							-		
							-		
							-		
							1		
							1		
							1		
							Drilling technique added water to boring. Water levels may		
							not be indicative of natural groundwater level.		
							1		
S	1. Bac	kground PI	D readi	ngs 1-2	ppm. Oth	ner tha	n SS-2, sample readings at background levels.	Stenh	ens Assoc
Remarks		•		•	• •		d. No water measured at depth of collapse.		Consulting
Ū	Soil/ro								

B-14

Location:

		Gro	undwa	ter:			Project: MWRA Pipeline Project, Contract No. 6905	Borin	g No. B-
Dept	h:	6 ft.			i i			-007 Sh	
Time		End of D	Drilling	, casir	ng remov	ved		on ID 1.3	
			3				Foreman: John Galvin Hammer Wt.: 140 lb	Fall:	30"
					_			sh ID 4	
∵	Blows	2	_	_	o e	<u>-</u>	Finish Date: 4/8/2008 Rig Type: Mobile Dr		
E	<u> </u>	<u>o</u>	<u>:</u>	.⊑	3/6 Tin	ρu	SACE Staff: J. Turner Northing: 3006261.4 Ea		786671.3
bt l	S.	dμ	٠.	ن (e š	g)	Surface El.: + 64.9 ft Datum: Vert: BCB; Horiz.		Equipment
Depth (ft.)	Cas.	Sample No.	Pen. (in.)	Rec. (in.)	Blows/6" or Core Time	PID (ppm)	Description & Classification	Stratum	
┢═╴			_	_		_	~6 in. Asphalt Driller adv. Roller bit to 1ft	Asphalt	motanou
	push						Cobbles	Cobbles	
1		SS-1	24	12	13	0	5" Dense, gray, medium to coarse SAND (SP), wet.		
	47				27		7" Dense, brown fine to coarse SAND, some Gravel,	-	
	35				23		trace silt (SP-SM)	FILL	
	33				20				
3	15	SS-2	24	3	19	0	Medium dense, brown, fine to medium SAND, little		
	10				15		Gravel, trace silt, (SP-SM), wet.		
	29				17				
ļ _		00.0	0.4	7	17	_	Cirrilan ta CC C		
5	18	SS-3	24	7	39 18	0	Similar to SS-2.	$\overline{}$	
 		1			14		1	<u> </u>	
 	33				25		1		
7		SS-4	24	9	15	0	Medium dense, brown, GRAVEL and fine to coarse SAND		
	17				13		(GW), wet.	0	
	40	1			25		1 ' "	SAND	
	43				33]	S/S	
9	22	SS-5	24	3	30	0	Very dense, brown, medium to coarse SAND and		
					27		GRAVEL, little fine Sand (SP), wet		
	42				24				
11		66 E	24	0	32 20		No recovery Driller indicated mostly group in week		
11	1	SS-6	24	U	12		No recovery. Driller indicated mostly gravel in wash		
 		 			12		1		
	†				22		1		
							Boring terminated at about 13 ft.		
]		
	↓						_		
							1		
<u> </u>	1						1		
<u> </u>	<u> </u>						4		
-	1						4		
 					 		1		
	†						1		
							1		
	1						1		
]		
							_		
	. ↓	<u> </u>					1		
<u> </u>	<u> </u>						4		
<u> </u>	1						-		
-	-	 					4		
 	1						1		
							1		
	1						1		
		1					1		
]		
	↓								
<u> </u>	1						1		
<u> </u>							4		
-	1						4		
	4 5	<u> </u>	<u> </u>			. 144 :			
ķ	1. Drill	iing techniq	ue adde	ea wate	r to boring	j. Wate	er levels may not be indicative of natural groundwater level.	Steph	ens Associat
emarks								A PARTY	PRESENCE OF STATES
en			•				indicated, are approximate. Transitions may be gradual.	Insightful, saving So for Buildin	lutions Goo
. ~	 Variati 	anc hotwor	an ovnic	ration	acations a	nd ove	or time special po expected		The dealers 0.1

Depth	ا و	Gro u 4.8 ft.	undwa 	ter:			Project:MWRA Pipeline Project, Contract No. 6905Boring No.Boring No.Location:Saugus, MAProject Number:026-08-007Sheet1
Time:		End of D)rillina	. casir	na remov	ved	Contractor: GeoLogic Sampler Type: Split spoon ID 1.375" OD 2
Time.		LIIG OI L	l	, casii	ig remov	veu	Foreman: John Galvin Hammer Wt.: 140 lb Fall: 30"
							Start Date: 4/7/2008 Drill Technique: Drive&Wash ID 4" OD 4.5
$\overline{}$	Blows	<u>ه</u> .			Blows/6" or Core Time		Finish Date: 4/7/2008 Rig Type: Mobile Drill Truck-mounted
Depth (ft.)	<u>6</u>	Sample No.	Pen. (in.)	Rec. (in.)	ا يا وا	PID (ppm)	
£	В.	jdı	i) .	i) .	vs/	dd)	
ер	Cas.	am	eu	ec	<u> </u>	Ω	Surface El.: + 66.2 ft Datum: Vert: BCB; Horiz. NAD83 Equipmer
	ပ	S	Д	8	B	Ь	Description & Classification Stratum Installed
\vdash							~6 in. Asphalt Driller adv. Roller bit to 1ft Asphalt
<u> </u>	push	00.4	0.4	4.4		_	Cobbles Cobbles
1 '		SS-1	24	14	7	0	6" Dense, gray m to c SAND, some Gravel (SP), wet.
					33		8" Very dense, brown, fine to medium SAND, little 그 드 Silt, little Gravel, trace brick (SM), wet
\vdash	2*				70 48		, , , , , , , , , , , , , , , , , , , ,
3		SS-2	24	5	48 17	1	*Driller adv. Roller bit to 3', then drove casing to 3 ft
3	12	33-2	24	3	33	-	Dense, brown, fine to coarse SAND, little Gravel, trace silt (SW), wet.
-					27		trace siit (SVV), wet.
$\vdash \vdash \vdash$	27				24		
5	_	SS-3	24	10	21	0	Medium dense, brown, fine to coarse SAND,
	27				18	,	Pulls and a later of the control of
\vdash					24		Ilttie gravei, trace siit (SW-SM), moist.
\vdash	54				27		ἄ
7	7.0	SS-4	24	12	29	0	Very dense, brown fine to coarse SAND and GRAVEL,
	73			-	33		trace silt (SP-SM), wet.
	00				41		
	82				57		
9	20	SS-5	24	12	31	0	Similar to SS-4.
	38				32		
	43				29		
	43				28		
11		SS-6	24	8	18	0	Medium dense, brown, fine to coarse SAND, little
$\sqcup \bot$					20		Gravel (SW), wet.
					13		
$\sqcup \!\!\! \perp$					11		
$\sqcup \sqcup$							Boring terminated at about 13 ft.
\longmapsto							
\longmapsto							
$\vdash \vdash \vdash$							
\vdash							
$\vdash \vdash \vdash$							
$\vdash \vdash$							
\vdash							
 							
\square							
$\sqcup \!\!\!\! \perp$							
\sqcup							
\longmapsto							
\longmapsto							
$\vdash \vdash$							
\vdash							
$\vdash \!$							
$\vdash \vdash \vdash$							
$\vdash \vdash$							
\vdash							
					-4-1 '	. \^/ -	
		na toohnia	الم عظظم	atew he	r to boring	1 Mate	er levels may not be indicative of natural groundwater level.

_			undwa		ı	1	Project: MWRA Pipeline Project, Contract No. 6905 Boring No. B-17
Dept		10.9 ft.		7.6 ft.		oll.	Location: Saugus, MA Project Number: 026-08-007 Sheet 1 of
Time	<u>:</u>	End of D	ווווזע פחוווזע	arter	weii inst	યા	Contractor: GeoLogic Sampler Type: Split spoon ID 1.375" OD 2"
							Foreman: John Galvin Hammer Wt.: 140 lb Fall: 30" Start Date: 4/4/2008 Drill Technique: Drive&Wash ID 4" OD 4.5"
(۸s	<u>o</u> .			or e	_	
Depth (ft.)	Blows	Sample No.	n.	n.)	Blows/6" or Core Time	PID (ppm)	Finish Date:4/7/2008Rig Type:Mobile Drill Truck-mountedSACE Staff:J. TurnerNorthing:3006805.6Easting:786781.2
ž	 B	ldu	Pen. (in.)	Rec. (in.)	ws, e T	ď)	Surface El.: + 71.4 ft Datum: Vert: BCB; Horiz. NAD83 Equipment
Эер	Cas.	san	en	Sec	3lo	٩	Description & Classification Stratum Installed
	0	0,	ш	ш.	шО		12" Asphalt Driller adv. Roller bit to 1ft Asphalt
	βι						
1	of casing	SS-1	8	4	36	0	Very dense, gray medium to coarse SAND (SP), wet. Driller advanced roller bit ahead to 3 ft., then attempted 4" casing, then 5" casing. Boring skewed. No water return. No recovery. Poulders 1.3 ft. skewed assing. Bering effect 3.8 ft.
	ပ္ပိ				50/2"		Very dense, gray medium to coarse SAND (SP), wet. Driller advanced roller bit ahead to 3 ft., then attempted
	90						4" casing, then 5" casing. Boring skewed.
	ahead lers						4" casing, then 5" casing. Boring skewed. No water return. No recovery. Paydors 1.2 th skewed assign. Paring affect 2.8 th
3	ah	SS-2	0	0	50/0"		No recovery.
	bit Di						Boulders 1-3 ft. skewed casing. Boring offset 2.8 ft.
	ler bo						
	lo de	CC 2	_	_	E0/0"		casing to 4' & 4" casing to 5', no water return.
5 5.5	nced roller bit ahe through boulders	SS-3 R-1	0 10	5	50/0" 4 min		No recovery. Boulder - very hard black Dioritic rock
ა.၁	유	rX-1	10	3	4 111111		No water return.
	dve						Driller drove 3" casing to ~7.5 ft. and advanced roller
	r a						Boulder - very hard black Dioritic rock No water return. Driller drove 3" casing to ~7.5 ft. and advanced roller bit to 8 ft. through another boulder, then sampled SS-4.
	Driller advanced roller bit through boulc			1			
8	۵	SS-4	24	11	8	0	1" Loose fine to coarse SAND and GRAVEL (SW), wet.
					2		2" Medium stiff, dark brown non-plastic SILT, little
	42				4		2" Medium stiff, dark brown non-plastic SIL1, little fine Sand, trace organics (ML) - likely former topsoil. 8" Medium stiff, reddish brown non plastic SILT, some fine to medium Sand (ML), wet (sample).
					28		8" Medium stiff, reddish brown non plastic SILT,
	127						Boulder - very hard black Dioritic rock No water return. Driller drove 3" casing to ~7.5 ft. and advanced roller bit to 8 ft. through another boulder, then sampled SS-4. 1" Loose fine to coarse SAND and GRAVEL (SW), wet. 2" Medium stiff, dark brown non-plastic SILT, little fine Sand, trace organics (ML) - likely former topsoil. 8" Medium stiff, reddish brown non plastic SILT, some fine to medium Sand (ML), wet (sample). Driller removed 3" & 4" casing, advanced 5" roller bit
	156						to 9' and drove to 14'.
	400						
	139						through boulder at ~5.5 ft., then reinserted 4" casing to 9' and drove to 14'.
	87						📆 =
	07	0.0					
14	22	SS-5	24	0	25		No Recovery.
					26 25		
	40				25		
	,				۷4	ļ	Change based on casing blows
	108						diameter
	270						D borehole to
	270						borehole to V V V V V V V V V V V V V V V V V V
	236						diameter
	200	00 -			0.5		borehole to
18	ļ	SS-6	24	12	30	0	very dense, brown, fine to coarse SAND, little Gravel,
					32 20		trace (+) silt (SW-SM), wet.
	1				30		
					30		Boring terminated at about 21 ft.
	ł						Bonny terminated at about 21 It.
	1						
	1						
	1						
	t						
	1. Drilli	na technia	ue adde	ed wate	r to boring	ı. Wate	r levels may not be indicative of natural groundwater level. Stephens Associat
Remarks						,aic	Consulting En
ша	Soil/ro	ck strata ar	nd arour	ndwatei	r surface	where i	ndicated, are approximate. Transitions may be gradual.
			n explo		,		ntdicated, are approximate. Transitions may be gradual.

Dept		7 ft. in ca		7.0 ft.				Borin -007 Sh	eet	1	of
Depth (ft.)	Cas. Blows	Sample No.	Pen. (in.)	Rec. (in.)	Blows/6" or	(mdd	Contractor: GeoLogic Sampler Type: Split spot Foreman: John Galvin Hammer Wt.: 140 lb Start Date: 3/30/2008 Drill Technique: Drive&Wa Finish Date: 3/31/2008 Rig Type: Mobile Dr SACE Staff: J. Turner Northing: 3006830.2 Ea Surface El.: ± 72.9 ft Datum: Vert: BCB; Horiz Description & Classification	ill Truck-n	7868 Eq u	30" D ted 377.	1 ent
	push	00.4	0.4	45		0.0	6" Asphalt Driller adv. Roller bit to 1ft Cobble	Asphalt Cobbles	70		ا ا
1	27	SS-1	24	15	20 33 18	0.9	3" Dense, gray coarse SAND, moist. 12" Dense, brown, fine to medium SAND, some Silt (SM), little Gravel, moist		Sand		
3	16 5	SS-2	24	7	14 8 7	0.4	Medium dense, brown, fine to medium SAND, some Gravel, little Silt (SM), wet	FILL		: Well riser	
5	10 7	SS-3	24	0.5	8 10 6 4	0.7	Pieces of gravel.	E	Bentonite Chips	10 ft of 2" ID PVC Well riser	ing —
	13	00.4	0.4	7	2	0.4	57W77-1777-1777-1777-1777-1777-1777-1777	∇	Bento	10 ft o	Protective Casing
7	18 17	SS-4	24	7	13 10 5 3	0.4	Stiff, light brown, non-plastic SILT and fine to coarse SAND (ML), wet.		_		Prote
9	casing	SS-5	15	10	20 47 50/3"	0.4	Very dense, light brown, fine to coarse SAND, some non-plastic Silt, some Gravel (SM), wet.		Sand backfill	creen	
	Roller bit ahead of						Driller advanced roller bit ahead of casing to 14 ft., then advanced casing to 14 ft. and sampled SS-6	SILTY SAND	Š	Slotted PVC Well screen	
14	왕 82/8"	SS-6	11	6	38 100/5"	0.4	Very dense, light brown, fine to medium SAND, little (-) non-plastic Silt (SP-SM), wet.	IS		5 ft. S	
16		R-1	42		3 min/ft 4 min/ft 4 min/ft		Driller indicated top of rock about 15 ft. based on action of drilling equipment. Driller advanced roller bit to about 16 ft. Black, very hard, fresh to slightly weathered, aphanitic, meta-Dioritic rock, perhaps contact metamorphism, very closely spaced joints near horizontal, joint surface undulating, no infilling observed, minor rust staining,	ROCK	dia	▼ 4.5" amete orehol	
19.5		R-2	18		3 min/6 6 min/1		also healed joints with veins of minearal infilling. Core barrel jamed ~19.5 ft. RQD = 30/42" = 71% Black, very hard, fresh, aphanitic, Dioritic rock, closely spaced near horizontal to low angle (~30 deg.) joints, joint surface undulating, no infilling observed, also healed joints with veins of minearal infilling. RQD = 15"/18" = 83%				
							Boring terminated about 21 ft.				
							Drilling technique added water to boring. Water levels may				

			Gro	undwa	ter:			Project: MWRA Pipeline Project, Contract No. 6905	Boring	g No. B-1	19
	Depth):	8 ft. in c						-007 Sh		1
	Time:		End of D	Drilling				<u></u> · · · <u>_ · · · · · </u>	oon ID 1.3		
								Foreman: John Galvin Hammer Wt.: 140 lb	Fall:	30"	
		S	ó			ō			ash ID 4		
	ft.)	Blows	Sample No.	<u>.</u>	·	Blows/6" or Core Time	Ē		ill Truck-m		S
	Depth (ft.)	ă	ble	Pen. (in.)	Rec. (in.)	s/€	PID (ppm)	SACE Staff: J. Turner Northing: 3007157.4 Ea		786938.0	Remarks
	ept	Cas.	E	Ä.	<u>ပ</u> ွဲ	ow) <u>a</u>	Surface El.: <u>+</u> 82.8 ft Datum: Vert: BCB; Horiz		Equipment	E
	ŏ	Ü	Š	P	Ř	шç	Ы	Description & Classification	Stratum	Installed	Ŗ
								6" Asphalt Driller adv. Roller bit to 1ft	Asphalt		
	4		00.4			0.4		Cobbles	<u>Cobbles</u>		
	1		SS-1	6	2	21 50/1"	0.3				
						50/1		Dense gray-brown fine to coarse SAND, trace silt, trace gravel (SW), wet.	FILL		2
								Siit, trace graver (OVV), wet.			
	3		SS-2	24	5	13	0	Medium Dense, light brown fine to medium SAND			
						13		and GRAVEL, trace silt (SP-SM), wet	<u> </u>		
						14		, , , , , , , , , , , , , , , , , , , ,	щ ≶		
						16			멸망		
	5		SS-3	24	4	10	0	Medium Dense, light brown GRAVEL, some fine to	PROBABLE D and GRA FILL		
						9		coarse Sand, trace silt (GW), wet.	RC ar		
						9		1	요		
	-		CC 4	4.5	2	5		Donos block CBAVEL (CB)	PROBABLE SAND and GRAVEL FILL		
	7		SS-4	15	3	7	0	Dense, black GRAVEL (GP), wet. Driller advanced 4" casing to 8 ft. then roller bit			
			1			50/3"		Drilling water lost at 8-8.5 ft. Driller advanced	<u> </u>		
						00/0		3" casing to 8.5 ft., roller bit to 9 ft.	-	•	
	9		R-1	36	12	9 min/3	ft.	Very hard, moderately weathered, severely fractured,			
) —								aphanitic, Dioritic rock (Gravel). Core barrel			
, —								jammed repeatedly.			
								RQD = 0%			
									_ ×		
								Baring and a firm and a firm and a second and a second and a firm and a second and	ROCK		
								Boring collapsed after rock core barrel removed.	M M		
								Prescribed boring depth reached - boring terminated at about 12 ft.			
								terminated at about 12 it.			
_											
5 —											
	-										
_											
) —								1]		}
]		
								1]		
								-]		
]		
						-		1			ļ
	\vdash					 		1]		ļ
5 —						<u> </u>		1]		}
								1]		
								Drilling technique added water to boring. Water levels may			
								not be indicative of natural groundwater level.			
								<u> </u>			
	S	1. PID	backgound	d readin	gs 0.3 t	to 0.4 ppm	for S-	PID malfunction. S-2,3,4 read 48 hrs. later with new PID.	Steph	ens Associate	es
	Remarks	2. Obs	truction at	~2 ft. D	riller of	fset ~3 ft.	west a	nd continued.		Consulting Eng	1000
	e u	Soil/ro	ck strata ar	nd groui	ndwate	r surface,	where i	indicated, are approximate. Transitions may be gradual.	Insightful, 0 saving Solo	utions Gente	tructura echnica
	Ŗ	Variati	ons betwee	en explo	ration I	ocations a	and ove	er time should be expected.	for Building Infrastructu	as and	
	Boring	No.:		B-19		Locatio	n:	See Exploration Location Plan 668 Main Street, Wilmingt	on, MA 018	887 (978) 988	-211

		Gro	undwa	ter.			Project: MWRA Pipeline Project, Contract No. 6905	Boring	No. B-2	20
Dept	h:	2.8 ft.						-007 Sh e		1
Time	:	End of D	rilling	, casir	ng remov	vec		oon ID 1.37	75" OD 2"	
							Foreman: John Galvin Hammer Wt.: 140 lb	Fall:	30"	
	Ø	o.			o «			ash ID 4		
∃	Blows	Ž	<u>:</u>	÷	6" e	m)		ill Truck-m		S)
<u>ج</u>	<u> </u>	e d	≒	: <u> </u>	vs/	dd)	SACE Staff: J. Turner Northing: 3007201.6 Ea		786847.9	arl
Depth (ft.)	Cas.	Sample No.	Pen. (in.)	Rec. (in.)	Blows/6" or Core Time	PID (ppm)	Surface El.: + 82.9 ft Datum: Vert: BCB; Horiz		Equipment	Remarks
_		S	₾	8	B C	Ь	Description & Classification	Stratum	Installed	R
	push 7						6" Asphalt Driller adv. Roller bit to 1ft Gravel and Cobbles	Asphalt .		1
1		SS-1	24	13	7	0	4" Very dense, gray medium to coarse SAND (SP), wet.			
<u> </u>	81	00 1		10	60	-	9" Very dense, brown, fine to medium SAND and			
	F-7				38		GRAVEL, little non-plastic Silt (SM), wet.	$\overline{}$		
	57				28		, , , , , , , , , , , , , , , , , , , ,			
3	ng	SS-2	3	0.5	50/3"	0	Very dense, gray-brown piece of GRAVEL and fine to			
	asi						coarse SAND (GP), wet.			
<u> </u>	of casing						Driller advanced roller bit to 5 ft. before driving casing	FILL		
	bit ahead of c before driving	00.0	0		EE	0	Driller noted boulders.	<u>\</u>		ļ
5	hes e d	SS-3	8	5	55 50/2"	0	Very dense, brown fine to medium SAND, some Gravel, little non-plastic Silt (SM), wet	Щ		
\vdash	fal for				JU/2		Driller advanced roller bit to 7 ft. before driving casing	AB 다		
\vdash	r bi						Driller noted boulders.	OBABI SAND FILL		
7	Roller bit ahead before driv	SS-4	11	11	55	0	Very dense, gray-brown fine to medium SAND and	PROBABLE SAND FILL		
	∝				100/5"		non-plastic SILT (SM), trace coarse sand, wet	<u> </u>		
L	↓						Driller advanced roller bit to 8.5 ft. before driving casing			
8.5	1	R-1	24	24	7 min		Very hard, fresh, gray with light pink, medium to coarse			
 	4		1		0 min		grained Granitic rock, no joints, 2 drilling fractures RQD = 100%			
	1				9 min		NQD = 100%			
10.5	†	R-2	24	22	12 min		14" similar to R-1.	는 동		
. 5.0	<u> </u>	.,,_	<u> </u>				8" Very hard, fresh, black, fine grained Dioritic rock, joints	ROCK		
	1				9 min		low angle (~30 deg.), undulating, no infilling	Ľ.		
							RQD = 20/24" = 83%			
-	1									
	4						Boring terminated at about 12.5 ft.			
 	1									
 	1									
	+									
	†									
	4									
 	1		-							
—	+									
	†									
										<u> </u>
	↓ _									
ļ										
	4									
-			-							
<u> </u>	†		-							
	<u> </u>									
-	4									
 										
	+		-							
	1 Drilli	na technic	الات عظم	ad wata	r to borina	\/\/ata	or levels may not be indicative of natural groundwater level	Ct1	ana Bassatat	
rks	ı. Drilli	ng techniq	ue adde	u wate	i io boring	. vvate	er levels may not be indicative of natural groundwater level.	Stepho	ens Associate Consulting Eng	e S gineers
Remarks	Soil/ro	ck strata ar	nd arou	ndwater	r surface v	where	indicated, are approximate. Transitions may be gradual.	Insightful, C	Cost- SI	tructural
Rei			•				r time should be expected.	saving Solutor for Buildings Infrastructure	tions Geote	echnical
	ng No.:		B-20		Locatio		See Exploration Location Plan 668 Main Street, Wilmingt		10 0000 10	
2011	.9 110		20 د			•••	200 Exploration Education Flair 000 Main Offect, Williamigt	211, IVIA 010	C. (310) 300	_ 1 1

			Gro	undwa	ter:			Project: MWRA Pipeline Project, Contract No. 6905 Boring No. B-	-21
[Depth	ո։	3.2 ft.					Location: Saugus, MA Project Number: 026-08-007 Sheet 1 o	f
ħ	Time:		End of d	rilling,	inside	e casing		Contractor: GeoLogic Sampler Type: Split spoon ID 1.375" OD 2	"
								Foreman: John Galvin Hammer Wt.: 140 lb Fall: 30"	
						<u>_</u>		Start Date: 4/24/2008 Drill Technique: Drive&Wash ID 4" OD 4.5	,"
	£	Blows	Sample No.	_	_	Blows/6" or Core Time	<u>-</u>	Finish Date: 4/24/2008 Rig Type: Mobile Drill Truck-mounted	1
	Depth (ft.)	읆	ole	Pen. (in.)	Rec. (in.)	s/6	PID (ppm)	SACE Staff: J. Turner Northing: 3007447.7 Easting: 786895.1	ıt
	pt	S.	ш	<u>.</u>	S	e Š	3	Surface El.: + 83.9 ft Datum: Vert: BCB; Horiz. NAD83 Equipmen	t
	De	Cas.	Sa	Pe	Re	ဗိ ဗိ	뭅	Description & Classification Stratum Installed	
╁								7" Asphalt Driller adv. Roller bit to 1ft Asphalt	T
		push					-		Ī
	1	7*	SS-1	7	7	51	0.9	3" Very dense, black and gray, medium to coarse	
						50/1"		SAND (SP), wet.	L
L		6*						4" Very dense, brown fine to medium SAND, trace	ŀ
	2		SS-2	24	7	43	0	silt, SP), wet. Dense, gray-brown, fine to medium SAND, some Silt,	H
⊩	3	42	33-2	24		29	U	little Gravel (SM), wet.	ŀ
┢						17		ilitile Graver (GM), wet.	ŀ
┢		31				14			ŀ
╫	5	0.4	SS-3	24	8	19	0	6" Similar to S-2 - corrosion sample	ŀ
╟		81				36		2" Very stiff, dark brown SILT, some fine Sand, trace	T
		41				19		organics, (ML), likely former topsoil, wet - geo sample. ㅁ _	
		71				12			
	7	16	SS-4	24	7	17	0	Very dense, gray fine to medium SAND and GRAVEL,	ļ
\Vdash						24		organics, (ML), likely former topsoil, wet - geo sample. Very dense, gray fine to medium SAND and GRAVEL, little (-) Silt (SM), wet.	-
╟		87				46 30		"	}
╟	9		SS-5	3	1	50/3"	0	Very dense, gray and black, fine to coarse SAND	+
╟	9.5		R-1	12	12	6 min/ft			上
╫						2,70		and GRAVEL (SW), piece of gravel in spoon tip, wet. R-1 Very hard, black, fresh, fine to medium grained Dioritic rock, joints near horiz, to near vertical	ŀ
	R-2		R-2	24	19	6 min/ft		Dioritic rock, joints near horiz. to near vertical,	Γ
								also healed joints with veins of minearal infilling.	
						6 min/ft		Core barrel jammed. RQD = 0%	L
								R-2 Very hard, black, fresh, fine grained Dioritic rock with	L
L								white veins of minear infilling in healed joints, joints	L
F								near horiz. to ~45 deg., spaced about 1-4 in. RQD = 4/24" = 17%	-
⊩								Boring terminated at about 12.5 ft.	
┢								Bonng terminated at about 12.0 ft.	-
┪									
									-
									L
L									ŀ
F									ŀ
╟									F
╟									-
╟									
╁									ľ
									Ī
L									L
L									L
╟									L
╟									-
╟									}
╟									╁
╟									ŀ
╁									ľ
╟									j
									L
\parallel									L
F				<u> </u>	<u> </u>			■ ***	
	ķ	1. Drilli	ng techniq	ue adde	ed wate	r to boring	. Wate	or levels may not be indicative of natural groundwater level. Stephens Associa Consulting E	tes
	emarks	_	_					Processor Control of the Control of	
	en			•					Stru
L	<u>~</u>		ons betwee		ration I			r time should be expected. Hydrology &	200
_		g No.:		B-21		Locatio	n:	See Exploration Location Plan 668 Main Street, Wilmington, MA 01887 (978) 98	8-2

			Gro	undwa	iter:			Project: MWRA Pipeline Project, Contract No. 6905	Boring	g No. B-2	22
	Dept	h:	3.1 ft.					Location: Saugus, MA Project Number: 026-08	8-007 Sh	eet 1 of	1
	Time	:	End of d	Irilling,	, inside	e casing			oon ID 1.3	75" OD 2"	
								Foreman: John Galvin Hammer Wt.: 140 lb	Fall:	30"	
		ဖွ	ö			٠ a			ash ID 4		
	ft.)	Blows	Ž	·	<u>.</u>	3" (Œ		rill Truck-m		S)
) 	8	ble	Ē	Ë	/s/	ldd	SACE Staff: J. Turner Northing: 3007507.7 E		786995.3	ar
	Depth (ft.)	Cas.	Sample No.	Pen. (in.)	Rec. (in.)	Blows/6" or Core Time	PID (ppm)	Surface El.: + 85.3 ft Datum: Vert: BCB; Horiz		Equipment	Remarks
0 —	۵	Ö	ΐ	ď	Ř	шÖ		Description & Classification	Stratum	Installed	Ř
_		push						7" Asphalt Driller adv. Roller bit to 1ft	Asphalt		4
	1		SS-1	24	16	12		5" Concrete 5" Dense, gray, medium SAND (SP), wet.	Concrete		1
	-	49	33-1	24	10	37		11" Very dense, brown fine to medium SAND, some			
						46		Gravel, little Silt (SM), moist			
		71				42			∇		
	3	33	SS-2	24	14	33		Very dense, brown fine to medium SAND, trace gravel,			
		55				41		trace silt (SP), moist.			
		81				39			اب ـا		
5 —	5		SS-3	24	9	40 33		Very dense, gray brown fine to coarse SAND and	밀모		
		74	33-3	24	9	30		GRAVEL, little Silt (SM), rust staining over ~2"	PROBABLE SAND AND RAVEL FILI		
		400				47		length near middle of sample, wet.	Ş Ž Ş		
		103				44			PROBABLE SAND AND GRAVEL FILL		
	7		SS-4	3	0	50/3"		No recovery.	.		
	_		D 1	40	47	E		Vanchard blook front fire maked District			
	8	<u> </u>	R-1	48	47	5 min/ft		Very hard, black, fresh, fine grained Dioritic rock, fractures spaced 15-32 in., dipping ~30 deg.			$\ \cdot \ $
	-			 		6 min/ft		RQD = 47/48" = 98%			
40						0 11111 1/10		1145 = 11710 = 5576			
10 —						5 min/ft					
									ROCK		
		 				5 min/ft		Desire two installed about 40 ft	RO		
								Boring terminated at about 12 ft.			
		ļ									(
15 —											
		<u> </u>									(nennennennenne
		Ì									
20 —											├ ╢
	L	<u></u>									
	 			<u> </u>							
				 							
		†									
25 —											
20		ļ									
	 			<u> </u>							
	-			 							
	S	1. Drilli	ing techniq	ue adde	ed wate	r to boring	Wate	er levels may not be indicative of natural groundwater level.	Steph	ens Associate	es
	Remarks									Consulting Eng	ineers
) iii	Soil/ro	ck strata ar	nd groui	ndwatei	surface,	where	ndicated, are approximate. Transitions may be gradual.	Insightful, (saving Sol	utions Gent	tructural echnical
	Ä	Variati	ons betwee	en explo	ration I	ocations a	ind ove	r time should be expected.	for Building Infrastructu	as and	
	Borin	g No.:		B-22		Locatio	n:	See Exploration Location Plan 668 Main Street, Wilming	ton, MA 018	887 (978) 988	-2115

Depti	1:	Gro	undwa				Project:MWRA Pipeline Project, Contract No. 6905Location:Saugus, MAProject Number:026-08-06	Boring 07 She	
Depth (ft.)	Blows	Sample No.	Pen. (in.)	Rec. (in.)	Blows/6" or Core Time	PID (ppm)	Contractor: GeoLogic Sampler Type: Split spool Foreman: John Galvin Hammer Wt.: 140 lb Start Date: 4/2/2008 Drill Technique: Drive&Wash Finish Date: 4/3/2008 Rig Type: Mobile Drill SACE Staff: J. Turner Northing: 3007625.9 East	Fall: 1 ID 4" Truck-moting: 7	30" OD 4.5" ounted '86929.9
Dep	push Cas.	Sam	Pen	Rec	Blo	PID	·	Stratum Asphalt	Equipment Installed
1		SS-1	14	6	7	0	3" Dense gray medium SAND (SP), wet.	_	
	30 69				53 50/2"		3" Dense, brown medium SAND, trace fine sand, trace gravel (SP), wet.	립	
3	62	SS-2	14	7	83	0	Very dense, gray-brown fine to medium SAND,	AVE	
					72 50/2"		some Gravel, little Silt (SP-SM), wet.	3/GR	
5	90	SS-3	4	2	100/4"	0	Very dense, black, brown and gray GRAVEL, some	LDEF	
	153 63				100/4		coarse Sand (GP), wet - Fill. Driller noted boulders that skewed and bent casing	BOULDER/GRAVEL FILL	
7		SS-4	24	8	28	0	2" Dense, dark brown non-plastic SILT and fine SAND,		
					7 64		trace organics (ML) - former topsoil. 6" Very dense, light brown non-plastic SILT, some	PROBABLE SAND AND GRAVEL	
					39		fine to medium SAND, little Gravel (ML), wet. Driller advanced roller bit ahead of casing to 9 ft.	ABLE GR/	
							Casing broke with driving from 7 to 9 ft. Driller removed casing, abandoned boring, offset and	3OB, AND	
							advanced boring B-23A about 2 ft. south.	<u>a</u>	
-									
-									
emarks							er levels may not be indicative of natural groundwater level. Indicated, are approximate. Transitions may be gradual.	Stephe Insightful, Co	ns Associate Consulting Eng

	Gro	undwa	iter:			Project: MWRA Pipeline Project, Contract No. 6905	<u>Bo</u> rin	g No. B
Depth:	7 ft.						-007 Sh	
Time:	End of D	Drilling					oon ID 1.3	
						Foreman: John Galvin Hammer Wt.: 140 lb	Fall:	30"
_ ×	ું			o e	•	Start Date: 4/3/2008 Drill Technique: Drive&Wa Finish Date: 4/3/2008 Rig Type: Mobile Dr	ash ID 4	
Depth (ft.)	Sample No.	Pen. (in.)	Rec. (in.)	Blows/6" or Core Time	PID (ppm)	SACE Staff: J. Turner Northing: 3007625.9 Ea		786929.9
at l	l m	<u>ا</u>	c. (ws re	d) (Surface El.: + 88.5 ft Datum: Vert: BCB; Horiz		Equipme
Deptl	Sa	Pe	Re	ခြဲ ပိ	ЫC	Description & Classification	Stratum	
							<u> </u>	
							Α	
							GR	
						Refer to log of boring B-23 for upper 9 ft.	<u> </u>	
							BOULDER/GRAVEL FILI	
							INC	
						Driller advanced rollerbit to 4 ft., 4" casing to 4',	ĕ	
			-			roller bit to 9 ft., 3" casing to 9 ft. Driller encountered		
\vdash			-			numerous boulders - difficult drilling.	∇	
						Change indicated based on boring B-23		
						•		
\Vdash		-					PROBABLE SAND AND GRAVEL	
9	S-5	16	0.5	34		Piece of gravel in spoon tip.	S/S	
			0.0	64		r loos of graver in opeon up.	SLE 3R/	
				50/4"			ROBABLE SAN AND GRAVEL	
						Driller advanced roller bit to 12.5 ft. then casing.	RO A A	
						Driller indicated top of rock at about 12 ft. based	Ф	
						on roller bit action		
12.5	R-1	60	53	1 min		Very hard, fresh to slightly weathered, black, fine		
				5 min		grained Dioritic rock, closely spaced joints (~2-10"), slight rust staining, joints near horizontal to low angle		
				3 111111		dipping up to ~30 degrees, undulating, no infilling		
				4 min		observed, also healed joints with veins of minearal		
				E min		infilling. Fracture zone of gravel ~4 in. long near middle of core.		
				5 min		RQD = 35/60" = 58%		
				4 min			~	
47.5	D.0	00	0.4	0		Manufacial foods blood for analysis Bloods and subtra	ROCK	
17.5	R-2	36	31	3 min		Very hard, fresh, black, fine grained Dioritic rock, white pegmatitic seam near bottom of run with joint at seam.	R	
				2 min		Healed joints with veins of mineral infilling. No other		
						joints in run. Joints dip at ~10-30 deg., no infilling		
 		-		3 min		observed. RQD = 30/36" = 83%		
						1/4D - 30/30 - 03/8		
						Boring terminated at about 20.5 ft.		
\parallel			-					
 								
			-					
 								
 								
y 1. C	rilling technia	ue adde	ed wate	er to boring	ı. Wate	er levels may not be indicative of natural groundwater level.	Stenh	ens Associa
emarks	•			J		· ·	- Copin	Consulting E

			0					Duniants MANDA Displies Duriant Contract No. COOF	Davis	- Na D 0	
	Dani	L .		undwa '	iter:	1 1		Project: MWRA Pipeline Project, Contract No. 6905	Boring		:4
	Depti		Note 1					Location: Saugus, MA Project Number: 026-08		eet 1 of	1
	Time	:						<u> </u>	oon ID 1.3		
								Foreman: John Galvin Hammer Wt.: 140 lb	Fall:	30"	
		S	ö			ה ה			ash ID 4		
	£	Blows	Sample No.	·	·	Blows/6" or Core Time	Ē		ill Truck-m	nounted	S
	Depth (ft.)	ĕ	<u>e</u>	Pen. (in.)	Rec. (in.)	s/6	PID (ppm)	SACE Staff: J. Turner Northing: 3007775.0 Ea	sting:	787037.5	Remarks
	효	S.	Ĕ	-	ن	e Š	<u> </u>	Surface El.: + 96.6 ft Datum: Vert: BCB; Horiz	NAD83	Equipment	ms
	De	Cas.	Sal	Pe	Re	မ္က	吕	Description & Classification	Stratum	Installed	Re
0 —				_	_		_	6" Asphalt Driller adv. Roller bit to 1ft	Asphalt	motanoa	_
		Push						Cobbles	Cobbles		1
	1		SS-1	14	8	3	0	4" Medium dense, gray medium SAND (SP).	Copples		
	<u>'</u>	30	- 00 1	17	-	20		4" Dense, brown fine to medium SAND, little Gravel,			
						50/2"		trace silt (SP), wet.			
		38				30/2		trace siit (or), wet.			
	3		SS-2	4	2	50/4"	0	Very dense, light brown, fine to coarse SAND, little			
		23	00-2			30/4	- 0	non-plastic Silt, little Gravel (SM), wet			
								non-plastic ont, little oraver (ow), wet	╛		
		118						1	ᇤ		
5 —	5		SS-3	20	8	40	0	Very dense, light brown, fine to medium SAND and	Щ		├
		41	33-3	20	0	46	U	non-plastic SILT, (SM), wet	BI		
	-					83			ďβ		
	 	105				50/2"		Driller advanced roller bit ahead of casing from 5-7'	PROBABLE FILL		
	7		SS-4	2	2	50/2"	0	Similar to S.2. expent land! Croup!	급		
			33-4			50/2	U	Similar to S-3, except 'and' Gravel			
	 							Driller advanced roller bit ahead of casing ~6 in. and lost water, then advanced casing to ~7.5 ft. and	∤ -		
		1				-		end for night. Pull casing to ~7.5 ft. and cap			
	9		R-1	48	38	5 min					
	9		K-1	40	30	3 111111		Driller advanced roller bit to 9 ft. and set 3" casing			
10 —						4 min		Driller indicated top of weathered rock ~8 ft			
						4 min		26" Very hard, fresh to slightly weathered, black,			
						4 min		fine grained Dioritic rock, no joints or fractures			
						4 min		12" Very hard, moderately weathered, pink and gray,			
						2 min		medium grained Granitic rock, highly fractured (gravel),			
						3 min		some rust staining. RQD = 54%	ROCK		
	12		D 0	24	0	2 min/2	££	core barrel jammed at about 13 ft.	Õ		
	13		R-2	24	8	3 min/2	II.	Very hard, moderately weathered, medium grained	<u> </u>		
								orange and pink Granitic rock (gravel), some Dioritic			
								fragments, highly fractured. RQD = 0%			
15 —	15		D 2	26	20			Core barrel jammed about 15 ft.			
	15		R-3	36	20			8" Gravel 12" Very hard, moderately weathered, medium grained			
								orange and pink Granitic rock, highly fractured, some			
						-		rust staining in joints RQD = 0%			
		1				-		NQD = 0 /0			
	 	<u> </u>		-	<u> </u>	 		Roring terminated shout 19 ft			
	 	1						Boring terminated about 18 ft.			
	 							1			
	 	1						1			
20 —								1			 -
	-	1				1		1			
	-							1			
		+		1		 		1			
	 							1			
	 	1						1			
	 							1			
	 	1						1			
								1			
	 	1						1			
<u> 2</u> 5 —	-					1		1			
	 	ł		-	<u> </u>	 		1			
	 							1			
	 	1						1			
	 							1			
	 	1						1			
	 		<u> </u>	<u> </u>	<u> </u>	<u> </u>		<u> </u>	Description 1990	2000	
	ırks		•			er to boring	. Wate	er levels may not be indicative of natural groundwater level.	Steph	ens Associate	es
	ī	at 5 ft.	- no water	present	t.					Consulting Eng	meers

Soil/rock strata and groundwater surface, where indicated, are approximate. Transitions may be gradual. Variations between exploration locations and over time should be expected.

Structural Geotechnical Hydrology & Hydraulics

cas. Blows	Samble No.		insid	e casing		•	oon ID 1.3	75" OD 2
Cas.				0 0009	•			
Cas.	nple No.					Foreman: John Galvin Hammer Wt.: 140 lb	Eall:	30"
Cas.	nple No.						Fall:	
Cas.	n ble N			Blows/6" or Core Time				
Cas.	əldu	_ ` _ `	<u>-</u>	Ę, Ĕ	PID (ppm)		rill Truck-m	
Cas.	_	Pen. (in.)	Rec. (in.)	s⁄.	do	SACE Staff: J. Turner Northing: 3008011.5 Ea		786969.9
	u	Ŀ.	ن	S e)	Surface El.: + 108.5 ft Datum: Vert: BCB; Horiz	. NAD83	Equipmen
	Sa) e	%	i ∺ လ	;	Description & Classification	Stratum	Installed
push	•		_		_	6" Asphalt Driller adv. Roller bit to 1ft	Asphalt	
push			-			1		
	00.4	00	4.5	00	_	All Dance areas and district to account CAND (CD) such	. N	
	SS-1	20	15	28	0	4" Dense, gray medium to coarse SAND (SP), wet.	ᇢ핂	
				65		11" Very dense, brown fine to coarse SAND,	\exists	
62*				66		little Gravel, little Silt, (SW-SM), moist.	s:. ⊃	
				50/2"		* Driller advanced rollerbit to 3 ft. then drove casing		
_ 0	SS-2	0	0	50/0"		No recovery.	₽,' E	
un	R-1	12	12	4 min/ft		Granitic boulder.	8 H	
spun casing						RQD=0%.	S &	
0							PROBABLE SAND, GRAVEL, BOULDER FILL	
137	SS-3	24	14	27	49	To very defise, drange-blown, medium to coarse		
131	-			57		SAND and GRAVEL (SP), wet. Note 1.	$\overline{}$	
200				34		4" Very dense, brown fine to coarse SAND, little Gravel,		
∠96				47		some non-plastic Silt (SM), wet.		
	SS-4	5	1		2.7	Very dense, brown and black medium to coarse SAND		
				, -				
	R-2	48	26	5 min/ft	<u> </u>			
		Ī	Ī	1				
				4 min/ft				
				1 min/ft			X	
				1 111111/10			8	
				1 min/ft		NQD = 20/40 = 42/0	∝	
				1 111111/10				
						Paring terminated at about 12 F ft		
						Boning terminated at about 12.5 it.		
	-							
				-				
						Drilling technique added water to boring. Water levels mov		
						not be mulcative of natural groundwater level.		
			<u> </u>			1	1201 121	2-11-12
						samples from top 10", geotech sample from bottom 4",	Steph	ens Associa Consulting E
corrosi	on sample	from bo	oth top	and bottor	n.			
Soil/ro	ck strata ar	nd groui	ndwate	r surface,	where i	indicated, are approximate. Transitions may be gradual.	saving Sol	itions Go
√ariatio	ons betwee	en explo	ration I	ocations a	nd ove	r time should be expected.	for Building Infrastructo	is and
128	296 296 201 201 202 203 203 204 204 204 205 205 206 207 207 207 207 207 207 207	R-2 R-2 I. Sample SS-3, corrosion sample Soil/rock strata al	SS-4 5 R-2 48 R-2 48 I. Sample SS-3, environe corrosion sample from both social from the corrosion sample from both social from the corrosion sample from both social from the corrosion sample from both social from the corrosion sample from both social from the corrosion sample from both social from the corrosion sample from both social from the corrosion sample from both social from the corrosion sample from both social from the corrosion sample from both social from the corrosion sample from both social from the corrosion sample from both social from the corrosion sample from both social from the corrosion sample from both social from the corrosion sample	SS-4 5 1 R-2 48 26 R-2 48 26 R-3 48 26 R-4 8 26 R-5 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8	296 SS-4 5 1 100/5" R-2 48 26 5 min/ft 1 min/ft 1 min/ft 1 min/ft 1 sample SS-3, environmental jar and VC corrosion sample from both top and bottor soil/rock strata and groundwater surface, /ariations between exploration locations a	296 SS-4 5 1 100/5" 2.7 R-2 48 26 5 min/ft. 4 min/ft. 1 min/ft. 1 min/ft. 1 min/ft. 1 sample SS-3, environmental jar and VOA vial corrosion sample from both top and bottom. Soil/rock strata and groundwater surface, where invariations between exploration locations and over the corresponding to t	296 34 4" Very dense, brown fine to coarse SAND, little Gravel, some non-plastic Silt (SM), wet. SS-4 5 1 100/5" 2.7 Very dense, brown and black medium to coarse SAND and GRAVEL (SP/GP) - likely wash material. R-2 48 26 5 min/ft. Very hard, black, fresh to slightly weathered, fine grained Dioritic rock, upper 20" one joint dipping -30 deg., lower 28 in. little recovery, fragments <2 in., core barrel advanced rapidly, likely sand seam or highly weathered rock. RQD = 20/48" = 42% Boring terminated at about 12.5 ft. Drilling technique added water to boring. Water levels may not be indicative of natural groundwater level. Sample SS-3, environmental jar and VOA vial samples from top 10", geotech sample from bottom 4", corrosion sample from both top and bottom. Solirock strata and groundwater surface, where indicated, are approximate. Transitions may be gradual.	296 34 4" Very dense, brown fine to coarse SAND, little Gravel, some non-plastic Silt (SM), wet. SS-4 5 1 100/5" 2.7 Very dense, brown and black medium to coarse SAND and GRAVEL (SP/GP) - likely wash material. Driller advanced rapidly, likely sand seam or highly weathered, fine grained Dioritic rock, upper 20" one joint dipping -30 deg, lower 28 in, little recovery, fragments <2 in, core barrel advanced rapidly, likely sand seam or highly weathered rock. RQD = 20/48" = 42% Boring terminated at about 12.5 ft. Drilling technique added water to boring. Water levels may not be indicative of natural groundwater level. Sanple SS-3, environmental jar and VOA vial samples from top 10", geotech sample from bottom 4", corcusson sample from bott top and bottom. Sanple SS-3, environmental jar and VOA vial samples from top 10", geotech sample from bottom 4", corcusson sample from bott top and bottom. Scelincos strata and groundwater surface, where indicated, are approximate. Transitions may be gradual.

