Sediment Sampling Results Figures & Tables

Excerpted from Sediment Management Plan (Gomez and Sullivan Engineers, January 2024)

Figure 1: Location Map