Dept	h:	9.5 ft.	undwa 				Project: MWRA Pipeline Project, Contract No. 6905 Location: Saugus, MA Project Number: 026-08	<u>Bo</u> rin 3-007 Sh	
Time):	End of d	Irilling,	insid	e casing		Contractor: GeoLogic Sampler Type: Split sp	oon ID 1.3	75" OD 2
							Foreman: John Galvin Hammer Wt.: 140 lb	Fall:	30"
	S	i i			5		Start Date: 4/21/2008 Drill Technique: Drive&W	ash ID 4	" OD 4.5
ff.)	Blows	Sample No.	·	·	Blows/6" or Core Time	Ē		ill Truck-m	
Depth (ft.)	B	<u>e</u>	Pen. (in.)	Rec. (in.)	s/e	PID (ppm)	SACE Staff: J. Turner Northing: 3008057.5 Ea		787080.0
pt	vi.	Ē	Ġ.	ပ္ပဲ	o e	_	Surface El.: + 111.1 ft Datum: Vert: BCB; Horiz	. NAD83	Equipme
De	Ca	Sa	Pe	Re	m S	ੂ	Description & Classification	Stratum	Installed
							6" Asphalt Driller adv. Roller bit to ~1.2ft	Asphalt	
	push						8" Concrete	Concrete	
1.2	pusii	SS-1	7	3	32	0	2" Dense, gray medium SAND (SP), wet.		
					50/1"		1" Very dense, brown GRAVEL and fine to coarse		
	63*						SAND (GW), wet.	뿔 없	
		00.0	_	_	E0/0#		*Driller adv. roller bit through boulder to 3 ft., then casing.	B ∃ ⊣	
3	1	SS-2	3	0	50/3"		No recovery.	OBAE JULD FILL	
							Driller advanced roller bit and casing incrementally	PROBABLE BOULDER FILL	
	Ŧ						through boulders from about 3 to 7 ft.	_	
	1		1	1			No return on drilling water		
	1]		
<u> </u>		.	00		0		 		
7	4	R-1	36	33	6 min/ft		Very hard, gray, white and black, slightly weathered to		
	1				4 min/ft		fresh, coarse grained Granitic rock, staining in joints, joints spaced 0.5 to 8 in., near horizontal to ~20 deg		
	†				 + 111111/1L		No water return during coring		
	1				7 min/ft		RQD = 18/36" = 50%		
	1						1		
10		R-2	24	24	7 min/ft		Similar to R-1.	ROCK	
							RQD=13/24" = 54%	Ď	
	1				5 min/ft			RC	
							Barlan tannila stad at abaad 40 ft		
	4						Boring terminated at about 12 ft.		
	†								
	1								
	4								
	+								
	1								
	1								
	1						1		
 	+						1		
	+						1		
	†								
	1								
	↓ ¯								
-	1								
-	+						1		
	+						1		
-	†						1		
							1		
	1				<u> </u>				
S	1. Drill	ing techniq	ue adde	ed wate	r to boring	Wate	er levels may not be indicative of natural groundwater level.	Stenh	ens Associ
Remarks	1	~ ¬			9		, , , , , , , , , , , , , , , , , , , ,	Otepin	Consulting I
Ę	Soil/ro	ck strata ar	nd groui	ndwate	r surface, v	where i	indicated, are approximate. Transitions may be gradual.	Insightful, saving Sol	Cost- utions
a)			•				er time should be expected.	saving Sol for Building Infrastructi	utions G as and are Hydrology &

L			undwa	ter:	i	1	Project: MWRA Pipeline Project, Contract No. 6905	Boring		
Deptl		10.9 ft.		<u> </u>	L.,		Location: Saugus, MA Project Number: 026-08			
Time	:	End of d	Irilling,	insid	e casing			oon ID 1.3		1
							Foreman: John Galvin Hammer Wt.: 140 lb	Fall:	30"	1
	S	ċ			=		Start Date: 4/22/2008 Drill Technique: Drive&Wa	ash ID 4	" OD 4.5"	1
E.	Blows	2	_	_	l e	<u>-</u>	Finish Date: 4/22/2008 Rig Type: Mobile Dr	ill Truck-m	ounted	1
±	36	<u>o</u>	.⊑	.⊑	ı;e	ρπ	SACE Staff: J. Turner Northing: 3008360.7 Ea		787032.6	t
ই	 	du	· ·	· ;	(8 €	g)	Surface El.: + 113.6 ft Datum: Vert: BCB; Horiz.		Equipment	đ
Depth (ft.)	Cas.	Sample No.	Pen. (in.)	Rec. (in.)	Blows/6" or Core Time	PID (ppm)	Description & Classification	Stratum	Installed	1
	0	0)	<u> </u>	<u> </u>	шО	1			installed	+
								Asphalt		ŀ
	push	00.4	0.1			_	3" Concrete	Concrete		-
1	F	SS-1	24	1	31	0	Very dense, fine to medium SAND and GRAVEL (SP),			L
					27		wet - gravel in spoon tip			L
	56*				26		*Driller adv. roller bit to 3 ft. then drove casing. Casing	'' ''		L
	-				61		skewed. Driller removed and spun casing to 3 ft.	PROBABLE BOULDER FILL		
3	_ 0	SS-2	3	0	50/3"		No recovery.	OBAE ULD FILL		L
	spun asing							5 5 7		L
	spun casing						Driller adv. Roller bit through boulders to 5 ft., then	ᇟᅃ		L
)						spun casing to 5 ft.	l		L
5		R-1	60	60	6 min/ft		Very hard, brown, gray and black, slightly to moderately			Γ
							weathered, medium to coarse grained Granitic rock,	[ľ
					4 min/ft		staining in joints, joints spaced 0-10 in., near	[ľ
							horizontal to near vertical with most joints dipping]		ľ
					5 min/ft		~30-45 degrees.]		r
						-	RQD = 18/60" = 30%			t
					6 min/ft		No water return when coring			t
					J	-		¥		t
					7 min/ft			ROCK		ŀ
					/10			RC		ŀ
10		R-2	24	24	5 min/2	ft	Similar to R-1, except moderately weathered, highly			ŀ
10		11-2	24	<u> </u>	J 111111/2	11.	fractured, joint spacing <4".	∇		ŀ
-					 			<u> </u>		ŀ
ļ			1		 		RQD = 0%	-		ŀ
<u> </u>							Paring terminated at about 42 ft			ŀ
							Boring terminated at about 12 ft.			ŀ
<u> </u>										ļ
<u> </u>]		ļ
<u> </u>]		L
]		L
]		L
]		
]		I
]		L
]		
]		I
]		ſ
								[ſ
								[ľ
								[ľ
										ľ
					İ					f
										t
										t
										ŀ
					†					ŀ
-					 					ŀ
1]		ŀ
<u> </u>]		ŀ
-]		ŀ
<u> </u>			1]		1
├ ──			1]		ŀ
<u> </u>			1]		1
<u> </u>]		ŀ
<u> </u>					<u> </u>]		ŀ
<u> </u>					ļ]		l
<u> </u>					ļ					ŀ
Щ					<u> </u>				31	<u>1</u>
S	1. Drilli	ng techniq	ue adde	ed wate	r to boring	j. Wate	r levels may not be indicative of natural groundwater level.	Steph	ens Associat	e
Remarks									Consulting Eng	giı
Ĕ	Soil/roo	ck strata ar	nd groui	ndwate	r surface,	where i	ndicated, are approximate. Transitions may be gradual.	Insightful, 0 saving Sok	Cost- S utions Geol	Str
	1/0=:04:	ons betwee	en explo	ration I	ocations a	nd ove	r time should be expected.	saving Solution Building Infrastructu	s and re Hydrology & H	
Re	variatio									

		В	ORII	NG LO	•			∑B 1		Pag	ge 1 of 1
Client	:		Gree	n International	Affiliates, Inc.		Boring Location	on: See Fig. 2	Boring Method:	Drive & V	Vash
Contr	actor:		New	Hampshire Bor	ing				Core Barrel:	2-inch ID	NX
Эрега	tor:		S. Bo				Ground Elevat		Casing ID:	4-inch ID	····
	ed By:			heeler			Total Depth (ft		Sampler:		split spoon
		Finish:	plit Spoon	6 - 6/7/06	Part B. Mari	لِب	Groundwater I				0-inch
Abbre	vi≢tlon:	DP= U=⊔	Direct Push	n Sample Tube Sample ample	Pen. = Penetration Rec. = Recovery L WOR = Weight Of WOH = Weight Of Information	engih Rods	OVM = Or NA,NM ≈ I		y = Pocket Torvane Shear S p = Pocket Penetrometer Ur	_	essive Strength
Elevation (ft)	Depth (ft)	Sample No.	Pen./Rec. (inches)	Sample Depth [Sample Elev.] (ft)	Blows per 6 in. or RQD (%)	OVM (ppm)	Layer	. De	scriptions		Remarks
8		S S	G E	S S S	2 5 G	18					
		S1	24/8	0.4 to 2.4	5-17-20-22	0.7	SAND	5" of aspiralt S1 - WIDELY GRADED SA coarse sand, ≋10 nonplasti gravel (max size ≘1/2"), br	c fines, ≝10% fine sub	SP), fine to rounded	Env. Sample at 9:50 am.
F	-					•					
-		S2	3/0	4,0 to 4.3	100/3	<u> </u>	L	S2 - No Recovery			Spoon
L	- 5	13	1 3,0	7,0104.3	COURT	广	BEDROCK	\ Bi	DROCK		bouncing at
		- C1	60/50	5.0 to 10.0	RQD = 78%	-	BEDROCK	C1 - GRANITE, hard, fine to sound, slightly weathered to 21* spacing, staining on joil Core time (min/ft): 4.5-7-4.8	o fresh, low to high and hts, light gray	hyritic texture de joints at 4-	4.3 feet. Roller bit to feet. Losing wate from ≅7 to 1 feet.
ļ	- 10	_	 		· · · · · · · · · · · · · · · · · · ·	_	ļ	POTTOM OF PODEUOLE	10.0 FEET		
ļ							į	BOTTOM OF BOREHOLE,	D.O FEET		
į										4	
							· ·				
Ī						1	ļ	·			
						l					
Ì	- 15					1					
ŀ					ı	}					
ŀ						1					
ŀ]					
ŀ						İ					
ŀ	- 20					1					
ļ								•			
Į] .				
]								
										•	{
ſ	- 25						1				ĺ
Ī	- 25										[
Ī	•										1
f	•				Į						
Ì	•			ĺ	{			1			İ
1	•					 .		1			
iotes	_30 <u>:</u> 1.	L Borehole	backlille	d with soil cutting	gs and clean s	and a	I and topped with	cold patch upon completion.			<u> </u>
Groun prese tratific	ndwater ont at the callon iir	flubtuation time mea	s may occu surements : int approxin	e at times and under or due to conditions were made. nate boundaries be				WRA Water Main bute 1 32280	GEL	1021 Mai	sultants, inc in Street ter, MA 018

			В	ORII	NG LO	3			∑ B2		Pag	ge 1 of 1
Clie	nt:			Gree	n International	Affiliates, Inc.		Boring Locati	on: See Fig. 2	Boring Method:	Drive & W	/ash
	tracto				Hampshire Bor	ring				Core Barrel:	2-inch ID	NX
	rator				olduc			Ground Eleva		Casing ID:	4-inch ID	**
	ged B		Finish		/heeler 06 - 8/7/06		-4	Total Depth (f	<u> </u>	Sampler: Hammer Wt./Fall:		split spoon
	eviati			plit Spoon		Pen. » Penetration	lenat	Groundwater		Pocket Torvane Shear Street	140-16 / 31 ngth	J-INGR
2304	1		DP = U = L	Direct Pust	h Sample Tube Sample Sample	Rac. ≈ Recovery Low WOR = Weight Of WOH = Weight Of	engih Rods	OVM = OI NA,NM =		Pocket Penetrometer Uncor		essive Strength
€		t		T	1		=	<u> </u>				
Elevation (ft)	Depth (ft)		Sample No.	Pen/Rec. (inches)	Sample Depth (Sample Elev.] (ft)	Blows per 6 in. or RQD (%)	OVM (ppm)	Layer		criptions		Remarks
	°		S1	24/4	0.5 to 2.5	22-19-20-22	0	SAND	6" of ashalt S1 - WIDELY GRADED SAN coarse sand, ≈10% nonplast gravet (max size ±1/2"), brov	c fines, ≝5% fine subro		
	ŀ	1				ļ				•		
	t		S2	11/3	4.0 to 4.9	45-100/5*	0	1	S2 - WIDELY GRADED SAN			-
	-5	F					Ť		coarse sand, ≘10% nonplasti ∖gravel (max size ≘1/4"), brow	n	unded	
			C1	60/50	5.0 to 10.0	RQD = 68%	-	BEDROCK	BEC	PROCK FEET coarse grained, porphyr from 12-16*, moderately joints at 1-15* spacing,	to slightly	
ĺ	-10	L	<u> </u>									
									BOTTOM OF BOREHOLE, 10	O FEET		
	- 15											
!	- 20				-							
	-25											
						·						·
منتا	30	Ţ	1					<u> </u>	·			
Note									old patch upon completion.			
Grou prea Strattii	Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made. Strattlication lines represent approximate boundaries between soil types: GE							Ro B Prol. No.: 06	WRA Water Main oute 1 2280 nnfield/Saugus, MA	GEI CONSUSTANTE	1021 Mair	ultants, inc. 1 Street er, MA 01890

REPORT OF BORING No. BB-1A SHEET 1 DF 3 FILE Mg. 15400,41 CHKD. BY PROJECT GZA DRILLING, INC. Walnut St and RTE 1 Interchange Saugus, MA Bridge S-5-16 1215 W. CHESTMUT ST., BROCKTON, MA 02401 (A DIVISION OF GZA GEOENVIRONMENTAL, INC.) BORING LOCATION M3003666,33 E786329.04
GROUND SURFACE ELEVATION 64.80 DATUM
DATE START 7-10-97(9:00AM)DATE END 7-15-97(8:30am)* P. Wordell J. Forde FOREMAN: CLASSIFIED BY: INSPECTOR: G. French READINGS GROLMOWATER UNLESS OTHERWISE MOTED. SAMPLER CONSISTS OF A 2" SPLIT SPOOM DRIVEN USING A 140 Lb. HAMMER FALLING 30 lb. SAMPLER: CASING STABILIZATION TIME MATER DATE TIME UNLESS OTHERWISE MOTED, CASING DRIVEN USING A 300 Lb. NAMMER FALLING 24 In. CASING: 251 Completion 7-15-97 4" & 3" CASING SIZE: SAMPLE SAMPLE DESCRIPTION STRATUM DESCRIPTION PEN./ REC DEPTH (Ft.) BLOUS/6" Mo. OFBN 0 29-19-24 ASPHALT n **S-1** 18/12 64-21 Dry, dense, brown, fIME TO COARSE SAMD, some fine Gravel, some inorganic Silt. 1. Dry, very dense, brown, FIME TO COARSE SAMD, some fine Gravel, trace Cobbles, trace inorganic Silt. S-2 18/11 5-6'6" 29-31-24 Dry, very dense, brown, FINE TO COARSE SAND, some fine Gravel, trace inorganic Sand, trace Asphalt. 5-3 18/18 10-11/6" 48-46-56 Dry, very dense, black-brown, FINE TO COARSE SAND AND GRAVEL, trace Asphalt, trace Inorganic Silt. **S-4** 18/7 15-16/6 19-9-57 20.0' 20 Dry, medium dense, yellow-brown, FINE TO CDARSE SAND AND GRAVEL, trace fine Gravel, trace inorganic Silt, trace Topsoil. 22.0 20-21/6* 15-12-11 5-5 18/18 25 Wet, medium dense, brown, FINE TO COARSE SAMD, some fine Gravel, trace inorganic Sflt. 15-14-8 18/13 25-26'6" 5-6 28.0 Wet, dense, gray, FIME SAMD, trace Organic Silt. 30 30-31'6" 21-15-16 18/14 **1-7** 35.0' 2. Wet, medium dense, gray-brown, FINE SAMD, some coarse Sand, trace fine Gravel, trace inorganic Sitt. 35 13-14-14 35-36/6" 18/9 5-8 40.0 Wet, medium dense, yellow-brown, INORGANIC SILI, some fine Sand. 12-10-15 40-41'6"

	13-10	18/12	45-46'6"	12-13-15	Wet, medium dense, brown, FINE TO COARSE SAND, some fine Gravel, trace inorganic Silt.
	 	1		 	
	 	†		†	-
	—			 	-
50	\$-11	18/10	50-51/6"	13-16-15	Wet, dense,
	+			 	
 	+			 	-
	 			 	
	1			 	-
55	5-12	18/10	55-56'6"	14-12-10	list medium dense brown FIME TO COASES
-	+				Wet, medium dense, brown, FINE TO COARSE — SAMB, trace fine Gravet, trace inormanic Silt.
-	 			 	
-	 				58.5
-	 				
50	s-13	18/16	10 1111	77 /7 60	-
-	3-13	10/10	60-61/6*	77-47-52	Wet, very dense, brown, FINE TO COARSE SAND AND GRAVEL, trace inorganic Silt.
-					<u>-</u>
-	 				
-					4
5					_
	S-14	0/0	65-65	140/0"	66.0′
<u> </u>	C-1	60/3	66-71	4	Gray-black GRANITE, RECOVERY = 5%
				5	
				5	
0				5	
				6	
	C-2	60/12	71-76	4	Wenthered, gray-black GRANITE with Quartz seams/joints throughout. RECOVERY = 20%
			· ·	6	- seame/joints throughout. RECOVERY = 20%
		T		6	
			1	5	1
				5	proplet trademon to the
	C-3	48/0	76-BO	4	
				5	RECOVERY A OX
				6	
				4	
	t-4	60/22	80-85	6	RECOVERY • 33%
				7	Weathered, pink-gray GRANITE, numerous seams/joints throughout,
			-	7	
				8	
				5	
	C-5 (50/36	65-90	6	
	_			6	RECOVERY = 60X
		$\neg +$		7	1 1
\vdash	$\overline{}$				
1				5	1
-					Detter of business of Mil
LAMEN A	SOIL		Project	CIVE com	Bottom of boring at 90'
me/ft	Deneil	у	Blows/FI	SIVE SOILS Density	manage of the second section of the parties of the parties of the section of the
- 4 -10	٧.	LOOSE	, < 2	V. SOFT	2. Installed 2º PVC well at 35' depth, utilized 5' screen and 30' riser pipe.
10-30	M.	LOOSE DENSE	2- 4 4- 8	SOFT M. STIFF	3. Losing water coring rock from 72/ death
50-50 50	٧.	DENSE DENSE	8-15 15-30	V. STIFF	·
			> 30	HARD	Crair th = Ci
s:	1) STI	RATIFIC IER LEVI	ATION LINES EL READINGS	REPRESENT A	APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL. HADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

-			1215 W		ZA DRILLING, INUT ST., BR F GZA GOENV	INC. OCKTON, NA 02 IRONMENTAL, I	2401 INC.)	PROJECT REPORT OF BORING No. BS-2 SHEET 1 DF-2 SHEET 1 DF-2 FILE No. 1540041 CHKD. BY									
10	LAS	MAN:	ED BY:	Bi Jo	erry Wordell Shn Forde French				NG LOCATI NO SURFAC START 8-	04 E ELEV 6-97(9							
3	AMP	LER:	UNI	ESS OT	HERWISE NOTE	D. SAMPLER CO	DNSISTS OF A	2" SPLIT 0 In.						READI			_
1.	467	NG:							}	DATE	TIME	WAT		CASING		ZATION TIM	-
1	,73 i	441	HAP	MER FAI	LING 24 In.	D, CASING DRI			-	-8-97	ļ	9.7	<u>"</u>		Complet	1011	
9	_	ING SIZE: 4" OTHER:									L	L					\dashv
	E	CAL			SAMPLE		-	SAMPLE DESC	RIPTION				KEN	STRA	TUN DES	CRIPTION	
1	Ŧ	G S	No.	PEN./ REC	DEPTH (ft.)	BLOWS/6"							•				_
T	0		5-1	18/9	64-5,04	41-29-22	ASPHALT	ense brown.	FINE TO	COARSE		/6#.	İ	01			
	4	-					SAMO, some	iense, brown, fine Gravel,	trace in	organi	C						
]					- 1					
	İ						<u> </u>					- -		-			
	5						1		_ 1_				į				- 1
			s-2	18/9	5-6'6"	6-9-11	Dry, medium	dense, brown trace coarditt.	n, FINE S se Sand,	IAMD, t trace	FRCO						
1	5 d						inorganic S	iit.	·								
							4				_		į				
												.0,					ı
1	10			\			<u> </u>				eE	Ŧ					- 1
		\Box	\$-3	18/8	10-11/6*	5-5-7	SAMO, some	dense, brown fine Gravel,	trace in	organi	e e			-			ı
	4		1	1	<u>L</u>		Bile:					-					-
			ļ	matc			4										ĺ
1			ļ	to	nex TIS		4		•						•		ļ
`.	15	ļ¦	<u> </u>	1874	4E. 14/4=	10-6-5	 	dense bros	n GRAVEI	trace		1					ļ
1.	b		5-4	18/1	15-16/6*	10-0-3	Cobbles, tr	dense, brow race inorgani	c Silt.	,		- }					
1	T.		<u> </u>				1										j
			 -				4								•]
			 				1				20	.0/					ļ
	20		S-5	18/8	20-21/6"	7-7-8	Wet. medium	dense, brow	n, FINE S	AND, t		7					1
			 				inorganic	dense, brow trace fine	Gravel,	traće		1					l
			 				1					1	.				
		<u> </u>	 	<u> </u>			1					1					-
			 			~	1					1					
1	25		S-6	18/0	25-26'6#	10-12-12	NO RECOVERY	۲.				1					
		-]						İ				İ
١]					-			*		- [
١]						ļ				- [
	30						J										
	5 0		5-7	18/10	30-31/6*	8-19-17	1										J
						1.	1		-					1			
			<u> </u>	<u> </u>				**** *					.	.			
			 				4										
	35	<u></u>	<u> </u>	<u> </u>			4										
_		<u></u>	5-8	18/10	35-36'6"	7-8-11	Wet, mediu inorganic	m dense, brow Silt.	m, FINE	SAND, 1	rece	1					
*.		-	1	 	 	ļ	4										
1		-	 	 	 		4										
		-	 	 	 	<u> </u>					11	0.0					
-	40	-	 	1.5.55	10.11		1400		Elle ca	MD							
		-	S-9	12/12	40-41'	15-37	inorganic	dense, brown, Silt.	, FIME SA		4	1.01		1			

	_	_	_		•	, ¥ i l
10	· 	5-3	18/8	10-11'6"	5-5-7	Wet, medium dense, brown, FINE TO COARSE SAMO, some fine Gravel, trace inorganic
						Silt.
15					40 4 8	tra matter dance home POSINES trans
		5-4	18/1	15-16/6	10-6-5	Wet, medium dense, brown GRAVEL, trace Cobbles, trace inorganic Silt.
	-					
	-					
1	\vdash					20.0′
20	-	s-5	18/8	20-21/6"	7-7-8	Wet, medium dense, brown, FINE SAND, trace
	\vdash					Wet, medium dense, brown, FINE SAND, trace coarse Sand, trace fine Gravel, trace inorganic Silt.
1						
25						
"		\$-6	18/0	25-26'6"	10-12-12	NO RECOVERY.
30		s-7	18/10	30-31/6*	8-10-17	
		8-7	10/10	30-31-6-	0-10-11	
	\vdash					
					· · · · · · · · · · · · · · · · · · ·	And the second s
35		5-8	18/10	35-36/6"	7-8-11	Wet, medium dense, brown, FINE SAND, trace
						inorganic Silt.
}						
40						40.07
	\vdash	5-9 5-9A	12/12	40-41'	15-37 23	Wet, very dense, brown, FINE SAMD, some inorganic Sitt. 41.0'
		5.74	6/4	#1-41-0-		Wet, very dense, brown, FIME TO COARSE SAMO, some fine Gravel, some inorganic Sitt.
1	-				MIM/FT	45.0'
45		C-1	60/42	45-50	2:33	
					3:42	Pink-gray mottled black GRANITE with
					5:29	Quertž, numerous seems/joints throughout.
					8:48	
50					10:21	
		C-S	60/32	50-55	8:40	
		·			8:41	RECOVERY = 53%
	-				9:23	
	-				10:15	
55	-				14270	Sottom of boring at 55'.
G	PANUL	UR SOI	L\$	CO	ESIVE SOILS	REMARKS: * Total hours worked on boring 13 hours 30 minutes.
-	ous/F	t Dene	LOOSE		Ft Density	-
4	-10 10-30		LOOSE	2- 4	V. SOFT SOFT M. STIFF	
1 3	50-50 50		DENSE DENSE	8-15	\$11FF V. \$11FF	
				> 30	HARD	SCALE 1" = 5"
NOT	ES:	1)	TRATIF	ICATION LIN	S REPRESENT	APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.

1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

APPENDIX C GEOTECHNICAL LABORATORY TEST RESULTS



Project: Number: 026-08-007 Sheet 1 of Name: MWRA Contract No. 6905, Pipeline

Original Work:

Ву:

R. Kline June 9, 2008 Date: Subject: Checked By: J. Turner Date: June 13, 2008

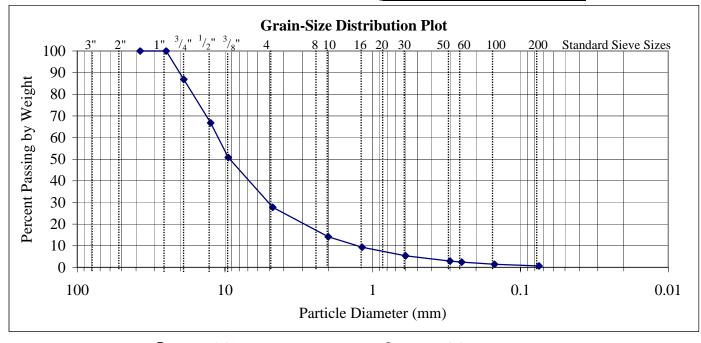
Laboratory Testing Grain Size Distribution

Rte. 1, Saugus, MA

Boring Number: Sample Depth: 1-3' Top 10" B-1 Sample Number: S-1

Sample Description: Black GRAVEL, some medium to coarse Sand

Sieve De	signation	Nominal Sie	eve Opening	Tare Weight	Sieve+Soil Wt.	Soil Weight (g)	Percent
Standard	Alternate	mm	inches	(g)	(g)	Con Weight (g)	Passing
37.5 mm	1-1/2"	37.5	1.476"	501.6	501.6	0.0	100.0
25.0 mm	1"	25	0.984"	502.7	502.7	0.0	100.0
19.0 mm	3/4"	19	0.748"	596	621.2	25.2	86.9
12.5 mm	1/2"	12.5	0.492"	607.2	645.8	38.6	66.8
9.5	3/8"	9.5	0.374"	565.2	595.8	30.6	50.8
4.75 mm	No. 4	4.75	0.187"	527.7	571.9	44.2	27.8
2.00 mm	No. 10	2	0.078"	450.8	476.9	26.1	14.2
1.18 mm	No. 16	1.18	0.0464"	401.2	410.5	9.3	9.3
600 µm	No. 30	0.6	0.0236"	410.5	418.1	7.6	5.4
300 µm	No. 50	0.3	.0118"	416.8	421.5	4.7	2.9
250 µm	No. 60	0.25	0.0098"	339.9	340.8	0.9	2.4
150 µm	No. 100	0.15	0.0059"	303.7	305.6	1.9	1.5
75 µm	No. 200	0.075	0.0029"	301.6	303.1	1.5	0.7
Pan				340.4	341.7	1.3	0.0
				Sc	oil Wt. Sum (g):	191.9	<u> </u>



 $D_{10} =$ 1.25 mm Cu = 9.6 $D_{30} =$ 5 mm Cc = 1.7 $D_{60} =$ 12 USCS Classification = **GW** mm

Copyright © 2008 Stephens Associates Consulting Engineers LLC

Revisions:

By: Date: Date: By:



Project: Number: 026-08-007 Sheet 1 of Name: MWRA Contract No. 6905, Pipeline

Original Work:

Ву:

R. Kline June 2, 2008 Date: Subject: Checked By: J. Turner Date: June 13, 2008

Laboratory Testing Grain Size Distribution

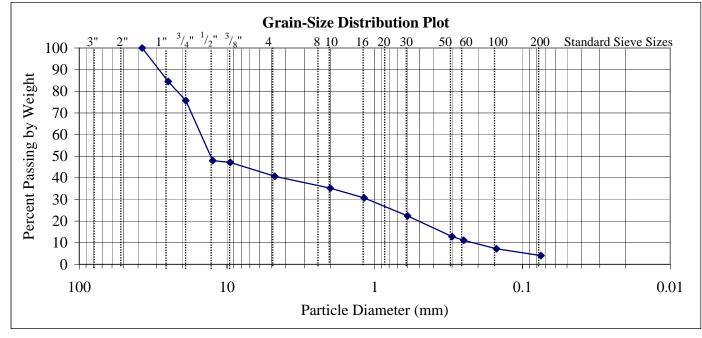
Rte. 1, Saugus, MA

Boring Number: Sample Depth: 9-11' B-1 Sample Number: S-4

Sample Description: Brown GRAVEL and fine to medium SAND

Sieve De	signation	Nominal Signature	eve Opening	Tare Weight	Sieve+Soil Wt.	Soil Weight (g)	Percent
Standard	Alternate	mm	inches	(g)	(g)	30 113.g. (g)	Passing
37.5 mm	1-1/2"	37.5	1.476"	501.4	501.4	0.0	100.0
25.0 mm	1"	25	0.984"	502.6	529.2	26.6	84.5
19.0 mm	3/4"	19	0.748"	595.9	611	15.1	75.7
12.5 mm	1/2"	12.5	0.492"	607.6	655.3	47.7	48.0
9.5	3/8"	9.5	0.374"	565.3	566.7	1.4	47.1
4.75 mm	No. 4	4.75	0.187"	527.7	538.8	11.1	40.7
2.00 mm	No. 10	2	0.078"	450.7	460.1	9.4	35.2
1.18 mm	No. 16	1.18	0.0464"	401.1	408.8	7.7	30.7
600 µm	No. 30	0.6	0.0236"	410.1	424.4	14.3	22.4
300 µm	No. 50	0.3	.0118"	416.2	432.6	16.4	12.9
250 µm	No. 60	0.25	0.0098"	339.9	342.9	3.0	11.1
150 µm	No. 100	0.15	0.0059"	303.5	310.2	6.7	7.2
75 µm	No. 200	0.075	0.0029"	301.4	306.8	5.4	4.1
Pan				340.3	347.3	7.0	0.0
				90	il Wt Sum (a):	171.8	

Soil Wt. Sum (g): 1/1.8



 $D_{10} =$ 0.225 mm Cu = 71.1 $D_{30} =$ Cc = 0.4 1.2 mm

 $D_{60} =$ 16 USCS Classification = mm GP

Copyright © 2008 Stephens Associates Consulting Engineers LLC

Revisions:

By: Date: Date:



Project: Number: 026-08-007 Sheet MWRA Contract No. 6905, Pipeline Name: Original Work: Rte. 1, Saugus, MA June 2, 2008 Permeability Estimate by R. Kline Date: Subject: Checked By: J. Turner Date: June 13, 2008 Kozeny-Carman Formula

Boring Number: **B-1** Sample Number: **S-4** Sample Depth: **9-11'**

According to References 1 and 3, (Note: Reference List at end of data sheets) Permeability may be estimated as $k = (\gamma/\mu)(1/C_{K-C})(1/S^2)[e^3/(1+e)]$

 γ = assumed unit weight of water in situ, lb/ft³ = 62.4 = 9800 N/m³ μ = viscosity of water, Ns/m² = 0.00131 at 10 °C

 C_{K-C} = Kozeny-Carman empirical coefficient; reported as 4.8±0.3, usually taken as 5, =

S = specific surface area per unit volume of particles = $SF^*\Sigma((P_{No D}-P_{No d})/d)$

 $P_{No D}$ = percentage by weight smaller than size D

 P_{Nod} = percentage by weight larger than the next size d

 D_{eq} = equivalent grain size for particles smaller than D_{min} of gradation = $D_{min}/3^{0.5}$

SF = Shape Factor for particle angularity = 7.5

SF = 6.6 for rounded particles; 7.5 for medium angularity; 8.4 for angular (after Loudon, presented in Ref. 1)

thus, Permeability, may be estimated as $k = (\gamma/\mu)(1/C_{K-C})\{1/\Sigma[(P_{N_0} - P_{N_0} d)/d]\}^2(1/SF^2)[e^3/(1+e)]$, Table 1 below

Further, according Ref. 2, measured permeability typically varies from 1/3 to 3 times the estimated permeability. The references also note that this method may overpredict permeability when soil is gravel, and the results present an upper bound. The formula is not suitable for plastic soils.

	TABL	E 1 - SUM OF (P	No D - P _{No d})/d	
Sieve De	signation	Nominal Sieve	Percent	(P _{NoD} -P _{Nod})/ d
Standard	Alternate	Opening (cm)	Passing	(1/cm)
37.5 mm	1-1/2"	3.750	100.0	
25.0 mm	1"	2.500	84.5	6.2
19.0 mm	3/4"	1.900	75.7	4.6
12.5 mm	1/2"	1.250	48.0	22.2
9.5	3/8"	0.950	47.1	0.9
4.75 mm	No. 4	0.475	40.7	13.6
2.00 mm	No. 10	0.200	35.2	27.4
1.18 mm	No. 16	0.118	30.7	38.0
600 µm	No. 30	0.060	22.4	138.7
300 µm	No. 50	0.030	12.9	318.2
250 µm	No. 60	0.025	11.1	69.8
150 µm	No. 100	0.015	7.2	260.0
75 µm	No. 200	0.008	4.1	415.7
D_{eq}		0.004	0.0	946.9
•				
		•	Sum:	2262 1

Estimate Void Ratio (e) from Relative Density (Ref. 4)

 $D_r^2 = (N_1)60/C_P C_A C_{OCR}$

 $(N_1)60=$ 69 $C_P=60+25logD_{50}=$ 87.8 $D_{50}=$ 13 mm $C_A=1.2+0.05log(t/100)=$ 1.19 t(yr)= 70 $C_{OCR}=OCR^{U.18}=$ 1 $D_r=$ 0.81166

 $e_{max} = 0.85$ $e = e_{max} - (D_r)(e_{max} - e_{min})$ $e_{min} = 0.14$ e = 0.27372

thus, range of permeability is estimated as:

Estimated range of k (cm/s)							
Probable		Probable					
measured	Calculated	measured					
lower bnd	lower bnd Estimate						
2.8E-03	8.4E-03	2.5E-02					

Copyright © 2008 Stephens Associates Consulting Engineers LLC Revisions:

By: Date:

______Bate:



Project: Number: 026-08-007 Sheet 1 of Name: MWRA Contract No. 6905, Pipeline

Original Work:

R. Kline June 2, 2008 By: Date: Subject: Checked By: J. Turner Date: June 13, 2008

Laboratory Testing

Grain Size Distribution

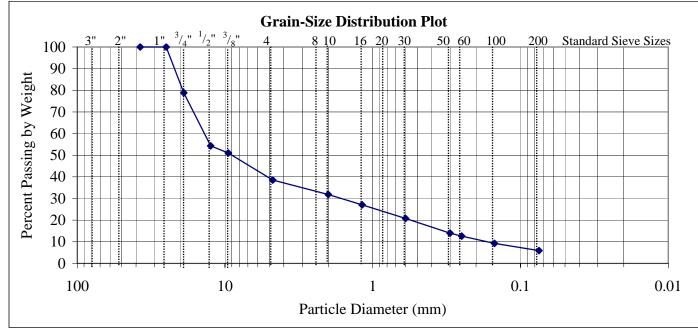
Rte. 1, Saugus, MA

Boring Number: Sample Number: S-1 Sample Depth: 1-3' Bottom 7" B-2

Sample Description: Gray GRAVEL and fine to medium SAND, trace silt

Sieve De	signation	Nominal Sie	eve Opening	Tare Weight	Sieve+Soil Wt.	Soil Weight (g)	Percent
Standard	Alternate	mm	inches	(g)	(g)	Son Weight (g)	Passing
37.5 mm	1-1/2"	37.5	1.476"	501.4	501.4	0.0	100.0
25.0 mm	1"	25	0.984"	502.6	502.6	0.0	100.0
19.0 mm	3/4"	19	0.748"	595.9	627.7	31.8	78.8
12.5 mm	1/2"	12.5	0.492"	607.6	644.4	36.8	54.3
9.5	3/8"	9.5	0.374"	565.3	570.2	4.9	51.0
4.75 mm	No. 4	4.75	0.187"	527.7	546.5	18.8	38.5
2.00 mm	No. 10	2	0.078"	450.7	460.7	10.0	31.8
1.18 mm	No. 16	1.18	0.0464"	401.1	408.3	7.2	27.0
600 µm	No. 30	0.6	0.0236"	410.1	419.5	9.4	20.8
300 µm	No. 50	0.3	.0118"	416.2	426.4	10.2	14.0
250 µm	No. 60	0.25	0.0098"	339.9	342.0	2.1	12.6
150 µm	No. 100	0.15	0.0059"	303.5	308.5	5.0	9.3
75 µm	No. 200	0.075	0.0029"	301.4	306.4	5.0	5.9
Pan				340.3	349.2	8.9	0.0
				10	bil Wt. Sum (a):	150.1	

Soil VVt. Sum (g):



 $D_{10} =$ 0.165 mm Cu = 90.9 $D_{30} =$ 1.75 mm Cc = 1.2

 $D_{60} =$ 15 USCS Classification = mm

Copyright © 2008 Stephens Associates Consulting Engineers LLC

Revisions:

By: Date: Date:



GW

 Project:
 Number:
 026-08-007
 Sheet
 1
 of
 1

 Name:
 MWRA Contract No. 6905, Pipeline

Original Work:

By: R. Kline Date: June 2, 2008 Subject: Checked By: J. Turner Date: June 13, 2008

Laboratory Testing

Rte. 1, Saugus, MA

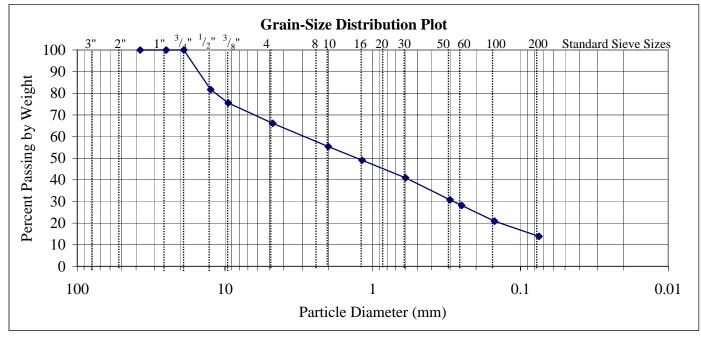
Grain Size Distribution

Boring Number: B-2 Sample Number: S-2 Sample Depth: 3-5'

Sample Description: Brown fine to coarse SAND, some Gravel, little Silt

	signation		eve Opening	Tare Weight	Sieve+Soil Wt.	Soil Weight (g)	Percent
Standard	Alternate	mm	inches	(g)	(g)	0 (0/	Passing
37.5 mm	1-1/2"	37.5	1.476"	501.3	501.3	0.0	100.0
25.0 mm	1"	25	0.984"	502.5	502.5	0.0	100.0
19.0 mm	3/4"	19	0.748"	595.7	595.7	0.0	100.0
12.5 mm	1/2"	12.5	0.492"	607.5	620.3	12.8	81.7
9.5	3/8"	9.5	0.374"	565.2	569.5	4.3	75.5
4.75 mm	No. 4	4.75	0.187"	527.7	534.3	6.6	66.1
2.00 mm	No. 10	2	0.078"	450.9	458.4	7.5	55.4
1.18 mm	No. 16	1.18	0.0464"	401.3	405.7	4.4	49.1
600 µm	No. 30	0.6	0.0236"	410.4	416.1	5.7	40.9
300 µm	No. 50	0.3	.0118"	416.6	423.7	7.1	30.8
250 µm	No. 60	0.25	0.0098"	340.0	341.8	1.8	28.2
150 µm	No. 100	0.15	0.0059"	303.8	308.9	5.1	20.9
75 µm	No. 200	0.075	0.0029"	301.8	306.7	4.9	13.9
Pan				340.5	350.2	9.7	0.0
				So	oil Wt. Sum (a):	69.9	

Soil Wt. Sum (g): 69.9



 $D_{10} = N/A$ mm Cu = N/A $D_{30} = 0.275$ mm Cc = N/A

 $D_{60} = 3.25$ mm USCS Classification = SM

Copyright $\hbox{@}$ 2008 Stephens Associates Consulting Engineers LLC

Revisions:

By: Date: Date:



Project: Number: 026-08-007 Sheet MWRA Contract No. 6905, Pipeline Name: Original Work: Rte. 1, Saugus, MA R. Kline Permeability Estimate by Date: June 2, 2008 Subject: Checked By: J. Turner Date: June 13, 2008 Kozeny-Carman Formula

Boring Number: B-2 Sample Number: S-2 Sample Depth: 3-5'

According to References 1 and 3, (Note: Reference List at end of data sheets) Permeability may be estimated as $k = (\gamma/\mu)(1/C_{K-C})(1/S^2)[e^3/(1+e)]$

 γ = assumed unit weight of water in situ, lb/ft³ = 62.4 = 9800 N/m³ μ = viscosity of water, Ns/m² = 0.00131 at 10 °C

 C_{K-C} = Kozeny-Carman empirical coefficient; reported as 4.8±0.3, usually taken as 5, =

S = specific surface area per unit volume of particles = $SF^*\Sigma((P_{No D}-P_{No d})/d)$

 $P_{No D}$ = percentage by weight smaller than size D

 P_{Nod} = percentage by weight larger than the next size d

 D_{eq} = equivalent grain size for particles smaller than D_{min} of gradation = $D_{min}/3^{0.5}$

SF = Shape Factor for particle angularity = 7.5

SF = 6.6 for rounded particles; 7.5 for medium angularity; 8.4 for angular (after Loudon, presented in Ref. 1)

thus, Permeability, may be estimated as $k = (\gamma/\mu)(1/C_{K-C})\{1/\Sigma[(P_{N_0,D}-P_{N_0,d})/d]\}^2(1/SF^2)[e^3/(1+e)]$, Table 1 below

Further, according Ref. 2, measured permeability typically varies from 1/3 to 3 times the estimated permeability. The references also note that this method may overpredict permeability when soil is gravel, and the results present an upper bound. The formula is not suitable for plastic soils.

	TABL	E 1 - SUM OF (P	No D - P _{No d})/d	
Sieve De	signation	Nominal Sieve	Percent	(P _{NoD} -P _{Nod})/ d
Standard	Alternate	Opening (cm)	Passing	(1/cm)
37.5 mm	1-1/2"	3.750	100.0	
25.0 mm	1"	2.500	100.0	0.0
19.0 mm	3/4"	1.900	100.0	0.0
12.5 mm	1/2"	1.250	81.7	14.6
9.5	3/8"	0.950	75.5	6.5
4.75 mm	No. 4	0.475	66.1	19.9
2.00 mm	No. 10	0.200	55.4	53.6
1.18 mm	No. 16	0.118	49.1	53.3
600 µm	No. 30	0.060	40.9	135.9
300 µm	No. 50	0.030	30.8	338.6
250 µm	No. 60	0.025	28.2	103.0
150 µm	No. 100	0.015	20.9	486.4
75 µm	No. 200	0.008	13.9	931.6
D_{eq}		0.004	0.0	3210.1
			Sum:	5353.6

Estimate Void Ratio (e) from Relative Density (Ref. 4)

 $D_r^2 = (N_1)60/C_P C_A C_{OCR}$

 $(N_1)60=$ 47 $C_P=60+25logD_{50}=$ 62.8 $D_{50}=$ 1.3 mm $C_A=1.2+0.05log(t/100)=$ 1.19 t(yr)= 70 $C_{OCR}=OCR^{0.18}=$ 1 $D_r=$ 0.79198

 $e_{max} = 0.85$ $e = e_{max} - (D_r)(e_{max} - e_{min})$ $e_{min} = 0.14$ e = 0.28769

thus, range of permeability is estimated as:

Estimated range of k (cm/s)							
Probable	Probable						
measured	Calculated	measured					
lower bnd	Estimate	upper bnd					
5.7E-04	1.7E-03	5.1E-03					

Copyright © 2008 Stephens Associates Consulting Engineers LL0	С
Revisions:	



Original Work:

Ву: R. Kline June 2, 2008 Date: Subject: **Laboratory Testing**

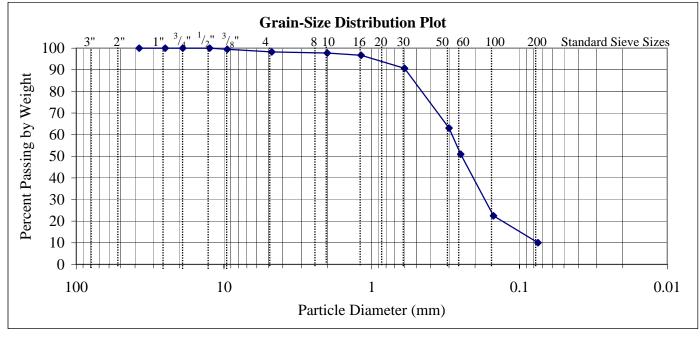
Rte. 1, Saugus, MA

Checked By: J. Turner Date: June 13, 2008 Grain Size Distribution

Boring Number: Sample Number: S-4 Sample Depth: 7-9' B-2

Sample Description: Gray fine to medium SAND, trace silt

Sieve De	signation	Nominal Sie	eve Opening	Tare Weight	Sieve+Soil Wt.	Soil Weight (g)	Percent
Standard	Alternate	mm	inches	(g)	(g)	Oon Weight (g)	Passing
37.5 mm	1-1/2"	37.5	1.476"	501.3	501.3	0.0	100.0
25.0 mm	1"	25	0.984"	502.5	502.5	0.0	100.0
19.0 mm	3/4"	19	0.748"	595.8	595.8	0.0	100.0
12.5 mm	1/2"	12.5	0.492"	607.6	607.6	0.0	100.0
9.5	3/8"	9.5	0.374"	565.2	565.5	0.3	99.5
4.75 mm	No. 4	4.75	0.187"	527.7	528.4	0.7	98.3
2.00 mm	No. 10	2	0.078"	450.6	450.9	0.3	97.8
1.18 mm	No. 16	1.18	0.0464"	401.2	401.8	0.6	96.7
600 µm	No. 30	0.6	0.0236"	410.3	413.8	3.5	90.7
300 µm	No. 50	0.3	.0118"	416.4	432.4	16.0	63.0
250 µm	No. 60	0.25	0.0098"	340.0	347.0	7.0	50.9
150 µm	No. 100	0.15	0.0059"	303.6	320.1	16.5	22.5
75 µm	No. 200	0.075	0.0029"	301.6	308.8	7.2	10.0
Pan				340.5	346.3	5.8	0.0
				Sc	oil Wt. Sum (g):	57.9	



 $D_{10} =$ 0.075 mm Cu = 3.7 $D_{30} =$ Cc = 0.175 mm 1.5

 $D_{60} =$ 0.28 USCS Classification = SP-SM mm

Copyright © 2008 Stephens Associates Consulting Engineers LLC

Revisions:

By: Date: Date: By:



Project: Number: 026-08-007 Sheet MWRA Contract No. 6905, Pipeline Name: Original Work: Rte. 1, Saugus, MA R. Kline Permeability Estimate by Date: June 2, 2008 Subject: Checked By: J. Turner Date: June 13, 2008 Kozeny-Carman Formula

Boring Number: Sample Number: S-4 Sample Depth: 7-9'

According to References 1 and 3, (Note: Reference List at end of data sheets) Permeability may be estimated as $k = (\gamma/\mu)(1/C_{K-C})(1/S^2)[e^3/(1+e)]$

9800 γ = assumed unit weight of water in situ, lb/ft³ N/m^3 0.00131 at 10 °C

 μ = viscosity of water, Ns/m² C_{K-C} = Kozeny-Carman empirical coefficient; reported as 4.8±0.3, usually taken as 5, =

S = specific surface area per unit volume of particles = $SF^*\Sigma((P_{No D}-P_{No d})/d)$

=

 $P_{N_0 D}$ = percentage by weight smaller than size D

P_{No d} = percentage by weight larger than the next size d

 D_{eq} = equivalent grain size for particles smaller than D_{min} of gradation = $D_{min}/3^{0.5}$

SF = Shape Factor for particle angularity =

SF = 6.6 for rounded particles; 7.5 for medium angularity; 8.4 for angular (after Loudon, presented in Ref. 1)

thus, Permeability, may be estimated as $k = (\gamma/\mu)(1/C_{K-C})\{1/\Sigma[(P_{N_0} - P_{N_0} d)/d]\}^2(1/SF^2)[e^3/(1+e)]$, Table 1 below

Further, according Ref. 2, measured permeability typically varies from 1/3 to 3 times the estimated permeability. The references also note that this method may overpredict permeability when soil is gravel, and the results present an upper bound. The formula is not suitable for plastic soils.

	TABL	E 1 - SUM OF (P	No D - P _{No d})/d	
Sieve De	signation	Nominal Sieve	Percent	(P _{NoD} -P _{Nod})/ d
Standard	Alternate	Opening (cm)	Passing	(1/cm)
37.5 mm	1-1/2"	3.750	100.0	
25.0 mm	1"	2.500	100.0	0.0
19.0 mm	3/4"	1.900	100.0	0.0
12.5 mm	1/2"	1.250	100.0	0.0
9.5	3/8"	0.950	99.5	0.5
4.75 mm	No. 4	0.475	98.3	2.5
2.00 mm	No. 10	0.200	97.8	2.6
1.18 mm	No. 16	0.118	96.7	8.8
600 µm	No. 30	0.060	90.7	100.7
300 µm	No. 50	0.030	63.0	921.1
250 µm	No. 60	0.025	50.9	483.6
150 µm	No. 100	0.015	22.5	1899.8
75 µm	No. 200	0.008	10.0	1658.0
D_{eq}		0.004	0.0	2313.4
•				
			Sum:	7391 2

Estimate Void Ratio (e) from Relative Density (Ref. 4)

 $D_r^2 = (N_1)60/C_P C_A C_{OCR}$

(N₁)60= $C_P = 60 + 25 \log D_{50} = 44.9$ $D_{50} = 0.25 \text{ mm}$ $C_A=1.2+0.05\log(t/100)=$ 1.19 t(yr) = 70 $C_{OCR} = OCR^{0.18} =$ $D_r = 0.94641$

 $e_{max} = 0.95$ $e=e_{max}-(D_r)(e_{max}-e_{min})$ e_{min}= e= 0.24019

thus, range of permeability is estimated as:

Estimated range of k (cm/s)					
Probable Probable					
measured	measured				
lower bnd Estimate upper bnd					
1.8E-04	5.4E-04	1.6E-03			

Copyright © 2008 Stephens Associates Consulting Engineers LL
Revisions:

By: Date: Date:



Original Work:

Ву: R. Kline June 2, 2008 Date: Subject: Checked By: J. Turner Date: June 13, 2008

Laboratory Testing

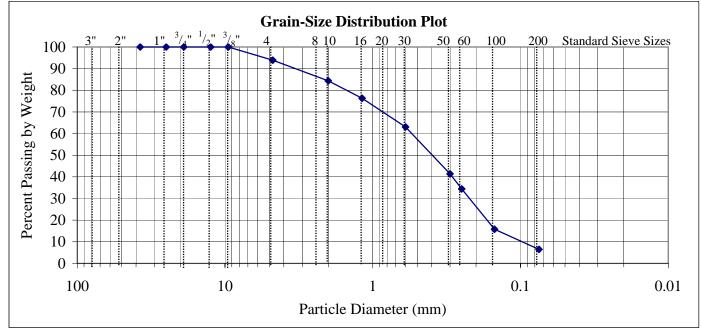
Grain Size Distribution

Rte. 1, Saugus, MA

Boring Number: Sample Number: S-5 Sample Depth: 9-11' B-2

Sample Description: Gray fine to medium SAND, trace silt

Sieve De	signation	Nominal Sign	eve Opening	Tare Weight	Sieve+Soil Wt.	Soil Weight (g)	Percent
Standard	Alternate	mm	inches	(g)	(g)	Son Weight (g)	Passing
37.5 mm	1-1/2"	37.5	1.476"	501.3	501.3	0.0	100.0
25.0 mm	1"	25	0.984"	502.5	502.5	0.0	100.0
19.0 mm	3/4"	19	0.748"	595.8	595.8	0.0	100.0
12.5 mm	1/2"	12.5	0.492"	607.8	607.8	0.0	100.0
9.5	3/8"	9.5	0.374"	565.4	565.4	0.0	100.0
4.75 mm	No. 4	4.75	0.187"	527.9	536.1	8.2	93.9
2.00 mm	No. 10	2	0.078"	450.8	463.6	12.8	84.4
1.18 mm	No. 16	1.18	0.0464"	401.3	412.1	10.8	76.3
600 µm	No. 30	0.6	0.0236"	410.4	428.2	17.8	63.0
300 µm	No. 50	0.3	.0118"	416.6	445.7	29.1	41.4
250 µm	No. 60	0.25	0.0098"	340.1	349.4	9.3	34.4
150 µm	No. 100	0.15	0.0059"	303.8	328.8	25.0	15.8
75 µm	No. 200	0.075	0.0029"	301.8	314.3	12.5	6.5
Pan				340.6	349.3	8.7	0.0
				Sc	<u>l</u> oil Wt. Sum (g):	134.2	



 $D_{10} =$ 0.095 mm Cu = 5.8 $D_{30} =$ Cc = 0.225 mm 1.0

 $D_{60} =$ 0.55 USCS Classification = SP-SM mm

Copyright © 2008 Stephens Associates Consulting Engineers LLC

Revisions:

By: Date: Date: By:



Project: Number: 026-08-007 Sheet MWRA Contract No. 6905, Pipeline Name: Original Work: Rte. 1, Saugus, MA R. Kline Permeability Estimate by Date: June 2, 2008 Subject: Checked By: J. Turner Date: June 13, 2008 Kozeny-Carman Formula

Boring Number: **B-2** Sample Number: **S-5** Sample Depth: **9-11'**

According to References 1 and 3, (Note: Reference List at end of data sheets) Permeability may be estimated as $k = (\gamma/\mu)(1/C_{K-C})(1/S^2)[e^3/(1+e)]$

 γ = assumed unit weight of water in situ, lb/ft³ = 62.4 = 9800 N/m³ μ = viscosity of water, Ns/m² = 0.00131 at 10 °C

 C_{K-C} = Kozeny-Carman empirical coefficient; reported as 4.8±0.3, usually taken as 5, =

S = specific surface area per unit volume of particles = $SF^*\Sigma((P_{No D}-P_{No d})/d)$

 $P_{No D}$ = percentage by weight smaller than size D

 P_{Nod} = percentage by weight larger than the next size d

 D_{eq} = equivalent grain size for particles smaller than D_{min} of gradation = $D_{min}/3^{0.5}$

SF = Shape Factor for particle angularity = 7.5

SF = 6.6 for rounded particles; 7.5 for medium angularity; 8.4 for angular (after Loudon, presented in Ref. 1)

thus, Permeability, may be estimated as $k = (\gamma/\mu)(1/C_{K-C})\{1/\Sigma[(P_{N_0,D}-P_{N_0,d})/d]\}^2(1/SF^2)[e^3/(1+e)]$, Table 1 below

Further, according Ref. 2, measured permeability typically varies from 1/3 to 3 times the estimated permeability. The references also note that this method may overpredict permeability when soil is gravel, and the results present an upper bound. The formula is not suitable for plastic soils.

	TABL	E 1 - SUM OF (P	No D - P _{No d})/d	
Sieve De	signation	Nominal Sieve	Percent	(P _{NoD} -P _{Nod})/ d
Standard	Alternate	Opening (cm)	Passing	(1/cm)
37.5 mm	1-1/2"	3.750	100.0	
25.0 mm	1"	2.500	100.0	0.0
19.0 mm	3/4"	1.900	100.0	0.0
12.5 mm	1/2"	1.250	100.0	0.0
9.5	3/8"	0.950	100.0	0.0
4.75 mm	No. 4	0.475	93.9	12.9
2.00 mm	No. 10	0.200	84.4	47.7
1.18 mm	No. 16	0.118	76.3	68.2
600 µm	No. 30	0.060	63.0	221.1
300 µm	No. 50	0.030	41.4	722.8
250 µm	No. 60	0.025	34.4	277.2
150 µm	No. 100	0.015	15.8	1241.9
75 µm	No. 200	0.008	6.5	1241.9
D_{eq}		0.004	0.0	1497.2
			Sum:	5330.8

Estimate Void Ratio (e) from Relative Density (Ref. 4)

 $D_r^2 = (N_1)60/C_P C_A C_{OCR}$

 $\begin{array}{llll} (N_1)60=&33\\ C_P=60+25logD_{50}=&50.1\\ D_{50}=&0.4&mm\\ C_A=1.2+0.05log(t/100)=&1.19\\ t(yr)=&70\\ C_{OCR}=OCR^{0.18}=&1\\ D_r=&0.74364 \end{array}$

 $e_{max} = 0.95$ $e = e_{max} - (D_r)(e_{max} - e_{min})$ $e_{min} = 0.2$ e = 0.39227

thus, range of permeability is estimated as:

Estimated range of k (cm/s)					
Probable Probable					
measured	measured Calculated				
lower bnd	Estimate	upper bnd			
1.4E-03	4.1E-03	1.2E-02			

Revisions:

By: Date: ______ Date: _____



Original Work:

R. Kline June 2, 2008 By: Date: Subject: Checked By: J. Turner Date: June 13, 2008

Laboratory Testing

Grain Size Distribution

Rte. 1, Saugus, MA

Boring Number: Sample Number: S-6 B-2 Sample Depth: 11-13'

Sample Description: Gray fine to medium SAND, some Silt

Sieve De Standard	signation Alternate		eve Opening inches	Tare Weight (g)	Sieve+Soil Wt. (g)	Soil Weight (g)	Percent Passing
		mm					
37.5 mm	1-1/2"	37.5	1.476"	501.3	501.3	0.0	100.0
25.0 mm	1"	25	0.984"	502.5	502.5	0.0	100.0
19.0 mm	3/4"	19	0.748"	595.8	595.8	0.0	100.0
12.5 mm	1/2"	12.5	0.492"	607.6	607.6	0.0	100.0
9.5	3/8"	9.5	0.374"	565.2	565.2	0.0	100.0
4.75 mm	No. 4	4.75	0.187"	527.7	527.7	0.0	100.0
2.00 mm	No. 10	2	0.078"	450.6	450.8	0.2	99.9
1.18 mm	No. 16	1.18	0.0464"	401.2	401.6	0.4	99.6
600 µm	No. 30	0.6	0.0236"	410.3	413.4	3.1	97.8
300 µm	No. 50	0.3	.0118"	416.4	450.3	33.9	78.0
250 µm	No. 60	0.25	0.0098"	340.0	354.9	14.9	69.3
150 µm	No. 100	0.15	0.0059"	303.6	340.8	37.2	47.5
75 µm	No. 200	0.075	0.0029"	301.6	333.0	31.4	29.1
Pan				340.5	390.2	49.7	0.0
				Sc	oil Wt. Sum (a):	170.8	

Soil Wt. Sum (g): **Grain-Size Distribution Plot** 50 60 100 200 Standard Sieve Sizes 100 90 Percent Passing by Weight 80 70 60 50 40 30 20 10 0 0.1 100 10 1 0.01 Particle Diameter (mm)

 $D_{10} =$ N/A mm Cu = N/A $D_{30} =$ 0.076 mm Cc = N/A

 $D_{60} =$ USCS Classification = 0.2 mm SM

Copyright © 2008 Stephens Associates Consulting Engineers LLC

Revisions:

By: Date: Date: Ву<u>:</u>



Project: Number: 026-08-007 Sheet MWRA Contract No. 6905, Pipeline Name: Original Work: Rte. 1, Saugus, MA R. Kline June 2, 2008 Permeability Estimate by Date: Subject: Checked By: J. Turner Date: June 13, 2008 Kozeny-Carman Formula

Boring Number: B-2 Sample Number: S-6 Sample Depth: 11-13'

According to References 1 and 3, (Note: Reference List at end of data sheets) Permeability may be estimated as $k = (\gamma/\mu)(1/C_{K-C})(1/S^2)[e^3/(1+e)]$

 γ = assumed unit weight of water in situ, lb/ft³ = 62.4 = 9800 N/m³ μ = viscosity of water, Ns/m² = 0.00131 at 10 °C

 C_{K-C} = Kozeny-Carman empirical coefficient; reported as 4.8±0.3, usually taken as 5, =

S = specific surface area per unit volume of particles = $SF^*\Sigma((P_{No D}-P_{No d})/d)$

 $P_{No D}$ = percentage by weight smaller than size D

 P_{Nod} = percentage by weight larger than the next size d

 D_{eq} = equivalent grain size for particles smaller than D_{min} of gradation = $D_{min}/3^{0.5}$

SF = Shape Factor for particle angularity = 7.5

SF = 6.6 for rounded particles; 7.5 for medium angularity; 8.4 for angular (after Loudon, presented in Ref. 1)

thus, Permeability, may be estimated as $k = (\gamma/\mu)(1/C_{K-C})\{1/\Sigma[(P_{N_0} - P_{N_0} d)/d]\}^2(1/SF^2)[e^3/(1+e)]$, Table 1 below

Further, according Ref. 2, measured permeability typically varies from 1/3 to 3 times the estimated permeability. The references also note that this method may overpredict permeability when soil is gravel, and the results present an upper bound. The formula is not suitable for plastic soils.

TABLE 1 - SUM OF (P _{No D} - P _{No d})/d							
Sieve De	signation	Nominal Sieve	Percent	(P _{NoD} -P _{Nod})/ d			
Standard	Alternate	Opening (cm)	Passing	(1/cm)			
37.5 mm	1-1/2"	3.750	100.0				
25.0 mm	1"	2.500	100.0	0.0			
19.0 mm	3/4"	1.900	100.0	0.0			
12.5 mm	1/2"	1.250	100.0	0.0			
9.5	3/8"	0.950	100.0	0.0			
4.75 mm	No. 4	0.475	100.0	0.0			
2.00 mm	No. 10	0.200	99.9	0.6			
1.18 mm	No. 16	0.118	99.6	2.0			
600 µm	No. 30	0.060	97.8	30.2			
300 µm	No. 50	0.030	78.0	661.6			
250 µm	No. 60	0.025	69.3	348.9			
150 µm	No. 100	0.015	47.5	1452.0			
75 µm	No. 200	0.008	29.1	2451.2			
D_{eq}		0.004	0.0	6720.0			
			Sum:	11666.5			

Estimate Void Ratio (e) from Relative Density (Ref. 4)

 $D_r^2 = (N_1)60/C_P C_A C_{OCR}$

 $\begin{array}{lll} (N_1)60=&15\\ C_P=60+25logD_{50}=&41.1\\ D_{50}=&0.18\ mm\\ C_A=1.2+0.05log(t/100)=&1.19\\ t(yr)=&70\\ C_{OCR}=OCR^{0.18}=&1\\ D_r=&0.55344 \end{array}$

 $e_{max} = 0.9$ $e = e_{max} - (D_r)(e_{max} - e_{min})$ $e_{min} = 0.3$ e = 0.56794

thus, range of permeability is estimated as:

Estimated range of k (cm/s)					
Probable Probable					
measured	measured Calculated				
lower bnd	lower bnd Estimate				
7.6E-04	2.3E-03	6.8E-03			

Copyright © 2008 Stephens Associates Consulting Engineers LLC Revisions:

Stephens Associates
Consulting Engineers
Insightful Costsaving Solutions
for Buildings and
Infrastructure
Hydrology & Hydraulics

 Project:
 Number:
 026-08-007
 Sheet
 1
 of
 1

 Name:
 MWRA Contract No. 6905, Pipeline

Nan

Rte. 1, Saugus, MA

Laboratory Testing

By: R. Kline Date: June 2, 2008 Subject: Checked By: J. Turner Date: June 13, 2008

B-4

Original Work:

Boring Number:

Grain Size Distribution

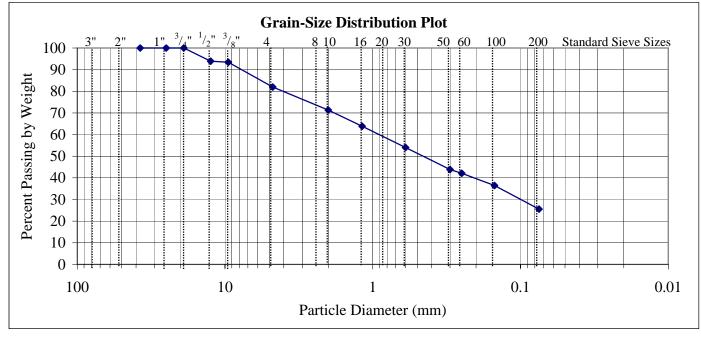
Sample Depth: 1-3' Bottom 9"

Sample Number: S-1

Sample Description: Gray and black fine to coarse SAND, some Silt, little Gravel

Sieve De	signation	Nominal Signal	eve Opening	Tare Weight	Sieve+Soil Wt.	Soil Weight (g)	Percent
Standard	Alternate	mm	inches	(g)	(g)	Con Woight (g)	Passing
37.5 mm	1-1/2"	37.5	1.476"	501.4	501.4	0.0	100.0
25.0 mm	1"	25	0.984"	502.6	502.6	0.0	100.0
19.0 mm	3/4"	19	0.748"	595.9	595.9	0.0	100.0
12.5 mm	1/2"	12.5	0.492"	607.6	614.2	6.6	93.9
9.5	3/8"	9.5	0.374"	565.3	565.8	0.5	93.4
4.75 mm	No. 4	4.75	0.187"	527.7	540.1	12.4	82.0
2.00 mm	No. 10	2	0.078"	450.7	462.2	11.5	71.3
1.18 mm	No. 16	1.18	0.0464"	401.1	409.2	8.1	63.8
600 µm	No. 30	0.6	0.0236"	410.1	420.7	10.6	54.0
300 µm	No. 50	0.3	.0118"	416.2	427.2	11.0	43.8
250 µm	No. 60	0.25	0.0098"	339.9	341.8	1.9	42.1
150 µm	No. 100	0.15	0.0059"	303.5	309.6	6.1	36.4
75 µm	No. 200	0.075	0.0029"	301.4	313.2	11.8	25.5
Pan				340.3	367.9	27.6	0.0
					sil M/+ Cum (a).	100.1	

Soil Wt. Sum (g): 108.1



 $D_{10} = N/A$ mm Cu = N/A $D_{30} = 0.1$ mm Cc = N/A

 $D_{60} = 0.9$ mm USCS Classification = SM

 ${\it Copyright} @ 2008 {\it Stephens Associates Consulting Engineers LLC}\\$

Revisions:

By: _____ Date: _____ Date: _____



Original Work:

Ву: R. Kline June 2, 2008 Date: Subject: **Laboratory Testing**

Rte. 1, Saugus, MA

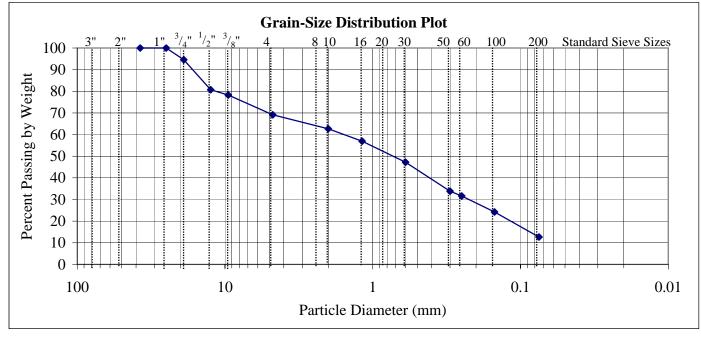
Checked By: J. Turner Date: June 13, 2008 Grain Size Distribution

Boring Number: B-4 Sample Number: S-4 Sample Depth: 7-9'

Sample Description: Gray fine to medium SAND, some Gravel, little Silt

	signation	Nominal Sie	eve Opening	Tare Weight	Sieve+Soil Wt.	Soil Weight (g)	Percent
Standard	Alternate	mm	inches	(g)	(g)	Son Weight (g)	Passing
37.5 mm	1-1/2"	37.5	1.476"	501.3	501.3	0.0	100.0
25.0 mm	1"	25	0.984"	502.6	502.6	0.0	100.0
19.0 mm	3/4"	19	0.748"	595.9	601.8	5.9	94.5
12.5 mm	1/2"	12.5	0.492"	607.7	622.7	15.0	80.7
9.5	3/8"	9.5	0.374"	565.4	568.0	2.6	78.3
4.75 mm	No. 4	4.75	0.187"	527.9	537.8	9.9	69.1
2.00 mm	No. 10	2	0.078"	451.1	458.1	7.0	62.7
1.18 mm	No. 16	1.18	0.0464"	401.3	407.5	6.2	56.9
600 µm	No. 30	0.6	0.0236"	410.4	420.9	10.5	47.2
300 µm	No. 50	0.3	.0118"	416.6	431.1	14.5	33.8
250 µm	No. 60	0.25	0.0098"	340.0	342.4	2.4	31.6
150 µm	No. 100	0.15	0.0059"	303.7	311.7	8.0	24.2
75 µm	No. 200	0.075	0.0029"	301.6	314.1	12.5	12.7
Pan				340.4	354.1	13.7	0.0
					bil Wt. Sum (a):	108.2	

Soil VVt. Sum (g):



 $D_{10} =$ N/A mm Cu = N/A $D_{30} =$ 0.225 mm Cc = N/A

 $D_{60} =$ USCS Classification = 1.65 mm SM

Copyright © 2008 Stephens Associates Consulting Engineers LLC

Revisions:

By: Date: Date:



Project: Number: 026-08-007 Sheet MWRA Contract No. 6905, Pipeline Name: Original Work: Rte. 1, Saugus, MA R. Kline Permeability Estimate by Date: June 2, 2008 Subject: Checked By: J. Turner Date: June 13, 2008 Kozeny-Carman Formula

Boring Number: **B-4** Sample Number: **S-4** Sample Depth: **7-9'**

According to References 1 and 3, (Note: Reference List at end of data sheets) Permeability may be estimated as $k = (\gamma/\mu)(1/C_{K-C})(1/S^2)[e^3/(1+e)]$

 γ = assumed unit weight of water in situ, lb/ft³ = 62.4 = 9800 N/m³ μ = viscosity of water, Ns/m² = 0.00131 at 10 °C

 C_{K-C} = Kozeny-Carman empirical coefficient; reported as 4.8±0.3, usually taken as 5, =

S = specific surface area per unit volume of particles = $SF^*\Sigma((P_{No D}-P_{No d})/d)$

 $P_{No D}$ = percentage by weight smaller than size D

 P_{Nod} = percentage by weight larger than the next size d

 D_{eq} = equivalent grain size for particles smaller than D_{min} of gradation = $D_{min}/3^{0.5}$

SF = Shape Factor for particle angularity = 7.5

SF = 6.6 for rounded particles; 7.5 for medium angularity; 8.4 for angular (after Loudon, presented in Ref. 1)

thus, Permeability, may be estimated as $k = (\gamma/\mu)(1/C_{K-C})\{1/\Sigma[(P_{N_0} - P_{N_0} d)/d]\}^2(1/SF^2)[e^3/(1+e)]$, Table 1 below

Further, according Ref. 2, measured permeability typically varies from 1/3 to 3 times the estimated permeability. The references also note that this method may overpredict permeability when soil is gravel, and the results present an upper bound. The formula is not suitable for plastic soils.

TABLE 1 - SUM OF (P _{No D} - P _{No d})/d							
Sieve De	signation	Nominal Sieve	Percent	(P _{NoD} -P _{Nod})/ d			
Standard	Alternate	Opening (cm)	Passing	(1/cm)			
37.5 mm	1-1/2"	3.750	100.0				
25.0 mm	1"	2.500	100.0	0.0			
19.0 mm	3/4"	1.900	94.5	2.9			
12.5 mm	1/2"	1.250	80.7	11.1			
9.5	3/8"	0.950	78.3	2.5			
4.75 mm	No. 4	0.475	69.1	19.3			
2.00 mm	No. 10	0.200	62.7	32.3			
1.18 mm	No. 16	0.118	56.9	48.6			
600 µm	No. 30	0.060	47.2	161.7			
300 µm	No. 50	0.030	33.8	446.7			
250 µm	No. 60	0.025	31.6	88.7			
150 µm	No. 100	0.015	24.2	492.9			
75 µm	No. 200	0.008	12.7	1540.4			
D_{eq}		0.004	0.0	2924.1			
•							
		•	Sum:	5771 2			

Estimate Void Ratio (e) from Relative Density (Ref. 4)

 $D_r^2 = (N_1)60/C_P C_A C_{OCR}$

 $(N_1)60=$ 19 $C_P=60+25logD_{50}=$ 56.6 $D_{50}=$ 0.73 mm $C_A=1.2+0.05log(t/100)=$ 1.19 t(yr)= 70 $C_{OCR}=OCR^{0.18}=$ 1 $D_r=$ 0.5307

 $e_{max} = 0.85$ $e = e_{max} - (D_r)(e_{max} - e_{min})$ $e_{min} = 0.14$ e = 0.4732

thus, range of permeability is estimated as:

Estimated range of k (cm/s)						
Probable Probable						
measured	Calculated	measured				
lower bnd	Estimate	upper bnd				
1.9E-03	5.7E-03	1.7E-02				

Copyright © 2008 Stephens Associates Consulting Engineers LLC
Revisions:

By: Date: _______ Date: _______

Stephens Associates
Consulting Engineers
Insightful Coetsaving Solutions
for Buildings and
Initiastructure
Hydrology & Hydraulics

Project: Number: 026-08-007 Sheet 1 of

Name:

MWRA Contract No. 6905, Pipeline Rte. 1, Saugus, MA

Original Work:

R. Kline By: Checked By: J. Turner Date:

June 4, 2008 Date: Subject: June 13, 2008

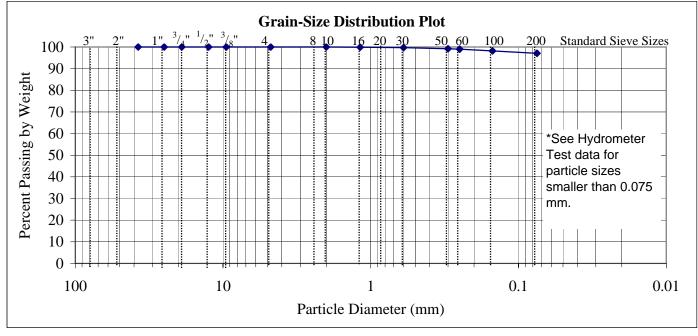
Laboratory Testing

Grain Size Distribution

Boring Number: Sample Number: S-5 Sample Depth: 9-11' Bottom 4" B-4

Sample Description: Brown slightly plastic SILT

Sieve De	signation	Nominal Sie	eve Opening	Tare Weight	Sieve+Soil Wt.	Soil Weight (g)	Percent
Standard	Alternate	mm	inches	(g)	(g)	Son Weight (g)	Passing
37.5 mm	1-1/2"	37.5	1.476"	501.3	501.3	0.0	100.0
25.0 mm	1"	25	0.984"	502.5	502.5	0.0	100.0
19.0 mm	3/4"	19	0.748"	595.8	595.8	0.0	100.0
12.5 mm	1/2"	12.5	0.492"	607.6	607.6	0.0	100.0
9.5	3/8"	9.5	0.374"	565.2	565.2	0.0	100.0
4.75 mm	No. 4	4.75	0.187"	527.8	527.8	0.0	100.0
2.00 mm	No. 10	2	0.078"	450.9	450.9	0.0	100.0
1.18 mm	No. 16	1.18	0.0464"	401.2	401.3	0.1	99.9
600 µm	No. 30	0.6	0.0236"	410.4	410.6	0.2	99.7
300 µm	No. 50	0.3	.0118"	416.6	417.1	0.5	99.2
250 µm	No. 60	0.25	0.0098"	339.9	340.1	0.2	99.0
150 µm	No. 100	0.15	0.0059"	303.2	304.0	0.8	98.2
75 µm	No. 200	0.075	0.0029"	301.7	302.8	1.1	97.1
Pan				340.4	436.7	96.3	0.0
				Sc	l bil Wt. Sum (g):	99.2	



 $D_{10} =$ N/A mm Cu = N/A $D_{30} =$ N/A mm Cc = N/A

 $D_{60} =$ N/A USCS Classification = CL mm

Copyright © 2008 Stephens Associates Consulting Engineers LLC

Revisions:

By: Date: Date: By:



026-08-007 **Project:** Number: Sheet 1 of MWRA Contract No. 6905, Pipeline Name: Original Work: Rte. 1, Saugus, MA By: R. Kline Date: June 4, 2008 Subject: **Laboratory Testing** Checked By: J. Turner Date: June 13, 2008 **Hydrometer Analysis**

Boring Number: B-4 Sample Number: S-5 Sample Depth: 9-11'

Sample Description: Brown slightly plastic SILT

Calculation for Percent of Soil in Suspension: P = (R*a/W)*100

P = percent of soil in suspension at the level of the hydrometer, i.e. percent smaller diameter

R = Hydrometer reading with composite correction

a = correction factor for specific gravity of soil solids other than 2.65

Calculation for Particle Diameter: $D = K (L/T)^{0.5}$ D = particle diameter, mm T = time, min.

L = distance from the suspension surface to the level at which the density of the suspension is measured, cm

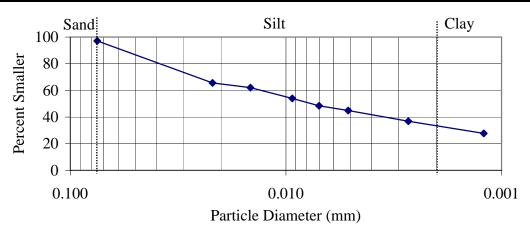
K = constant depending on the temperature of the suspension and the specific gravity of the soil particles.

Values of K for a range of temperatures and specific gravities are given in Table 3 of ASTM D-422

The value of K does not change for a series of readings constituting a test, while values of L and T do vary.

Test Constants: Hydrometer Type: 152H
Reading of Hydrometer in Solution Only (g/l): 3.0 Temperature of Solution (°C) 20.0
Specific Gravity of Soil Solids (Assumed): 2.65 a: 1.00
Dry Soil Weight, W (g): 99.1 K: 0.01365

Time (min)	Reading (g/l)	Corrected Reading (g/l)	L	Diameter (mm)	% in suspension
	Data from S	0.0750	97.1		
2	68	65	5.15	0.0219	65.6
5	64.5	61.5	5.72	0.0146	62.1
15	56.5	53.5	7.03	0.0093	54.0
30	51	48	7.94	0.0070	48.4
60	47.5	44.5	8.51	0.0051	44.9
250	39.5	36.5	9.82	0.0027	36.8
1440	30.5	27.5	11.30	0.0012	27.7



Copyright © 2008 Stephens Associates Consulting Engineers LLC Revisions:

By: Date:

Date:

Stephens Associates
Consulting Engineers
Insightful, Costsawing Solutions for Buildings and for Buildings and Geotechnical

Project: Number:

Name:

026-08-007

Sheet 1 of

MWRA Contract No. 6905, Pipeline

Rte. 1, Saugus, MA

Original Work:

R. Kline By: Checked By: J. Turner Date:

Date:

June 3, 2008 June 13, 2008

Subject:

Laboratory Testing

Atterberg Limits

Boring Number:

B-4

Sample Number: S-5

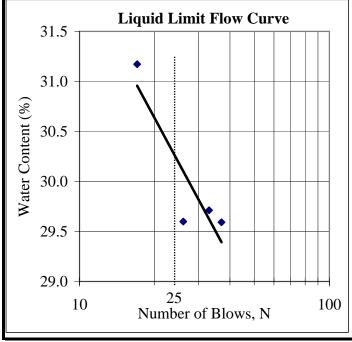
Sample Depth: 9-11'

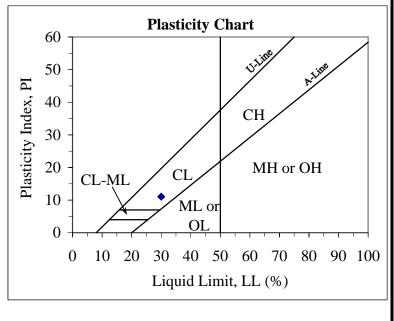
Sample Description: Brown slightly plastic SILT

LIQUID LIMIT							
Container Number	13	2	10	21			
Tare Weight (g)	16.20	16.45	16.28	16.46			
Weight Wet Soil+Container Tare (g)	23.82	24.20	23.92	25.97			
Weight Dry Soil+Container Tare (g)	22.08	22.43	22.17	23.71			
Weight Water (g)	1.74	1.77	1.75	2.26			
Weight Dry Soil (g)	5.88	5.98	5.89	7.25			
Water Content (%)	29.6	29.6	29.7	31.2			
Number of Blows, N	37	26	33	17			

PLASTIC LIMIT							
Container Number	15	14					
Tare Weight (g)	16.20	16.30					
Weight Wet Soil+Container Tare (g)	25.31	26.13					
Weight Dry Soil+Container Tare (g)	23.89	24.53					
Weight Water (g)	1.42	1.60					
Weight Dry Soil (g)	7.69	8.23					
Water Content (%)	18.5	19.4					

SUMMARY OF RESULTS						
Natural Water Content	37					
Liquid Limit, LL	30					
Plastic Limit, PL	19					
Plasticity Index, PI	11					
Liquidity Index, LI	1.59					
USCS Classification	CL					





Copyright © 2008 Stephens Associates Consulting Engineers LLC

Revisions:

By:____ Date: Date: By:_

Stephens Associates Consulting Engineers

www.stephensengineers.com 668 Main Street, Wilmington, MA 01887 (978) 988-2115

Original Work:

By: R. Kline Date: June 2, 2008 Subject: Checked By: J. Turner Date: June 13, 2008

Laboratory Testing
Grain Size Distribution

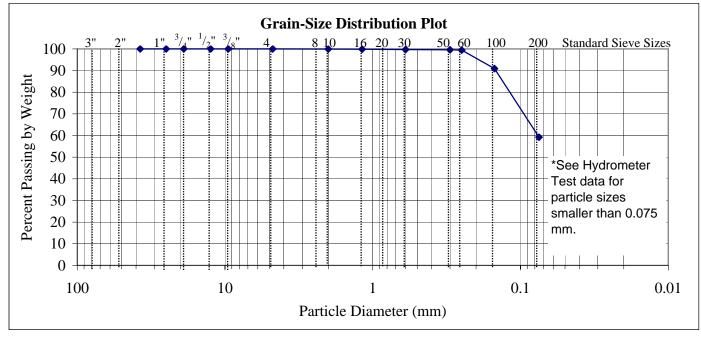
Rte. 1, Saugus, MA

Boring Number: B-5 Sample Number: S-4 Sample Depth: 7-9'

Sample Description: Light brown non-plastic SILT and fine SAND

Sieve De	signation	Nominal Signature	eve Opening	Tare Weight	Sieve+Soil Wt.	Soil Weight (g)	Percent	
Standard	Alternate	mm	inches	(g)	(g) Son Trongin (g		Passing	
37.5 mm	1-1/2"	37.5	1.476"	501.3	501.3	0.0	100.0	
25.0 mm	1"	25	0.984"	502.5	502.5	0.0	100.0	
19.0 mm	3/4"	19	0.748"	595.8	595.8	0.0	100.0	
12.5 mm	1/2"	12.5	0.492"	607.6	607.6	0.0	100.0	
9.5	3/8"	9.5	0.374"	565.4	565.4	0.0	100.0	
4.75 mm	No. 4	4.75	0.187"	527.9	527.9	0.0	100.0	
2.00 mm	No. 10	2	0.078"	450.9	451.0	0.1	99.9	
1.18 mm	No. 16	1.18	0.0464"	401.3	401.4	0.1	99.9	
600 µm	No. 30	0.6	0.0236"	410.4	410.6	0.2	99.7	
300 µm	No. 50	0.3	.0118"	416.6	416.8	0.2	99.6	
250 µm	No. 60	0.25	0.0098"	340.0	340.2	0.2	99.4	
150 µm	No. 100	0.15	0.0059"	303.7	315.9	12.2	90.9	
75 µm	No. 200	0.075	0.0029"	301.7	347.0	45.3	59.2	
Pan				340.4	425.0	84.6	0.0	
				Sc	oil Wt. Sum (a):	142.9		

Soil Wt. Sum (g): 142.9



 $D_{10} = N/A$ mm Cu = N/A $D_{30} = N/A$ mm Cc = N/A

 $D_{60} = 0.075$ mm USCS Classification = ML

Copyright © 2008 Stephens Associates Consulting Engineers LLC

Revisions:

By: Date: Date:



			Project	: Number:	026-08-007	Sheet 1 of	1
				Name:	MWRA Contract No.	6905, Pipeline	
Origina	l Work:				Rte. 1, Saug	us, MA	
By:	R. Kline	Date:	June 3, 2008	Subject:	Laboratory T	Testing	
Checke	ed By: J. Turr	ner Date:	June 13, 2008	<u> </u>	Hydrometer A	Analysis	

Boring Number: B-5 Sample Number: S-4 Sample Depth: 7-9'

Sample Description: Light brown SILT and fine Sand

Calculation for Percent of Soil in Suspension: P = (R*a/W)*100

P = percent of soil in suspension at the level of the hydrometer, i.e. percent smaller diameter

R = Hydrometer reading with composite correction

a = correction factor for specific gravity of soil solids other than 2.65

Calculation for Particle Diameter: $D = K (L/T)^{0.5}$ D = particle diameter, mm T = time, min.

L = distance from the suspension surface to the level at which the density of the suspension is measured, cm

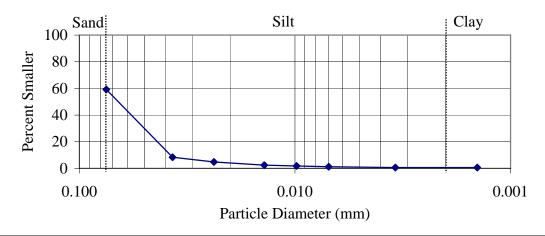
K = constant depending on the temperature of the suspension and the specific gravity of the soil particles.

Values of K for a range of temperatures and specific gravities are given in Table 3 of ASTM D-422

The value of K does not change for a series of readings constituting a test, while values of L and T do vary.

Test Constants: Hydrometer Type: 152H
Reading of Hydrometer in Solution Only (g/l): 3.0 Temperature of Solution (°C) 20.0
Specific Gravity of Soil Solids (Assumed): 2.65 a: 1.00
Dry Soil Weight, W (g): 83.8 K: 0.01365

Time (min)	Reading (g/l)	Corrected Reading (g/l)	L	Diameter (mm)	% in suspension
	Data from S	0.0750	59.2		
2	10	7	14.66	0.0370	8.4
5	7	4	15.15	0.0238	4.8
15	5	2	15.48	0.0139	2.4
30	4.5	1.5	15.56	0.0098	1.8
60	4	1	15.64	0.0070	1.2
250	3.5	0.5	15.73	0.0034	0.6
1440	3.5	0.5	15.73	0.0014	0.6



Copyright © 2008 Stephens Associates Consulting Engineers LLC Revisions:

By: Date:

Date:

Stephens Associates
Consulting Engineers
Insightful, Costsaving Solutions
for Buildings and
Infrastructure
Hydrology & Hydraulics

Project: Number: 026-08-007 Sheet MWRA Contract No. 6905, Pipeline Name: Original Work: Rte. 1, Saugus, MA R. Kline Permeability Estimate by Date: June 2, 2008 Subject: Checked By: J. Turner Date: June 13, 2008 Kozeny-Carman Formula

Boring Number: **B-5** Sample Number: **S-4** Sample Depth: **7-9**'

According to References 1 and 3, (Note: Reference List at end of data sheets) Permeability may be estimated as $k = (\gamma/\mu)(1/C_{K-C})(1/S^2)[e^3/(1+e)]$

 γ = assumed unit weight of water in situ, lb/ft³ = 62.4 = 9800 N/m³ μ = viscosity of water, Ns/m² = 0.00131 at 10 °C

 C_{K-C} = Kozeny-Carman empirical coefficient; reported as 4.8±0.3, usually taken as 5, =

S = specific surface area per unit volume of particles = $SF^*\Sigma((P_{No D}-P_{No d})/d)$

 $P_{No D}$ = percentage by weight smaller than size D

 P_{Nod} = percentage by weight larger than the next size d

 D_{eq} = equivalent grain size for particles smaller than D_{min} of gradation = $D_{min}/3^{0.5}$

SF = Shape Factor for particle angularity = 7.5

SF = 6.6 for rounded particles; 7.5 for medium angularity; 8.4 for angular (after Loudon, presented in Ref. 1)

thus, Permeability, may be estimated as $k = (\gamma/\mu)(1/C_{K-C})\{1/\Sigma[(P_{N_0,D}-P_{N_0,d})/d]\}^2(1/SF^2)[e^3/(1+e)]$, Table 1 below

Further, according Ref. 2, measured permeability typically varies from 1/3 to 3 times the estimated permeability. The references also note that this method may overpredict permeability when soil is gravel, and the results present an upper bound. The formula is not suitable for plastic soils.

	TABLE 1 - SUM OF (P _{No D} - P _{No d})/d						
Sieve De	Sieve Designation		Percent	(P _{NoD} -P _{Nod})/ d			
Standard	Alternate	Opening (cm)	Passing	(1/cm)			
4.75 mm	No. 4	0.475	100.0	0.0			
2.00 mm	No. 10	0.200	99.9	0.3			
1.18 mm	No. 16	0.118	99.9	0.6			
600 µm	No. 30	0.060	99.7	2.3			
300 µm	No. 50	0.030	99.6	4.7			
250 µm	No. 60	0.025	99.4	5.6			
150 µm	No. 100	0.015	90.9	569.2			
75 µm	No. 200	0.008	59.2	4226.7			
•		0.00370	8.4	13730.3			
		0.00238	4.8	1512.6			
		0.00139	2.4	1726.6			
Hydro	meter	0.00098	1.8	612.2			
		0.00070	1.2	857.1			
		0.00034	0.6	1764.7			
			0.6	0.0			
D_{eq}		0.00008	0.0	7423.1			
			Sum:	32436.2			

Estimate Void Ratio (e) from Relative Density (Ref. 4)

 $D_r^2 = (N_1)60/C_P C_A C_{OCR}$

 $(N_1)60=$ 25 $C_P=60+25logD_{50}=$ 30.5 $D_{50}=$ 0.07 mm $C_A=1.2+0.05log(t/100)=$ 1.19 t(yr)= 70 $C_{OCR}=OCR^{0.18}=$ 1 $D_r=$ 0.82931

 $e_{max} = 0.9$ $e = e_{max} - (D_r)(e_{max} - e_{min})$ $e_{min} = 0.3$ e = 0.40241

thus, range of permeability is estimated as:

Estimated range of k (cm/s)				
Probable		Probable		
measured	Calculated	measured		
lower bnd	Estimate	upper bnd		
3.9E-05	1.2E-04	3.5E-04		

Copyright © 2008 Stephens Associates Consulting Engineers LL	.C
--	----

Revisions:

By: Date: Date:



Original Work:

R. Kline June 6, 2008 By: Date: Subject: Checked By: J. Turner Date: June 13, 2008

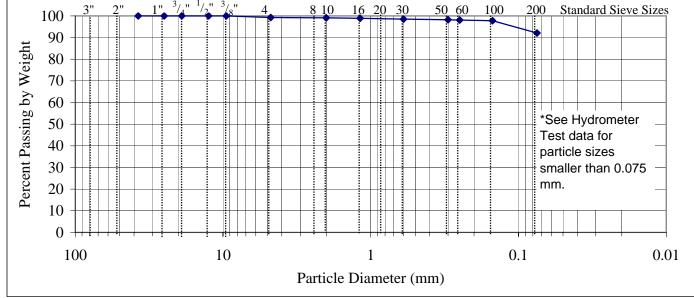
Rte. 1, Saugus, MA **Laboratory Testing** Grain Size Distribution

Boring Number: Sample Number: S-5 Sample Depth: 9-11' B-5

Sample Description: Light brown non-plastic SILT

Sieve De	signation	Nominal Sie	eve Opening	Tare Weight	Sieve+Soil Wt.	Soil Weight (g)	Percent
Standard	Alternate	mm	inches	(g)	(g)	Con Weight (g)	Passing
37.5 mm	1-1/2"	37.5	1.476"	501.3	501.3	0.0	100.0
25.0 mm	1"	25	0.984"	502.5	502.5	0.0	100.0
19.0 mm	3/4"	19	0.748"	595.8	595.8	0.0	100.0
12.5 mm	1/2"	12.5	0.492"	607.5	607.5	0.0	100.0
9.5	3/8"	9.5	0.374"	565.1	565.1	0.0	100.0
4.75 mm	No. 4	4.75	0.187"	527.6	528.6	1.0	99.3
2.00 mm	No. 10	2	0.078"	450.8	451.0	0.2	99.1
1.18 mm	No. 16	1.18	0.0464"	401.1	401.4	0.3	98.9
600 µm	No. 30	0.6	0.0236"	410.3	410.8	0.5	98.5
300 µm	No. 50	0.3	.0118"	416.6	417.0	0.4	98.2
250 µm	No. 60	0.25	0.0098"	339.9	340.1	0.2	98.1
150 µm	No. 100	0.15	0.0059"	303.6	304.0	0.4	97.8
75 µm	No. 200	0.075	0.0029"	301.6	309.3	7.7	92.1
Pan				340.3	464.9	124.6	0.0
				Sc	l oil Wt. Sum (g):	135.3	

Grain-Size Distribution Plot 200 Standard Sieve Sizes 16 50 60 100 100 90 80 70



 $D_{10} =$ N/A mm Cu = N/A $D_{30} =$ N/A Cc = N/A mm $D_{60} =$ N/A USCS Classification = mm

Copyright © 2008 Stephens Associ	ates Consulting Engineers LLC
----------------------------------	-------------------------------

Revisions:

By: Date: Date: Ву<u>:</u>



026-08-007 **Project:** Number: Sheet 1 of MWRA Contract No. 6905, Pipeline Name: Original Work: Rte. 1, Saugus, MA R. Kline Date: June 11, 2008 Subject: **Laboratory Testing** Checked By: J. Turner Date: June 13, 2008 **Hydrometer Analysis**

Boring Number: B-5 Sample Number: S-5 Sample Depth: 9-11'

Sample Description: Light brown non-plastic SILT

By:

P = (R*a/W)*100Calculation for Percent of Soil in Suspension:

P = percent of soil in suspension at the level of the hydrometer, i.e. percent smaller diameter

R = Hydrometer reading with composite correction

a = correction factor for specific gravity of soil solids other than 2.65

 $D = K (L/T)^{0.5}$ Calculation for Particle Diameter: T = time, min. D = particle diameter, mm

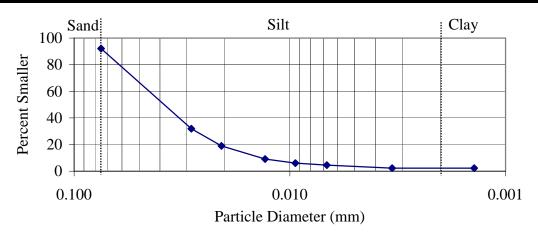
L = distance from the suspension surface to the level at which the density of the suspension is measured, cm

K = constant depending on the temperature of the suspension and the specific gravity of the soil particles. Values of K for a range of temperatures and specific gravities are given in Table 3 of ASTM D-422

The value of K does not change for a series of readings constituting a test, while values of L and T do vary.

Test Constants: Hydrometer Type: 152H Reading of Hydrometer in Solution Only (g/l): Temperature of Solution (°C) 3.0 20.6 Specific Gravity of Soil Solids (Assumed): 2.65 1.00 a: Dry Soil Weight, W (g): K: 0.013555 131.6

Time (min)	Reading (g/l)	Corrected Reading (g/l)	L	Diameter (mm)	% in suspension
	Data from S	0.0750	92.1		
2	45	42	8.92	0.0286	31.9
5	28	25	11.71	0.0207	19.0
15	15	12	13.84	0.0130	9.1
30	11	8	14.50	0.0094	6.1
60	9	6	14.82	0.0067	4.6
250	6	3	15.32	0.0034	2.3
1440	6	3	15.32	0.0014	2.3



Copyright © 2008 Stephens Associates Consulting Engineers LLC Revisions:

By: Date: Date: **Stephens Associates Consulting Engineers**

Project: Number: 026-08-007 Sheet 1 of Name: MWRA Contract No. 6905, Pipeline Original Work: Rte. 1, Saugus, MA R. Kline Permeability Estimate by Date: June 6, 2008 Subject: Checked By: J. Turner Date: June 13, 2008 Kozeny-Carman Formula

Boring Number: **B-5** Sample Number: **S-5** Sample Depth: **9-11'**

According to References 1 and 3, (Note: Reference List at end of data sheets) Permeability may be estimated as $k = (\gamma/\mu)(1/C_{K-C})(1/S^2)[e^3/(1+e)]$

 γ = assumed unit weight of water in situ, lb/ft³ = 62.4 = 9800 N/m³ μ = viscosity of water, Ns/m² = 0.00131 at 10 °C

 C_{K-C} = Kozeny-Carman empirical coefficient; reported as 4.8±0.3, usually taken as 5, =

S = specific surface area per unit volume of particles = $SF^*\Sigma((P_{No D}-P_{No d})/d)$

 $P_{No D}$ = percentage by weight smaller than size D

 P_{Nod} = percentage by weight larger than the next size d

 D_{eq} = equivalent grain size for particles smaller than D_{min} of gradation = $D_{min}/3^{0.5}$

SF = Shape Factor for particle angularity = 7.5

SF = 6.6 for rounded particles; 7.5 for medium angularity; 8.4 for angular (after Loudon, presented in Ref. 1)

thus, Permeability, may be estimated as $k = (\gamma/\mu)(1/C_{K-C})\{1/\Sigma[(P_{N_0,D}-P_{N_0,d})/d]\}^2(1/SF^2)[e^3/(1+e)]$, Table 1 below

Further, according Ref. 2, measured permeability typically varies from 1/3 to 3 times the estimated permeability. The references also note that this method may overpredict permeability when soil is gravel, and the results present an upper bound. The formula is not suitable for plastic soils.

	TABLE 1 - SUM OF (P _{No D} - P _{No d})/d						
Sieve De	Sieve Designation		Percent	(P _{NoD} -P _{Nod})/ d			
Standard	Alternate	Opening (cm)	Passing	(1/cm)			
9.5	3/8"	0.950	100.0	0.0			
4.75 mm	No. 4	0.475	99.3	1.6			
2.00 mm	No. 10	0.200	99.1	0.7			
1.18 mm	No. 16	0.118	98.9	1.9			
600 µm	No. 30	0.060	98.5	6.2			
300 µm	No. 50	0.030	98.2	9.9			
250 µm	No. 60	0.025	98.1	5.9			
150 µm	No. 100	0.015	97.8	19.7			
75 µm	No. 200	0.008	92.1	758.8			
		0.00286	31.9	21046.0			
		0.00207	19.0	6231.9			
		0.00130	9.1	7615.4			
Hydro	meter	0.00094	6.1	3191.5			
		0.00067	4.6	2238.8			
			2.3	6764.7			
		0.00014	2.3	0.0			
D_{eq}		0.00008	0.0	28455.1			
			Sum:	76348.0			

Estimate Void Ratio (e) from Relative Density (Ref. 4)

 $D_r^2 = (N_1)60/C_P C_A C_{OCR}$

 $\begin{array}{llll} (N_1)60 = & 23 \\ C_P = 60 + 25 log D_{50} = & 24.4 \\ D_{50} = & 0.04 & mm \\ C_A = 1.2 + 0.05 log (t/100) = & 1.19 \\ t(yr) = & 70 \\ C_{OCR} = OCR^{0.18} = & 1 \\ D_r = & 0.89007 \end{array}$

 $e_{max} = 0.9$ $e = e_{max} - (D_r)(e_{max} - e_{min})$ $e_{min} = 0.3$ e = 0.36596

thus, range of permeability is estimated as:

Estimated range of k (cm/s)				
Probable		Probable		
measured	Calculated	measured		
lower bnd	Estimate	upper bnd		
5.5E-06	1.6E-05	4.9E-05		

Copyright © 2008 Stephens Ass	ociates Consulting E	ngineers LLC
Revisions:		



 Project:
 Number:
 026-08-007
 Sheet
 1
 of
 1

 Name:
 MWRA Contract No. 6905, Pipeline

Original Work:

By: R. Kline Date: June 2, 2008 Subject: Checked By: J. Turner Date: June 13, 2008

Laboratory Testing
Grain Size Distribution

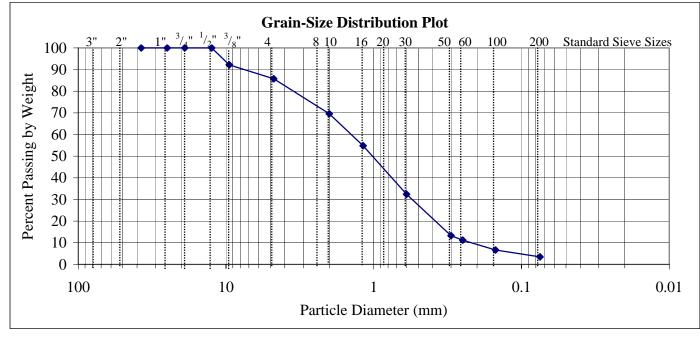
Rte. 1, Saugus, MA

Boring Number: B-6 Sample Number: S-4 Sample Depth: 7-9' Middle 6"

Sample Description: Brown fine to coarse SAND, little Gravel

Sieve De	signation	Nominal Signature	eve Opening	Tare Weight	Sieve+Soil Wt.	Soil Weight (g)	Percent
Standard	Alternate	mm	inches	(g)	(g)	Con Worght (g)	Passing
37.5 mm	1-1/2"	37.5	1.476"	501.3	501.3	0.0	100.0
25.0 mm	1"	25	0.984"	502.5	502.5	0.0	100.0
19.0 mm	3/4"	19	0.748"	595.8	595.8	0.0	100.0
12.5 mm	1/2"	12.5	0.492"	607.7	607.7	0.0	100.0
9.5	3/8"	9.5	0.374"	565.4	573.3	7.9	92.2
4.75 mm	No. 4	4.75	0.187"	527.8	534.3	6.5	85.7
2.00 mm	No. 10	2	0.078"	450.7	467.0	16.3	69.6
1.18 mm	No. 16	1.18	0.0464"	401.2	416.1	14.9	54.8
600 µm	No. 30	0.6	0.0236"	410.3	432.9	22.6	32.4
300 µm	No. 50	0.3	.0118"	416.4	435.7	19.3	13.3
250 µm	No. 60	0.25	0.0098"	340.0	342.1	2.1	11.2
150 µm	No. 100	0.15	0.0059"	303.6	308.2	4.6	6.6
75 µm	No. 200	0.075	0.0029"	301.6	304.8	3.2	3.5
Pan				340.5	344.0	3.5	0.0
				90	oil Wt Sum (a):	100.9	

Soil Wt. Sum (g): 100.9



 $D_{10} = 0.215 \text{ mm}$ Cu = 7.7 $D_{30} = 0.55 \text{ mm}$ Cc = 0.9

 $D_{60} = 1.65$ mm USCS Classification = SP

Copyright © 2008 Stephens Associates Consulting Engineers LLC

Revisions:

By: Date: ______ Date: ______



Project: Number: 026-08-007 Sheet MWRA Contract No. 6905, Pipeline Name: Original Work: Rte. 1, Saugus, MA R. Kline June 2, 2008 Permeability Estimate by Date: Subject: Checked By: J. Turner Date: June 13, 2008 Kozeny-Carman Formula

Boring Number: **B-6** Sample Number: **S-4** Sample Depth: **7-9' Middle 6"**

According to References 1 and 3, (Note: Reference List at end of data sheets) Permeability may be estimated as $k = (\gamma/\mu)(1/C_{K-C})(1/S^2)[e^3/(1+e)]$

 γ = assumed unit weight of water in situ, lb/ft³ = 62.4 = 9800 N/m³ μ = viscosity of water, Ns/m² = 0.00131 at 10 °C

 C_{K-C} = Kozeny-Carman empirical coefficient; reported as 4.8±0.3, usually taken as 5, =

S = specific surface area per unit volume of particles = $SF^*\Sigma((P_{No D}-P_{No d})/d)$

 $P_{No D}$ = percentage by weight smaller than size D

 P_{Nod} = percentage by weight larger than the next size d

 D_{eq} = equivalent grain size for particles smaller than D_{min} of gradation = $D_{min}/3^{0.5}$

SF = Shape Factor for particle angularity = 7.5

SF = 6.6 for rounded particles; 7.5 for medium angularity; 8.4 for angular (after Loudon, presented in Ref. 1)

thus, Permeability, may be estimated as $k = (\gamma/\mu)(1/C_{K-C})\{1/\Sigma[(P_{N_0,D}-P_{N_0,d})/d]\}^2(1/SF^2)[e^3/(1+e)]$, Table 1 below

Further, according Ref. 2, measured permeability typically varies from 1/3 to 3 times the estimated permeability. The references also note that this method may overpredict permeability when soil is gravel, and the results present an upper bound. The formula is not suitable for plastic soils.

	TABLE 1 - SUM OF (P _{No D} - P _{No d})/d						
Sieve De	Sieve Designation		Percent	(P _{NoD} -P _{Nod})/ d			
Standard	Alternate	Opening (cm)	Passing	(1/cm)			
37.5 mm	1-1/2"	3.750	100.0	-			
25.0 mm	1"	2.500	100.0	0.0			
19.0 mm	3/4"	1.900	100.0	0.0			
12.5 mm	1/2"	1.250	100.0	0.0			
9.5	3/8"	0.950	92.2	8.2			
4.75 mm	No. 4	0.475	85.7	13.6			
2.00 mm	No. 10	0.200	69.6	80.8			
1.18 mm	No. 16	0.118	54.8	125.1			
600 µm	No. 30	0.060	32.4	373.3			
300 µm	No. 50	0.030	13.3	637.6			
250 µm	No. 60	0.025	11.2	83.3			
150 µm	No. 100	0.015	6.6	303.9			
75 µm	No. 200	0.008	3.5	422.9			
D_{eq}		0.004	0.0	801.1			
·							
			Sum:	2849.7			

Estimate Void Ratio (e) from Relative Density (Ref. 4)

 $D_r^2 = (N_1)60/C_P C_A C_{OCR}$

 $(N_1)60=$ 23 $C_P=60+25logD_{50}=$ 60 $D_{50}=$ 1 mm $C_A=1.2+0.05log(t/100)=$ 1.19 t(yr)= 70 $C_{OCR}=OCR^{U.18}=$ 1 $D_r=$ 0.56703

 $e_{max} = 0.95$ $e = e_{max} - (D_r)(e_{max} - e_{min})$ $e_{min} = 0.2$ e = 0.52473

thus, range of permeability is estimated as:

Estimated range of k (cm/s)				
Probable		Probable		
measured	Calculated	measured		
lower bnd	Estimate	upper bnd		
1.0E-02	3.1E-02	9.3E-02		

Copyright © 2008 Stephens Associates Consulting Engineers LLC Revisions:

Nevisions.

By: Date: ______ Date: _____



Original Work:

R. Kline June 2, 2008 By: Date: Subject: Checked By: J. Turner Date: June 13, 2008

Rte. 1, Saugus, MA **Laboratory Testing**

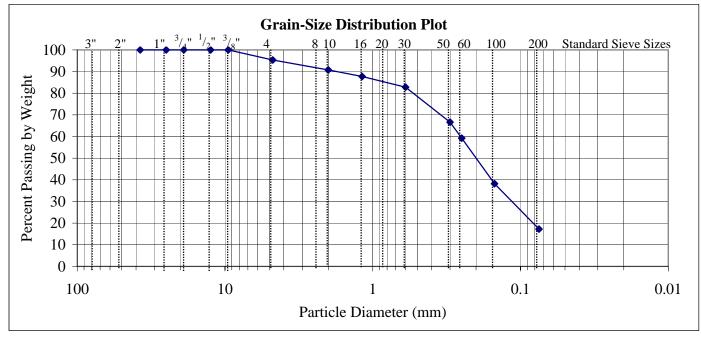
Grain Size Distribution

Boring Number: Sample Number: S-5 Sample Depth: 9-11' B-6

Sample Description: Brown fine to medium SAND, little Silt

Sieve De Standard	signation Alternate		eve Opening inches	Tare Weight (g)	Sieve+Soil Wt.	Soil Weight (g)	Percent Passing
		mm					
37.5 mm	1-1/2"	37.5	1.476"	501.3	501.3	0.0	100.0
25.0 mm	1"	25	0.984"	502.5	502.5	0.0	100.0
19.0 mm	3/4"	19	0.748"	595.8	595.8	0.0	100.0
12.5 mm	1/2"	12.5	0.492"	607.7	607.7	0.0	100.0
9.5	3/8"	9.5	0.374"	565.4	565.4	0.0	100.0
4.75 mm	No. 4	4.75	0.187"	527.8	535.9	8.1	95.3
2.00 mm	No. 10	2	0.078"	450.8	458.7	7.9	90.8
1.18 mm	No. 16	1.18	0.0464"	401.2	406.5	5.3	87.7
600 µm	No. 30	0.6	0.0236"	410.3	418.9	8.6	82.8
300 µm	No. 50	0.3	.0118"	416.5	444.5	28.0	66.6
250 µm	No. 60	0.25	0.0098"	340.0	352.8	12.8	59.3
150 µm	No. 100	0.15	0.0059"	303.7	340.2	36.5	38.2
75 µm	No. 200	0.075	0.0029"	301.6	338.0	36.4	17.2
Pan				340.5	370.4	29.9	0.0
•					11144 0 ()	470 5	

Soil Wt. Sum (g): 173.5



 $D_{10} =$ N/A mm Cu = N/A $D_{30} =$ 0.12 mm Cc = N/A

 $D_{60} =$ 0.26 USCS Classification = mm SM

Copyright © 2008 Stephens Associates Consulting Engineers LLC

Revisions:

By: Date: Date:



Project: Number: 026-08-007 Sheet MWRA Contract No. 6905, Pipeline Name: Original Work: Rte. 1, Saugus, MA R. Kline Permeability Estimate by Date: June 2, 2008 Subject: Checked By: J. Turner Date: June 13, 2008 Kozeny-Carman Formula

Boring Number: **B-6** Sample Number: **S-5** Sample Depth: **9-11'**

According to References 1 and 3, (Note: Reference List at end of data sheets) Permeability may be estimated as $k = (\gamma/\mu)(1/C_{K-C})(1/S^2)[e^3/(1+e)]$

 γ = assumed unit weight of water in situ, lb/ft³ = 62.4 = 9800 N/m³ μ = viscosity of water, Ns/m² = 0.00131 at 10 °C

 C_{K-C} = Kozeny-Carman empirical coefficient; reported as 4.8±0.3, usually taken as 5, =

S = specific surface area per unit volume of particles = $SF^*\Sigma((P_{No D}-P_{No d})/d)$

 $P_{No D}$ = percentage by weight smaller than size D

 $P_{No d}$ = percentage by weight larger than the next size d

 D_{eq} = equivalent grain size for particles smaller than D_{min} of gradation = $D_{min}/3^{0.5}$

SF = Shape Factor for particle angularity = 7.5

SF = 6.6 for rounded particles; 7.5 for medium angularity; 8.4 for angular (after Loudon, presented in Ref. 1)

thus, Permeability, may be estimated as $k = (\gamma/\mu)(1/C_{K-C})\{1/\Sigma[(P_{N_0,D}-P_{N_0,d})/d]\}^2(1/SF^2)[e^3/(1+e)]$, Table 1 below

Further, according Ref. 2, measured permeability typically varies from 1/3 to 3 times the estimated permeability. The references also note that this method may overpredict permeability when soil is gravel, and the results present an upper bound. The formula is not suitable for plastic soils.

TABLE 1 - SUM OF (P _{No D} - P _{No d})/d								
Sieve De	signation	Nominal Sieve	Percent	(P _{NoD} -P _{Nod})/ d				
Standard	Alternate	Opening (cm)	Passing	(1/cm)				
37.5 mm	1-1/2"	3.750	100.0					
25.0 mm	1"	2.500	100.0	0.0				
19.0 mm	3/4"	1.900	100.0	0.0				
12.5 mm	1/2"	1.250	100.0	0.0				
9.5	3/8"	0.950	100.0	0.0				
4.75 mm	No. 4	0.475	95.3	9.8				
2.00 mm	No. 10	0.200	90.8	22.8				
1.18 mm	No. 16	0.118	87.7	25.9				
600 µm	No. 30	0.060	82.8	82.6				
300 µm	No. 50	0.030	66.6	537.9				
250 µm	No. 60	0.025	59.3	295.1				
150 µm	No. 100	0.015	38.2	1402.5				
75 µm	No. 200	0.008	17.2	2797.3				
D_{eq}		0.004	0.0	3979.9				
•								
		•	Sum:	9153.8				

Estimate Void Ratio (e) from Relative Density (Ref. 4)

 $D_r^2 = (N_1)60/C_P C_A C_{OCR}$

 $(N_1)60=$ 23 $C_P=60+25logD_{50}=$ 42.5 $D_{50}=$ 0.2 mm $C_A=1.2+0.05log(t/100)=$ 1.19 t(yr)= 70 $C_{OCR}=OCR^{0.18}=$ 1 $D_r=$ 0.67352

 $e_{max} = 0.9$ $e = e_{max} - (D_r)(e_{max} - e_{min})$ $e_{min} = 0.3$ e = 0.49589

thus, range of permeability is estimated as:

Estimated range of k (cm/s)							
Probable Probable							
measured	Calculated	measured					
lower bnd	Estimate	upper bnd					
8.6E-04	2.6E-03	7.8E-03					

Copyright © 2008 Stephens As	ssociates Consulting Engineers LLC
Revisions:	

By:______Date: _____

Date:



Project: Number: 026-08-007 Sheet 1 of Name:

By:

MWRA Contract No. 6905, Pipeline Rte. 1, Saugus, MA

Original Work: R. Kline June 9, 2008 Date: Subject: Checked By: J. Turner Date: June 13, 2008

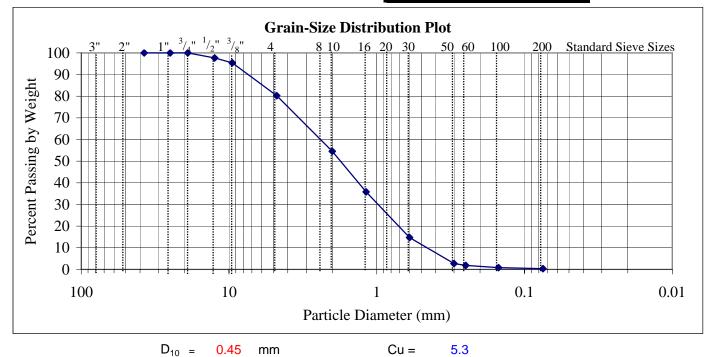
Laboratory Testing Grain Size Distribution

Boring Number: Sample Number: S-1 Sample Depth: 1-3' Top 5" B-8

Sample Description: Gray medium to coarse SAND, little Gravel

Sieve De	signation	Nominal Signature	eve Opening	Tare Weight	Sieve+Soil Wt.	Soil Weight (g)	Percent
Standard	Alternate	mm	inches	(g)	(g)	Con Worght (g)	Passing
37.5 mm	1-1/2"	37.5	1.476"	501.3	501.3	0.0	100.0
25.0 mm	1"	25	0.984"	502.5	502.5	0.0	100.0
19.0 mm	3/4"	19	0.748"	596	596	0.0	100.0
12.5 mm	1/2"	12.5	0.492"	607.2	612.0	4.8	97.7
9.5	3/8"	9.5	0.374"	565.2	569.9	4.7	95.4
4.75 mm	No. 4	4.75	0.187"	527.7	559.2	31.5	80.2
2.00 mm	No. 10	2	0.078"	450.8	504.0	53.2	54.6
1.18 mm	No. 16	1.18	0.0464"	401.2	440.1	38.9	35.8
600 µm	No. 30	0.6	0.0236"	410.5	454.2	43.7	14.7
300 µm	No. 50	0.3	.0118"	416.8	441.7	24.9	2.7
250 µm	No. 60	0.25	0.0098"	339.9	341.7	1.8	1.8
150 µm	No. 100	0.15	0.0059"	303.7	305.8	2.1	8.0
75 µm	No. 200	0.075	0.0029"	301.6	302.6	1.0	0.3
Pan				340.4	341.1	0.7	0.0
				90	il Wt. Sum (a):	207.3	

Soil Wt. Sum (g):



Cc =

Copyright © 2008 Stephens Associates Consulting Engineers LLC

 $D_{30} =$

 $D_{60} =$

0.975

2.4

mm

mm

Revisions:

By: Date: Date:



0.9

SP

USCS Classification =

Original Work:

By: R. Kline Date: June 2, 2008 Subject:

Laboratory Testing

Rte. 1, Saugus, MA

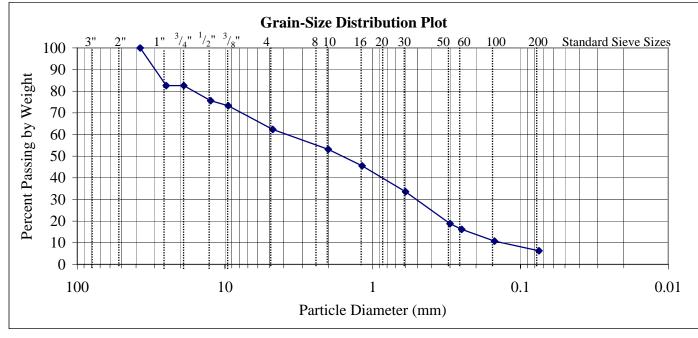
Checked By: J. Turner Date: June 13, 2008 Grain Size Distribution

Boring Number: B-8 Sample Number: S-1 Sample Depth: 1-3' Bottom 11"

Sample Description: Brown fine to medium SAND and GRAVEL, trace silt

	signation		eve Opening	Tare Weight	Sieve+Soil Wt.	Soil Weight (g)	Percent
Standard	Alternate	mm	inches	(g)	(g)	3 (6)	Passing
37.5 mm	1-1/2"	37.5	1.476"	501.4	501.4	0.0	100.0
25.0 mm	1"	25	0.984"	502.5	544.8	42.3	82.6
19.0 mm	3/4"	19	0.748"	595.9	595.9	0.0	82.6
12.5 mm	1/2"	12.5	0.492"	607.6	624.5	16.9	75.6
9.5	3/8"	9.5	0.374"	565.2	570.9	5.7	73.3
4.75 mm	No. 4	4.75	0.187"	527.8	554.4	26.6	62.3
2.00 mm	No. 10	2	0.078"	450.9	473.2	22.3	53.1
1.18 mm	No. 16	1.18	0.0464"	401.2	419.7	18.5	45.5
600 µm	No. 30	0.6	0.0236"	410.4	439.5	29.1	33.6
300 µm	No. 50	0.3	.0118"	416.6	452.4	35.8	18.8
250 µm	No. 60	0.25	0.0098"	339.9	346.3	6.4	16.2
150 µm	No. 100	0.15	0.0059"	303.7	316.9	13.2	10.7
75 µm	No. 200	0.075	0.0029"	301.7	312.5	10.8	6.3
Pan				340.4	355.7	15.3	0.0
				Sc	oil Wt Sum (a):	242 9	

Soil Wt. Sum (g): 242.9



 $D_{10} = 0.14$ mm Cu = 27.1 $D_{30} = 0.5$ mm Cc = 0.5

 $D_{30} = 0.3$ mm CC = 0.3 $D_{60} = 3.8$ mm USCS Classification =

Copyright © 2008 Stephens Associates Consulting Engineers LLC

Revisions:

By: _____ Date: _____ Date: _____



SP-SM

Original Work:

By: R. Kline Date: June 2, 2008 Subject:

Laboratory Testing

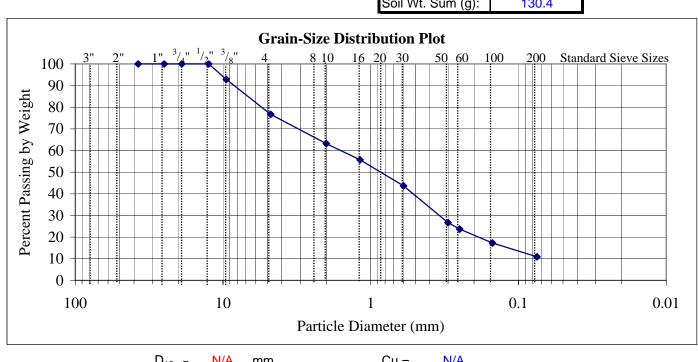
Rte. 1, Saugus, MA

Checked By: J. Turner Date: June 13, 2008 Grain Size Distribution

Boring Number: B-9 Sample Number: S-2 Sample Depth: 3-5'

Sample Description: Brown fine to coarse SAND, some Gravel, little Silt

Sieve Designation		Nominal Sie	eve Opening	Tare Weight	Sieve+Soil Wt.	Soil Weight (g)	Percent
Standard	Alternate	mm	inches	(g)	(g)	2 3 11 3 19 11 (9)	Passing
37.5 mm	1-1/2"	37.5	1.476"	501.3	501.3	0.0	100.0
25.0 mm	1"	25	0.984"	502.5	502.5	0.0	100.0
19.0 mm	3/4"	19	0.748"	595.8	595.8	0.0	100.0
12.5 mm	1/2"	12.5	0.492"	607.5	607.5	0.0	100.0
9.5	3/8"	9.5	0.374"	565.2	574.5	9.3	92.9
4.75 mm	No. 4	4.75	0.187"	527.7	548.8	21.1	76.7
2.00 mm	No. 10	2	0.078"	450.9	468.5	17.6	63.2
1.18 mm	No. 16	1.18	0.0464"	401.3	411.1	9.8	55.7
600 µm	No. 30	0.6	0.0236"	410.4	426.1	15.7	43.6
300 µm	No. 50	0.3	.0118"	416.6	438.7	22.1	26.7
250 µm	No. 60	0.25	0.0098"	340.0	343.9	3.9	23.7
150 µm	No. 100	0.15	0.0059"	303.8	312.2	8.4	17.3
75 µm	No. 200	0.075	0.0029"	301.8	310.1	8.3	10.9
Pan				340.5	354.7	14.2	0.0
				Sc	oil Wt Sum (a):	130 4	



 $D_{10} = N/A$ mm Cu = N/A $D_{30} = 0.35$ mm Cc = N/A

 D_{60} = 1.8 mm USCS Classification = SW-SM

Copyright © 2008 Stephens Associates Consulting Engineers LLC

Revisions:

By: Date: Date:



Project: Number: 026-08-007 Sheet MWRA Contract No. 6905, Pipeline Name: Original Work: Rte. 1, Saugus, MA R. Kline Permeability Estimate by Date: June 2, 2008 Subject: Checked By: J. Turner Date: June 13, 2008 Kozeny-Carman Formula

Boring Number: B-9 Sample Number: S-2 Sample Depth: 3-5'

According to References 1 and 3, (Note: Reference List at end of data sheets) Permeability may be estimated as $k = (\gamma/\mu)(1/C_{K-C})(1/S^2)[e^3/(1+e)]$

 γ = assumed unit weight of water in situ, lb/ft³ = 62.4 = 9800 N/m³ μ = viscosity of water, Ns/m² = 0.00131 at 10 °C

 C_{K-C} = Kozeny-Carman empirical coefficient; reported as 4.8±0.3, usually taken as 5, =

S = specific surface area per unit volume of particles = $SF^*\Sigma((P_{No D}-P_{No d})/d)$

 $P_{No D}$ = percentage by weight smaller than size D

 P_{Nod} = percentage by weight larger than the next size d

 D_{eq} = equivalent grain size for particles smaller than D_{min} of gradation = $D_{min}/3^{0.5}$

SF = Shape Factor for particle angularity = 7.5

SF = 6.6 for rounded particles; 7.5 for medium angularity; 8.4 for angular (after Loudon, presented in Ref. 1)

thus, Permeability, may be estimated as $k = (\gamma/\mu)(1/C_{K-C})\{1/\Sigma[(P_{N_0} - P_{N_0} d)/d]\}^2(1/SF^2)[e^3/(1+e)]$, Table 1 below

Further, according Ref. 2, measured permeability typically varies from 1/3 to 3 times the estimated permeability. The references also note that this method may overpredict permeability when soil is gravel, and the results present an upper bound. The formula is not suitable for plastic soils.

TABLE 1 - SUM OF (P _{No D} - P _{No d})/d								
Sieve De	signation	Nominal Sieve	Percent	(P _{NoD} -P _{Nod})/ d				
Standard	Alternate	Opening (cm)	Passing	(1/cm)				
37.5 mm	1-1/2"	3.750	100.0					
25.0 mm	1"	2.500	100.0	0.0				
19.0 mm	3/4"	1.900	100.0	0.0				
12.5 mm	1/2"	1.250	100.0	0.0				
9.5	3/8"	0.950	92.9	7.5				
4.75 mm	No. 4	0.475	76.7	34.1				
2.00 mm	No. 10	0.200	63.2	67.5				
1.18 mm	No. 16	0.118	55.7	63.7				
600 µm	No. 30	0.060	43.6	200.7				
300 µm	No. 50	0.030	26.7	564.9				
250 µm	No. 60	0.025	23.7	119.6				
150 µm	No. 100	0.015	17.3	429.4				
75 µm	No. 200	0.008	10.9	848.7				
D_{eq}		0.004	0.0	2514.8				
			Sum:	4850.9				

Estimate Void Ratio (e) from Relative Density (Ref. 4)

 $D_r^2 = (N_1)60/C_P C_A C_{OCR}$

 $(N_1)60=$ 54 $C_P=60+25logD_{50}=$ 58.2 $D_{50}=$ 0.85 mm $C_A=1.2+0.05log(t/100)=$ 1.19 t(yr)= 70 $C_{OCR}=OCR^{0.18}=$ 1 $D_r=$ 0.8819

 $e_{max} = 0.85$ $e = e_{max} - (D_r)(e_{max} - e_{min})$ $e_{min} = 0.14$ e = 0.22385

thus, range of permeability is estimated as:

Estimated range of k (cm/s)							
Probable Probable							
measured	Calculated	measured					
lower bnd	Estimate	upper bnd					
3.5E-04	1.0E-03	3.1E-03					

Copyright © 2008 Stephens Associates Consulting Engineers LL0	С
Revisions:	



Original Work:

R. Kline June 2, 2008 By: Date: Subject: Checked By: J. Turner Date: June 13, 2008

Laboratory Testing

Grain Size Distribution

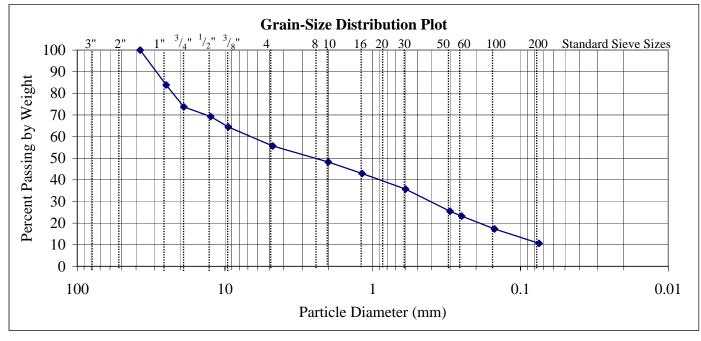
Rte. 1, Saugus, MA

Boring Number: Sample Number: S-1 Sample Depth: 1-3' Bottom 11" B-11

Sample Description: Brown fine to medium SAND and GRAVEL, little Silt

	signation		eve Opening	Tare Weight	Sieve+Soil Wt.	Soil Weight (g)	Percent
Standard	Alternate	mm	inches	(g)	(g)	0 (0)	Passing
37.5 mm	1-1/2"	37.5	1.476"	501.3	501.3	0.0	100.0
25.0 mm	1"	25	0.984"	502.4	546.8	44.4	83.9
19.0 mm	3/4"	19	0.748"	595.7	623.5	27.8	73.8
12.5 mm	1/2"	12.5	0.492"	607.5	619.8	12.3	69.3
9.5	3/8"	9.5	0.374"	565.2	578.5	13.3	64.4
4.75 mm	No. 4	4.75	0.187"	527.2	551.4	24.2	55.7
2.00 mm	No. 10	2	0.078"	450.9	471.2	20.3	48.3
1.18 mm	No. 16	1.18	0.0464"	401.3	416.0	14.7	42.9
600 µm	No. 30	0.6	0.0236"	410.4	430.2	19.8	35.7
300 µm	No. 50	0.3	.0118"	416.6	444.8	28.2	25.5
250 µm	No. 60	0.25	0.0098"	340.0	346.2	6.2	23.2
150 µm	No. 100	0.15	0.0059"	303.8	320.1	16.3	17.3
75 µm	No. 200	0.075	0.0029"	301.8	320.1	18.3	10.7
Pan				340.5	369.8	29.3	0.0
				Co	oil Mt Sum (a).	275.1	

Soil Wt. Sum (g): 275.1



 $D_{10} =$ N/A mm Cu = N/A $D_{30} =$ 0.4 mm Cc = N/A

 $D_{60} =$ USCS Classification = SW-SM 6.75 mm

Copyright © 2008 Stephens Associates Consulting Engineers LLC

Revisions:

By: Date: Date:



 Project:
 Number:
 026-08-007
 Sheet
 1
 of
 1

 Name:
 MWRA Contract No. 6905, Pipeline

Original Work:

By: R. Kline Date: June 2, 2008 Subject: Checked By: J. Turner Date: June 13, 2008

Laboratory Testing
Grain Size Distribution

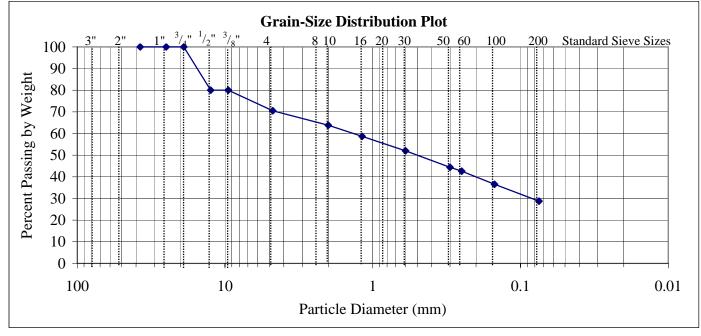
Rte. 1, Saugus, MA

Boring Number: B-11 Sample Number: S-4 Sample Depth: 7-9'

Sample Description: Brown fine to medium SAND, some Gravel, some Silt

Sieve De	signation	Nominal Sie	eve Opening	Tare Weight	Sieve+Soil Wt.	Soil Weight (g)	Percent
Standard	Alternate	mm	inches	(g)	(g)	Con Worgin (g)	Passing
37.5 mm	1-1/2"	37.5	1.476"	501.3	501.3	0.0	100.0
25.0 mm	1"	25	0.984"	502.7	502.7	0.0	100.0
19.0 mm	3/4"	19	0.748"	595.9	595.9	0.0	100.0
12.5 mm	1/2"	12.5	0.492"	607.7	629.2	21.5	80.0
9.5	3/8"	9.5	0.374"	565.4	565.4	0.0	80.0
4.75 mm	No. 4	4.75	0.187"	527.9	538.1	10.2	70.5
2.00 mm	No. 10	2	0.078"	451.1	458.3	7.2	63.8
1.18 mm	No. 16	1.18	0.0464"	401.4	406.9	5.5	58.7
600 µm	No. 30	0.6	0.0236"	410.6	417.8	7.2	52.0
300 µm	No. 50	0.3	.0118"	416.9	425.1	8.2	44.4
250 µm	No. 60	0.25	0.0098"	340.2	342.1	1.9	42.6
150 µm	No. 100	0.15	0.0059"	303.8	310.3	6.5	36.6
75 µm	No. 200	0.075	0.0029"	301.9	310.3	8.4	28.7
Pan				340.4	371.3	30.9	0.0
			·	_	oil Mt Sum (a).	107.5	·

Soil Wt. Sum (g): 107.5



 $D_{10} = N/A$ mm Cu = N/A $D_{30} = 0.83$ mm Cc = N/A

 $D_{60} = 1.4$ mm USCS Classification = SM

Copyright © 2008 Stephens Associates Consulting Engineers LLC

Revisions:

By: _____ Date: _____ Date: _____



Project: Number: 026-08-007 Sheet MWRA Contract No. 6905, Pipeline Name: Original Work: Rte. 1, Saugus, MA R. Kline Permeability Estimate by Date: June 2, 2008 Subject: Checked By: J. Turner Date: June 13, 2008 Kozeny-Carman Formula

Boring Number: **B-11** Sample Number: **S-4** Sample Depth: **7-9'**

According to References 1 and 3, (Note: Reference List at end of data sheets) Permeability may be estimated as $k = (\gamma/\mu)(1/C_{K-C})(1/S^2)[e^3/(1+e)]$

 γ = assumed unit weight of water in situ, lb/ft³ = 62.4 = 9800 N/m³ μ = viscosity of water, Ns/m² = 0.00131 at 10 °C

 C_{K-C} = Kozeny-Carman empirical coefficient; reported as 4.8±0.3, usually taken as 5, =

S = specific surface area per unit volume of particles = $SF^*\Sigma((P_{No D}-P_{No d})/d)$

 $P_{No D}$ = percentage by weight smaller than size D

 $P_{No d}$ = percentage by weight larger than the next size d

 D_{eq} = equivalent grain size for particles smaller than D_{min} of gradation = $D_{min}/3^{0.5}$

SF = Shape Factor for particle angularity = 7.5

SF = 6.6 for rounded particles; 7.5 for medium angularity; 8.4 for angular (after Loudon, presented in Ref. 1)

thus, Permeability, may be estimated as $k = (\gamma/\mu)(1/C_{K-C})\{1/\Sigma[(P_{N_0} - P_{N_0} d)/d]\}^2(1/SF^2)[e^3/(1+e)]$, Table 1 below

Further, according Ref. 2, measured permeability typically varies from 1/3 to 3 times the estimated permeability. The references also note that this method may overpredict permeability when soil is gravel, and the results present an upper bound. The formula is not suitable for plastic soils.

TABLE 1 - SUM OF (P _{No D} - P _{No d})/d						
Sieve De	signation	Nominal Sieve	Percent	(P _{NoD} -P _{Nod})/ d		
Standard	Alternate	Opening (cm)	Passing	(1/cm)		
19.0 mm	3/4"	1.900	100.0	0.0		
12.5 mm	1/2"	1.250	80.0	16.0		
9.5	3/8"	0.950	80.0	0.0		
4.75 mm	No. 4	0.475	70.5	20.0		
2.00 mm	No. 10	0.200	63.8	33.5		
1.18 mm	No. 16	0.118	58.7	43.4		
600 µm	No. 30	0.060	52.0	111.6		
300 µm	No. 50	0.030	44.4	254.3		
250 µm	No. 60	0.025	42.6	70.7		
150 µm	No. 100	0.015	36.6	403.1		
75 µm	No. 200	0.008	28.7	1041.9		
D _{eq}		0.004	0.0	6638.2		
		L	Sum:	8632.6		

Estimate Void Ratio (e) from Relative Density (Ref. 4)

 $D_r^2 = (N_1)60/C_P C_A C_{OCR}$

 $(N_1)60=$ 39 $C_P=60+25logD_{50}=$ 52.5 $D_{50}=$ 0.5 mm $C_A=1.2+0.05log(t/100)=$ 1.19 t(yr)= 70 $C_{OCR}=OCR^{0.18}=$ 1 $D_r=$ 0.78954

 $e_{max} = 0.85$ $e = e_{max} - (D_r)(e_{max} - e_{min})$ $e_{min} = 0.14$ e = 0.28943

thus, range of permeability is estimated as:

Estimated range of k (cm/s)			
Probable	Probable		
measured	Calculated	measured	
lower bnd	Estimate	upper bnd	
2.2E-04	6.7E-04	2.0E-03	

Copyright © 2008 Stephens	Associates Consulting Engineers LL	C

Revisions:

By:_____ Date: _____ By:_____ Date: _____



Original Work:

R. Kline June 2, 2008 By: Date: Subject: Checked By: J. Turner Date: June 13, 2008

Laboratory Testing

Grain Size Distribution

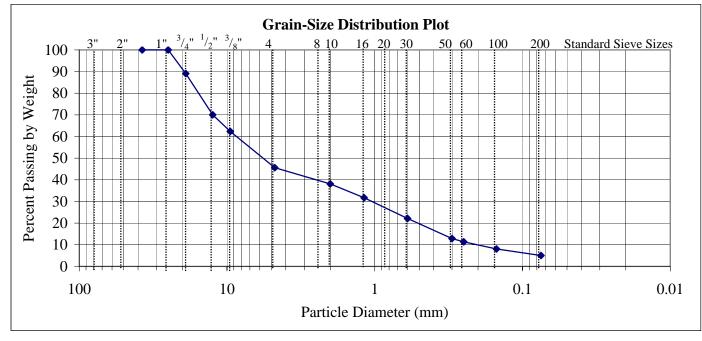
Rte. 1, Saugus, MA

Boring Number: Sample Number: S-1 Sample Depth: 1-3' B-12

Sample Description: Gray GRAVEL and fine to medium SAND, trace silt

Sieve De	signation	Nominal Sie	eve Opening	Tare Weight	Sieve+Soil Wt.	Soil Weight (g)	Percent
Standard	Alternate	mm	inches	(g)	(g)	Con Weight (g)	Passing
37.5 mm	1-1/2"	37.5	1.476"	501.4	501.4	0.0	100.0
25.0 mm	1"	25	0.984"	502.5	502.5	0.0	100.0
19.0 mm	3/4"	19	0.748"	595.9	623.5	27.6	89.1
12.5 mm	1/2"	12.5	0.492"	607.6	655.6	48.0	70.0
9.5	3/8"	9.5	0.374"	565.1	584.5	19.4	62.4
4.75 mm	No. 4	4.75	0.187"	527.7	570.0	42.3	45.6
2.00 mm	No. 10	2	0.078"	450.7	469.6	18.9	38.1
1.18 mm	No. 16	1.18	0.0464"	401.1	417.3	16.2	31.7
600 µm	No. 30	0.6	0.0236"	410.2	434.3	24.1	22.1
300 µm	No. 50	0.3	.0118"	416.4	439.8	23.4	12.9
250 µm	No. 60	0.25	0.0098"	339.9	343.8	3.9	11.3
150 µm	No. 100	0.15	0.0059"	303.7	312.0	8.3	8.0
75 µm	No. 200	0.075	0.0029"	301.9	309.5	7.6	5.0
Pan				340.4	353.1	12.7	0.0
İ					oil \\/t Cum (a\:	252.4	

Soil Wt. Sum (g): 252.4



 $D_{10} =$ 0.2 mm Cu = 43.0 $D_{30} =$ 1.08 mm Cc = 0.7

 $D_{60} =$ USCS Classification = **GP-GM** 8.6 mm

Copyright © 2008 Stephens Associates Consulting Engineers LLC

Revisions:

By: Date: Date:



 Project:
 Number:
 026-08-007
 Sheet
 1
 of
 1

 Name:
 MWRA Contract No. 6905, Pipeline
 Pipeline
 Image: Name

Original Work:

By: R. Kline Date: June 5, 2008 Subject: Checked By: J. Turner Date: June 13, 2008

Laboratory Testing
Grain Size Distribution

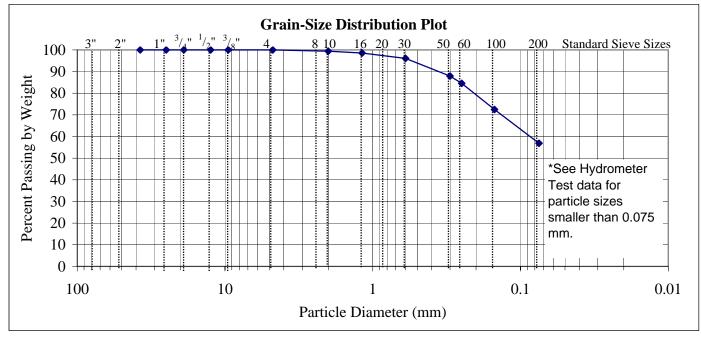
Rte. 1, Saugus, MA

Boring Number: B-12 Sample Number: S-5 Sample Depth: 10-12'

Sample Description: Gray to olive brown non-plastic SILT and fine SAND

	signation		eve Opening	Tare Weight	Sieve+Soil Wt.	Soil Weight (g)	Percent
Standard	Alternate	mm	inches	(g)	(g)	(9)	Passing
37.5 mm	1-1/2"	37.5	1.476"	501.3	501.3	0.0	100.0
25.0 mm	1"	25	0.984"	502.5	502.5	0.0	100.0
19.0 mm	3/4"	19	0.748"	595.8	595.8	0.0	100.0
12.5 mm	1/2"	12.5	0.492"	607.6	607.6	0.0	100.0
9.5	3/8"	9.5	0.374"	565.6	565.6	0.0	100.0
4.75 mm	No. 4	4.75	0.187"	527.9	527.9	0.0	100.0
2.00 mm	No. 10	2	0.078"	450.8	451.6	0.8	99.4
1.18 mm	No. 16	1.18	0.0464"	401.2	402.3	1.1	98.6
600 µm	No. 30	0.6	0.0236"	410.3	413.6	3.3	96.1
300 µm	No. 50	0.3	.0118"	416.6	427.5	10.9	87.9
250 µm	No. 60	0.25	0.0098"	340.0	344.5	4.5	84.5
150 µm	No. 100	0.15	0.0059"	303.7	319.8	16.1	72.5
75 µm	No. 200	0.075	0.0029"	301.6	322.4	20.8	56.9
Pan				340.4	416.2	75.8	0.0
				So	oil Wt Sum (a):	133.3	

Soil Wt. Sum (g): 133.3



 $D_{60} = 0.085$ mm USCS Classification = ML

Copyright © 2008 Stephens Associates Consulting Engineers LLC

Revisions:

By:______ Date: ______ Date: ______



			Project	: Number:	026-08-007	Sheet 1 o	of 1
				Name:	MWRA Contract No. 69	05, Pipeline	
Origina	l Work:				Rte. 1, Saugus,	MA	
By:	R. Kline	Date:	June 6, 2008	Subject:	Laboratory Tes	ting	
Checke	d By: J. Turr	ner Date:	June 13, 2008		Hydrometer Ana	llysis	

Boring Number: B-12 Sample Number: S-5 Sample Depth: 10-12'

Sample Description: Grey to olive brown non-plastic SILT and fine SAND

Calculation for Percent of Soil in Suspension: P = (R*a/W)*100

P = percent of soil in suspension at the level of the hydrometer, i.e. percent smaller diameter

R = Hydrometer reading with composite correction

a = correction factor for specific gravity of soil solids other than 2.65

 $D = K (L/T)^{0.5}$ Calculation for Particle Diameter: T = time, min. D = particle diameter, mm

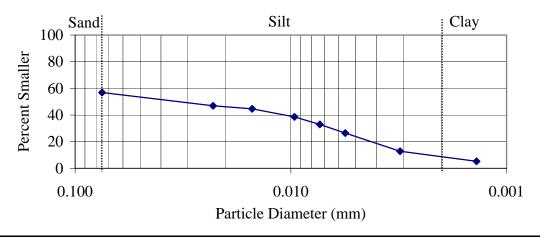
L = distance from the suspension surface to the level at which the density of the suspension is measured, cm

K = constant depending on the temperature of the suspension and the specific gravity of the soil particles. Values of K for a range of temperatures and specific gravities are given in Table 3 of ASTM D-422

The value of K does not change for a series of readings constituting a test, while values of L and T do vary.

Test Constants: Hydrometer Type: 152H Temperature of Solution (°C) Reading of Hydrometer in Solution Only (g/l): 3.0 20.0 Specific Gravity of Soil Solids (Assumed): 2.65 1.00 a: Dry Soil Weight, W (g): K: 132.1 0.01365

Time (min)	Reading (g/l)	Corrected Reading (g/l)	L	Diameter (mm)	% in suspension
	Data from S	0.0750	56.9		
2	65	62	5.64	0.0229	46.9
5	62	59	6.13	0.0151	44.7
15	54	51	7.44	0.0096	38.6
30	46.5	43.5	8.67	0.0073	32.9
60	38	35	10.07	0.0056	26.5
250	20	17	13.02	0.0031	12.9
1440	10	7	14.66	0.0014	5.3



Copyright © 2008 Stephens Associates Consulting Engineers LLC Revisions:

By: Date:

Date:



Project: Number: 026-08-007 Sheet 1 of MWRA Contract No. 6905, Pipeline Name: Original Work: Rte. 1, Saugus, MA R. Kline Permeability Estimate by Date: June 5, 2008 Subject: Checked By: J. Turner Date: June 13, 2008 Kozeny-Carman Formula

Boring Number: B-12 Sample Number: S-5 Sample Depth: 10-12'

According to References 1 and 3, (Note: Reference List at end of data sheets) Permeability may be estimated as $k = (\gamma/\mu)(1/C_{K-C})(1/S^2)[e^3/(1+e)]$

 γ = assumed unit weight of water in situ, lb/ft³ = 62.4 = 9800 N/m³ μ = viscosity of water, Ns/m² = 0.00131 at 10 °C

 C_{K-C} = Kozeny-Carman empirical coefficient; reported as 4.8±0.3, usually taken as 5, =

S = specific surface area per unit volume of particles = $SF^*\Sigma((P_{No D}-P_{No d})/d)$

 $P_{No D}$ = percentage by weight smaller than size D

 P_{Nod} = percentage by weight larger than the next size d

 D_{eq} = equivalent grain size for particles smaller than D_{min} of gradation = $D_{min}/3^{0.5}$

SF = Shape Factor for particle angularity = 7.5

SF = 6.6 for rounded particles; 7.5 for medium angularity; 8.4 for angular (after Loudon, presented in Ref. 1)

thus, Permeability, may be estimated as $k = (\gamma/\mu)(1/C_{K-C})\{1/\Sigma[(P_{N_0,D}-P_{N_0,d})/d]\}^2(1/SF^2)[e^3/(1+e)]$, Table 1 below

Further, according Ref. 2, measured permeability typically varies from 1/3 to 3 times the estimated permeability. The references also note that this method may overpredict permeability when soil is gravel, and the results present an upper bound. The formula is not suitable for plastic soils.

TABLE 1 - SUM OF (P _{No D} - P _{No d})/d					
Sieve Designation		Nominal Sieve	Percent	(P _{NoD} -P _{Nod})/ d	
Standard	Alternate	Opening (cm)	Passing	(1/cm)	
4.75 mm	No. 4	0.475	100.0	0.0	
2.00 mm	No. 10	0.200	99.4	3.0	
1.18 mm	No. 16	0.118	98.6	7.0	
600 µm	No. 30	0.060	96.1	41.3	
300 µm	No. 50	0.030	87.9	272.6	
250 µm	No. 60	0.025	84.5	135.0	
150 µm	No. 100	0.015	72.5	805.2	
75 µm	No. 200	0.008	56.9	2080.5	
		0.00229	46.9	4351.2	
			44.7	1457.0	
		0.00096	38.6	6354.2	
Hydro	meter	0.00073	32.9	7808.2	
		0.00056	26.5	11428.6	
		0.00031	12.9	43871.0	
		0.00014	5.3	54285.7	
D_{eq}		0.00008	0.0	65570.5	
	-		Sum:	198470.9	

Estimate Void Ratio (e) from Relative Density (Ref. 4)

 $D_r^2 = (N_1)60/C_P C_A C_{OCR}$

 $(N_1)60=$ 38 $C_P=60+25logD_{50}=$ 22.8 $D_{50}=$ 0.03 mm $C_A=1.2+0.05log(t/100)=$ 1.19 t(yr)= 70 $C_{OCR}=OCR^{0.18}=$ 1 $D_r=$ 1.18241 > 1, use 1.0

 $e_{max} = 1.8$ $e = e_{max} - (D_r)(e_{max} - e_{min})$ e = 0.25

thus, range of permeability is estimated as:

Estimated range of k (cm/s)			
Probable	Probable		
measured	Calculated	measured	
lower bnd	Estimate	upper bnd	
2.8E-07	8.4E-07	2.5E-06	

Copyright $\hbox{@}$ 2008 Stephens Associates Consulting Engineers LLC

Revisions:

By: Date: ______ Date: _____



Project: Number: 026-08-007 Sheet 1 of MWRA Contract No. 6905, Pipeline Name: Original Work: Rte. 1, Saugus, MA R. Kline June 3, 2008 **Laboratory Testing** By: Date: Subject: Checked By: J. Turner Date: June 13, 2008 Atterberg Limits

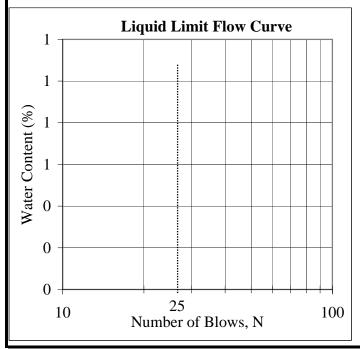
Sample Depth: 10-12' Boring Number: B-12 Sample Number: S-5

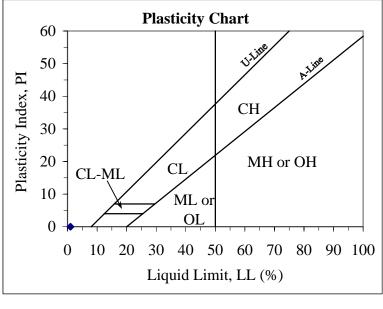
Sample Description: Grey to olive brown non-plastic SILT and fine SAND

LIQUID LIMIT				
Container Number				
Tare Weight (g)				
Weight Wet Soil+Container Tare (g)				
Weight Dry Soil+Container Tare (g)	*Non Plastic. Liquid Limit test			
Weight Water (g)	could not be performed.			
Weight Dry Soil (g)				
Water Content (%)				
Number of Blows, N				

PLASTIC LIMIT					
Container Number	7	1			
Tare Weight (g)	19.67	16.38			
Weight Wet Soil+Container Tare (g)	27.46	23.70			
Weight Dry Soil+Container Tare (g)	26.59	22.90			
Weight Water (g)	0.87	0.80			
Weight Dry Soil (g)	6.92	6.52			
Water Content (%)	12.6	12.3			

SUMMARY OF RESULTS				
Natural Water Content	16			
Liquid Limit, LL	N/A			
Plastic Limit, PL	12			
Plasticity Index, Pl	N/A			
Liquidity Index, LI	N/A			
USCS Classification	ML			





Copyright © 2008 Stephens Associates Consulting Engineers LLC

Revisions:

By:____ Date: Date: By:_



Rte. 1, Saugus, MA

Laboratory Testing

R. Kline June 9, 2008 By: Date: Subject: Checked By: J. Turner Date: June 13, 2008

Original Work:

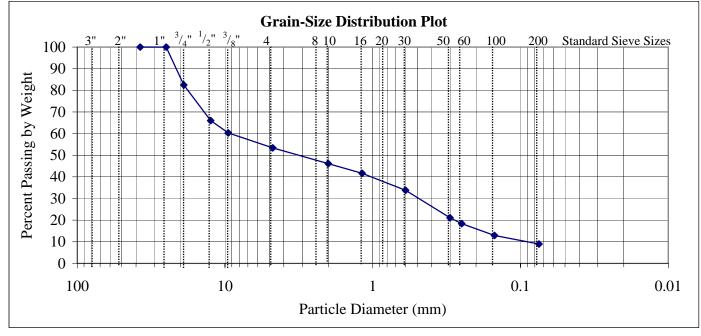
Grain Size Distribution

Boring Number: Sample Number: S-1 Sample Depth: 1-3' B-13

Sample Description: Brown fine to medium SAND and GRAVEL, trace silt

Sieve Designation		Nominal Sieve Opening		Tare Weight	Sieve+Soil Wt.	Soil Weight (g)	Percent
Standard	Alternate	mm	inches	(g)	(g)	Con Weight (g)	Passing
37.5 mm	1-1/2"	37.5	1.476"	501.3	501.3	0.0	100.0
25.0 mm	1"	25	0.984"	502.8	502.8	0.0	100.0
19.0 mm	3/4"	19	0.748"	595.8	628.9	33.1	82.5
12.5 mm	1/2"	12.5	0.492"	607.6	638.7	31.1	66.0
9.5	3/8"	9.5	0.374"	565.3	576.0	10.7	60.3
4.75 mm	No. 4	4.75	0.187"	527.7	540.8	13.1	53.4
2.00 mm	No. 10	2	0.078"	450.8	464.5	13.7	46.1
1.18 mm	No. 16	1.18	0.0464"	401.2	409.7	8.5	41.6
600 µm	No. 30	0.6	0.0236"	410.3	425.1	14.8	33.8
300 µm	No. 50	0.3	.0118"	416.6	440.6	24.0	21.1
250 µm	No. 60	0.25	0.0098"	340.0	345.1	5.1	18.4
150 µm	No. 100	0.15	0.0059"	303.7	314.0	10.3	12.9
75 µm	No. 200	0.075	0.0029"	301.6	309.1	7.5	9.0
Pan				340.4	357.3	16.9	0.0
·	•	100 0	·				

Soil Wt. Sum (g): 188.8



 $D_{10} =$ 0.091 mm Cu = 101.6 $D_{30} =$ 0.485 mm Cc = 0.3

 $D_{60} =$ 9.25 USCS Classification = SP-SM mm

Copyright © 2008 Stephens Associates Consulting Engineers LLC

Revisions: By:

Date: Date:



Original Work:

R. Kline June 2, 2008 By: Date: Subject: Checked By: J. Turner Date: June 13, 2008

Laboratory Testing

Grain Size Distribution

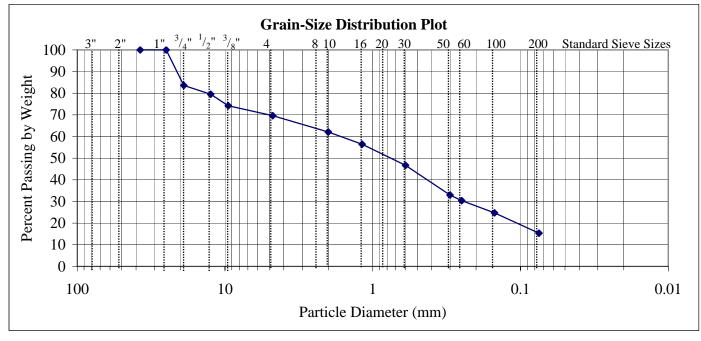
Rte. 1, Saugus, MA

Boring Number: Sample Number: S-2 B-13 Sample Depth: 3-5'

Sample Description: Brown fine to medium SAND, some Gravel, little Silt

Sieve Designation Standard Alternate		Nominal Sieve Opening mm inches		Tare Weight (g)	Sieve+Soil Wt.	Soil Weight (g)	Percent Passing
37.5 mm	1-1/2"	37.5	1.476"	501.3	501.3	0.0	100.0
25.0 mm	1"	25	0.984"	502.5	502.5	0.0	100.0
19.0 mm	3/4"	19	0.748"	595.9	621.8	25.9	83.6
12.5 mm	1/2"	12.5	0.492"	607.8	614.2	6.4	79.5
9.5	3/8"	9.5	0.374"	565.4	573.8	8.4	74.2
4.75 mm	No. 4	4.75	0.187"	527.9	535.1	7.2	69.6
2.00 mm	No. 10	2	0.078"	450.8	462.7	11.9	62.1
1.18 mm	No. 16	1.18	0.0464"	401.3	410.2	8.9	56.4
600 µm	No. 30	0.6	0.0236"	410.4	425.8	15.4	46.7
300 µm	No. 50	0.3	.0118"	416.6	438.2	21.6	33.0
250 µm	No. 60	0.25	0.0098"	340.1	344.2	4.1	30.4
150 µm	No. 100	0.15	0.0059"	303.8	312.7	8.9	24.7
75 μm	No. 200	0.075	0.0029"	301.8	316.6	14.8	15.3
Pan				340.6	364.8	24.2	0.0
					::I \M\\ C (a)		

Soil Wt. Sum (g): 157.7



 $D_{10} =$ N/A mm Cu = N/A $D_{30} =$ 0.25 mm Cc = N/A

 $D_{60} =$ USCS Classification = 1.7 mm SM

Copyright © 2008 Stephens Associates Consulting Engineers LLC

Revisions:

By: Date: Date:



 Project:
 Number:
 026-08-007
 Sheet
 1
 of
 1

 Name:
 MWRA Contract No. 6905, Pipeline

Original Work:

By: R. Kline Date: June 2, 2008 Subject: Checked By: J. Turner Date: June 13, 2008

Rte. 1, Saugus, MA

Laboratory Testing

Grain Size Distribution

Composite

Boring Number: B-13 Sample Number: S-3 & S-4 Sample Depth: 3-7'

Sample Description: Brown GRAVEL, some fine to medium Sand

Sieve De			eve Opening	Tare Weight	Sieve+Soil Wt.	Soil Weight (g)	Percent
Standard	Alternate	mm	inches	(g)	(g)		Passing
37.5 mm	1-1/2"	37.5	1.476"	501.3	501.3	0.0	100.0
25.0 mm	1"	25	0.984"	502.5	502.5	0.0	100.0
19.0 mm	3/4"	19	0.748"	595.8	665.9	70.1	69.1
12.5 mm	1/2"	12.5	0.492"	607.5	664.0	56.5	44.2
9.5	3/8"	9.5	0.374"	565.2	576.9	11.7	39.1
4.75 mm	No. 4	4.75	0.187"	527.7	539.4	11.7	33.9
2.00 mm	No. 10	2	0.078"	450.8	464.5	13.7	27.9
1.18 mm	No. 16	1.18	0.0464"	401.1	410.7	9.6	23.7
600 µm	No. 30	0.6	0.0236"	410.3	423.1	12.8	18.0
300 µm	No. 50	0.3	.0118"	416.5	430.4	13.9	11.9
250 µm	No. 60	0.25	0.0098"	339.9	342.3	2.4	10.8
150 µm	No. 100	0.15	0.0059"	303.6	311.0	7.4	7.6
75 µm	No. 200	0.075	0.0029"	302.0	308.3	6.3	4.8
Pan				340.3	351.2	10.9	0.0
				90	il Wt. Sum (g):	227	

Grain-Size Distribution Plot 8 10 16 20 30 50 60 100 200 Standard Sieve Sizes 100 90 Percent Passing by Weight 80 70 60 50 40 30 20 10 0 100 10 1 0.1 0.01 Particle Diameter (mm) $D_{10} =$ 0.21 Cu = 83.3 mm

Cc =

1.8

USCS Classification =

Copyright $\hbox{@}$ 2008 Stephens Associates Consulting Engineers LLC

 $D_{30} =$

 $D_{60} =$

2.6

17.5

mm

mm

Revisions:

By: ____ Date: ____ Date: ____



GW

Project: Number: 026-08-007 Sheet MWRA Contract No. 6905, Pipeline Name: Original Work: Rte. 1, Saugus, MA R. Kline Permeability Estimate by Date: June 2, 2008 Subject: Checked By: J. Turner Date: June 13, 2008 Kozeny-Carman Formula

Boring Number: B-13 Sample Number: S-3 & S-4 Sample Depth: 3-7'

According to References 1 and 3, (Note: Reference List at end of data sheets) Permeability may be estimated as $k = (\gamma/\mu)(1/C_{K-C})(1/S^2)[e^3/(1+e)]$

 γ = assumed unit weight of water in situ, lb/ft³ = 62.4 = 9800 N/m³ μ = viscosity of water, Ns/m² = 0.00131 at 10 °C

 C_{K-C} = Kozeny-Carman empirical coefficient; reported as 4.8±0.3, usually taken as 5, =

S = specific surface area per unit volume of particles = $SF^*\Sigma((P_{No D}-P_{No d})/d)$

 $P_{No D}$ = percentage by weight smaller than size D

 P_{Nod} = percentage by weight larger than the next size d

 D_{eq} = equivalent grain size for particles smaller than D_{min} of gradation = $D_{min}/3^{0.5}$

SF = Shape Factor for particle angularity = 7.5

SF = 6.6 for rounded particles; 7.5 for medium angularity; 8.4 for angular (after Loudon, presented in Ref. 1)

thus, Permeability, may be estimated as $k = (\gamma/\mu)(1/C_{K-C})\{1/\Sigma[(P_{N_0} - P_{N_0} d)/d]\}^2(1/SF^2)[e^3/(1+e)]$, Table 1 below

Further, according Ref. 2, measured permeability typically varies from 1/3 to 3 times the estimated permeability. The references also note that this method may overpredict permeability when soil is gravel, and the results present an upper bound. The formula is not suitable for plastic soils.

TABLE 1 - SUM OF (P _{No D} - P _{No d})/d						
Sieve Designation		Nominal Sieve	Percent	(P _{NoD} -P _{Nod})/ d		
Standard	Alternate	Opening (cm)	Passing	(1/cm)		
37.5 mm	1-1/2"	3.750	100.0			
25.0 mm	1"	2.500	100.0	0.0		
19.0 mm	3/4"	1.900	69.1	16.3		
12.5 mm	1/2"	1.250	44.2	19.9		
9.5	3/8"	0.950	39.1	5.4		
4.75 mm	No. 4	0.475	33.9	10.9		
2.00 mm	No. 10	0.200	27.9	30.2		
1.18 mm	No. 16	0.118	23.7	35.8		
600 µm	No. 30	0.060	18.0	94.0		
300 µm	No. 50	0.030	11.9	204.1		
250 µm	No. 60	0.025	10.8	42.3		
150 µm	No. 100	0.015	7.6	217.3		
75 µm	No. 200	0.008	4.8	370.0		
D_{eq}		0.004	0.0	1108.9		
•						
		•	Sum:	2155 1		

Estimate Void Ratio (e) from Relative Density (Ref. 4)

 $D_r^2 = (N_1)60/C_P C_A C_{OCR}$

 $(N_1)60=$ 34.5 $C_P=60+25logD_{50}=$ 89.4 $D_{50}=$ 15 mm $C_A=1.2+0.05log(t/100)=$ 1.19 t(yr)= 70 $C_{OCR}=OCR^{U.18}=$ 1 $D_r=$ 0.56892

 $e_{max} = 0.85$ $e = e_{max} - (D_r)(e_{max} - e_{min})$ $e_{min} = 0.14$ e = 0.44607

thus, range of permeability is estimated as:

Estimated range of k (cm/s)				
Probable		Probable		
measured	Calculated	measured		
lower bnd	Estimate	upper bnd		
1.2E-02	3.5E-02	1.1E-01		

Copyright © 2008 Stephens As	ssociates Consulting Engineers LLC
Revisions:	

By: Date:

Date:



Original Work:

Ву: R. Kline June 2, 2008 Date: Subject: Checked By: J. Turner Date: June 13, 2008

Laboratory Testing

Grain Size Distribution

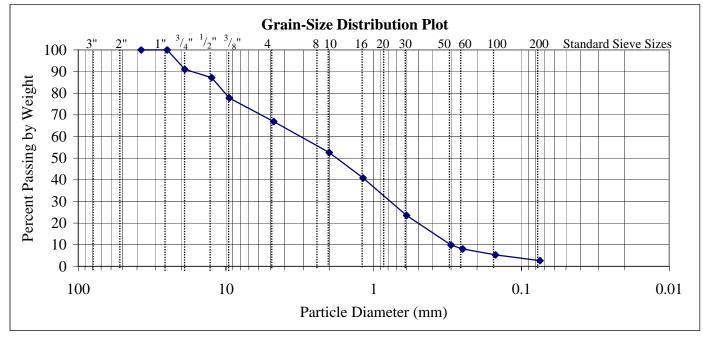
Rte. 1, Saugus, MA

Boring Number: Sample Number: S-6 B-13 Sample Depth: 14-16'

Sample Description: Gray/brown fine to coarse SAND, some Gravel

Sieve De	signation	Nominal Sie	eve Opening	Tare Weight	Sieve+Soil Wt.	Soil Weight (g)	Percent
Standard	Alternate	mm	inches	(g)	(g)	Ooli Weight (g)	Passing
37.5 mm	1-1/2"	37.5	1.476"	501.3	501.3	0.0	100.0
25.0 mm	1"	25	0.984"	502.6	502.6	0.0	100.0
19.0 mm	3/4"	19	0.748"	595.8	607.3	11.5	91.0
12.5 mm	1/2"	12.5	0.492"	607.5	612.4	4.9	87.2
9.5	3/8"	9.5	0.374"	565.2	577.2	12.0	77.8
4.75 mm	No. 4	4.75	0.187"	527.2	541.1	13.9	66.9
2.00 mm	No. 10	2	0.078"	450.9	469.2	18.3	52.6
1.18 mm	No. 16	1.18	0.0464"	401.3	416.3	15.0	40.8
600 µm	No. 30	0.6	0.0236"	410.4	432.5	22.1	23.6
300 µm	No. 50	0.3	.0118"	416.6	434.1	17.5	9.9
250 µm	No. 60	0.25	0.0098"	340.0	342.3	2.3	8.1
150 µm	No. 100	0.15	0.0059"	303.8	307.3	3.5	5.3
75 µm	No. 200	0.075	0.0029"	301.8	305.2	3.4	2.7
Pan				340.5	343.9	3.4	0.0
	•	•	•	Co	oil Wt Sum (a):	127 Q	•

Soil Wt. Sum (g): 127.8



 $D_{10} =$ 0.3 mm Cu = 10.8 $D_{30} =$ 0.76 mm Cc = 0.6

 $D_{60} =$ 3.25 USCS Classification = mm SP

Copyright © 2008 Stephens Associates Consulting Engineers LLC

Revisions:



Project: Number: 026-08-007 Sheet MWRA Contract No. 6905, Pipeline Name: Original Work: Rte. 1, Saugus, MA R. Kline Permeability Estimate by Date: June 2, 2008 Subject: Checked By: J. Turner Date: June 13, 2008 Kozeny-Carman Formula

Boring Number: B-13 Sample Number: S-6 Sample Depth: 14-16'

According to References 1 and 3, (Note: Reference List at end of data sheets) Permeability may be estimated as $k = (\gamma/\mu)(1/C_{K-C})(1/S^2)[e^3/(1+e)]$

 γ = assumed unit weight of water in situ, lb/ft³ = 62.4 = 9800 N/m³ μ = viscosity of water, Ns/m² = 0.00131 at 10 °C

 C_{K-C} = Kozeny-Carman empirical coefficient; reported as 4.8±0.3, usually taken as 5, =

S = specific surface area per unit volume of particles = $SF^*\Sigma((P_{No D}-P_{No d})/d)$

 $P_{No D}$ = percentage by weight smaller than size D

P_{No d} = percentage by weight larger than the next size d

 D_{eq} = equivalent grain size for particles smaller than D_{min} of gradation = $D_{min}/3^{0.5}$

SF = Shape Factor for particle angularity = 7.5

SF = 6.6 for rounded particles; 7.5 for medium angularity; 8.4 for angular (after Loudon, presented in Ref. 1)

thus, Permeability, may be estimated as $k = (\gamma/\mu)(1/C_{K-C})\{1/\Sigma[(P_{N_0} - P_{N_0} d)/d]\}^2(1/SF^2)[e^3/(1+e)]$, Table 1 below

Further, according Ref. 2, measured permeability typically varies from 1/3 to 3 times the estimated permeability. The references also note that this method may overpredict permeability when soil is gravel, and the results present an upper bound. The formula is not suitable for plastic soils.

TABLE 1 - SUM OF (P _{No D} - P _{No d})/d						
Sieve De	Sieve Designation		Percent	(P _{NoD} -P _{Nod})/ d		
Standard	Alternate	Opening (cm)	Passing	(1/cm)		
37.5 mm	1-1/2"	3.750	100.0			
25.0 mm	1"	2.500	100.0	0.0		
19.0 mm	3/4"	1.900	91.0	4.7		
12.5 mm	1/2"	1.250	87.2	3.1		
9.5	3/8"	0.950	77.8	9.9		
4.75 mm	No. 4	0.475	66.9	22.9		
2.00 mm	No. 10	0.200	52.6	71.6		
1.18 mm	No. 16	0.118	40.8	99.5		
600 µm	No. 30	0.060	23.6	288.2		
300 µm	No. 50	0.030	9.9	456.4		
250 µm	No. 60	0.025	8.1	72.0		
150 µm	No. 100	0.015	5.3	182.6		
75 µm	No. 200	0.008	2.7	354.7		
D_{eq}		0.004	0.0	614.4		
•						
		•	Sum:	2180.0		

Estimate Void Ratio (e) from Relative Density (Ref. 4)

 $D_r^2 = (N_1)60/C_P C_A C_{OCR}$

 $(N_1)60=$ 22 $C_P=60+25logD_{50}=$ 66.4 $D_{50}=$ 1.8 mm $C_A=1.2+0.05log(t/100)=$ 1.19 t(yr)= 70 $C_{OCR}=OCR^{U.18}=$ 1 $D_r=$ 0.52723

 $e_{max} = 0.9$ $e = e_{max} - (D_r)(e_{max} - e_{min})$ $e_{min} = 0.3$ e = 0.58366

thus, range of permeability is estimated as:

Estimated range of k (cm/s)				
Probable	able Probable			
measured	Calculated	measured		
lower bnd	Estimate	upper bnd		
2.3E-02	7.0E-02	2.1E-01		

Copyright © 2008 Stephens Associates Consulting Engineers LLC
Revisions:



Original Work:

Ву: R. Kline June 2, 2008 Date: Subject: Checked By: J. Turner Date: June 13, 2008

Laboratory Testing

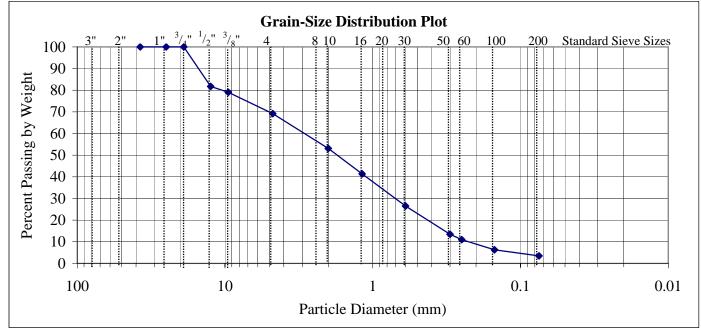
Grain Size Distribution

Rte. 1, Saugus, MA

Boring Number: Sample Number: S-3 Sample Depth: 6-8' B-14

Sample Description: Brown fine to coarse SAND, some Gravel

Sieve De	signation	Nominal Sign	eve Opening	Tare Weight	Sieve+Soil Wt.	Soil Weight (g)	Percent
Standard	Alternate	mm	inches	(g)	(g)	Soli Weight (g)	Passing
37.5 mm	1-1/2"	37.5	1.476"	501.2	501.2	0.0	100.0
25.0 mm	1"	25	0.984"	502.5	502.5	0.0	100.0
19.0 mm	3/4"	19	0.748"	595.8	595.8	0.0	100.0
12.5 mm	1/2"	12.5	0.492"	607.6	624.4	16.8	81.8
9.5	3/8"	9.5	0.374"	565.1	567.6	2.5	79.0
4.75 mm	No. 4	4.75	0.187"	527.7	536.8	9.1	69.2
2.00 mm	No. 10	2	0.078"	450.7	465.5	14.8	53.1
1.18 mm	No. 16	1.18	0.0464"	401.1	411.9	10.8	41.4
600 µm	No. 30	0.6	0.0236"	410.2	423.9	13.7	26.5
300 µm	No. 50	0.3	.0118"	416.4	428.4	12.0	13.5
250 µm	No. 60	0.25	0.0098"	339.9	342.2	2.3	11.0
150 µm	No. 100	0.15	0.0059"	303.7	308.0	4.3	6.3
75 µm	No. 200	0.075	0.0029"	301.9	304.5	2.6	3.5
Pan				340.4	343.6	3.2	0.0
				Sc	l oil Wt. Sum (g):	92.1	



 $D_{10} =$ 0.225 mm Cu = 14.4 $D_{30} =$ 0.7 0.7 mm Cc =

 $D_{60} =$ 3.25 USCS Classification = SP mm

Copyright © 2008 Stephens Associates Consulting Engineers LLC

Revisions:

By: Date: Date: By:



Project: Number: 026-08-007 Sheet MWRA Contract No. 6905, Pipeline Name: Original Work: Rte. 1, Saugus, MA R. Kline Permeability Estimate by Date: June 2, 2008 Subject: Checked By: J. Turner Date: June 13, 2008 Kozeny-Carman Formula

Boring Number: B-14 Sample Number: S-3 Sample Depth: 6-8'

According to References 1 and 3, (Note: Reference List at end of data sheets) Permeability may be estimated as $k = (\gamma/\mu)(1/C_{K-C})(1/S^2)[e^3/(1+e)]$

 γ = assumed unit weight of water in situ, lb/ft³ = 62.4 = 9800 N/m³ μ = viscosity of water, Ns/m² = 0.00131 at 10 °C

 C_{K-C} = Kozeny-Carman empirical coefficient; reported as 4.8±0.3, usually taken as 5, =

S = specific surface area per unit volume of particles = $SF^*\Sigma((P_{No D}-P_{No d})/d)$

 $P_{No D}$ = percentage by weight smaller than size D

 P_{Nod} = percentage by weight larger than the next size d

 D_{eq} = equivalent grain size for particles smaller than D_{min} of gradation = $D_{min}/3^{0.5}$

SF = Shape Factor for particle angularity = 7.5

SF = 6.6 for rounded particles; 7.5 for medium angularity; 8.4 for angular (after Loudon, presented in Ref. 1)

thus, Permeability, may be estimated as $k = (\gamma/\mu)(1/C_{K-C})\{1/\Sigma[(P_{N_0} - P_{N_0} d)/d]\}^2(1/SF^2)[e^3/(1+e)]$, Table 1 below

Further, according Ref. 2, measured permeability typically varies from 1/3 to 3 times the estimated permeability. The references also note that this method may overpredict permeability when soil is gravel, and the results present an upper bound. The formula is not suitable for plastic soils.

TABLE 1 - SUM OF (P _{No D} - P _{No d})/d						
Sieve Designation		Nominal Sieve	Percent	(P _{NoD} -P _{Nod})/ d		
Standard	Alternate	Opening (cm)	Passing	(1/cm)		
37.5 mm	1-1/2"	3.750	100.0			
25.0 mm	1"	2.500	100.0	0.0		
19.0 mm	3/4"	1.900	100.0	0.0		
12.5 mm	1/2"	1.250	81.8	14.6		
9.5	3/8"	0.950	79.0	2.9		
4.75 mm	No. 4	0.475	69.2	20.8		
2.00 mm	No. 10	0.200	53.1	80.3		
1.18 mm	No. 16	0.118	41.4	99.4		
600 µm	No. 30	0.060	26.5	247.9		
300 µm	No. 50	0.030	13.5	434.3		
250 µm	No. 60	0.025	11.0	99.9		
150 µm	No. 100	0.015	6.3	311.3		
75 µm	No. 200	0.008	3.5	376.4		
D_{eq}		0.004	0.0	802.4		
•						
	-	•	Sum:	2490.2		

Estimate Void Ratio (e) from Relative Density (Ref. 4)

 $D_r^2 = (N_1)60/C_P C_A C_{OCR}$

 $(N_1)60=$ 22 $C_P=60+25logD_{50}=$ 66.4 $D_{50}=$ 1.8 mm $C_A=1.2+0.05log(t/100)=$ 1.19 t(yr)= 70 $C_{OCR}=OCR^{0.18}=$ 1 $D_r=$ 0.52723

 $e_{max} = 0.85$ $e = e_{max} - (D_r)(e_{max} - e_{min})$ $e_{min} = 0.14$ e = 0.47566

thus, range of permeability is estimated as:

Estimated range of k (cm/s)				
Probable		Probable		
measured	Calculated	measured		
lower bnd	Estimate	upper bnd		
1.0E-02	3.1E-02	9.4E-02		

Copyright © 2008 Stephens As	ssociates Consulting Engineers LLC
Revisions:	

By:______Date: _____

Date:



Original Work:

R. Kline June 2, 2008 By: Date: Subject: Checked By: J. Turner Date: June 13, 2008

Laboratory Testing

Grain Size Distribution

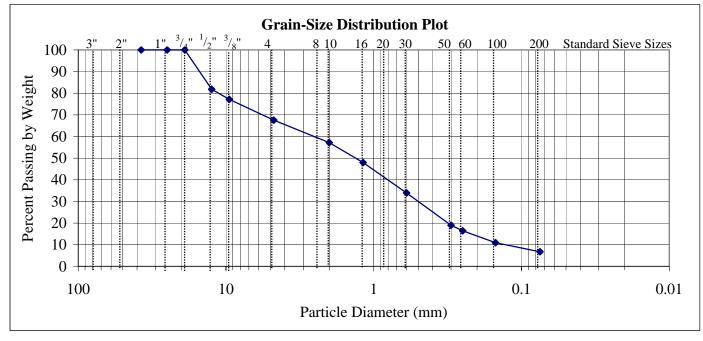
Rte. 1, Saugus, MA

Boring Number: Sample Number: S-1 Sample Depth: 1-3' Bottom 7" B-15

Sample Description: Brown fine to coarse SAND, some Gravel, trace silt

Sieve De	signation	Nominal Sie	eve Opening	Tare Weight	Sieve+Soil Wt.	Soil Weight (g)	Percent
Standard	Alternate	mm	inches	(g)	(g)	Con Worght (g)	Passing
37.5 mm	1-1/2"	37.5	1.476"	501.3	501.3	0.0	100.0
25.0 mm	1"	25	0.984"	502.5	502.5	0.0	100.0
19.0 mm	3/4"	19	0.748"	595.8	595.8	0.0	100.0
12.5 mm	1/2"	12.5	0.492"	607.8	630.9	23.1	81.8
9.5	3/8"	9.5	0.374"	565.4	571.3	5.9	77.2
4.75 mm	No. 4	4.75	0.187"	527.9	540.1	12.2	67.6
2.00 mm	No. 10	2	0.078"	450.8	464.0	13.2	57.2
1.18 mm	No. 16	1.18	0.0464"	401.3	413.0	11.7	48.0
600 µm	No. 30	0.6	0.0236"	410.4	428.2	17.8	33.9
300 µm	No. 50	0.3	.0118"	416.6	435.6	19.0	19.0
250 µm	No. 60	0.25	0.0098"	340.1	343.3	3.2	16.5
150 µm	No. 100	0.15	0.0059"	303.8	310.8	7.0	10.9
75 µm	No. 200	0.075	0.0029"	301.8	307.1	5.3	6.8
Pan				340.6	349.2	8.6	0.0
				C	oil Wt Sum (a):	127	

Soil Wt. Sum (g):



 $D_{10} =$ 0.13 Cu = 23.1 mm $D_{30} =$ 0.5 mm Cc = 0.6

 $D_{60} =$ 3 USCS Classification = SP-SM mm

Copyright © 2008 Stephens Associates Consulting Engineers LLC Revisions:



 Project:
 Number:
 026-08-007
 Sheet
 1
 of
 1

 Name:
 MWRA Contract No. 6905, Pipeline

Original Work:

By: R. Kline Date: June 2, 2008 Subject: Checked By: J. Turner Date: June 13, 2008

Rte. 1, Saugus, MA

Laboratory Testing

Grain Size Distribution

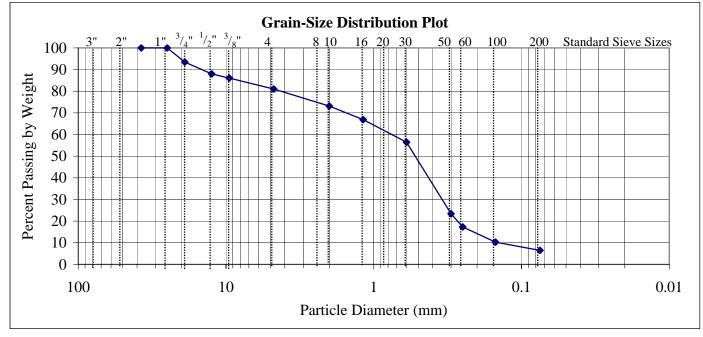
Composite

Boring Number: B-15 Sample Number: S-2 & S-3 Sample Depth: 3-7'

Sample Description: Brown fine to medium SAND, little Gravel, trace silt

Sieve De	signation	Nominal Sie	eve Opening	Tare Weight	Sieve+Soil Wt.	Soil Weight (g)	Percent
Standard	Alternate	mm	inches	(g)	(g)	3 (9)	Passing
37.5 mm	1-1/2"	37.5	1.476"	501.3	501.3	0.0	100.0
25.0 mm	1"	25	0.984"	502.5	502.5	0.0	100.0
19.0 mm	3/4"	19	0.748"	595.7	606.8	11.1	93.5
12.5 mm	1/2"	12.5	0.492"	607.5	616.8	9.3	88.0
9.5	3/8"	9.5	0.374"	565.2	568.5	3.3	86.1
4.75 mm	No. 4	4.75	0.187"	527.7	536.3	8.6	81.0
2.00 mm	No. 10	2	0.078"	450.8	464.2	13.4	73.1
1.18 mm	No. 16	1.18	0.0464"	401.1	411.7	10.6	66.9
600 µm	No. 30	0.6	0.0236"	410.3	428.1	17.8	56.4
300 µm	No. 50	0.3	.0118"	416.5	472.7	56.2	23.4
250 µm	No. 60	0.25	0.0098"	339.9	350.3	10.4	17.3
150 µm	No. 100	0.15	0.0059"	303.6	315.5	11.9	10.3
75 µm	No. 200	0.075	0.0029"	302.0	308.5	6.5	6.5
Pan				340.3	351.3	11.0	0.0
				Co	il \\/t Sum (a).	170 1	

Soil Wt. Sum (g): 170.1



 $D_{10} = 0.15$ mm Cu = 5.0 $D_{30} = 0.35$ mm Cc = 1.1

 $D_{60} = 0.75$ mm USCS Classification = SP-SM

Copyright © 2008 Stephens Associates Consulting Engineers LLC Revisions:



Project: Number: 026-08-007 Sheet MWRA Contract No. 6905, Pipeline Name: Original Work: Rte. 1, Saugus, MA R. Kline Permeability Estimate by Date: June 2, 2008 Subject: Checked By: J. Turner Date: June 13, 2008 Kozeny-Carman Formula

Boring Number: B-15 Sample Number: S-2 & S-3 Sample Depth: 3-7'

According to References 1 and 3, (Note: Reference List at end of data sheets) Permeability may be estimated as $k = (\gamma/\mu)(1/C_{K-C})(1/S^2)[e^3/(1+e)]$

 γ = assumed unit weight of water in situ, lb/ft³ = 62.4 = 9800 N/m³ μ = viscosity of water, Ns/m² = 0.00131 at 10 °C

 C_{K-C} = Kozeny-Carman empirical coefficient; reported as 4.8±0.3, usually taken as 5, =

S = specific surface area per unit volume of particles = $SF^*\Sigma((P_{No D}-P_{No d})/d)$

 $P_{No\ D}$ = percentage by weight smaller than size D

 P_{Nod} = percentage by weight larger than the next size d

 D_{eq} = equivalent grain size for particles smaller than D_{min} of gradation = $D_{min}/3^{0.5}$

SF = Shape Factor for particle angularity = 7.5

SF = 6.6 for rounded particles; 7.5 for medium angularity; 8.4 for angular (after Loudon, presented in Ref. 1)

thus, Permeability, may be estimated as $k = (\gamma/\mu)(1/C_{K-C})\{1/\Sigma[(P_{N_0,D}-P_{N_0,d})/d]\}^2(1/SF^2)[e^3/(1+e)]$, Table 1 below

Further, according Ref. 2, measured permeability typically varies from 1/3 to 3 times the estimated permeability. The references also note that this method may overpredict permeability when soil is gravel, and the results present an upper bound. The formula is not suitable for plastic soils.

TABLE 1 - SUM OF (P _{No D} - P _{No d})/d							
Sieve De	signation	Nominal Sieve	Percent	(P _{NoD} -P _{Nod})/ d			
Standard	Alternate	Opening (cm)	Passing	(1/cm)			
37.5 mm	1-1/2"	3.750	100.0				
25.0 mm	1"	2.500	100.0	0.0			
19.0 mm	3/4"	1.900	93.5	3.4			
12.5 mm	1/2"	1.250	88.0	4.4			
9.5	3/8"	0.950	86.1	2.0			
4.75 mm	No. 4	0.475	81.0	10.6			
2.00 mm	No. 10	0.200	73.1	39.4			
1.18 mm	No. 16	0.118	66.9	52.8			
600 µm	No. 30	0.060	56.4	174.4			
300 µm	No. 50	0.030	23.4	1101.3			
250 µm	No. 60	0.025	17.3	244.6			
150 µm	No. 100	0.015	10.3	466.4			
75 µm	No. 200	0.008	6.5	509.5			
D_{eq}		0.004	0.0	1493.4			
·							
_							
			Sum	4102.3			

Estimate Void Ratio (e) from Relative Density (Ref. 4)

 $D_r^2 = (N_1)60/C_P C_A C_{OCR}$

 $\begin{array}{lll} (N_1)60=&32\\ C_P=60+25logD_{50}=&53\\ D_{50}=&0.53\text{ mm}\\ C_A=1.2+0.05log(t/100)=&1.19\\ t(yr)=&70\\ C_{OCR}=OCR^{0.18}=&1\\ D_r=&0.7116 \end{array}$

 $e_{max} = 0.85$ $e = e_{max} - (D_r)(e_{max} - e_{min})$ $e_{min} = 0.14$ e = 0.34476

thus, range of permeability is estimated as:

Estimated range of k (cm/s)							
Probable Probable							
measured	Calculated	measured					
lower bnd	Estimate	upper bnd					
1.6E-03	4.8E-03	1.4E-02					

Copyright © 2008 Stephens Associates Consulting Engineers LL
Revisions:



Original Work:

Ву: R. Kline June 3, 2008 Date: Subject: Checked By: J. Turner Date: June 13, 2008

Laboratory Testing

Grain Size Distribution

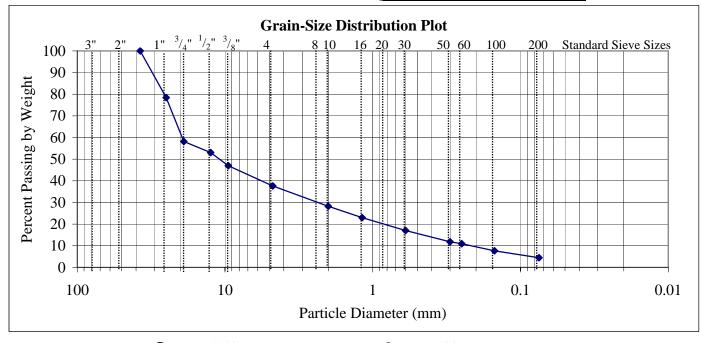
Rte. 1, Saugus, MA

Boring Number: Sample Depth: 7-9' B-15 Sample Number: S-4

Sample Description: Brown GRAVEL, some fine to medium Sand

Sieve De	signation	Nominal Sie	eve Opening	Tare Weight	Sieve+Soil Wt.	Soil Weight (g)	Percent
Standard	Alternate	mm	inches	(g)	(g)	Con Worght (g)	Passing
37.5 mm	1-1/2"	37.5	1.476"	501.4	501.4	0.0	100.0
25.0 mm	1"	25	0.984"	502.5	533.3	30.8	78.4
19.0 mm	3/4"	19	0.748"	595.8	624.7	28.9	58.2
12.5 mm	1/2"	12.5	0.492"	607.5	614.8	7.3	53.0
9.5	3/8"	9.5	0.374"	565.2	573.9	8.7	47.0
4.75 mm	No. 4	4.75	0.187"	527.7	541.0	13.3	37.6
2.00 mm	No. 10	2	0.078"	450.8	464.2	13.4	28.2
1.18 mm	No. 16	1.18	0.0464"	401.1	408.6	7.5	23.0
600 µm	No. 30	0.6	0.0236"	410.3	418.8	8.5	17.0
300 µm	No. 50	0.3	.0118"	416.5	423.9	7.4	11.8
250 µm	No. 60	0.25	0.0098"	339.9	341.2	1.3	10.9
150 µm	No. 100	0.15	0.0059"	303.6	308.3	4.7	7.6
75 µm	No. 200	0.075	0.0029"	302.0	306.5	4.5	4.5
Pan				340.3	346.7	6.4	0.0
					oil Wt Sum (a):	1/12 7	

Soil Wt. Sum (g): 142.7



 $D_{10} =$ 0.21 Cu = 90.5 mm $D_{30} =$ 2.25 mm Cc = 1.3

 $D_{60} =$ 19 USCS Classification = mm GW

Copyright © 2008 Stephens Associates Consulting Engineers LLC

Revisions:



Project: Number: 026-08-007 Sheet MWRA Contract No. 6905, Pipeline Name: Original Work: Rte. 1, Saugus, MA R. Kline Permeability Estimate by Date: June 3, 2008 Subject: Checked By: J. Turner Date: June 13, 2008 Kozeny-Carman Formula

Boring Number: B-15 Sample Number: S-4 Sample Depth: 7-9'

According to References 1 and 3, (Note: Reference List at end of data sheets) Permeability may be estimated as $k = (\gamma/\mu)(1/C_{K-C})(1/S^2)[e^3/(1+e)]$

 γ = assumed unit weight of water in situ, lb/ft³ = 62.4 = 9800 N/m³ μ = viscosity of water, Ns/m² = 0.00131 at 10 °C

 C_{K-C} = Kozeny-Carman empirical coefficient; reported as 4.8±0.3, usually taken as 5, =

S = specific surface area per unit volume of particles = $SF^*\Sigma((P_{No D}-P_{No d})/d)$

 $P_{N_0 D}$ = percentage by weight smaller than size D

P_{No d} = percentage by weight larger than the next size d

 D_{eq} = equivalent grain size for particles smaller than D_{min} of gradation = $D_{min}/3^{0.5}$

SF = Shape Factor for particle angularity = 7.5

SF = 6.6 for rounded particles; 7.5 for medium angularity; 8.4 for angular (after Loudon, presented in Ref. 1)

thus, Permeability, may be estimated as $k = (\gamma/\mu)(1/C_{K-C})\{1/\Sigma[(P_{N_0} - P_{N_0} d)/d]\}^2(1/SF^2)[e^3/(1+e)]$, Table 1 below

Further, according Ref. 2, measured permeability typically varies from 1/3 to 3 times the estimated permeability. The references also note that this method may overpredict permeability when soil is gravel, and the results present an upper bound. The formula is not suitable for plastic soils.

TABLE 1 - SUM OF (P _{No D} - P _{No d})/d								
Sieve De	signation	Nominal Sieve	Percent	(P _{NoD} -P _{Nod})/ d				
Standard	Alternate	Opening (cm)	Passing	(1/cm)				
37.5 mm	1-1/2"	3.750	100.0					
25.0 mm	1"	2.500	78.4	8.6				
19.0 mm	3/4"	1.900	58.2	10.7				
12.5 mm	1/2"	1.250	53.0	4.1				
9.5	3/8"	0.950	47.0	6.4				
4.75 mm	No. 4	0.475	37.6	19.6				
2.00 mm	No. 10	0.200	28.2	47.0				
1.18 mm	No. 16	0.118	23.0	44.5				
600 µm	No. 30	0.060	17.0	99.3				
300 µm	No. 50	0.030	11.8	172.9				
250 µm	No. 60	0.025	10.9	36.4				
150 µm	No. 100	0.015	7.6	219.6				
75 µm	No. 200	0.008	4.5	420.5				
D_{eq}		0.004	0.0	1035.8				
			Sum:	2125.3				

Estimate Void Ratio (e) from Relative Density (Ref. 4)

 $D_r^2 = (N_1)60/C_P C_A C_{OCR}$

 $(N_1)60=$ 34 $C_P=60+25logD_{50}=$ 87 $D_{50}=$ 12 mm $C_A=1.2+0.05log(t/100)=$ 1.19 t(yr)= 70 $C_{OCR}=OCR^{0.18}=$ 1 $D_r=$ 0.57259

 $e_{max} = 0.85$ $e = e_{max} - (D_r)(e_{max} - e_{min})$ $e_{min} = 0.14$ e = 0.44346

thus, range of permeability is estimated as:

Estimated range of k (cm/s)							
Probable		Probable					
measured	Calculated	measured					
lower bnd	Estimate	upper bnd					
1.2E-02	3.6E-02	1.1E-01					

Copyright © 2008 Stephens Associates Consulting Engineers LL	.C
--	----

Revisions:



Original Work:

R. Kline

Ву:

June 9, 2008 Date: Subject: Checked By: J. Turner Date: June 13, 2008

Laboratory Testing Grain Size Distribution

Rte. 1, Saugus, MA

Boring Number: Sample Number: S-1 Sample Depth: 1-3' Top 6" B-16

Sample Description: Gray medium to coarse SAND, some Gravel

Sieve Designation		Nominal Signal	eve Opening	Tare Weight	Sieve+Soil Wt.	Soil Weight (g)	Percent
Standard	Alternate	mm	inches	(g)	(g)	Son Weight (g)	Passing
37.5 mm	1-1/2"	37.5	1.476"	501.3	501.3	0.0	100.0
25.0 mm	1"	25	0.984"	502.5	502.5	0.0	100.0
19.0 mm	3/4"	19	0.748"	596	596	0.0	100.0
12.5 mm	1/2"	12.5	0.492"	607.2	633.9	26.7	84.0
9.5	3/8"	9.5	0.374"	565.2	567.2	2.0	82.8
4.75 mm	No. 4	4.75	0.187"	527.7	541.8	14.1	74.4
2.00 mm	No. 10	2	0.078"	450.8	486.8	36.0	52.8
1.18 mm	No. 16	1.18	0.0464"	401.2	430.1	28.9	35.5
600 µm	No. 30	0.6	0.0236"	410.5	444.6	34.1	15.1
300 µm	No. 50	0.3	.0118"	416.8	435.8	19.0	3.7
250 µm	No. 60	0.25	0.0098"	339.9	341.6	1.7	2.7
150 µm	No. 100	0.15	0.0059"	303.7	306.2	2.5	1.2
75 µm	No. 200	0.075	0.0029"	301.6	302.9	1.3	0.4
Pan				340.4	341.1	0.7	0.0
				9/	il Wt. Sum (g):	167	

Grain-Size Distribution Plot 16 20 30 50 60 100 200 Standard Sieve Sizes 100 90 Percent Passing by Weight 80 70 60 50 40 30 20

> $D_{10} =$ 0.44 mm Cu = 6.1 $D_{30} =$ Cc = 0.96 mm 8.0 $D_{60} =$ USCS Classification = 2.7 mm

1

Particle Diameter (mm)

10

Copyright © 2008 Stephens Associates Consulting Engineers LLC Revisions:

10 0

100

By: Date: Date: By:



0.01

0.1

SP

Original Work:

By: R. Kline Date: June 3, 2008 Subject: Checked By: J. Turner Date: June 13, 2008

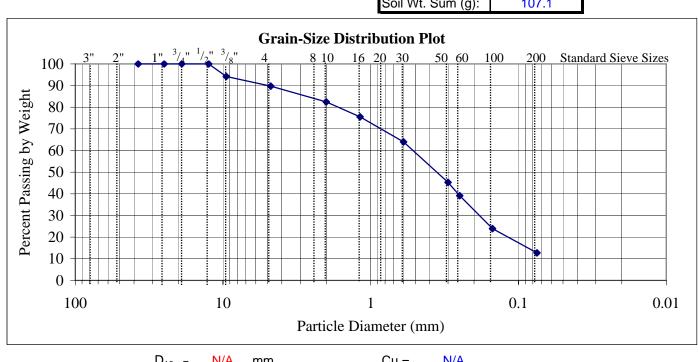
Rte. 1, Saugus, MA
Laboratory Testing

Grain Size Distribution

Boring Number: B-16 Sample Number: S-1 Sample Depth: 1-3' Bottom 8"

Sample Description: Brown fine to medium SAND, little Gravel, little Silt

Sieve Designation		Nominal Sie	eve Opening	Tare Weight	Sieve+Soil Wt.	Soil Weight (g)	Percent
Standard	Alternate	mm	inches	(g)	(g)	Con Worght (g)	Passing
37.5 mm	1-1/2"	37.5	1.476"	501.3	501.3	0.0	100.0
25.0 mm	1"	25	0.984"	502.5	502.5	0.0	100.0
19.0 mm	3/4"	19	0.748"	595.8	595.8	0.0	100.0
12.5 mm	1/2"	12.5	0.492"	607.5	607.5	0.0	100.0
9.5	3/8"	9.5	0.374"	565.2	571.4	6.2	94.2
4.75 mm	No. 4	4.75	0.187"	527.8	532.6	4.8	89.7
2.00 mm	No. 10	2	0.078"	450.8	458.6	7.8	82.4
1.18 mm	No. 16	1.18	0.0464"	401.1	408.5	7.4	75.5
600 µm	No. 30	0.6	0.0236"	410.3	422.7	12.4	64.0
300 µm	No. 50	0.3	.0118"	416.5	436.5	20.0	45.3
250 µm	No. 60	0.25	0.0098"	339.9	346.5	6.6	39.1
150 µm	No. 100	0.15	0.0059"	303.6	319.9	16.3	23.9
75 µm	No. 200	0.075	0.0029"	301.6	313.6	12.0	12.7
Pan				340.3	353.9	13.6	0.0
				_			
				Sc	oil Wt Sum (a):	107 1	



 $D_{10} = N/A$ mm Cu = N/A $D_{30} = 0.18$ mm Cc = N/A

 $D_{60} = 0.525$ mm USCS Classification = SM

Copyright $\ @$ 2008 Stephens Associates Consulting Engineers LLC

Revisions:

By: _____ Date: _____ Date: _____



Original Work:

R. Kline June 3, 2008 By: Date: Subject: Checked By: J. Turner Date: June 13, 2008

Laboratory Testing

Grain Size Distribution

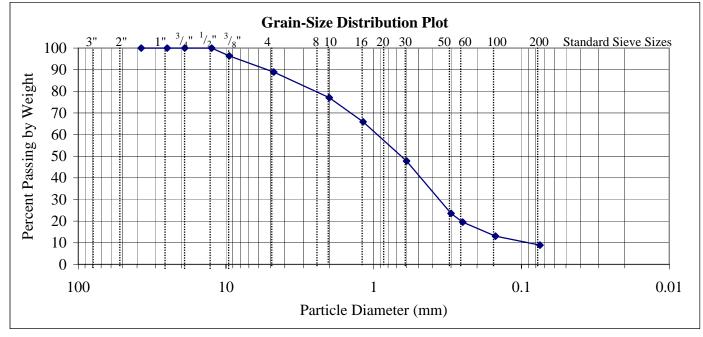
Rte. 1, Saugus, MA

Boring Number: Sample Number: S-3 B-16 Sample Depth: 5-7'

Sample Description: Brown fine to coarse SAND, little Gravel, trace silt

Sieve De	signation	Nominal Sie	eve Opening	Tare Weight	Sieve+Soil Wt.	Soil Weight (g)	Percent
Standard	Alternate	mm	inches	(g)	(g)	Con Weight (g)	Passing
37.5 mm	1-1/2"	37.5	1.476"	501.3	501.3	0.0	100.0
25.0 mm	1"	25	0.984"	502.5	502.5	0.0	100.0
19.0 mm	3/4"	19	0.748"	595.8	595.8	0.0	100.0
12.5 mm	1/2"	12.5	0.492"	607.6	607.6	0.0	100.0
9.5	3/8"	9.5	0.374"	565.4	570.7	5.3	96.4
4.75 mm	No. 4	4.75	0.187"	527.9	538.9	11.0	88.9
2.00 mm	No. 10	2	0.078"	450.9	468.3	17.4	77.1
1.18 mm	No. 16	1.18	0.0464"	401.3	417.7	16.4	65.9
600 µm	No. 30	0.6	0.0236"	410.4	437.0	26.6	47.8
300 µm	No. 50	0.3	.0118"	416.6	452.2	35.6	23.6
250 µm	No. 60	0.25	0.0098"	340.0	345.9	5.9	19.5
150 µm	No. 100	0.15	0.0059"	303.7	313.2	9.5	13.1
75 µm	No. 200	0.075	0.0029"	301.7	307.8	6.1	8.9
Pan				340.4	353.5	13.1	0.0
	•	•	•	0	oil Wt Sum (a):	146.0	•

Soil Wt. Sum (g): 146.9



 $D_{10} =$ 0.085 mm Cu = 11.1 $D_{30} =$ 1.7 0.365 mm Cc =

 $D_{60} =$ USCS Classification = SW-SM 0.94 mm

Copyright © 2008 Stephens Associates Consulting Engineers LLC

Revisions:



Project: Number: 026-08-007 Sheet MWRA Contract No. 6905, Pipeline Name: Original Work: Rte. 1, Saugus, MA R. Kline Permeability Estimate by Date: June 3, 2008 Subject: Checked By: J. Turner Date: June 13, 2008 Kozeny-Carman Formula

Boring Number: **B-16** Sample Number: **S-3** Sample Depth: **5-7'**

According to References 1 and 3, (Note: Reference List at end of data sheets) Permeability may be estimated as $k = (\gamma/\mu)(1/C_{K-C})(1/S^2)[e^3/(1+e)]$

 γ = assumed unit weight of water in situ, lb/ft³ = 62.4 = 9800 N/m³ μ = viscosity of water, Ns/m² = 0.00131 at 10 °C

 C_{K-C} = Kozeny-Carman empirical coefficient; reported as 4.8±0.3, usually taken as 5, =

S = specific surface area per unit volume of particles = $SF^*\Sigma((P_{No D}-P_{No d})/d)$

 $P_{No D}$ = percentage by weight smaller than size D

 P_{Nod} = percentage by weight larger than the next size d

 D_{eq} = equivalent grain size for particles smaller than D_{min} of gradation = $D_{min}/3^{0.5}$

SF = Shape Factor for particle angularity = 7.5

SF = 6.6 for rounded particles; 7.5 for medium angularity; 8.4 for angular (after Loudon, presented in Ref. 1)

thus, Permeability, may be estimated as $k = (\gamma/\mu)(1/C_{K-C})\{1/\Sigma[(P_{N_0} - P_{N_0} d)/d]\}^2(1/SF^2)[e^3/(1+e)]$, Table 1 below

Further, according Ref. 2, measured permeability typically varies from 1/3 to 3 times the estimated permeability. The references also note that this method may overpredict permeability when soil is gravel, and the results present an upper bound. The formula is not suitable for plastic soils.

	TABLE 1 - SUM OF (P _{No D} - P _{No d})/d				
Sieve De	eve Designation Nominal Sieve		Percent	(P _{NoD} -P _{Nod})/ d	
Standard	Alternate	Opening (cm)	Passing	(1/cm)	
37.5 mm	1-1/2"	3.750	100.0	-	
25.0 mm	1"	2.500	100.0	0.0	
19.0 mm	3/4"	1.900	100.0	0.0	
12.5 mm	1/2"	1.250	100.0	0.0	
9.5	3/8"	0.950	96.4	3.8	
4.75 mm	No. 4	0.475	88.9	15.8	
2.00 mm	No. 10	0.200	77.1	59.2	
1.18 mm	No. 16	0.118	65.9	94.6	
600 µm	No. 30	0.060	47.8	301.8	
300 µm	No. 50	0.030	23.6	807.8	
250 µm	No. 60	0.025	19.5	160.7	
150 µm	No. 100	0.015	13.1	431.1	
75 µm	No. 200	0.008	8.9	553.7	
D_{eq}		0.004	0.0	2059.4	
•					
	•	•	Sum:	4487 9	

Estimate Void Ratio (e) from Relative Density (Ref. 4)

 $D_r^2 = (N_1)60/C_P C_A C_{OCR}$

 $\begin{array}{lll} (N_1)60=&40\\ C_P=60+25logD_{50}=&55.3\\ D_{50}=&0.65\text{ mm}\\ C_A=1.2+0.05log(t/100)=&1.19\\ t(yr)=&70\\ C_{OCR}=OCR^{0.18}=&1\\ D_r=&0.77874 \end{array}$

 $e_{max} = 0.85$ $e = e_{max} - (D_r)(e_{max} - e_{min})$ $e_{min} = 0.14$ e = 0.29709

thus, range of permeability is estimated as:

Estimated range of k (cm/s)			
Probable		Probable	
measured	Calculated	measured	
lower bnd	Estimate	upper bnd	
8.9E-04	2.7E-03	8.0E-03	

Copyright ©	2008 Stephen	s Associates	Consulting	Engineers	LLC
Davisiana					

Revisions:



Original Work:

R. Kline June 3, 2008 By: Date: Subject: Checked By: J. Turner Date: June 13, 2008

Laboratory Testing

Grain Size Distribution

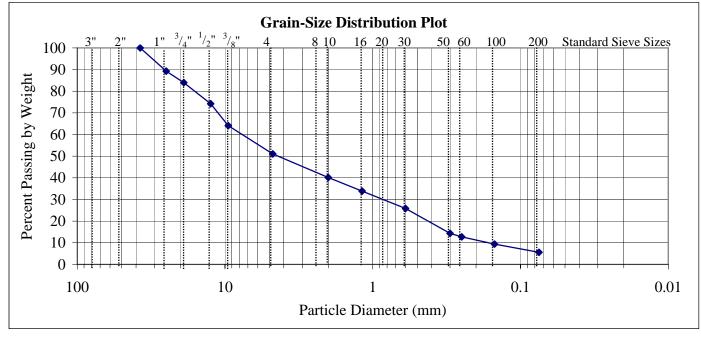
Rte. 1, Saugus, MA

Boring Number: Sample Number: S-4 Sample Depth: 7-9' B-16

Sample Description: Brown fine to coarse SAND and GRAVEL, trace silt

Sieve De Standard	signation Alternate	Nominal Sie	eve Opening inches	Tare Weight (g)	Sieve+Soil Wt.	Soil Weight (g)	Percent Passing
37.5 mm	1-1/2"	37.5	1.476"	501.5	501.5	0.0	100.0
25.0 mm	1"	25	0.984"	502.5	528	25.5	89.3
	•	t	0.964	595.9	608.6		
19.0 mm	3/4"	19				12.7	84.0
12.5 mm	1/2"	12.5	0.492"	607.7	631.0	23.3	74.2
9.5	3/8"	9.5	0.374"	565.4	589.5	24.1	64.1
4.75 mm	No. 4	4.75	0.187"	527.8	558.9	31.1	51.0
2.00 mm	No. 10	2	0.078"	450.8	476.8	26.0	40.1
1.18 mm	No. 16	1.18	0.0464"	401.2	416.1	14.9	33.9
600 µm	No. 30	0.6	0.0236"	410.3	429.4	19.1	25.8
300 µm	No. 50	0.3	.0118"	416.5	443.9	27.4	14.4
250 µm	No. 60	0.25	0.0098"	340.0	343.9	3.9	12.7
150 µm	No. 100	0.15	0.0059"	303.7	311.6	7.9	9.4
75 µm	No. 200	0.075	0.0029"	301.6	310.7	9.1	5.6
Pan				340.5	353.8	13.3	0.0
				·			
Coil MA Comp (c)				220.2			

Soil Wt. Sum (g): 238.3



 $D_{10} =$ 0.16 mm Cu = 47.5 $D_{30} =$ 0.825 mm Cc = 0.6

 $D_{60} =$ 7.6 USCS Classification = SP-SM mm

Copyright © 2008 Stephens Associates Consulting Engineers LLC

Revisions:



Project: Number: 026-08-007 Sheet MWRA Contract No. 6905, Pipeline Name: Original Work: Rte. 1, Saugus, MA R. Kline Permeability Estimate by Date: June 3, 2008 Subject: Checked By: J. Turner Date: June 13, 2008 Kozeny-Carman Formula

Boring Number: **B-16** Sample Number: **S-4** Sample Depth: **7-9'**

According to References 1 and 3, (Note: Reference List at end of data sheets) Permeability may be estimated as $k = (\gamma/\mu)(1/C_{K-C})(1/S^2)[e^3/(1+e)]$

 γ = assumed unit weight of water in situ, lb/ft³ = 62.4 = 9800 N/m³ μ = viscosity of water, Ns/m² = 0.00131 at 10 °C

 C_{K-C} = Kozeny-Carman empirical coefficient; reported as 4.8±0.3, usually taken as 5, =

S = specific surface area per unit volume of particles = $SF^*\Sigma((P_{No D}-P_{No d})/d)$

 $P_{No D}$ = percentage by weight smaller than size D

 $P_{No d}$ = percentage by weight larger than the next size d

 D_{eq} = equivalent grain size for particles smaller than D_{min} of gradation = $D_{min}/3^{0.5}$

SF = Shape Factor for particle angularity = 7.5

SF = 6.6 for rounded particles; 7.5 for medium angularity; 8.4 for angular (after Loudon, presented in Ref. 1)

thus, Permeability, may be estimated as $k = (\gamma/\mu)(1/C_{K-C})\{1/\Sigma[(P_{N_0,D}-P_{N_0,d})/d]\}^2(1/SF^2)[e^3/(1+e)]$, Table 1 below

Further, according Ref. 2, measured permeability typically varies from 1/3 to 3 times the estimated permeability. The references also note that this method may overpredict permeability when soil is gravel, and the results present an upper bound. The formula is not suitable for plastic soils.

	TABLE 1 - SUM OF (P _{No D} - P _{No d})/d				
Sieve De	signation	Nominal Sieve	Percent	(P _{NoD} -P _{Nod})/ d	
Standard	Alternate	Opening (cm)	Passing	(1/cm)	
37.5 mm	1-1/2"	3.750	100.0		
25.0 mm	1"	2.500	89.3	4.3	
19.0 mm	3/4"	1.900	84.0	2.8	
12.5 mm	1/2"	1.250	74.2	7.8	
9.5	3/8"	0.950	64.1	10.6	
4.75 mm	No. 4	0.475	51.0	27.5	
2.00 mm	No. 10	0.200	40.1	54.6	
1.18 mm	No. 16	0.118	33.9	53.0	
600 µm	No. 30	0.060	25.8	133.6	
300 µm	No. 50	0.030	14.4	383.3	
250 µm	No. 60	0.025	12.7	65.5	
150 µm	No. 100	0.015	9.4	221.0	
75 µm	No. 200	0.008	5.6	509.2	
D_{eq}		0.004	0.0	1288.9	
			Sum:	2762.0	

Estimate Void Ratio (e) from Relative Density (Ref. 4)

 $D_r^2 = (N_1)60/C_P C_A C_{OCR}$

 $(N_1)60=$ 66 $C_P=60+25logD_{50}=$ 76.1 $D_{50}=$ 4.4 mm $C_A=1.2+0.05log(t/100)=$ 1.19 t(yr)= 70 $C_{OCR}=OCR^{0.18}=$ 1 $D_r=$ 0.85297

 $e_{max} = 0.85$ $e = e_{max} - (D_r)(e_{max} - e_{min})$ $e_{min} = 0.14$ e = 0.24439

thus, range of permeability is estimated as:

Estimated range of k (cm/s)			
Probable		Probable	
measured	Calculated	measured	
lower bnd	Estimate	upper bnd	
1.4E-03	4.1E-03	1.2E-02	

Copyright ©	2008 Stephen	s Associates	Consulting	Engineers	LLC
Davisiana					

Revisions:



Original Work:

By: R. Kline Date: June 2, 2008 Subject: Checked By: J. Turner Date: June 13, 2008

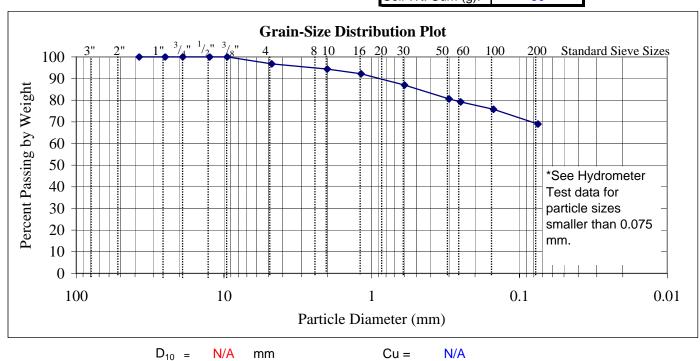
Laboratory Testing
Grain Size Distribution

Rte. 1, Saugus, MA

Boring Number: B-17 Sample Number: S-4 Sample Depth: 8-10' Bottom 8"

Sample Description: Red/brown non-plastic SILT, little fine to medium Sand

Sieve De	signation	Nominal Sie	eve Opening	Tare Weight	Sieve+Soil Wt.	Soil Weight (g)	Percent
Standard	Alternate	mm	inches	(g)	(g)	Ooli Weight (g)	Passing
37.5 mm	1-1/2"	37.5	1.476"	501.3	501.3	0.0	100.0
25.0 mm	1"	25	0.984"	502.5	502.5	0.0	100.0
19.0 mm	3/4"	19	0.748"	595.8	595.8	0.0	100.0
12.5 mm	1/2"	12.5	0.492"	607.6	607.6	0.0	100.0
9.5	3/8"	9.5	0.374"	565.4	565.4	0.0	100.0
4.75 mm	No. 4	4.75	0.187"	527.9	529.5	1.6	96.8
2.00 mm	No. 10	2	0.078"	450.9	452.1	1.2	94.4
1.18 mm	No. 16	1.18	0.0464"	401.3	402.4	1.1	92.2
600 µm	No. 30	0.6	0.0236"	410.4	413.0	2.6	87.0
300 µm	No. 50	0.3	.0118"	416.6	419.8	3.2	80.6
250 µm	No. 60	0.25	0.0098"	340.0	340.7	0.7	79.2
150 µm	No. 100	0.15	0.0059"	303.7	305.4	1.7	75.8
75 µm	No. 200	0.075	0.0029"	301.7	305.1	3.4	69.0
Pan				340.4	374.9	34.5	0.0
				Sc	<u>l</u> il Wt. Sum (g):	50	



Cc =

Copyright $\hbox{@}$ 2008 Stephens Associates Consulting Engineers LLC

 $D_{30} =$

 $D_{60} =$

N/A

N/A

mm

mm

Revisions:

By:______ Date: ______ Date: _____



N/A

ML

USCS Classification =

026-08-007 **Project:** Number: Sheet 1 of MWRA Contract No. 6905, Pipeline Name: Original Work: Rte. 1, Saugus, MA By: R. Kline Date: June 3, 2008 Subject: **Laboratory Testing** Checked By: J. Turner Date: June 13, 2008 **Hydrometer Analysis**

Boring Number: B-17 Sample Number: S-4 Sample Depth: 8-10' Bottom 8"

Sample Description: Red/brown non-plastic SILT, little fine to medium Sand

P = (R*a/W)*100Calculation for Percent of Soil in Suspension:

P = percent of soil in suspension at the level of the hydrometer, i.e. percent smaller diameter

R = Hydrometer reading with composite correction

a = correction factor for specific gravity of soil solids other than 2.65

 $D = K (L/T)^{0.5}$ Calculation for Particle Diameter: T = time, min. D = particle diameter, mm

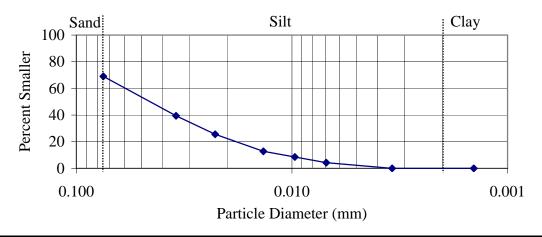
L = distance from the suspension surface to the level at which the density of the suspension is measured, cm

K = constant depending on the temperature of the suspension and the specific gravity of the soil particles. Values of K for a range of temperatures and specific gravities are given in Table 3 of ASTM D-422

The value of K does not change for a series of readings constituting a test, while values of L and T do vary.

Test Constants: Hydrometer Type: 152H Reading of Hydrometer in Solution Only (g/l): Temperature of Solution (°C) 3.0 20.0 Specific Gravity of Soil Solids (Assumed): 2.65 1.00 a: Dry Soil Weight, W (g): K: 46.9 0.01365

Time (min)	Reading (g/l)	Corrected Reading (g/l)	L	Diameter (mm)	% in suspension
	Data from S	ieve Analysis		0.0750	69
2	21.5	18.5	12.77	0.0345	39.4
5	15	12	13.84	0.0227	25.6
15	9	6	14.82	0.0136	12.8
30	7	4	15.15	0.0097	8.5
60	5	2	15.48	0.0069	4.3
250	3	0	15.81	0.0034	0.0
1440	2.5	0	15.89	0.0014	0.0



Copyright © 2008 Stephens Associates Consulting Engineers LLC Revisions:

By: Date: Date: **Stephens Associates**

Consulting Engineers

Project: Number: 026-08-007 Sheet MWRA Contract No. 6905, Pipeline Name: Original Work: Rte. 1, Saugus, MA R. Kline Permeability Estimate by Date: June 2, 2008 Subject: Checked By: J. Turner Date: June 13, 2008 Kozeny-Carman Formula

Boring Number: B-17 Sample Number: S-4 Sample Depth: 8-10' Bottom 8"

According to References 1 and 3, (Note: Reference List at end of data sheets) Permeability may be estimated as $k = (\gamma/\mu)(1/C_{K-C})(1/S^2)[e^3/(1+e)]$

 γ = assumed unit weight of water in situ, lb/ft³ = 62.4 = 9800 N/m³ μ = viscosity of water, Ns/m² = 0.00131 at 10 °C

 C_{K-C} = Kozeny-Carman empirical coefficient; reported as 4.8±0.3, usually taken as 5, =

S = specific surface area per unit volume of particles = $SF^*\Sigma((P_{No D}-P_{No d})/d)$

 $P_{No D}$ = percentage by weight smaller than size D

P_{No d} = percentage by weight larger than the next size d

 D_{eq} = equivalent grain size for particles smaller than D_{min} of gradation = $D_{min}/3^{0.5}$

SF = Shape Factor for particle angularity = 7.5

SF = 6.6 for rounded particles; 7.5 for medium angularity; 8.4 for angular (after Loudon, presented in Ref. 1)

thus, Permeability, may be estimated as $k = (\gamma/\mu)(1/C_{K-C})\{1/\Sigma[(P_{N_0,D}-P_{N_0,d})/d]\}^2(1/SF^2)[e^3/(1+e)]$, Table 1 below

Further, according Ref. 2, measured permeability typically varies from 1/3 to 3 times the estimated permeability. The references also note that this method may overpredict permeability when soil is gravel, and the results present an upper bound. The formula is not suitable for plastic soils.

	TABLE 1 - SUM OF (P _{No D} - P _{No d})/d				
Sieve De	signation	Nominal Sieve	Percent	(P _{NoD} -P _{Nod})/ d	
Standard	Alternate	Opening (cm)	Passing	(1/cm)	
9.5	3/8"	0.950	100.0	0.0	
4.75 mm	No. 4	0.475	96.8	6.7	
2.00 mm	No. 10	0.200	94.4	12.0	
1.18 mm	No. 16	0.118	92.2	18.6	
600 µm	No. 30	0.060	87.0	86.7	
300 µm	No. 50	0.030	80.6	213.3	
250 µm	No. 60	0.025	79.2	56.0	
150 µm	No. 100	0.015	75.8	226.7	
75 µm	No. 200	0.008	69.0	906.7	
		0.00345	39.4	8579.7	
		0.00227	25.6	6079.3	
		0.00136	12.8	9411.8	
Hydro	meter	0.00097	8.5	4433.0	
		0.00069	4.3	6087.0	
			0.0	12647.1	
			0.0	0.0	
			Sum:	48764.5	

Estimate Void Ratio (e) from Relative Density (Ref. 4)

 $D_r^2 = (N_1)60/C_P C_A C_{OCR}$

 $(N_1)60=$ 5 $C_P=60+25logD_{50}=$ 26.3 $D_{50}=$ 0.05 mm $C_A=1.2+0.05log(t/100)=$ 1.19 t(yr)= 70 $C_{OCR}=OCR^{U.18}=$ 1 $D_r=$ 0.39909

 $e_{max} = 0.9$ $e = e_{max} - (D_r)(e_{max} - e_{min})$ $e_{min} = 0.3$ e = 0.66055

thus, range of permeability is estimated as:

Estimated range of k (cm/s)			
Probable		Probable	
measured	Calculated	measured	
lower bnd	Estimate	upper bnd	
6.5E-05	1.9E-04	5.8E-04	

Copyright © 2008 Stephens Associates Consulting Engineers LLC
Revisions:



 Project:
 Number:
 026-08-007
 Sheet
 1
 of
 1

 Name:
 MWRA Contract No. 6905, Pipeline

Original Work:

Rte. 1, Saugus, MA

By: R. Kline Date: June 3, 2008 Subject: Checked By: J. Turner Date: June 13, 2008

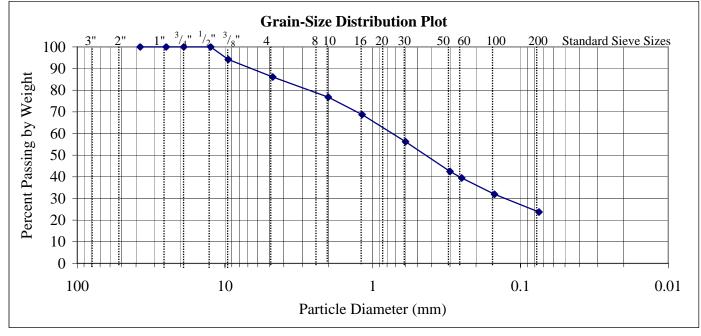
Laboratory TestingGrain Size Distribution

Boring Number: B-18 Sample Number: S-1 Sample Depth: 1-3' Bottom 12"

Sample Description: Brown fine to medium SAND, little Gravel, some Silt

Sieve De			9		Sieve+Soil Wt.	Soil Weight (g)	Percent Passing
Standard	Alternate	mm	inches	(g)	(g)		rassing
37.5 mm	1-1/2"	37.5	1.476"	501.3	501.3	0.0	100.0
25.0 mm	1"	25	0.984"	502.5	502.5	0.0	100.0
19.0 mm	3/4"	19	0.748"	595.8	595.8	0.0	100.0
12.5 mm	1/2"	12.5	0.492"	607.7	607.7	0.0	100.0
9.5	3/8"	9.5	0.374"	565.4	577.5	12.1	94.2
4.75 mm	No. 4	4.75	0.187"	527.9	544.8	16.9	86.1
2.00 mm	No. 10	2	0.078"	451.1	470.5	19.4	76.8
1.18 mm	No. 16	1.18	0.0464"	401.4	418.2	16.8	68.7
600 µm	No. 30	0.6	0.0236"	410.6	436.7	26.1	56.2
300 µm	No. 50	0.3	.0118"	416.9	445.6	28.7	42.4
250 µm	No. 60	0.25	0.0098"	340.2	346.4	6.2	39.5
150 µm	No. 100	0.15	0.0059"	303.8	319.5	15.7	31.9
75 µm	No. 200	0.075	0.0029"	301.9	319.0	17.1	23.7
Pan	_		_	340.4	389.9	49.5	0.0
				•	il Wt Sum (a):	208.5	

Soil Wt. Sum (g): 208.5



 $D_{60} = 0.74$ mm USCS Classification = SM

Copyright $\hbox{@}$ 2008 Stephens Associates Consulting Engineers LLC

Revisions:

By: _____ Date: _____ Date: _____



Original Work:

R. Kline June 3, 2008 By: Date: Subject: Checked By: J. Turner Date: June 13, 2008

Laboratory Testing

Grain Size Distribution

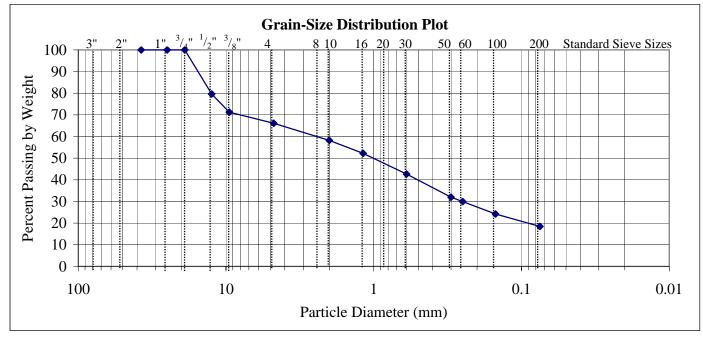
Rte. 1, Saugus, MA

Boring Number: Sample Number: S-2 B-18 Sample Depth: 3-5'

Sample Description: Brown fine to medium SAND, some Gravel, little Silt

Standard Alternate mm inches (g) (g) (g) Passing 37.5 mm 1-1/2" 37.5 1.476" 501.3 501.3 0.0 100.0 25.0 mm 1" 25 0.984" 502.5 502.5 0.0 100.0 19.0 mm 3/4" 19 0.748" 595.8 595.8 0.0 100.0 12.5 mm 1/2" 12.5 0.492" 607.5 624.5 17.0 79.6 9.5 3/8" 9.5 0.374" 565.2 572.2 7.0 71.3 4.75 mm No. 4 4.75 0.187" 527.8 532.1 4.3 66.1 2.00 mm No. 10 2 0.078" 450.8 457.4 6.6 58.2 1.18 mm No. 16 1.18 0.0464" 401.1 406.1 5.0 52.2 600 μm No. 30 0.6 0.0236" 410.3 418.3 8.0 42.6 300 μm <th>Sieve De</th> <th>signation</th> <th>Nominal Sie</th> <th>eve Opening</th> <th>Tare Weight</th> <th>Sieve+Soil Wt.</th> <th>Soil Weight (g)</th> <th>Percent</th>	Sieve De	signation	Nominal Sie	eve Opening	Tare Weight	Sieve+Soil Wt.	Soil Weight (g)	Percent
25.0 mm 1" 25 0.984" 502.5 502.5 0.0 100.0 19.0 mm 3/4" 19 0.748" 595.8 595.8 0.0 100.0 12.5 mm 1/2" 12.5 0.492" 607.5 624.5 17.0 79.6 9.5 3/8" 9.5 0.374" 565.2 572.2 7.0 71.3 4.75 mm No. 4 4.75 0.187" 527.8 532.1 4.3 66.1 2.00 mm No. 10 2 0.078" 450.8 457.4 6.6 58.2 1.18 mm No. 16 1.18 0.0464" 401.1 406.1 5.0 52.2 600 μm No. 30 0.6 0.0236" 410.3 418.3 8.0 42.6 300 μm No. 50 0.3 .0118" 416.5 425.4 8.9 32.0 250 μm No. 60 0.25 0.0098" 339.9 341.6 1.7 29.9 150 μm	Standard	Alternate	mm	inches	(g)	(g)	Con Worgin (g)	Passing
19.0 mm 3/4" 19 0.748" 595.8 595.8 0.0 100.0 12.5 mm 1/2" 12.5 0.492" 607.5 624.5 17.0 79.6 9.5 3/8" 9.5 0.374" 565.2 572.2 7.0 71.3 4.75 mm No. 4 4.75 0.187" 527.8 532.1 4.3 66.1 2.00 mm No. 10 2 0.078" 450.8 457.4 6.6 58.2 1.18 mm No. 16 1.18 0.0464" 401.1 406.1 5.0 52.2 600 μm No. 30 0.6 0.0236" 410.3 418.3 8.0 42.6 300 μm No. 50 0.3 .0118" 416.5 425.4 8.9 32.0 250 μm No. 60 0.25 0.0098" 339.9 341.6 1.7 29.9 150 μm No. 100 0.15 0.0059" 303.6 308.4 4.8 24.2 75 μm No. 200 0.075 0.0029" 301.6 306.4 4.8 18.4	37.5 mm	1-1/2"	37.5	1.476"	501.3	501.3	0.0	100.0
12.5 mm 1/2" 12.5 0.492" 607.5 624.5 17.0 79.6 9.5 3/8" 9.5 0.374" 565.2 572.2 7.0 71.3 4.75 mm No. 4 4.75 0.187" 527.8 532.1 4.3 66.1 2.00 mm No. 10 2 0.078" 450.8 457.4 6.6 58.2 1.18 mm No. 16 1.18 0.0464" 401.1 406.1 5.0 52.2 600 μm No. 30 0.6 0.0236" 410.3 418.3 8.0 42.6 300 μm No. 50 0.3 .0118" 416.5 425.4 8.9 32.0 250 μm No. 60 0.25 0.0098" 339.9 341.6 1.7 29.9 150 μm No. 100 0.15 0.0059" 303.6 308.4 4.8 24.2 75 μm No. 200 0.075 0.0029" 301.6 306.4 4.8 18.4	25.0 mm	1"	25	0.984"	502.5	502.5	0.0	100.0
9.5 3/8" 9.5 0.374" 565.2 572.2 7.0 71.3 4.75 mm No. 4 4.75 0.187" 527.8 532.1 4.3 66.1 2.00 mm No. 10 2 0.078" 450.8 457.4 6.6 58.2 1.18 mm No. 16 1.18 0.0464" 401.1 406.1 5.0 52.2 600 μm No. 30 0.6 0.0236" 410.3 418.3 8.0 42.6 300 μm No. 50 0.3 .0118" 416.5 425.4 8.9 32.0 250 μm No. 60 0.25 0.0098" 339.9 341.6 1.7 29.9 150 μm No. 100 0.15 0.0059" 303.6 308.4 4.8 24.2 75 μm No. 200 0.075 0.0029" 301.6 306.4 4.8 18.4	19.0 mm	3/4"	19	0.748"	595.8	595.8	0.0	100.0
4.75 mm No. 4 4.75 0.187" 527.8 532.1 4.3 66.1 2.00 mm No. 10 2 0.078" 450.8 457.4 6.6 58.2 1.18 mm No. 16 1.18 0.0464" 401.1 406.1 5.0 52.2 600 μm No. 30 0.6 0.0236" 410.3 418.3 8.0 42.6 300 μm No. 50 0.3 .0118" 416.5 425.4 8.9 32.0 250 μm No. 60 0.25 0.0098" 339.9 341.6 1.7 29.9 150 μm No. 100 0.15 0.0059" 303.6 308.4 4.8 24.2 75 μm No. 200 0.075 0.0029" 301.6 306.4 4.8 18.4	12.5 mm	1/2"	12.5	0.492"	607.5	624.5	17.0	79.6
2.00 mm No. 10 2 0.078" 450.8 457.4 6.6 58.2 1.18 mm No. 16 1.18 0.0464" 401.1 406.1 5.0 52.2 600 μm No. 30 0.6 0.0236" 410.3 418.3 8.0 42.6 300 μm No. 50 0.3 .0118" 416.5 425.4 8.9 32.0 250 μm No. 60 0.25 0.0098" 339.9 341.6 1.7 29.9 150 μm No. 100 0.15 0.0059" 303.6 308.4 4.8 24.2 75 μm No. 200 0.075 0.0029" 301.6 306.4 4.8 18.4	9.5	3/8"	9.5	0.374"	565.2	572.2	7.0	71.3
1.18 mm No. 16 1.18 0.0464" 401.1 406.1 5.0 52.2 600 μm No. 30 0.6 0.0236" 410.3 418.3 8.0 42.6 300 μm No. 50 0.3 .0118" 416.5 425.4 8.9 32.0 250 μm No. 60 0.25 0.0098" 339.9 341.6 1.7 29.9 150 μm No. 100 0.15 0.0059" 303.6 308.4 4.8 24.2 75 μm No. 200 0.075 0.0029" 301.6 306.4 4.8 18.4	4.75 mm	No. 4	4.75	0.187"	527.8	532.1	4.3	66.1
600 μm No. 30 0.6 0.0236" 410.3 418.3 8.0 42.6 300 μm No. 50 0.3 .0118" 416.5 425.4 8.9 32.0 250 μm No. 60 0.25 0.0098" 339.9 341.6 1.7 29.9 150 μm No. 100 0.15 0.0059" 303.6 308.4 4.8 24.2 75 μm No. 200 0.075 0.0029" 301.6 306.4 4.8 18.4	2.00 mm	No. 10	2	0.078"	450.8	457.4	6.6	58.2
300 μm No. 50 0.3 .0118" 416.5 425.4 8.9 32.0 250 μm No. 60 0.25 0.0098" 339.9 341.6 1.7 29.9 150 μm No. 100 0.15 0.0059" 303.6 308.4 4.8 24.2 75 μm No. 200 0.075 0.0029" 301.6 306.4 4.8 18.4	1.18 mm	No. 16	1.18	0.0464"	401.1	406.1	5.0	52.2
250 μm No. 60 0.25 0.0098" 339.9 341.6 1.7 29.9 150 μm No. 100 0.15 0.0059" 303.6 308.4 4.8 24.2 75 μm No. 200 0.075 0.0029" 301.6 306.4 4.8 18.4	600 µm	No. 30	0.6	0.0236"	410.3	418.3	8.0	42.6
150 μm No. 100 0.15 0.0059" 303.6 308.4 4.8 24.2 75 μm No. 200 0.075 0.0029" 301.6 306.4 4.8 18.4	300 µm	No. 50	0.3	.0118"	416.5	425.4	8.9	32.0
75 µm No. 200 0.075 0.0029" 301.6 306.4 4.8 18.4	250 µm	No. 60	0.25	0.0098"	339.9	341.6	1.7	29.9
	150 µm	No. 100	0.15	0.0059"	303.6	308.4	4.8	24.2
Pan 340.3 355.7 15.4 0.0	75 µm	No. 200	0.075	0.0029"	301.6	306.4	4.8	18.4
	Pan				340.3	355.7	15.4	0.0
Soil Wt Sum (a): 83.5								

Soil Wt. Sum (g): 83.5



 $D_{10} =$ N/A mm Cu = N/A $D_{30} =$ 0.25 mm Cc = N/A

 $D_{60} =$ 2.5 USCS Classification = mm SM

Copyright © 2008 Stephens Associates Consulting Engineers LLC

Revisions:



Original Work:

R. Kline June 3, 2008 By: Date: Subject: Checked By: J. Turner Date: June 13, 2008

Laboratory Testing

Grain Size Distribution

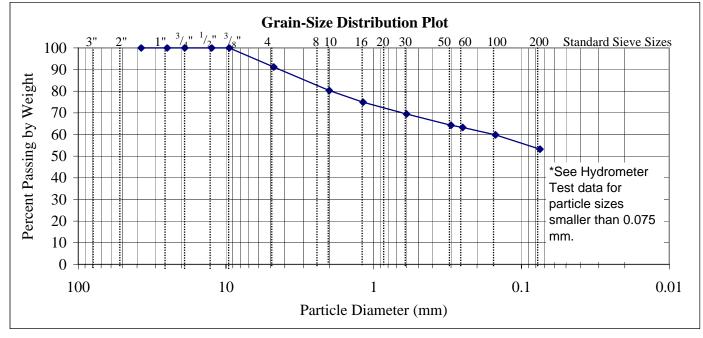
Rte. 1, Saugus, MA

Boring Number: Sample Number: S-4 Sample Depth: 7-9' B-18

Sample Description: Light brown non-plastic SILT and fine to coarse SAND

Sieve De	signation	Nominal Sieve Opening		Tare Weight	Sieve+Soil Wt.	Soil Weight (g)	Percent
Standard	Alternate	mm	inches	(g)	(g)	Con Woight (g)	Passing
37.5 mm	1-1/2"	37.5	1.476"	501.3	501.3	0.0	100.0
25.0 mm	1"	25	0.984"	502.5	502.5	0.0	100.0
19.0 mm	3/4"	19	0.748"	595.8	595.8	0.0	100.0
12.5 mm	1/2"	12.5	0.492"	607.6	607.6	0.0	100.0
9.5	3/8"	9.5	0.374"	565.2	565.2	0.0	100.0
4.75 mm	No. 4	4.75	0.187"	527.7	532.1	4.4	91.2
2.00 mm	No. 10	2	0.078"	450.7	456.1	5.4	80.3
1.18 mm	No. 16	1.18	0.0464"	401.2	403.9	2.7	74.9
600 µm	No. 30	0.6	0.0236"	410.3	413.0	2.7	69.5
300 µm	No. 50	0.3	.0118"	416.7	419.3	2.6	64.3
250 µm	No. 60	0.25	0.0098"	339.9	340.4	0.5	63.3
150 µm	No. 100	0.15	0.0059"	303.7	305.4	1.7	59.8
75 µm	No. 200	0.075	0.0029"	301.6	304.9	3.3	53.2
Pan				340.4	366.9	26.5	0.0
				9,	oil Wt. Sum (a):	49.8	

Soil Wt. Sum (g):



 $D_{10} =$ N/A mm Cu = N/A $D_{30} =$ N/A mm Cc = N/A

 $D_{60} =$ USCS Classification = 0.16 mm ML

Copyright © 2008 Stephens Associates Consulting Engineers LLC

Revisions:



		Project	: Number:	026-08-007	Sheet	1	of	1	
			Name:	MWRA Contract No. 690	5, Pipelii	ne			
Origina	al Work:				Rte. 1, Saugus, l	MA			
Ву:	R. Kline Date: June 5, 2		June 5, 2008	Subject:	Laboratory Testing				
Checke	ed By: J. Turr	ner Date:	June 13, 2008	<u> </u>	Hydrometer Anal	ysis			

Boring Number: B-18 Sample Number: S-4 Sample Depth: 7-9'

Sample Description: Light brown non-plastic SILT and fine to coarse SAND

Calculation for Percent of Soil in Suspension: P = (R*a/W)*100

P = percent of soil in suspension at the level of the hydrometer, i.e. percent smaller diameter

R = Hydrometer reading with composite correction

a = correction factor for specific gravity of soil solids other than 2.65

Calculation for Particle Diameter: $D = K (L/T)^{0.5}$ D = particle diameter, mm T = time, min.

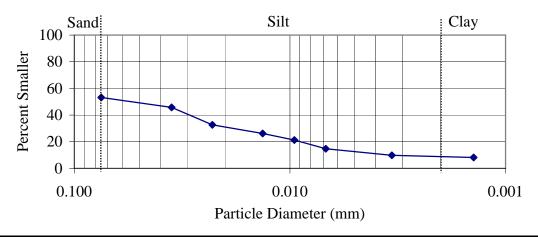
L = distance from the suspension surface to the level at which the density of the suspension is measured, cm

K = constant depending on the temperature of the suspension and the specific gravity of the soil particles. Values of K for a range of temperatures and specific gravities are given in Table 3 of ASTM D-422

The value of K does not change for a series of readings constituting a test, while values of L and T do vary.

Test Constants: Hydrometer Type: 152H
Reading of Hydrometer in Solution Only (g/l): 3.0 Temperature of Solution (°C) 20.3
Specific Gravity of Soil Solids (Assumed): 2.65 a: 1.00
Dry Soil Weight, W (g): 30.6 K: 0.013603

Time (min)	Reading (g/l)	Corrected Reading (g/l)	L	Diameter (mm)	% in suspension
	Data from S	0.0750	53.2		
2	17	14	13.51	0.0354	45.8
5	13	10	14.17	0.0229	32.7
15	11	8	14.50	0.0134	26.1
30	9.5	6.5	14.74	0.0095	21.2
60	7.5	4.5	15.07	0.0068	14.7
250	6	3	15.32	0.0034	9.8
1440	5.5	2.5	15.40	0.0014	8.2



Copyright © 2008 Stephens Associates Consulting Engineers LLC

Revisions:

By:_____ Date: _____

Date:

Stephens Associates
Consulting Engineers
Insightful, Costsaving Solutions for Buildings and Geotechnical

Project: Number: 026-08-007 Sheet MWRA Contract No. 6905, Pipeline Name: Original Work: Rte. 1, Saugus, MA R. Kline Permeability Estimate by Date: June 3, 2008 Subject: Checked By: J. Turner Date: June 13, 2008 Kozeny-Carman Formula

Boring Number: B-18 Sample Number: S-4 Sample Depth: 7-9'

According to References 1 and 3, (Note: Reference List at end of data sheets) Permeability may be estimated as $k = (\gamma/\mu)(1/C_{K-C})(1/S^2)[e^3/(1+e)]$

 γ = assumed unit weight of water in situ, lb/ft³ = 62.4 = 9800 N/m³ μ = viscosity of water, Ns/m² = 0.00131 at 10 °C

 C_{K-C} = Kozeny-Carman empirical coefficient; reported as 4.8±0.3, usually taken as 5, =

S = specific surface area per unit volume of particles = $SF^*\Sigma((P_{No D}-P_{No d})/d)$

 $P_{No D}$ = percentage by weight smaller than size D

P_{No d} = percentage by weight larger than the next size d

 D_{eq} = equivalent grain size for particles smaller than D_{min} of gradation = $D_{min}/3^{0.5}$

SF = Shape Factor for particle angularity = 7.5

SF = 6.6 for rounded particles; 7.5 for medium angularity; 8.4 for angular (after Loudon, presented in Ref. 1)

thus, Permeability, may be estimated as $k = (\gamma/\mu)(1/C_{K-C})\{1/\Sigma[(P_{N_0,D}-P_{N_0,d})/d]\}^2(1/SF^2)[e^3/(1+e)]$, Table 1 below

Further, according Ref. 2, measured permeability typically varies from 1/3 to 3 times the estimated permeability. The references also note that this method may overpredict permeability when soil is gravel, and the results present an upper bound. The formula is not suitable for plastic soils.

TABLE 1 - SUM OF (P _{No D} - P _{No d})/d										
Sieve De	signation	Nominal Sieve	Percent	(P _{NoD} -P _{Nod})/ d						
Standard	Alternate	Opening (cm)	Passing	(1/cm)						
9.5	3/8"	0.950	100.0	0.0						
4.75 mm	No. 4	0.475	91.2	18.6						
2.00 mm	No. 10	0.200	80.3	54.2						
1.18 mm	No. 16	0.118	74.9	45.9						
600 µm	No. 30	0.060	69.5	90.4						
300 µm	No. 50	0.030	64.3	174.0						
250 µm	No. 60	0.025	63.3	40.2						
150 µm	No. 100	0.015	59.8	227.6						
75 µm	No. 200	0.008	53.2	883.5						
		0.00354	45.8	2094.0						
		0.00229	32.7	5720.5						
		0.00134	26.1	4925.4						
Hydro	meter	0.00095	21.2	5157.9						
		0.00068	14.7	9558.8						
		0.00034	9.8	14411.8						
		0.00014	8.2	11428.6						
D_{eq}		0.00008	0.0	101448.7						
			Sum:	156280.1						

Estimate Void Ratio (e) from Relative Density (Ref. 4)

 $D_r^2 = (N_1)60/C_P C_A C_{OCR}$

 $\begin{array}{llll} (N_1)60=&12\\ C_P=60+25logD_{50}=&28\\ D_{50}=&0.05\text{ mm}\\ C_A=1.2+0.05log(t/100)=&1.19\\ t(yr)=&70\\ C_{OCR}=OCR^{0.18}=&1\\ D_r=&0.59951 \end{array}$

 $e_{max} = 1.8$ $e = e_{max} - (D_r)(e_{max} - e_{min})$ $e_{min} = 0.25$ e = 0.87076

thus, range of permeability is estimated as:

Estimated range of k (cm/s)						
Probable		Probable				
measured	Calculated	measured				
lower bnd	Estimate	upper bnd				
1.3E-05	3.8E-05	1.2E-04				

Copyright © 2008 Stephens Associates Consulting Engineers LLC

Revisions:



 Project:
 Number:
 026-08-007
 Sheet
 1
 of
 1

 Name:
 MWRA Contract No. 6905, Pipeline

Original Work:

By: R. Kline Date: June 4, 2008 Subject: Checked By: J. Turner Date: June 13, 2008

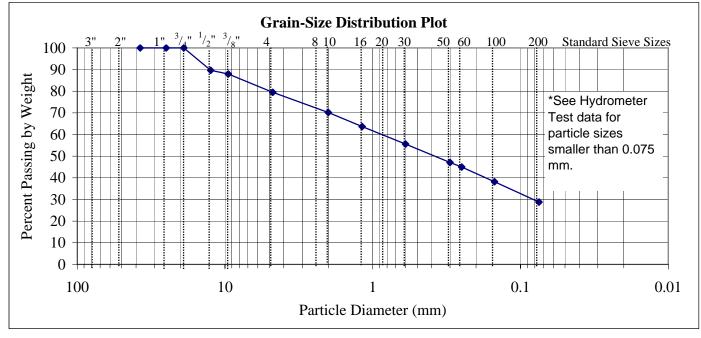
Laboratory Testing
Grain Size Distribution

Rte. 1, Saugus, MA

Boring Number: B-18 Sample Number: S-5 Sample Depth: 9-11' Sample Description: Light brown fine to medium SAND, some Gravel, some non-plastic Silt

Sieve De			eve Opening	Tare Weight	Sieve+Soil Wt.	Soil Weight (g)	Percent Passing
Standard	Alternate	mm	inches	(g)	(g)		Passing
37.5 mm	1-1/2"	37.5	1.476"	501.3	501.3	0.0	100.0
25.0 mm	1"	25	0.984"	502.5	502.5	0.0	100.0
19.0 mm	3/4"	19	0.748"	595.8	595.8	0.0	100.0
12.5 mm	1/2"	12.5	0.492"	607.8	626.0	18.2	89.7
9.5	3/8"	9.5	0.374"	565.4	568.4	3.0	88.0
4.75 mm	No. 4	4.75	0.187"	527.9	542.8	14.9	79.5
2.00 mm	No. 10	2	0.078"	450.9	467.3	16.4	70.2
1.18 mm	No. 16	1.18	0.0464"	401.3	412.8	11.5	63.7
600 µm	No. 30	0.6	0.0236"	410.5	424.7	14.2	55.6
300 µm	No. 50	0.3	.0118"	416.8	431.8	15.0	47.1
250 µm	No. 60	0.25	0.0098"	340.2	343.9	3.7	45.0
150 µm	No. 100	0.15	0.0059"	303.8	315.8	12.0	38.2
75 µm	No. 200	0.075	0.0029"	301.8	318.3	16.5	28.8
Pan				340.6	391.3	50.7	0.0
					oil Wt Sum (a):	176.1	

Soil Wt. Sum (g): 176.1



 $D_{60} = 0.86$ mm USCS Classification = SM

Copyright $\hbox{@}$ 2008 Stephens Associates Consulting Engineers LLC

Revisions:

By: _____ Date: _____ Date: _____



		Project	: Number:	026-08-007	Sheet 1	of	1	
			Name:	MWRA Contract No. 6	905, Pipeline			
Original Work:					Rte. 1, Saugus	s, MA		
Ву:	R. Kline	Date:	June 5, 2008	Subject:	t: Laboratory Testing			
Checke	ed By: J. Turr	ner Date:	June 13, 2008		Hydrometer An	nalysis		

Boring Number: B-18 Sample Number: S-5 Sample Depth: 9-11' Sample Description: Light brown fine to medium SAND, some Gravel, some non-plastic Silt

P = (R*a/W)*100Calculation for Percent of Soil in Suspension:

P = percent of soil in suspension at the level of the hydrometer, i.e. percent smaller diameter

R = Hydrometer reading with composite correction

a = correction factor for specific gravity of soil solids other than 2.65

 $D = K (L/T)^{0.5}$ Calculation for Particle Diameter: T = time, min. D = particle diameter, mm

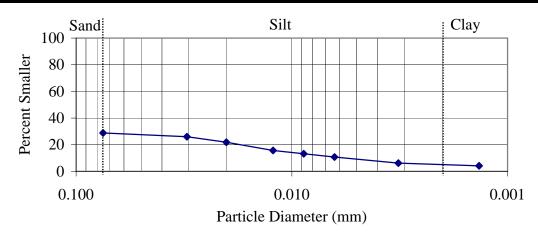
L = distance from the suspension surface to the level at which the density of the suspension is measured, cm

K = constant depending on the temperature of the suspension and the specific gravity of the soil particles. Values of K for a range of temperatures and specific gravities are given in Table 3 of ASTM D-422

The value of K does not change for a series of readings constituting a test, while values of L and T do vary.

Test Constants: Hydrometer Type: 152H Temperature of Solution (°C) Reading of Hydrometer in Solution Only (g/l): 3.0 22.2 Specific Gravity of Soil Solids (Assumed): 2.65 1.00 a: Dry Soil Weight, W (g): K: 0.013287 121.3

Time (min)	Reading (g/l)	Corrected Reading (g/l)	L	Diameter (mm)	% in suspension
	Data from S	0.0750	28.8		
2	34.5	31.5	10.64	0.0306	26.0
5	29.5	26.5	11.46	0.0201	21.8
15	22	19	12.69	0.0122	15.7
30	19	16	13.18	0.0088	13.2
60	16	13	13.68	0.0063	10.7
250	10.5	7.5	14.58	0.0032	6.2
1440	8	5	14.99	0.0014	4.1



Copyright © 2008 Stephens Associates Consulting Engineers LL	С
Revisions:	

Date: Date:



Project: Number: 026-08-007 Sheet MWRA Contract No. 6905, Pipeline Name: Original Work: Rte. 1, Saugus, MA R. Kline Permeability Estimate by Date: June 4, 2008 Subject: Checked By: J. Turner Date: June 13, 2008 Kozeny-Carman Formula

Boring Number: **B-18** Sample Number: **S-5** Sample Depth: **9-11'**

According to References 1 and 3, (Note: Reference List at end of data sheets) Permeability may be estimated as $k = (\gamma/\mu)(1/C_{K-C})(1/S^2)[e^3/(1+e)]$

 γ = assumed unit weight of water in situ, lb/ft³ = 62.4 = 9800 N/m³ μ = viscosity of water, Ns/m² = 0.00131 at 10 °C

 C_{K-C} = Kozeny-Carman empirical coefficient; reported as 4.8±0.3, usually taken as 5, =

S = specific surface area per unit volume of particles = $SF^*\Sigma((P_{No D}-P_{No d})/d)$

 $P_{No D}$ = percentage by weight smaller than size D

 P_{Nod} = percentage by weight larger than the next size d

 D_{eq} = equivalent grain size for particles smaller than D_{min} of gradation = $D_{min}/3^{0.5}$

SF = Shape Factor for particle angularity = 7.5

SF = 6.6 for rounded particles; 7.5 for medium angularity; 8.4 for angular (after Loudon, presented in Ref. 1)

thus, Permeability, may be estimated as $k = (\gamma/\mu)(1/C_{K-C})\{1/\Sigma[(P_{N_0} - P_{N_0} d)/d]\}^2(1/SF^2)[e^3/(1+e)]$, Table 1 below

Further, according Ref. 2, measured permeability typically varies from 1/3 to 3 times the estimated permeability. The references also note that this method may overpredict permeability when soil is gravel, and the results present an upper bound. The formula is not suitable for plastic soils.

present an upper bound. The formula is not suitable for plastic soils.						
	TABLI	E 1 - SUM OF (P	P _{No D} - P _{No d})/d			
Sieve De	signation	Nominal Sieve	Percent	(P _{NoD} -P _{Nod})/ d		
Standard	Alternate	Opening (cm)	Passing	(1/cm)		
19.0 mm	3/4"	1.900 100.0		0.0		
12.5 mm	1/2"	1.250	89.7	8.3		
9.5	3/8"	0.950	88.0	1.8		
4.75 mm	No. 4	0.475	79.5	17.8		
2.00 mm	No. 10	0.200	70.2	46.6		
1.18 mm	No. 16	0.118	63.7	55.3		
600 µm	No. 30	0.060	55.6	134.4		
300 µm	No. 50	0.030	47.1	283.9		
250 µm	No. 60	0.025	45.0	84.0		
150 µm	No. 100	0.015	38.2	454.3		
75 µm	No. 200	0.008	28.8	1249.3		
		0.00306	26.0	26.0 911.9		
		0.00201	21.8	2089.6		
		0.00122	15.7	5000.0		
Hydro	meter	0.00088	13.2	2840.9		
		0.00063	10.7	3968.3		
			6.2	14062.5		
		0.00014	4.1	15000.0		
D _{eq}		0.00008	0.0	50724.3		
<u> </u>			Sum:	96933.2		

Estimate Void Ratio (e) from Relative Density (Ref. 4)

 $D_r^2 = (N_1)60/C_P C_A C_{OCR}$

 $(N_1)60=$ 77 $C_P=60+25logD_{50}=$ 49.4 $D_{50}=$ 0.38 mm $C_A=1.2+0.05log(t/100)=$ 1.19 t(yr)= 70 $C_{OCR}=OCR^{U.18}=$ 1 $D_r=$ 1.14397 >1, use 1.0

 $e_{max} = 0.85$ $e = e_{max} - (D_r)(e_{max} - e_{min})$ $e_{min} = 0.14$ e = 0.14

thus, range of permeability is estimated as:

Estimated range of k (cm/s)					
Probable Probable					
measured	Calculated	measured			
lower bnd	Estimate	upper bnd			
2.3E-07	6.8E-07	2.0E-06			

Copyright © 2008 Stephens	Associates Consulting Engineers LLC
Revisions:	

By: Date:

__Date: _____ Date:



 Project:
 Number:
 026-08-007
 Sheet
 1
 of
 1

 Name:
 MWRA Contract No. 6905, Pipeline

Original Work:

By: R. Kline Date: June 4, 2008 Subject: Checked By: J. Turner Date: June 13, 2008

Rte. 1, Saugus, MA

Laboratory Testing

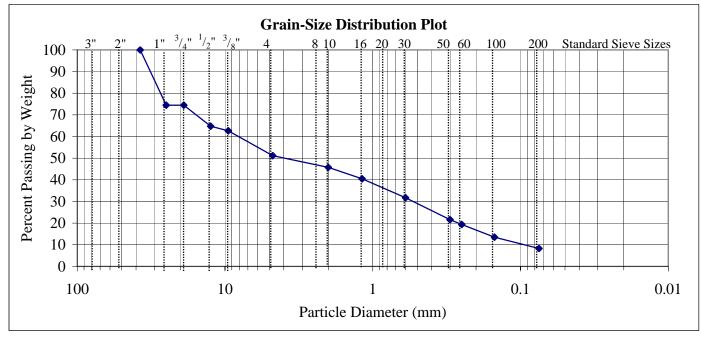
Grain Size Distribution

Boring Number: B-19 Sample Number: S-2 Sample Depth: 3-5'

Sample Description: Light brown fine to medium SAND and GRAVEL, trace silt

Sieve De	signation	Nominal Sie	eve Opening	Tare Weight	Sieve+Soil Wt.	Soil Weight (g)	Percent
Standard	Alternate	mm	inches	(g)	(g)	Con Worght (g)	Passing
37.5 mm	1-1/2"	37.5	1.476"	501.4	501.4	0.0	100.0
25.0 mm	1"	25	0.984"	502.5	529	26.5	74.5
19.0 mm	3/4"	19	0.748"	595.6	595.6	0.0	74.5
12.5 mm	1/2"	12.5	0.492"	607.6	617.7	10.1	64.7
9.5	3/8"	9.5	0.374"	565.2	567.4	2.2	62.6
4.75 mm	No. 4	4.75	0.187"	527.8	539.7	11.9	51.2
2.00 mm	No. 10	2	0.078"	450.9	456.5	5.6	45.8
1.18 mm	No. 16	1.18	0.0464"	401.2	406.7	5.5	40.5
600 µm	No. 30	0.6	0.0236"	410.4	419.5	9.1	31.7
300 µm	No. 50	0.3	.0118"	416.6	427.1	10.5	21.6
250 µm	No. 60	0.25	0.0098"	339.9	342.2	2.3	19.4
150 µm	No. 100	0.15	0.0059"	303.7	309.8	6.1	13.5
75 µm	No. 200	0.075	0.0029"	301.7	307.1	5.4	8.3
Pan				340.4	349.0	8.6	0.0

Soil Wt. Sum (g): 103.8



 $D_{10} = 0.09$ mm Cu = 88.9 $D_{30} = 0.525$ mm Cc = 0.4

 $D_{60} = 8$ mm USCS Classification = SP-SM

Copyright $\ @$ 2008 Stephens Associates Consulting Engineers LLC

Revisions:



 Project:
 Number:
 026-08-007
 Sheet
 1
 of
 1

 Name:
 MWRA Contract No. 6905, Pipeline

Original Work:

By: R. Kline Date: June 4, 2008 Subject: Checked By: J. Turner Date: June 13, 2008

Laboratory Testing
Grain Size Distribution

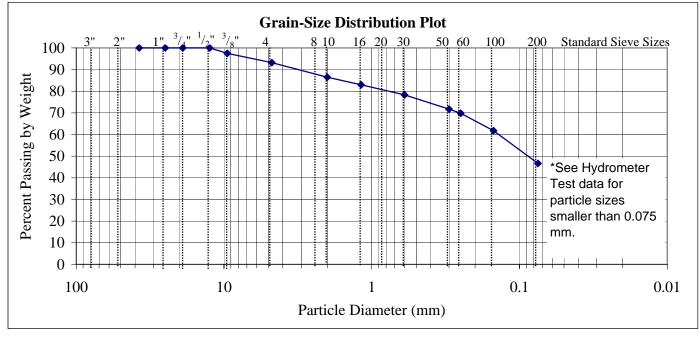
Rte. 1, Saugus, MA

Boring Number: B-20 Sample Number: S-4 Sample Depth: 7-9'

Sample Description: Gray-brown fine to medium SAND and non-plastic SILT

	signation		eve Opening	Tare Weight	Sieve+Soil Wt.	Soil Weight (g)	Percent
Standard	Alternate	mm	inches	(g)	(g)	3 (3/	Passing
37.5 mm	1-1/2"	37.5	1.476"	501.3	501.3	0.0	100.0
25.0 mm	1"	25	0.984"	502.5	502.5	0.0	100.0
19.0 mm	3/4"	19	0.748"	595.8	595.8	0.0	100.0
12.5 mm	1/2"	12.5	0.492"	607.8	607.8	0.0	100.0
9.5	3/8"	9.5	0.374"	565.4	567.6	2.2	97.5
4.75 mm	No. 4	4.75	0.187"	527.9	531.7	3.8	93.2
2.00 mm	No. 10	2	0.078"	450.9	456.8	5.9	86.5
1.18 mm	No. 16	1.18	0.0464"	401.3	404.4	3.1	83.0
600 µm	No. 30	0.6	0.0236"	410.5	414.6	4.1	78.3
300 µm	No. 50	0.3	.0118"	416.8	422.6	5.8	71.7
250 µm	No. 60	0.25	0.0098"	340.2	341.9	1.7	69.8
150 µm	No. 100	0.15	0.0059"	303.8	310.9	7.1	61.7
75 µm	No. 200	0.075	0.0029"	301.8	315.1	13.3	46.7
Pan				340.6	381.7	41.1	0.0
ı							
				So	oil Wt Sum (a):	88 1	

Soil Wt. Sum (g): 88.1



 $D_{10} = N/A$ mm Cu = N/A $D_{30} = N/A$ mm Cc = N/A

 $D_{60} = 0.175$ mm USCS Classification = SM

Copyright © 2008 Stephens Associates Consulting Engineers LLC

Revisions:

By:______ Date: ______ Date: ______



			Project	: Number:	026-08-007	Sheet 1 of	1
				Name:	MWRA Contract No.	6905, Pipeline	
Origina	l Work:				Rte. 1, Saug	us, MA	
By:	R. Kline	Date:	June 5, 2008	Subject:	Laboratory 1	Testing	
Checke	ed By: J. Turr	ner Date:	June 13, 2008	<u> </u>	Hydrometer A	Analysis	

Boring Number: B-20 Sample Number: S-4 Sample Depth: 7-9'

Sample Description: Gray-brown fine to medium SAND and non-plastic SILT

Calculation for Percent of Soil in Suspension: P = (R*a/W)*100

P = percent of soil in suspension at the level of the hydrometer, i.e. percent smaller diameter

R = Hydrometer reading with composite correction

a = correction factor for specific gravity of soil solids other than 2.65

Calculation for Particle Diameter: $D = K (L/T)^{0.5}$ D = particle diameter, mm T = time, min.

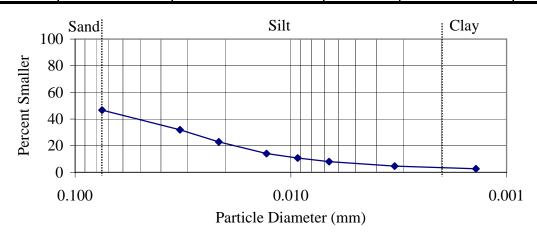
L = distance from the suspension surface to the level at which the density of the suspension is measured, cm

K = constant depending on the temperature of the suspension and the specific gravity of the soil particles. Values of K for a range of temperatures and specific gravities are given in Table 3 of ASTM D-422

The value of K does not change for a series of readings constituting a test, while values of L and T do vary.

Test Constants: Hydrometer Type: 152H
Reading of Hydrometer in Solution Only (g/l): 3.0 Temperature of Solution (°C) 21.7
Specific Gravity of Soil Solids (Assumed): 2.65 a: 1.00
Dry Soil Weight, W (g): 74.4 K: 0.013373

Time (min)	Reading (g/l)	Corrected Reading (g/l)	┙	Diameter (mm)	n) % in suspension	
	Data from Si	ieve Analysis		0.0750	46.7	
2	26.75	23.75	11.91	0.0326	31.9	
5	20	17	13.02	0.0216	22.8	
15	13.5	10.5	14.09	0.0130	14.1	
30	11	8	14.50	0.0093	10.8	
60	9	6	14.82	0.0066	8.1	
250	6.5	3.5	15.23	0.0033	4.7	
1440	5	2	15.48	0.0014	2.7	



Copyright © 2008 Stephens Associates Consulting Engineers LLC
Revisions:

By: Date: ______ Date:



Project: Number: 026-08-007 Sheet 1 of MWRA Contract No. 6905, Pipeline Name: Original Work: Rte. 1, Saugus, MA R. Kline Permeability Estimate by Date: June 4, 2008 Subject: Checked By: J. Turner Date: June 13, 2008 Kozeny-Carman Formula

Boring Number: **B-20** Sample Number: **S-4** Sample Depth: **7-9**'

According to References 1 and 3, (Note: Reference List at end of data sheets) Permeability may be estimated as $k = (\gamma/\mu)(1/C_{K-C})(1/S^2)[e^3/(1+e)]$

 γ = assumed unit weight of water in situ, lb/ft³ = 62.4 = 9800 N/m³ μ = viscosity of water, Ns/m² = 0.00131 at 10 °C

 C_{K-C} = Kozeny-Carman empirical coefficient; reported as 4.8±0.3, usually taken as 5, =

S = specific surface area per unit volume of particles = $SF^*\Sigma((P_{No D}-P_{No d})/d)$

 $P_{No D}$ = percentage by weight smaller than size D

 P_{Nod} = percentage by weight larger than the next size d

 D_{eq} = equivalent grain size for particles smaller than D_{min} of gradation = $D_{min}/3^{0.5}$

SF = Shape Factor for particle angularity = 7.5

SF = 6.6 for rounded particles; 7.5 for medium angularity; 8.4 for angular (after Loudon, presented in Ref. 1)

thus, Permeability, may be estimated as $k = (\gamma/\mu)(1/C_{K-C})\{1/\Sigma[(P_{N_0,D}-P_{N_0,d})/d]\}^2(1/SF^2)[e^3/(1+e)]$, Table 1 below

Further, according Ref. 2, measured permeability typically varies from 1/3 to 3 times the estimated permeability. The references also note that this method may overpredict permeability when soil is gravel, and the results present an upper bound. The formula is not suitable for plastic soils.

	TABLE 1 - SUM OF (P _{No D} - P _{No d})/d							
Sieve De	signation	Nominal Sieve	Percent	(P _{NoD} -P _{Nod})/ d				
Standard	Alternate	Opening (cm) Passing		(1/cm)				
12.5 mm	1/2"	1.250 100.0		0.0				
9.5	3/8"	0.950	97.5	2.6				
4.75 mm	No. 4	0.475	93.2	9.1				
2.00 mm	No. 10	0.200	86.5	33.5				
1.18 mm	No. 16	0.118	83.0	29.8				
600 µm	No. 30	0.060	78.3	77.6				
300 µm	No. 50	0.030	71.7	219.4				
250 µm	No. 60	0.025	69.8	77.2				
150 µm	No. 100	0.015	61.7	537.3				
75 µm	No. 200	0.008	46.7	2012.9				
		0.00326	31.9	4525.0				
		0.00216	22.8	4213.0				
		0.00130	14.1	6692.3				
Hydro	meter	0.00093	10.8	3548.4				
		0.00066	8.1	4090.9				
		0.00033	4.7	10303.0				
		0.00014	2.7	14285.7				
D _{eq}		0.00008	0.0	33403.8				
	Sum: 84061.5							

Estimate Void Ratio (e) from Relative Density (Ref. 4)

 $D_r^2 = (N_1)60/C_P C_A C_{OCR}$

 $(N_1)60=$ 95 $C_P=60+25logD_{50}=$ 33.7 $D_{50}=$ 0.09 mm $C_A=1.2+0.05log(t/100)=$ 1.19 t(yr)= 70 $C_{OCR}=OCR^{0.18}=$ 1 $D_r=$ 1.53687 >1, use 1.0

 $e_{max} = 0.85$ $e = e_{max} - (D_r)(e_{max} - e_{min})$ $e_{min} = 0.14$ e = 0.14

thus, range of permeability is estimated as:

Estimated range of k (cm/s)						
Probable Probable						
measured	Calculated	measured				
lower bnd	Estimate	upper bnd				
3.0E-07	9.1E-07	2.7E-06				

Copyright © 2008 Stephens	Associates Consulting Engineers LLC
Revisions:	

 Stephens Associates
Consulting Engineers
Insightful Costsaving Solutions
for Buildings and
Infrastructure
Hydrology & Hydraulics

Original Work:

R. Kline June 6, 2008 By: Date: Subject: **Laboratory Testing**

Rte. 1, Saugus, MA

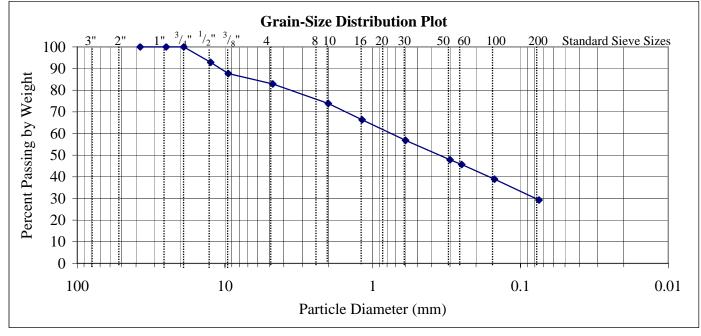
Checked By: J. Turner Date: June 13, 2008 Grain Size Distribution

Boring Number: Sample Number: S-2 B-21 Sample Depth: 3-5'

Sample Description: Gray-brown fine to medium SAND, some Silt, little Gravel

Sieve De	signation	Nominal Sig	eve Opening	Tare Weight	Sieve+Soil Wt.	Soil Weight (g)	Percent
Standard	Alternate	mm	inches	(g)	(g)	Oon Weight (g)	Passing
37.5 mm	1-1/2"	37.5	1.476"	501.3	501.3	0.0	100.0
25.0 mm	1"	25	0.984"	502.5	502.5	0.0	100.0
19.0 mm	3/4"	19	0.748"	596	596	0.0	100.0
12.5 mm	1/2"	12.5	0.492"	607.2	617.1	9.9	92.9
9.5	3/8"	9.5	0.374"	565.2	572.4	7.2	87.7
4.75 mm	No. 4	4.75	0.187"	527.7	534.4	6.7	82.9
2.00 mm	No. 10	2	0.078"	450.8	463.3	12.5	73.9
1.18 mm	No. 16	1.18	0.0464"	401.2	411.7	10.5	66.3
600 µm	No. 30	0.6	0.0236"	410.5	423.7	13.2	56.8
300 µm	No. 50	0.3	.0118"	416.8	429.3	12.5	47.8
250 µm	No. 60	0.25	0.0098"	339.9	342.9	3.0	45.7
150 µm	No. 100	0.15	0.0059"	303.7	313.1	9.4	38.9
75 µm	No. 200	0.075	0.0029"	301.6	315.0	13.4	29.3
Pan				340.4	381.1	40.7	0.0
				Sc	oil Wt. Sum (a):	139	

Soii vvt. Sum (g):



 $D_{10} =$ N/A mm Cu = N/A $D_{30} =$ 0.075 mm Cc = N/A

 $D_{60} =$ USCS Classification = 0.75 mm SM

Copyright © 2008 Stephens Associates Consulting Engineers LLC

Revisions:



Original Work:

R. Kline June 9, 2008 By: Date: Subject: **Laboratory Testing**

Rte. 1, Saugus, MA

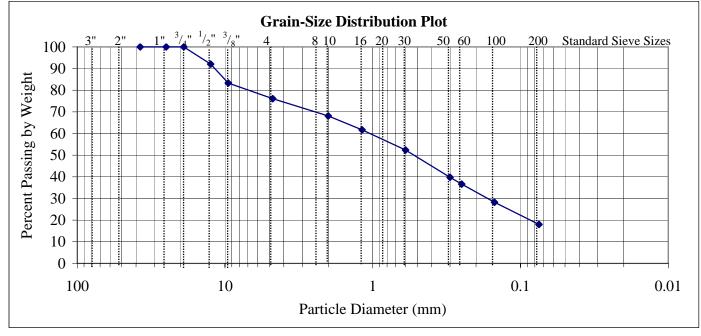
Checked By: J. Turner Date: June 13, 2008 Grain Size Distribution

Boring Number: Sample Number: S-1 Sample Depth: 1-3' Bottom 11" B-22

Sample Description: Gray fine to medium SAND, some Gravel, little Silt

Sieve De		Nominal Signal	eve Opening	Tare Weight	Sieve+Soil Wt.	Soil Weight (g)	Percent
Standard	Alternate	mm	inches	(g)	(g)	Oon Weight (g)	Passing
37.5 mm	1-1/2"	37.5	1.476"	501.3	501.3	0.0	100.0
25.0 mm	1"	25	0.984"	502.5	502.5	0.0	100.0
19.0 mm	3/4"	19	0.748"	595.8	595.8	0.0	100.0
12.5 mm	1/2"	12.5	0.492"	607.6	618.7	11.1	92.0
9.5	3/8"	9.5	0.374"	565.3	577.5	12.2	83.3
4.75 mm	No. 4	4.75	0.187"	527.7	537.8	10.1	76.1
2.00 mm	No. 10	2	0.078"	450.8	461.9	11.1	68.1
1.18 mm	No. 16	1.18	0.0464"	401.2	410.2	9.0	61.7
600 µm	No. 30	0.6	0.0236"	410.3	423.3	13.0	52.4
300 µm	No. 50	0.3	.0118"	416.6	434.2	17.6	39.8
250 µm	No. 60	0.25	0.0098"	340.0	344.4	4.4	36.6
150 µm	No. 100	0.15	0.0059"	303.7	315.4	11.7	28.2
75 µm	No. 200	0.075	0.0029"	301.6	315.9	14.3	18.0
Pan				340.4	365.5	25.1	0.0
				_	l bil Wt. Sum (a):	139.6	

Soil VVt. Sum (g):



 $D_{10} =$ N/A mm Cu = N/A $D_{30} =$ 0.175 mm Cc = N/A

 $D_{60} =$ USCS Classification = 1.1 mm SM

Copyright © 2008 Stephens Associates Consulting Engineers LLC

Revisions:



 Project:
 Number:
 026-08-007
 Sheet
 1
 of
 1

 Name:
 MWRA Contract No. 6905, Pipeline

Original Work:

By: R. Kline Date: June 5, 2008 Subject: Checked By: J. Turner Date: June 13, 2008

Laboratory Testing
Grain Size Distribution

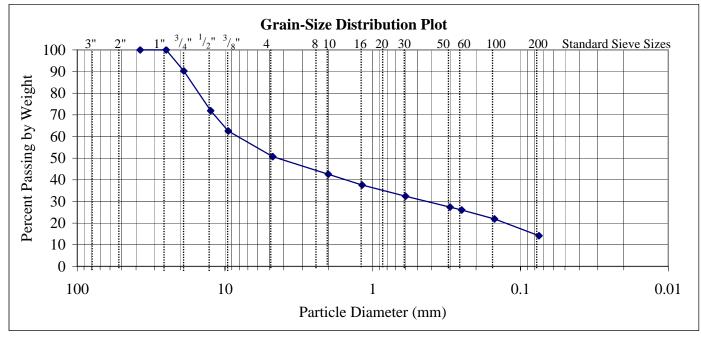
Rte. 1, Saugus, MA

Boring Number: B-22 Sample Number: S-3 Sample Depth: 5-7'

Sample Description: Gray-brown fine to medium SAND and GRAVEL, little Silt

Sieve De	signation	Nominal Sign	eve Opening	Tare Weight	Sieve+Soil Wt.	Soil Weight (g)	Percent
Standard	Alternate	mm	inches	(g)	(g)	Con Weight (g)	Passing
37.5 mm	1-1/2"	37.5	1.476"	501.3	501.3	0.0	100.0
25.0 mm	1"	25	0.984"	502.7	502.7	0.0	100.0
19.0 mm	3/4"	19	0.748"	596	612.2	16.2	90.3
12.5 mm	1/2"	12.5	0.492"	607.8	638.4	30.6	71.9
9.5	3/8"	9.5	0.374"	565.4	581.0	15.6	62.5
4.75 mm	No. 4	4.75	0.187"	527.9	547.6	19.7	50.7
2.00 mm	No. 10	2	0.078"	451.1	464.7	13.6	42.6
1.18 mm	No. 16	1.18	0.0464"	401.4	409.7	8.3	37.6
600 µm	No. 30	0.6	0.0236"	410.6	419.2	8.6	32.4
300 µm	No. 50	0.3	.0118"	416.9	425.3	8.4	27.4
250 µm	No. 60	0.25	0.0098"	340.1	342.3	2.2	26.1
150 µm	No. 100	0.15	0.0059"	303.8	310.7	6.9	21.9
75 µm	No. 200	0.075	0.0029"	301.8	314.7	12.9	14.2
Pan				340.5	364.1	23.6	0.0
				90	il Wt. Sum (a):	166.6	-

Soil Wt. Sum (g): 166.6



 $D_{10} = N/A$ mm Cu = N/A $D_{30} = 0.41$ mm Cc = N/A

 $D_{60} = 8.05$ mm USCS Classification = SM

 ${\it Copyright} \ @ \ 2008 \ {\it Stephens Associates Consulting Engineers LLC}$

Revisions:

By: _____ Date: _____ Date: _____



Project: Number: 026-08-007 Sheet MWRA Contract No. 6905, Pipeline Name: Original Work: Rte. 1, Saugus, MA R. Kline Permeability Estimate by Date: June 5, 2008 Subject: Checked By: J. Turner Date: June 13, 2008 Kozeny-Carman Formula

Boring Number: B-22 Sample Number: S-3 Sample Depth: 5-7'

According to References 1 and 3, (Note: Reference List at end of data sheets) Permeability may be estimated as $k = (\gamma/\mu)(1/C_{K-C})(1/S^2)[e^3/(1+e)]$

 γ = assumed unit weight of water in situ, lb/ft³ = 62.4 = 9800 N/m³ μ = viscosity of water, Ns/m² = 0.00131 at 10 °C

 C_{K-C} = Kozeny-Carman empirical coefficient; reported as 4.8±0.3, usually taken as 5, =

S = specific surface area per unit volume of particles = $SF^*\Sigma((P_{No D}-P_{No d})/d)$

 $P_{No D}$ = percentage by weight smaller than size D

 P_{Nod} = percentage by weight larger than the next size d

 D_{eq} = equivalent grain size for particles smaller than D_{min} of gradation = $D_{min}/3^{0.5}$

SF = Shape Factor for particle angularity = 7.5

SF = 6.6 for rounded particles; 7.5 for medium angularity; 8.4 for angular (after Loudon, presented in Ref. 1)

thus, Permeability, may be estimated as $k = (\gamma/\mu)(1/C_{K-C})\{1/\Sigma[(P_{N_0,D}-P_{N_0,d})/d]\}^2(1/SF^2)[e^3/(1+e)]$, Table 1 below

Further, according Ref. 2, measured permeability typically varies from 1/3 to 3 times the estimated permeability. The references also note that this method may overpredict permeability when soil is gravel, and the results present an upper bound. The formula is not suitable for plastic soils.

	TABL	E 1 - SUM OF (P	No D - P _{No d})/d		
Sieve De	signation	Nominal Sieve	Percent	(P _{NoD} -P _{Nod})/ d	
Standard	Alternate	Opening (cm)	Passing	(1/cm)	
37.5 mm	1-1/2"	3.750	100.0		
25.0 mm	1"	2.500	100.0	0.0	
19.0 mm	3/4"	1.900	90.3	5.1	
12.5 mm	1/2"	1.250	71.9	14.7	
9.5	3/8"	0.950	62.5	9.9	
4.75 mm	No. 4	0.475	50.7	24.9	
2.00 mm	No. 10	0.200	42.6	40.8	
1.18 mm	No. 16	0.118	37.6	42.2	
600 µm	No. 30	0.060	32.4	86.0	
300 µm	No. 50	0.030	27.4	168.1	
250 µm	No. 60	0.025	26.1	52.8	
150 µm	No. 100	0.015	21.9	276.1	
75 µm	No. 200	0.008	14.2	1032.4	
D_{eq}		0.004	0.0	3271.4	
•					
		•	Sum:	5024.5	

Estimate Void Ratio (e) from Relative Density (Ref. 4)

 $D_r^2 = (N_1)60/C_P C_A C_{OCR}$

 $(N_1)60=$ 78 $C_P=60+25logD_{50}=$ 76.3 $D_{50}=$ 4.5 mm $C_A=1.2+0.05log(t/100)=$ 1.19 t(yr)= 70 $C_{OCR}=OCR^{0.18}=$ 1 $D_r=$ 0.92579

 $e_{max} = 0.85$ $e = e_{max} - (D_r)(e_{max} - e_{min})$ $e_{min} = 0.14$ e = 0.19269

thus, range of permeability is estimated as:

Estimated range of k (cm/s)					
Probable		Probable			
measured	Calculated	measured			
lower bnd	Estimate	upper bnd			
2.1E-04	6.3E-04	1.9E-03			

Copyright © 2008 Stephens Associates Consulting Engineers LL	.C
--	----

Revisions:



Project:Number:026-08-007Sheet1of1Name:MWRA Contract No. 6905, Pipeline

Original Work:

By: R. Kline Date: June 5, 2008 Subject: Checked By: J. Turner Date: June 13, 2008

Laboratory Testing
Grain Size Distribution

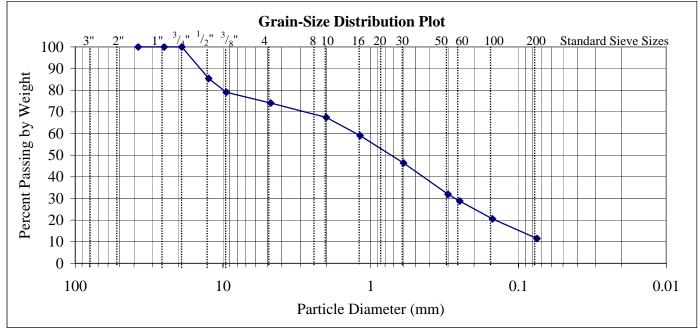
Rte. 1, Saugus, MA

Boring Number: B-23 Sample Number: S-2 Sample Depth: 3-5'

Sample Description: Gray-brown fine to medium SAND, some Gravel, little Silt

Sieve De	signation	Nominal Sie	eve Opening	Tare Weight	Sieve+Soil Wt.	Soil Weight (g)	Percent
Standard	Alternate	mm	inches	(g)	(g)	Con Worght (g)	Passing
37.5 mm	1-1/2"	37.5	1.476"	501.3	501.3	0.0	100.0
25.0 mm	1"	25	0.984"	502.5	502.5	0.0	100.0
19.0 mm	3/4"	19	0.748"	595.8	595.8	0.0	100.0
12.5 mm	1/2"	12.5	0.492"	607.6	621.9	14.3	85.5
9.5	3/8"	9.5	0.374"	565.2	571.5	6.3	79.0
4.75 mm	No. 4	4.75	0.187"	527.8	532.7	4.9	74.1
2.00 mm	No. 10	2	0.078"	450.9	457.4	6.5	67.4
1.18 mm	No. 16	1.18	0.0464"	401.2	409.5	8.3	59.0
600 µm	No. 30	0.6	0.0236"	410.4	422.8	12.4	46.4
300 µm	No. 50	0.3	.0118"	416.6	430.8	14.2	31.9
250 µm	No. 60	0.25	0.0098"	339.9	343.0	3.1	28.8
150 µm	No. 100	0.15	0.0059"	303.7	311.8	8.1	20.5
75 µm	No. 200	0.075	0.0029"	301.7	310.6	8.9	11.5
Pan				340.4	351.7	11.3	0.0
			•	C	oil Wt Sum (a):	08.3	·

Soil Wt. Sum (g): 98.3



 $D_{10} = N/A$ mm Cu = N/A $D_{30} = 0.265$ mm Cc = N/A

 $D_{60} = 1.25$ mm USCS Classification = SP-SM

Copyright © 2008 Stephens Associates Consulting Engineers LLC

Revisions:

By: Date: _______ Date: _______



 Project:
 Number:
 026-08-007
 Sheet
 1
 of
 1

 Name:
 MWRA Contract No. 6905, Pipeline

 Rte. 1, Saugus, MA

Original Work:

By: R. Kline Date: June 5, 2008 Subject: Checked By: J. Turner Date: June 13, 2008

Laboratory Testing
Grain Size Distribution

Checked By: J. Turner Date: June 13, 2008 Grain Size Distribution

Boring Number: B-23 Sample Number: S-4 Sample Depth: 7-9' Bottom 6"

Sample Description: Light brown non-plastic SILT, some fine to medium Sand, little Gravel

	signation	Nominal Sie	eve Opening	Tare Weight	Sieve+Soil Wt.	Soil Weight (g)	Percent
Standard	Alternate	mm	inches	(g)	(g)	0 0 11 0 19 11 (9)	Passing
37.5 mm	1-1/2"	37.5	1.476"	501.3	501.3	0.0	100.0
25.0 mm	1"	25	0.984"	502.5	502.5	0.0	100.0
19.0 mm	3/4"	19	0.748"	595.8	595.8	0.0	100.0
12.5 mm	1/2"	12.5	0.492"	607.5	607.5	0.0	100.0
9.5	3/8"	9.5	0.374"	565.1	567.6	2.5	96.3
4.75 mm	No. 4	4.75	0.187"	527.6	537.0	9.4	82.5
2.00 mm	No. 10	2	0.078"	450.8	454.9	4.1	76.5
1.18 mm	No. 16	1.18	0.0464"	401.1	403.1	2.0	73.6
600 µm	No. 30	0.6	0.0236"	410.3	412.8	2.5	69.9
300 µm	No. 50	0.3	.0118"	416.6	419.8	3.2	65.2
250 µm	No. 60	0.25	0.0098"	339.9	340.9	1.0	63.7
150 µm	No. 100	0.15	0.0059"	303.6	306.8	3.2	59.0
75 µm	No. 200	0.075	0.0029"	301.6	306.9	5.3	51.2
Pan				340.3	375.2	34.9	0.0
				Sc	<u>l</u> oil Wt. Sum (g):	68.1	

Grain-Size Distribution Plot 16 20 30 50 60 100 200 Standard Sieve Sizes 100 90 Percent Passing by Weight 80 70 60 50 *See Hydrometer 40 Test data for 30 particle sizes 20 smaller than 0.075 mm. 10 0 100 10 1 0.1 0.01 Particle Diameter (mm)

 ${\it Copyright} \ @ \ 2008 \ {\it Stephens Associates Consulting Engineers LLC}$

Revisions:

By: _____ Date: _____ Date: _____



		Project	: Number:	026-08-007	Sheet 1 of 1		
				Name:	MWRA Contract No	. 6905, Pipeline	
Origina	l Work:				Rte. 1, Sauç	gus, MA	
By:	R. Kline	Date:	June 9, 2008	Subject:	Laboratory	Testing	
Checke	ed By: J. Turr	ner Date:	June 13, 2008		Hydrometer	Analysis	

Boring Number: B-23 Sample Number: S-4 Sample Depth: 7-9' Bottom 6"

Sample Description: Light brown non-plastic SILT, some fine to medium Sand, little Gravel

Calculation for Percent of Soil in Suspension: P = (R*a/W)*100

P = percent of soil in suspension at the level of the hydrometer, i.e. percent smaller diameter

R = Hydrometer reading with composite correction

a = correction factor for specific gravity of soil solids other than 2.65

Calculation for Particle Diameter: $D = K (L/T)^{0.5}$ D = particle diameter, mm T = time, min.

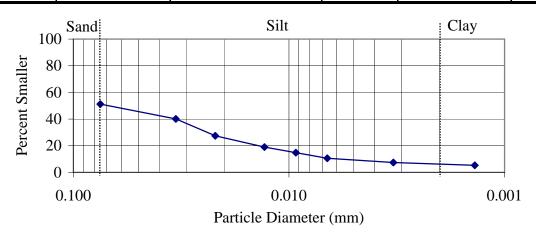
L = distance from the suspension surface to the level at which the density of the suspension is measured, cm

K = constant depending on the temperature of the suspension and the specific gravity of the soil particles. Values of K for a range of temperatures and specific gravities are given in Table 3 of ASTM D-422

The value of K does not change for a series of readings constituting a test, while values of L and T do vary.

Test Constants: Hydrometer Type: 152H
Reading of Hydrometer in Solution Only (g/l): 3.0 Temperature of Solution (°C) 22.2
Specific Gravity of Soil Solids (Assumed): 2.65 a: 1.00
Dry Soil Weight, W (g): 47.4 K: 0.013287

Time (min)	Reading (g/l)	Corrected Reading (g/l) L		Diameter (mm)	% in suspension
	Data from Si	0.0750	51.2		
2	22	19	12.69	0.0335	40.1
5	16	13	13.68	0.0220	27.4
15	12	9	14.33	0.0130	19.0
30	10	7	14.66	0.0093	14.8
60	8	5	14.99	0.0066	10.5
250	6.5	3.5	15.23	0.0033	7.4
1440	5.5	2.5	15.40	0.0014	5.3



Copyright © 2008 Stephens Associates Consulting Engineers LL	_C
Revisions:	



Project: Number: 026-08-007 Sheet 1 of MWRA Contract No. 6905, Pipeline Name: Original Work: Rte. 1, Saugus, MA R. Kline Permeability Estimate by Date: June 5, 2008 Subject: Checked By: J. Turner Date: June 13, 2008 Kozeny-Carman Formula

Boring Number: B-23 Sample Number: S-4 Sample Depth: 7-9' Bottom 6"

According to References 1 and 3, (Note: Reference List at end of data sheets) Permeability may be estimated as $k = (\gamma/\mu)(1/C_{K-C})(1/S^2)[e^3/(1+e)]$

 γ = assumed unit weight of water in situ, lb/ft³ = 62.4 = 9800 N/m³ μ = viscosity of water, Ns/m² = 0.00131 at 10 °C

 C_{K-C} = Kozeny-Carman empirical coefficient; reported as 4.8±0.3, usually taken as 5, =

S = specific surface area per unit volume of particles = $SF^*\Sigma((P_{No D}-P_{No d})/d)$

 $P_{No D}$ = percentage by weight smaller than size D

 $P_{No d}$ = percentage by weight larger than the next size d

 D_{eq} = equivalent grain size for particles smaller than D_{min} of gradation = $D_{min}/3^{0.5}$

SF = Shape Factor for particle angularity = 7.5

SF = 6.6 for rounded particles; 7.5 for medium angularity; 8.4 for angular (after Loudon, presented in Ref. 1)

thus, Permeability, may be estimated as $k = (\gamma/\mu)(1/C_{K-C})\{1/\Sigma[(P_{N_0,D}-P_{N_0,d})/d]\}^2(1/SF^2)[e^3/(1+e)]$, Table 1 below

Further, according Ref. 2, measured permeability typically varies from 1/3 to 3 times the estimated permeability. The references also note that this method may overpredict permeability when soil is gravel, and the results present an upper bound. The formula is not suitable for plastic soils.

	TABLE 1 - SUM OF (P _{No D} - P _{No d})/d							
Sieve De	signation	Nominal Sieve	Percent	(P _{NoD} -P _{Nod})/ d				
Standard	Alternate	Opening (cm)	Passing	(1/cm)				
12.5 mm	1/2"	1.250	100.0	0.0				
9.5	3/8"	0.950	96.3	3.9				
4.75 mm	No. 4	0.475	82.5	29.1				
2.00 mm	No. 10	0.200	76.5	30.1				
1.18 mm	No. 16	0.118	73.6	24.9				
600 µm	No. 30	0.060	69.9	61.2				
300 µm	No. 50	0.030	65.2	156.6				
250 µm	No. 60	0.025	63.7	58.7				
150 µm	No. 100	0.015	59.0	313.3				
75 µm	No. 200	0.008	51.2	1037.7				
		0.00335	40.1	3327.8				
		0.00220	27.4	5772.7				
		0.00130	19.0	6461.5				
Hydro	meter	0.00093	14.8	4516.1				
		0.00066	10.5	6515.2				
		0.00033	7.4	9393.9				
		0.00014	5.3	15000.0				
D_{eq}		0.00008	0.0	65570.5				
	_		Sum:	118273.2				

Estimate Void Ratio (e) from Relative Density (Ref. 4)

 $D_r^2 = (N_1)60/C_P C_A C_{OCR}$

 $(N_1)60=$ 59 $C_P=60+25logD_{50}=$ 31 $D_{50}=$ 0.07 mm $C_A=1.2+0.05log(t/100)=$ 1.19 t(yr)= 70 $C_{OCR}=OCR^{0.18}=$ 1 $D_r=$ 1.26404 >1, use 1.0

 $e=e_{max}-(D_r)(e_{max}-e_{min})$ $e_{min}=0.25$ e=0.25

thus, range of permeability is estimated as:

Estimated range of k (cm/s)					
Probable		Probable			
measured	Calculated	measured			
lower bnd	Estimate	upper bnd			
7.9E-07	2.4E-06	7.1E-06			

Copyright © 2008 Stephens As	ssociates Consulting Engineers LLC
Revisions:	

By: Date:

Date:



Project:Number:026-08-007Sheet1of1Name:MWRA Contract No. 6905, Pipeline

Original Work:

By: R. Kline Date: June 5, 2008 Subject: Checked By: J. Turner Date: June 13, 2008

Laboratory Testing
Grain Size Distribution

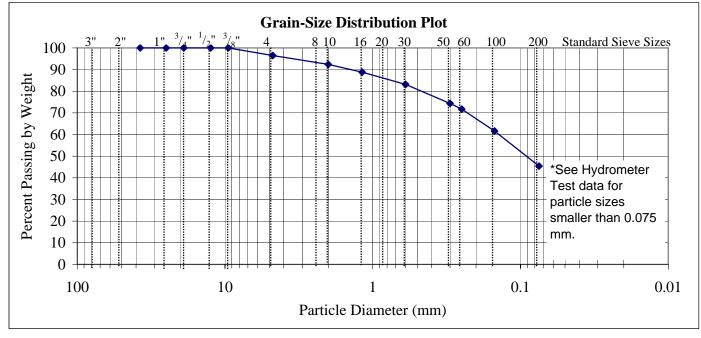
Rte. 1, Saugus, MA

Boring Number: B-24 Sample Number: S-3 Sample Depth: 5-7'

Sample Description: Light brown fine to medium SAND and non-plastic SILT

Sieve De	signation	Nominal Sign	eve Opening	Tare Weight	Sieve+Soil Wt.	Soil Weight (g)	Percent
Standard	Alternate	mm	inches	(g)	(g)	Con Woight (g)	Passing
37.5 mm	1-1/2"	37.5	1.476"	501.3	501.3	0.0	100.0
25.0 mm	1"	25	0.984"	502.5	502.5	0.0	100.0
19.0 mm	3/4"	19	0.748"	595.8	595.8	0.0	100.0
12.5 mm	1/2"	12.5	0.492"	607.5	607.5	0.0	100.0
9.5	3/8"	9.5	0.374"	565.1	565.1	0.0	100.0
4.75 mm	No. 4	4.75	0.187"	527.6	531.2	3.6	96.5
2.00 mm	No. 10	2	0.078"	450.8	455.0	4.2	92.4
1.18 mm	No. 16	1.18	0.0464"	401.1	404.8	3.7	88.8
600 µm	No. 30	0.6	0.0236"	410.3	416.1	5.8	83.1
300 µm	No. 50	0.3	.0118"	416.6	425.6	9.0	74.4
250 µm	No. 60	0.25	0.0098"	339.9	342.6	2.7	71.7
150 µm	No. 100	0.15	0.0059"	303.6	314.0	10.4	61.6
75 µm	No. 200	0.075	0.0029"	301.6	318.2	16.6	45.4
Pan				340.3	386.9	46.6	0.0
				90	oil Wt. Sum (a):	102.6	

Soil Wt. Sum (g): 102.6



 $D_{10} = N/A$ mm Cu = N/A $D_{30} = N/A$ mm Cc = N/A

 $D_{60} = 0.15$ mm USCS Classification = SM

Copyright © 2008 Stephens Associates Consulting Engineers LLC

Revisions:

By: _____ Date: _____ Date: _____



Project:		Project	: Number:	026-08-007 SI		1	of	1	
		Name:	MWRA Contract No. 69	05, Pipelii	ne				
Origina	al Work:				Rte. 1, Saugus,	MA			
Ву:	R. Kline	Date:	June 9, 2008	Subject:	Laboratory Tes	sting			
Checke	ed By: J. Turr	ner Date:	June 13, 2008		Hydrometer Ana	alysis			

Boring Number: B-24 Sample Number: S-3 Sample Depth: 5-7'

Sample Description: Light brown fine to medium SAND and non-plastic SILT

Calculation for Percent of Soil in Suspension: P = (R*a/W)*100

P = percent of soil in suspension at the level of the hydrometer, i.e. percent smaller diameter

R = Hydrometer reading with composite correction

a = correction factor for specific gravity of soil solids other than 2.65

Calculation for Particle Diameter: $D = K (L/T)^{0.5}$ D = particle diameter, mm T = time, min.

L = distance from the suspension surface to the level at which the density of the suspension is measured, cm

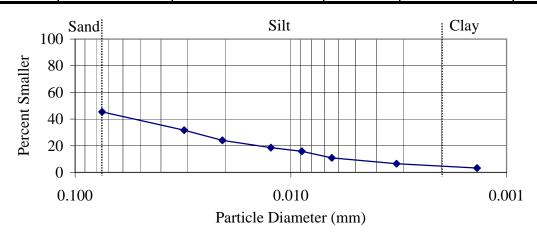
K = constant depending on the temperature of the suspension and the specific gravity of the soil particles.

Values of K for a range of temperatures and specific gravities are given in Table 3 of ASTM D-422

The value of K does not change for a series of readings constituting a test, while values of L and T do vary.

Test Constants: Hydrometer Type: 152H
Reading of Hydrometer in Solution Only (g/l): 3.0 Temperature of Solution (°C) 22.2
Specific Gravity of Soil Solids (Assumed): 2.65 a: 1.00
Dry Soil Weight, W (g): 91.5 K: 0.013287

Time (min)	Reading (g/l)	Corrected Reading (g/l) L		Diameter (mm)	% in suspension
	Data from Si	0.0750	45.4		
2	32	29	11.05	0.0312	31.7
5	25	22	12.20	0.0208	24.0
15	20	17	13.02	0.0124	18.6
30	17.5	14.5	13.43	0.0089	15.8
60	13	10	14.17	0.0065	10.9
250	9	6	14.82	0.0032	6.6
1440	6	3	15.32	0.0014	3.3



Copyright © 2008 Stephens Associates Consulting Engineers LL	С
Revisions:	

By: Date: ______Date: _____



Project: Number: 026-08-007 Sheet 1 of MWRA Contract No. 6905, Pipeline Name: Original Work: Rte. 1, Saugus, MA R. Kline Permeability Estimate by Date: June 5, 2008 Subject: Checked By: J. Turner Date: June 13, 2008 Kozeny-Carman Formula

Boring Number: **B-24** Sample Number: **S-3** Sample Depth: **5-7'**

According to References 1 and 3, (Note: Reference List at end of data sheets) Permeability may be estimated as $k = (\gamma/\mu)(1/C_{K-C})(1/S^2)[e^3/(1+e)]$

 γ = assumed unit weight of water in situ, lb/ft³ = 62.4 = 9800 N/m³ μ = viscosity of water, Ns/m² = 0.00131 at 10 °C

 C_{K-C} = Kozeny-Carman empirical coefficient; reported as 4.8±0.3, usually taken as 5, =

S = specific surface area per unit volume of particles = $SF^*\Sigma((P_{No D}-P_{No d})/d)$

 $P_{No D}$ = percentage by weight smaller than size D

 $P_{No d}$ = percentage by weight larger than the next size d

 D_{eq} = equivalent grain size for particles smaller than D_{min} of gradation = $D_{min}/3^{0.5}$

SF = Shape Factor for particle angularity = 7.5

SF = 6.6 for rounded particles; 7.5 for medium angularity; 8.4 for angular (after Loudon, presented in Ref. 1)

thus, Permeability, may be estimated as $k = (\gamma/\mu)(1/C_{K-C})\{1/\Sigma[(P_{N_0,D}-P_{N_0,d})/d]\}^2(1/SF^2)[e^3/(1+e)]$, Table 1 below

Further, according Ref. 2, measured permeability typically varies from 1/3 to 3 times the estimated permeability. The references also note that this method may overpredict permeability when soil is gravel, and the results present an upper bound. The formula is not suitable for plastic soils.

	TABLE 1 - SUM OF (P _{No D} - P _{No d})/d							
Sieve De	signation	Nominal Sieve	Percent	(P _{NoD} -P _{Nod})/ d				
Standard	Alternate	Opening (cm)	Passing	(1/cm)				
9.5	3/8"	0.950	100.0	0.0				
4.75 mm	No. 4	0.475	96.5	7.4				
2.00 mm	No. 10	0.200	92.4	20.5				
1.18 mm	No. 16	0.118	88.8	30.6				
600 µm	No. 30	0.060	83.1	94.2				
300 µm	No. 50	0.030	74.4	292.4				
250 µm	No. 60	0.025	71.7	105.3				
150 µm	No. 100	0.015	61.6	675.8				
75 µm	No. 200	0.008	45.4	2157.2				
			31.7	4397.1				
		0.00208	24.0	3701.9				
		0.00124	18.6	4354.8				
Hydro	meter	0.00089	15.8					
			0.00065 10.9					
		0.00032	6.6	13437.5				
		0.00014	3.3	23571.4				
D_{eq}		0.00008	0.0	40826.9				
			Sum:	104357.6				

Estimate Void Ratio (e) from Relative Density (Ref. 4)

 $D_r^2 = (N_1)60/C_P C_A C_{OCR}$

 $(N_1)60=$ 122 $C_P=60+25logD_{50}=$ 33.9 $D_{50}=$ 0.09 mm $C_A=1.2+0.05log(t/100)=$ 1.19 t(yr)= 70 $C_{OCR}=OCR^{0.18}=$ 1 $D_r=$ 1.73851 >1, use 1.0

 $e_{max} = 0.85$ $e = e_{max} - (D_r)(e_{max} - e_{min})$ $e_{min} = 0.14$ e = 0.14

thus, range of permeability is estimated as:

Estimated range of k (cm/s)					
Probable	Probable				
measured	easured Calculated				
lower bnd	Estimate	upper bnd			
2.0E-07	5.9E-07	1.8E-06			

Copyright © 2008 Stephens As	ssociates Consulting Engineers LLC
Revisions:	

By:______Date: _____

__Date: ____



Project:Number:026-08-007Sheet1of1Name:MWRA Contract No. 6905, Pipeline

Original Work:

By: R. Kline Date: June 5, 2008 Subject:

Laboratory Testing

Rte. 1, Saugus, MA

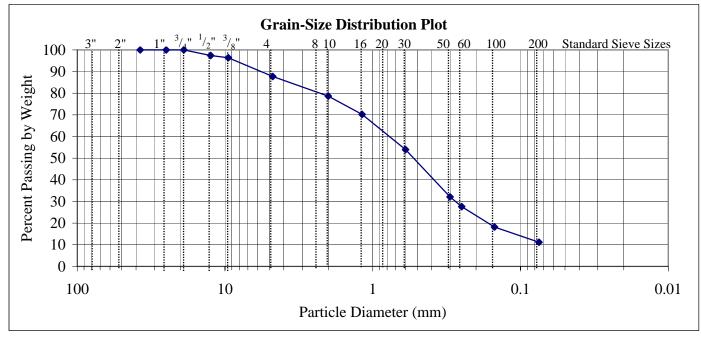
Checked By: J. Turner Date: June 13, 2008 Grain Size Distribution

Boring Number: B-25 Sample Number: S-1 Sample Depth: 1-3' Bottom 11"

Sample Description: Brown fine to medium SAND, little Gravel, little Silt

Sieve De			eve Opening	Tare Weight	Sieve+Soil Wt.	Soil Weight (g)	Percent
Standard	Alternate	mm	inches	(g)	(g)	0 (0)	Passing
37.5 mm	1-1/2"	37.5	1.476"	501.3	501.3	0.0	100.0
25.0 mm	1"	25	0.984"	502.5	502.5	0.0	100.0
19.0 mm	3/4"	19	0.748"	595.7	595.7	0.0	100.0
12.5 mm	1/2"	12.5	0.492"	607.7	613.1	5.4	97.4
9.5	3/8"	9.5	0.374"	565.4	567.5	2.1	96.4
4.75 mm	No. 4	4.75	0.187"	527.9	545.9	18.0	87.7
2.00 mm	No. 10	2	0.078"	451.1	470.0	18.9	78.6
1.18 mm	No. 16	1.18	0.0464"	401.4	418.9	17.5	70.2
600 µm	No. 30	0.6	0.0236"	410.6	444.4	33.8	53.9
300 µm	No. 50	0.3	.0118"	416.9	462.3	45.4	32.1
250 µm	No. 60	0.25	0.0098"	340.2	349.5	9.3	27.6
150 µm	No. 100	0.15	0.0059"	303.8	323.4	19.6	18.2
75 µm	No. 200	0.075	0.0029"	301.9	316.5	14.6	11.2
Pan				340.4	363.6	23.2	0.0
					il Wt Sum (a):	207.8	

Soil Wt. Sum (g): 207.8



 $D_{60} = 0.76$ mm USCS Classification = SW-SM

Copyright © 2008 Stephens Associates Consulting Engineers LLC

Revisions:

By: _____ Date: _____ Date: _____



Project: Number: 026-08-007 Sheet 1 of Name: MWRA Contract No. 6905, Pipeline

Original Work:

R. Kline June 5, 2008 By: Date: Subject: Checked By: J. Turner Date: June 13, 2008

Rte. 1, Saugus, MA **Laboratory Testing**

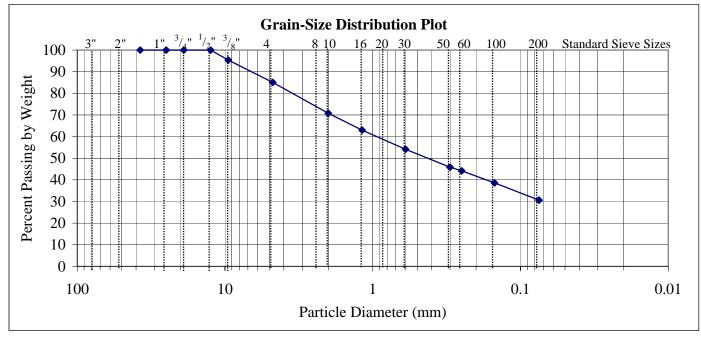
Grain Size Distribution

Boring Number: Sample Number: S-3 Sample Depth: 5-7' Bottom 4" B-25

Sample Description: Brown fine to coarse SAND, some Silt, little Gravel

Sieve De	signation	Nominal Sie	eve Opening	Tare Weight	Sieve+Soil Wt.	Soil Weight (g)	Percent	
Standard	Alternate	mm	inches	(g)	(g)	Ooli Weight (g)	Passing	
37.5 mm	1-1/2"	37.5	1.476"	501.3	501.3	0.0	100.0	
25.0 mm	1"	25	0.984"	502.5	502.5	0.0	100.0	
19.0 mm	3/4"	19	0.748"	595.8	595.8	0.0	100.0	
12.5 mm	1/2"	12.5	0.492"	607.7	607.7	0.0	100.0	
9.5	3/8"	9.5	0.374"	565.4	570.3	4.9	95.4	
4.75 mm	No. 4	4.75	0.187"	527.9	538.9	11.0	85.1	
2.00 mm	No. 10	2	0.078"	451.1	466.3	15.2	70.8	
1.18 mm	No. 16	1.18	0.0464"	401.4	409.7	8.3	63.0	
600 µm	No. 30	0.6	0.0236"	410.6	420.0	9.4	54.1	
300 µm	No. 50	0.3	.0118"	416.9	425.7	8.8	45.9	
250 µm	No. 60	0.25	0.0098"	340.2	342.0	1.8	44.2	
150 µm	No. 100	0.15	0.0059"	303.8	309.7	5.9	38.6	
75 µm	No. 200	0.075	0.0029"	301.9	310.4	8.5	30.6	
Pan				340.4	373.0	32.6	0.0	
				Sa	oil Mt Sum (a):	106.4	<u> </u>	

Soil Wt. Sum (g): 106.4



 $D_{10} =$ N/A mm Cu = N/A $D_{30} =$ N/A mm Cc = N/A

 $D_{60} =$ 0.95 USCS Classification = mm SM

Copyright © 2008 Stephens Associates Consulting Engineers LLC

Revisions:

By: Date: Date:



Project: Number: 026-08-007 Sheet MWRA Contract No. 6905, Pipeline Name: Original Work: Rte. 1, Saugus, MA R. Kline Permeability Estimate by Date: June 5, 2008 Subject: Checked By: J. Turner Date: June 13, 2008 Kozeny-Carman Formula

Boring Number: B-25 Sample Number: S-3 Sample Depth: 5-7' Bottom 4"

According to References 1 and 3, (Note: Reference List at end of data sheets) Permeability may be estimated as $k = (\gamma/\mu)(1/C_{K-C})(1/S^2)[e^3/(1+e)]$

 γ = assumed unit weight of water in situ, lb/ft³ = 62.4 = 9800 N/m³ μ = viscosity of water, Ns/m² = 0.00131 at 10 °C

 C_{K-C} = Kozeny-Carman empirical coefficient; reported as 4.8±0.3, usually taken as 5, =

S = specific surface area per unit volume of particles = $SF^*\Sigma((P_{No D}-P_{No d})/d)$

 $P_{No D}$ = percentage by weight smaller than size D

 P_{Nod} = percentage by weight larger than the next size d

 D_{eq} = equivalent grain size for particles smaller than D_{min} of gradation = $D_{min}/3^{0.5}$

SF = Shape Factor for particle angularity = 7.5

SF = 6.6 for rounded particles; 7.5 for medium angularity; 8.4 for angular (after Loudon, presented in Ref. 1)

thus, Permeability, may be estimated as $k = (\gamma/\mu)(1/C_{K-C})\{1/\Sigma[(P_{N_0,D}-P_{N_0,d})/d]\}^2(1/SF^2)[e^3/(1+e)]$, Table 1 below

Further, according Ref. 2, measured permeability typically varies from 1/3 to 3 times the estimated permeability. The references also note that this method may overpredict permeability when soil is gravel, and the results present an upper bound. The formula is not suitable for plastic soils.

TABLE 1 - SUM OF (P _{No D} - P _{No d})/d							
Sieve De	Sieve Designation		Percent	(P _{NoD} -P _{Nod})/ d			
Standard	Alternate	Opening (cm)	Passing	(1/cm)			
37.5 mm	1-1/2"	3.750	100.0				
25.0 mm	1"	2.500	100.0	0.0			
19.0 mm	3/4"	1.900	100.0	0.0			
12.5 mm	1/2"	1.250	100.0	0.0			
9.5	3/8"	0.950	95.4	4.8			
4.75 mm	No. 4	0.475	85.1	21.8			
2.00 mm	No. 10	0.200	70.8	71.4			
1.18 mm	No. 16	0.118	63.0	66.1			
600 µm	No. 30	0.060	54.1	147.2			
300 µm	No. 50	0.030	45.9	275.7			
250 µm	No. 60	0.025	44.2	67.7			
150 µm	No. 100	0.015	38.6	369.7			
75 µm	No. 200	0.008	30.6	1065.2			
D_{eq}		0.004	0.0	7075.8			
•							
		•	Sum:	9165.4			

Estimate Void Ratio (e) from Relative Density (Ref. 4)

 $D_r^2 = (N_1)60/C_P C_A C_{OCR}$

 $(N_1)60=$ 86 $C_P=60+25logD_{50}=$ 50.6 $D_{50}=$ 0.42 mm $C_A=1.2+0.05log(t/100)=$ 1.19 t(yr)= 70 $C_{OCR}=OCR^{U.18}=$ 1 $D_r=$ 1.19418 >1, use 1.0

 $e_{max} = 0.85$ $e = e_{max} - (D_r)(e_{max} - e_{min})$ $e_{min} = 0.14$ e = 0.14

thus, range of permeability is estimated as:

Estimated range of k (cm/s)					
Probable	Probable				
measured	easured Calculated				
lower bnd	Estimate	upper bnd			
2.5E-05	7.6E-05	2.3E-04			

Copyright © 2008 Stephens As	ssociates Consulting Engineers LLC
Revisions:	

By:______Date: _____

___Date: _____



		Name: MWRA Contract No.		
Original Work:			Rte. 1, Saugus,	
Ву:	Date:	Subject:	Permeability Estin	
Checked By:	Date:		Kozeny-Carman Formula	- References
Ref 1. Carrier III	, W.D. (2003), "Goodby	e, Hazen; Hello, Kozeny-C	arman," <i>Journal of Geotechnica</i>	al and
Geoenvironment	tal Egnineering, Vol. 129	9, No. 11, November 2003,	American Society of Civil Engi	neers
Ref 2 Aubertin	et al. (2005). Discussion	of "Goodbye Hazen: Hell	o, Kozeny-Carman," <i>Journal of</i>	Geotechnical and
			erican Society of Civil Engineers	
Geochvironinen	ar Egrinicening, voi. 13	1, 140. 0, August 2000, Alli	shear occiety of Givil Engineers	•
Def O Observie I	D.D. and Aubantin M. (2000) [Commonly Founding to De-	allat than I badanalla
			zeny-Carman's Equation to Pre	edict the Hydraulic
Conductivity of a	Soil, Canadian Geolec	chnical Journal, 40(3), 616-	020.	
			s for Foundation Design, Electri	c Power Research
Institute, prepare	ed by Cornell University,	Ithaca, NY, p <i>age 2-38.</i>		
Copyright © 2008 Steph	ens Associates Consulting Er	gineers LLC		Stephens Associates

Project: Number: ______ 026-08-007 ____ Sheet _ 1 _ of _ 1

APPENDIX D EXCAVATIONS



APPENDIX D - EXCAVATIONS

Stephens Associates Consulting Engineers, LLC (SA) is providing this information solely as a service to our Client. Under no circumstances should the information provided below be interpreted to mean that SA is assuming responsibility for construction site safety or the contractor's activities; such responsibility is not being implied and should not be inferred.

The Owner and the Contractor should make themselves aware of and become familiar with applicable local, state, and federal regulations, including, but not limited to, the current Occupational Safety and Health Administration Excavation and Trench Standards. In Federal Register, Volume 54, No. 209 (October 1989), the United States Department of Labor, Occupational Safety and Health Administration (**OSHA**) amended its "Construction Standards for Excavations, 29 CFR, Part 1926, Subpart P". This document was issued to reduce the risk of death or injury from collapse of trenches and excavations. This generally is the sole responsibility of the Contractor, who shall also be solely responsible for the means, methods, and sequencing of construction operations.

Excavations and Slopes

The Contractor is solely responsible for designing and constructing stable, temporary excavations and should shore, slope, or bench the sides of the excavations as required to maintain stability of the excavation sides and bottom. Slope height, slope inclination, or excavation depths (including utility trench excavations) should **in no case** exceed those specified in local, state, or federal safety regulations (e.g., OSHA Health and Safety Standards for Excavations, 29 CFR Part 1926, or successor regulations, etc.). The Owner and Contractor should be aware that such regulations are strictly enforced and, if they are not followed, could endanger worker and public health, safety and property, and be liable for substantial penalties.

The Contractor's responsible person, as defined in 29 CFR Part 1926, should evaluate the soil exposed in the excavations as part of the Contractor's safety procedures. The exposed slope face should be protected against the elements. If any excavation, including a utility trench, is extended to a depth of more than twenty (20) feet, it will be necessary to have the side slopes designed by a professional engineer registered in *the state where construction is occurring*. Vehicles and soil piles should be kept a minimum lateral distance from the crest of the slope equal to no less than 1.5 times the slope height.

Important note on Soil Variability

The soils to be excavated may vary significantly across the Site. Exploratory Borings performed as part of this Report indicate that near-surface soils are generally classified as Sand and Gravel based on ASTM D2488 – the Visual-Manual Procedure. This is considered Type C soil when applying the OSHA regulations. OSHA mandates that slope inclinations **not** exceed 1 ½: 1, horizontal: vertical, for Type C soils for excavations of 20 feet or less. Excavations should be evaluated by the Contractor's responsible person. Our preliminary soil classification is based solely on the our soil borings. The Contractor should verify that these soil conditions exist throughout the proposed area of excavation. The Contractor's responsible person, as defined in 29 CFR Part 1926, should evaluate the soil exposed in the excavations in accordance with OSHA requirements as part of the Contractor's regular procedures.

Temporary Shoring

Where excavations encroach on, or may undermine nearby structures, such as roadways and utilities, etc. or as an alternative to sloping, vertical excavations less than 20 feet in height can be temporarily shored. The Contractor or the Contractor's specialty subcontractor should be responsible for the design of the temporary shoring in accordance with applicable regulatory requirements and the Contract Documents.



026-08-007 Page D-2 of 2 7/25/08

Appendix C
Dilution Factor Calculations and Saugus River Data

Dilution Factor (DF) Calculations

The DF that was utilized in finding the appropriate DRCs was calculated as follows:

$$DF = (Qd + Qs)/Qd$$

Where: Qd is the maximum discharge flow rate

Qs is the receiving water flow rate (minimum for 7 consecutive days with a recurrence intercal of 10 years – 7Q10)

Note: Qs for the Saugus River was not available, therefore Qs was modified to represent the lowest flow over the 16 year period of available data for the Saugus River.

$$Qd = 210 \quad gpm$$

$$Coversion \quad 1.0 \quad gpm = 0.00223 \quad ft^{3}/s$$

$$210$$
 x 0.00223 = 0.4683 ft³/s

Therefore, Qd = 0.4683 ft³/s

Qs = 33.6 ft³/s (Average flow recorded over a 16 year period)

From: http://waterdata.usgs.gov/ma/nwis/uv?

$$DF = (Qd + Qs)/Qd = 72.75$$
 (See Table 1)

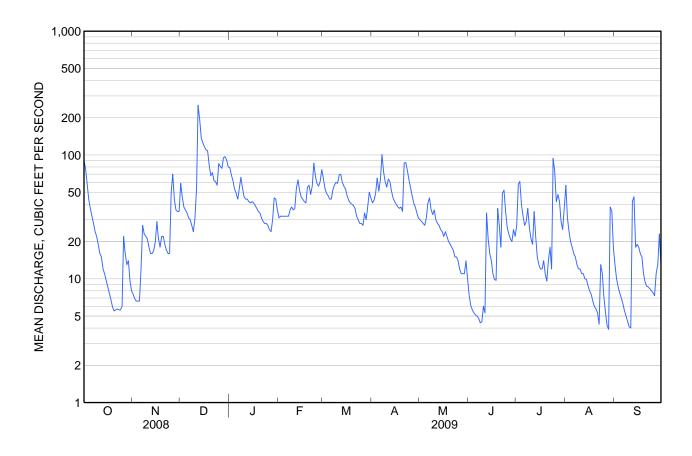
The calculated DF was then used to find the appropriate Dilution Range Concentrations (DRCs) contained in MAG91000, Appendix IV.

Water-Data Report 2009

01102345 SAUGUS RIVER AT SAUGUS IRONWORKS AT SAUGUS, MA—Continued

SUMMARY STATISTICS

·	Calendar Ye	ar 2008	Water Year	r 2009	Water Year	s 1994 - 2009
Annual total	15,979.6		12,508.5			
Annual mean	43.7		34.3		33.6	
Highest annual mean					56.5	2006
Lowest annual mean					14.5	2002
Highest daily mean	253	Dec 12	253	Dec 12	1,220	May 15, 2006
Lowest daily mean	3.6	Jul 19	3.9	Aug 28	0.50	Sep 5, 1999
Annual seven-day minimum	5.5	Jul 14	5.0	Jun 3	0.53	Aug 31, 1999
Maximum peak flow			319	Dec 12	1,420	May 14, 2006
Maximum peak stage			4.75	Dec 12	7.39	May 14, 2006
Instantaneous low flow			3.7	Aug 28	0.46	Sep 5, 1999
Annual runoff (cfsm)	2.10		1.65	C	1.61	•
Annual runoff (inches)	28.58		22.37		21.93	
10 percent exceeds	93		65		75	
50 percent exceeds	33		30		20	
90 percent exceeds	7.8		7.0		3.3	



Appendix D Material Safety Data Sheets



From: Mallinckrodt Baker, Inc. 222 Red School Lane Phillipsburg, NJ 08865



24 Hour Emergency Telephone: 908-859-2151 CHEMTREC: 1-800-424-9300

National Response in Canada CANUTEC: 613-996-6666

Outside U.S. And Canada Chemtrec: 703-527-3887

NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

All non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance

Calcium Hypochlorite

1. Product Identification

Synonyms: Hypochlorous Acid, Calcium Salt; Losantin; Calcium Hypochloride; Chlorinated lime

CAS No.: 7778-54-3 Molecular Weight: 142.98 Chemical Formula: CaCl2O2 Product Codes: 1378

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Calcium Hypochlorite	7778-54-3	100%	Yes

3. Hazards Identification

Emergency Overview

DANGER! STRONG OXIDIZER. CONTACT WITH OTHER MATERIAL MAY CAUSE FIRE. CORROSIVE. CAUSES BURNS TO ANY AREA OF CONTACT, HARMFUL IF SWALLOWED OR INHALED, WATER REACTIVE.

SAF-T-DATA^(tm) Ratings (Provided here for your convenience)

Health Rating: 2 - Moderate

Health Rating: 2 - Moderate Flammability Rating: 0 - None Reactivity Rating: 3 - Severe (Oxidizer) Contact Rating: 2 - Moderate

Lab Protective Equip: GOGGLES; LAB COAT; VENT HOOD; PROPER GLOVES

Storage Color Code: Yellow (Reactive)

Potential Health Effects

Inhalation:

Corrosive. Extremely destructive to tissues of the mucous membranes and upper respiratory tract. Symptoms may include burning sensation, coughing, wheezing, laryngitis, shortness of breath, headache, nausea and vomiting. Inhalation may be fatal as a result of spasm inflammation and edema of the larynx and bronchi, chemical pneumonitis and pulmonary edema.

Ingestion:

Corrosive. Swallowing can cause severe burns of the mouth, throat, and stomach. Can cause sore throat, vomiting, diarrhea.

Skin Contact:

Corrosive. Symptoms of redness, pain, and severe burn can occur.

Eye Contact:

Corrosive. Contact can cause blurred vision, redness, pain and severe tissue burns.

Chronic Exposure:

Repeated exposures to calcium hypochlorite may cause bronchitis to develop with cough and/or shortness of breath.

Aggravation of Pre-existing Conditions:

No information found.

4. First Aid Measures

Inhalation:

Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.

Ingestion:

If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. Get medical attention immediately.

Skin Contact:

Immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Get medical attention immediately. Wash clothing before reuse. Thoroughly clean shoes before reuse.

Eye Contact:

Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

5. Fire Fighting Measures

Fire:

Not combustible, but substance is a strong oxidizer and its heat of reaction with reducing agents or combustibles may cause ignition. Thermally unstable; at higher temperatures, may undergo accelerated decomposition with release of heat and oxygen.

Explosion:

Sealed containers may rupture when heated. An explosion can occur if either a carbon tetrachloride or a dry ammonium compound fire extinguisher is used to extinguish a fire involving calcium hypochlorite. Sensitive to mechanical impact.

Fire Extinguishing Media:

Use flooding quantities of water as fog or spray. Use water spray to keep fire-exposed containers cool. Avoid direct contact with water; reacts with water releasing chlorine gas. Fight fire from protected location or maximum possible distance. Do not use dry chemical fire extinguishers containing ammonium compounds. Do not use carbon tetrachloride fire extinguishers. Do not allow water runoff to enter sewers or waterways.

Special Information:

In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode.

6. Accidental Release Measures

Remove all sources of ignition. Keep water away from spilled material. Ventilate area of leak or spill. Wear appropriate personal protective equipment as specified in Section 8. Spills: Clean up spills in a manner that does not disperse dust into the air. Use non-sparking tools and equipment. Pick up spill for recovery or disposal and place in a closed container. Do not seal tightly.

7. Handling and Storage

Keep in a tightly closed container, stored in a cool, dry, ventilated area. Protect against physical damage and moisture. Isolate from any source of heat or ignition. Avoid storage on wood floors. Separate from incompatibles, combustibles, organic or other readily oxidizable materials. Containers of this material may be hazardous when empty since they retain product residues (dust, solids); observe all warnings and precautions listed for the product.

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:

None established.

Ventilation System:

A system of local and/or general exhaust is recommended to keep employee exposures as low as possible. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.

Personal Respirators (NIOSH Approved):

For conditions of use where exposure to the dust or mist is apparent, a half-face dust/mist respirator may be worn. For emergencies or instances where the exposure levels are not known, use a full-face positive-pressure, air-supplied respirator. WARNING: Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.

Skin Protection:

Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.

Eye Protection:

Use chemical safety goggles and/or a full face shield where splashing is possible. Maintain eye wash fountain and quick-drench facilities in work area.

9. Physical and Chemical Properties

Appearance:

White or grayish-white powder.

Odor:

Chlorine-like odor.

Solubility:

Soluble in water; reacts, releasing chlorine gas.

Specific Gravity:

2.35 @ 20C

pH:

No information found.

% Volatiles by volume @ 21C (70F):

0

Boiling Point:

No information found.

Melting Point:

Decomposes above 177C (350F), releasing oxygen.

Vapor Density (Air=1):

6.9

Vapor Pressure (mm Hg):

Not applicable.

Evaporation Rate (BuAc=1):

No information found.

10. Stability and Reactivity

Stability

Rapidly decomposes on expsure to air. May decompose violently if exposed to heat or direct sunlight. Thermally unstable; decomposes at 177C (350F).

Hazardous Decomposition Products:

Calcium hypochlorite gives off oxygen, chlorine and chlorine monoxide.

Hazardous Polymerization:

Will not occur.

Incompatibilities:

Calcium hypochlorite is a strong oxidizer. Reacts with water and acids giving off chlorine gas. Forms explosive compounds with ammonia and amines.

Incompatable with organic materials, nitrogen compounds and combustible materials.

Conditions to Avoid:

Heat, flame, moisture, dusting, sources of ignition and shock, and incompatibles.

11. Toxicological Information

Calcium hypochlorite: LD50 oral rat 850 mg/kg. Investigated as a tumorigen and mutagen.

12. Ecological Information

Environmental Fate:

No information found.

Environmental Toxicity: No information found.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be handled as hazardous waste and sent to a RCRA approved waste facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Domestic (Land, D.O.T.)

Proper Shipping Name: CALCIUM HYPOCHLORITE MIXTURE, DRY

Hazard Class: 5.1 UN/NA: UN1748 Packing Group: II

Information reported for product/size: 2.5KG

International (Water, I.M.O.)

Proper Shipping Name: CALCIUM HYPOCHLORITE, DRY

Hazard Class: 5.1 UN/NA: UN1748 Packing Group: II

Information reported for product/size: 2.5KG

15. Regulatory Information

Chemical Inventory Status - Part 1\				
Ingredient	TSCA	EC	Japan	Australia
Calcium Hypochlorite (7778-54-3)	Yes	Yes	Yes	Yes

\Chemical Inventory Status - Part 2\	、					
	Canada					
Ingredient			NDSL Phil.			
Calcium Hypochlorite (7778-54-3)	Yes	Yes	No Yes			
\Federal, State & International Regulations - Part 1\SARA 313						
Ingredient R			Chemical Catg.			
	lo No					
\Federal, State & International Regulations - Part 2\						
Ingredient C	CERCLA	261.33	8(d)			
	10					
Chemical Weapons Convention: No TSCA 12(b): No CDTA: No SARA 311/312: Acute: Yes Chronic: Yes Fire: Yes Pressure: No Reactivity: Yes (Pure / Solid)						

Australian Hazchem Code: 2PE

Poison Schedule: S5

WHMIS:

This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

16. Other Information

NFPA Ratings: Health: 3 Flammability: 0 Reactivity: 1 Other: Oxidizer

Label Hazard Warning:

DANGER! STRONG OXIDIZER. CONTACT WITH OTHER MATERIAL MAY CAUSE FIRE. CORROSIVE. CAUSES BURNS TO ANY AREA OF CONTACT. HARMFUL IF SWALLOWED OR INHALED. WATER REACTIVE.

Label Precautions:

Keep from contact with clothing and other combustible materials.

Store in a tightly closed container.

Remove and wash contaminated clothing promptly.

Do not store near combustible materials.

Do not get in eyes, on skin, or on clothing.

Do not breathe dust or vapor.

Keep container closed.

Use only with adequate ventilation.

Wash thoroughly after handling.

Do not contact with water.

Label First Aid:

If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. In all cases get medical attention immediately.

Product Use:

Laboratory Reagent.

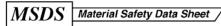
Revision Information:

MSDS Section(s) changed since last revision of document include: 3.

Disclaimer:

Mallinckrodt Baker, Inc. provides the information contained herein in good faith but makes no representation as to its comprehensiveness or accuracy. This document is intended only as a guide to the appropriate precautionary handling of the material by a properly trained person using this product. Individuals receiving the information must exercise their independent judgment in determining its appropriateness for a particular purpose. MALLINCKRODT BAKER, INC. MAKES NO REPRESENTATIONS OR WARRANTIES, EITHER EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION ANY WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE WITH RESPECT TO THE INFORMATION SET FORTH HEREIN OR THE PRODUCT TO WHICH THE INFORMATION REFERS. ACCORDINGLY, MALLINCKRODT BAKER, INC. WILL NOT BE RESPONSIBLE FOR DAMAGES RESULTING FROM USE OF OR RELIANCE UPON THIS INFORMATION.

Prepared by: Environmental Health & Safety Phone Number: (314) 654-1600 (U.S.A.)



Mallinckrodt Baker, Inc. 222 Red School Lane Phillipsburg, NJ 08865

24 Hour Emergency Telephone: 908-859-2151 CHEMTREC: 1-800-424-9300

Outside U.S. and Canada Chemtrec: 703-527-3887

NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chamicals.

All non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance.

SODIUM THIOSULFATE

1. Product Identification

Synonyms: Sodium thiosulfate, pentahydrate; thiosulfuric acid, disodium salt, pentahydrate

CAS No.: 7772-98-7 (Anhydrous) 10102-17-7 (Pentahydrate)

Molecular Weight: 248.17 Chemical Formula: Na2S2O3.5H2O

Product Codes:

J.T. Baker: 3945, 3946, 3951 Mallinckrodt: 7763, 7802, 8100

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Sodium Thiosulfate	7772-98-7	100%	Yes

3. Hazards Identification

Emergency Overview

CAUTION! MAY BE HARMFUL IF SWALLOWED OR INHALED. MAY CAUSE IRRITATION TO SKIN, EYES, AND RESPIRATORY TRACT.

 $SAF\text{-}T\text{-}DATA^{(tm)} \text{ Ratings (Provided here for your convenience)}$

Health Rating: 1 - Slight

Flammability Rating: 0 - None Reactivity Rating: 1 - Slight Contact Rating: 1 - Slight

Lab Protective Equip: GOGGLES; LAB COAT; PROPER GLOVES

Storage Color Code: Green (General Storage)

Potential Health Effects

May cause irritation to the respiratory tract. Symptoms may include coughing and shortness of breath.

Ingestion:

Low level of toxicity by ingestion. Diarrhea may occur by ingestion of large quantities.

Skin Contact:

Irritation may occur from prolonged skin contact. **Eye Contact:**

Contact may cause mechanical irritation.

Chronic Exposure:

Chronic exposure may cause skin effects. Aggravation of Pre-existing Conditions:

No information found.

4. First Aid Measures

Inhalation:

Remove to fresh air. Get medical attention for any breathing difficulty.

Ingestion:

Induce vomiting immediately as directed by medical personnel. Never give anything by mouth to an unconscious person. Get medical attention.

Skin Contact:

Wash exposed area with soap and water. Get medical advice if irritation develops.

Eye Contact:

Wash thoroughly with running water. Get medical advice if irritation develops.

5. Fire Fighting Measures

Fire:

Not considered to be a fire hazard.

Explosion:

Not considered to be an explosion hazard.

Fire Extinguishing Media:

Use any means suitable for extinguishing surrounding fire.

Special Information:

Use protective clothing and breathing equipment appropriate for the surrounding fire.

6. Accidental Release Measures

Ventilate area of leak or spill. Wear appropriate personal protective equipment as specified in Section 8. Spills: Sweep up and containerize for reclamation or disposal. Vacuuming or wet sweeping may be used to avoid dust dispersal.

7. Handling and Storage

Keep in a tightly closed container, stored in a cool, dry, ventilated area. Protect against physical damage. Isolate from incompatible substances. Containers of this material may be hazardous when empty since they retain product residues (dust, solids); observe all warnings and precautions listed for the product.

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:

None established.

Ventilation System:

In general, dilution ventilation is a satisfactory health hazard control for this substance. However, if conditions of use create discomfort to the worker, a local exhaust system should be considered.

Personal Respirators (NIOSH Approved):

For conditions of use where exposure to dust or mist is apparent and engineering controls are not feasible, a particulate respirator (NIOSH type N95 or better filters) may be worn. If oil particles (e.g. lubricants, cutting fluids, glycerine, etc.) are present, use a NIOSH type R or P filter. For emergencies or instances where the exposure levels are not known, use a full-face positive-pressure, air-supplied respirator. WARNING: Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.

Skin Protection:

Wear protective gloves and clean body-covering clothing.

Eye Protection:

Safety glasses. Maintain eye wash fountain and quick-drench facilities in work area

9. Physical and Chemical Properties

Appearance:

Monoclinic, colorless crystals.

Odor:

Odorless

Solubility:

79g/100 ml water @ 4C (39F)

Density:

pH:

No information found.

% Volatiles by volume @ 21C (70F):

Ó

Boiling Point:

> 100C (> 212F)

Melting Point:

48C (118F) Loses water @ 100C (212F)

Vapor Density (Air=1):

No information found.

Vapor Pressure (mm Hg):

No information found.

 $Evaporation \ Rate \ (BuAc=1): \\$

10. Stability and Reactivity

Stability:

Stable under ordinary conditions of use and storage. Stability limited in solution.

Hazardous Decomposition Products:

Oxides of sulfur and hydrogen sulfide. **Hazardous Polymerization:**

Will not occur.

Incompatibilities:

Sodium nitrate, halogens, and oxidizing agents. Reacts with acids to release sulfur dioxide.

Conditions to Avoid:

Incompatibles.

11. Toxicological Information

No LD50/LC50 information found relating to normal routes of occupational exposure.

\Cancer Lists\			
	NTP	Carcinogen	
Ingredient	Known	Anticipated	IARC Category
Sodium Thiosulfate (7772-98-7)	No	No	None

12. Ecological Information

Environmental Fate:

No information found.

Environmental Toxicity:

No information found.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be managed in an appropriate and approved waste disposal facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Not regulated.

15. Regulatory Information

```
Ingredient
 Sodium Thiosulfate (7772-98-7)
                                         Yes Yes Yes
 ------\Chemical Inventory Status - Part 2\-----
                                              --Canada--
           _____
 Sodium Thiosulfate (7772-98-7)
 -----\Federal, State & International Regulations - Part 1\-----
                                    -SARA 302-
                                                -----SARA 313-----
 Ingredient
                                    RQ TPQ
                                                List Chemical Catq.
                                  No No
 Sodium Thiosulfate (7772-98-7)
                                               No
                                                       No
 ------\Federal, State & International Regulations - Part 2\------
                                             -RCRA-
          -----
 Sodium Thiosulfate (7772-98-7)
Chemical Weapons Convention: No TSCA 12(b): No CDTA: No SARA 311/312: Acute: Yes Chronic: No Fire: No Pressure: No Reactivity: No (Pure / Solid)
```

Australian Hazchem Code: None allocated.

Poison Schedule: None allocated.

WHMIS:

This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

16. Other Information

NFPA Ratings: Health: 1 Flammability: 0 Reactivity: 0

Label Hazard Warning:

CAUTION! MAY BE HARMFUL IF SWALLOWED OR INHALED. MAY CAUSE IRRITATION TO SKIN, EYES, AND RESPIRATORY TRACT.

Label Precautions:

Avoid contact with eyes, skin and clothing.

Wash thoroughly after handling.

Avoid breathing dust.

Keep container closed.

Use with adequate ventilation.

Label First Aid:

If inhaled, remove to fresh air. Get medical attention for any breathing difficulty. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes. Get medical attention if irritation develops or persists. If swallowed, induce vomiting immediately as directed by medical personnel. Never give anything by mouth to an unconscious person.

Product Use:

Laboratory Reagent.

Revision Information:

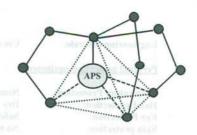
No Changes.

Disclaimer:

Mallinckrodt Baker, Inc. provides the information contained herein in good faith but makes no representation as to its comprehensiveness or accuracy. This document is intended only as a guide to the appropriate precautionary handling of the material by a properly trained person using this product. Individuals receiving the information must exercise their independent judgment in determining its appropriateness for a particular purpose. MALLINCKRODT BAKER, INC. MAKES NO REPRESENTATIONS OR WARRANTIES, EITHER EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION ANY WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE WITH RESPECT TO THE INFORMATION SET FORTH HEREIN OR THE PRODUCT TO WHICH THE INFORMATION REFERS, ACCORDINGLY, MALLINCKRODT BAKER, INC. WILL NOT BE RESPONSIBLE FOR DAMAGES RESULTING FROM USE OF OR RELIANCE UPON THIS INFORMATION.

Prepared by: Environmental Health & Safety Phone Number: (314) 654-1600 (U.S.A.)

Applied Polymer Systems, Inc.



Material Safety Data Sheet

IDENTIFICATION OF THE PRODUCT AND THE COMPANY

Product Name:

APS 702aa Floc Log

Supplied:

Applied Polymer Systems, Inc. 519 Industrial Drive Woodstock, GA 30189

www.siltstop.com Tel. 678-494-5998 Fax. 678-494-5298

COMPOSITION/INFORMATION ON INGREDIENTS

Identification of the preparation:

Anionic water-soluble Co-polymer gel

3. HAZARD IDENTIFICATION

Placement of these materials on wet walking surface will create extreme slipping hazard.

FIRST AID MEASURES

Inhalation:

None

Skin contact:

Contact with wet skin could cause dryness and chapping. Wash with soap and water. Use of

rubber gloves required.

Eye contact:

Rinse thoroughly with plenty of water, also under the eyelids, seek medical attention in case of

persistent irritation.

Ingestion:

Consult a physician

5. FIRE-FIGHTING MEASURES

Suitable extinguishing media:

Water, water spray, foam, carbon dioxide, dry powder.

Special fire-fighting precautions:

Floc Logs that become wet render surfaces extremely slippery.

Protective equipment for firefighters:

No special equipment required.

ACCIDENTAL RELEASE MEASURES

Personal precautions:

No special precautions required.

Methods for cleaning up:

Dry wipe as well as possible. Keep in suitable and closed containers for disposal.

After cleaning, flush away traces with water.

HANDLING AND STORAGE

Handling: Avoid contact with skin and eyes. Wash hands after handling.

Storage: Keep in a cool, dry place.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Engineering controls:

Use dry handling areas only. 21191242 19114109 belief A

Personal protection equipment

Respiratory Protection:

Hand protection:

Dry cloth, leather or rubber gloves.

Eve Protection:

Safety glasses with side shields. Do not wear contact lenses.

Skin protection:

No special protective clothing required.

Hygiene measures:

Wash hands before breaks and at end of work day.

PHYSICAL AND CHEMICAL PROPERTIES

Form:

Granular semi-solid gel

Color:

White to Brown

Odor:

None

pH:

7.89

Melting point:

N/A N/A

Flash point: Vapor density:

N/A

10. STABILITY AND REACTIVITY

Stability:

Product is stable, no hazardous polymerization will occur.

Materials to avoid:

Oxidizing agents may cause exothermic reactions.

Hazardous decomposition products:

Thermal decomposition may produce nitrogen oxides (NOx), carbon oxides.

11. TOXICOLOGICAL INFORMATION

Acute toxicity

Oral:

LC 50/Daphnia Magna/48h/>420mg/L

Inhalation:

None

12. ECOLOGICAL INFORMATION

Water Flea: LC 50/Daphnia Magna/48h/>420mg/l

Algae: EC 50/Selenastrum capricornutum/96h>500mg/l

Bioaccumulation: The product is not expected to bioaccumulate.

Persistence / degradability: Not readily biodegradable: (~85% after 180 days).

13. TRANSPORT AND REGULATORY INFORMATION

Not regulated by DOT,

RCRA status-Not a hazardous waste

NFPA and HMIS ratings:

NFPA Health:

Flammability:

0 Reactivity:

HMIS Health

3 2

Flammability

0 Reactivity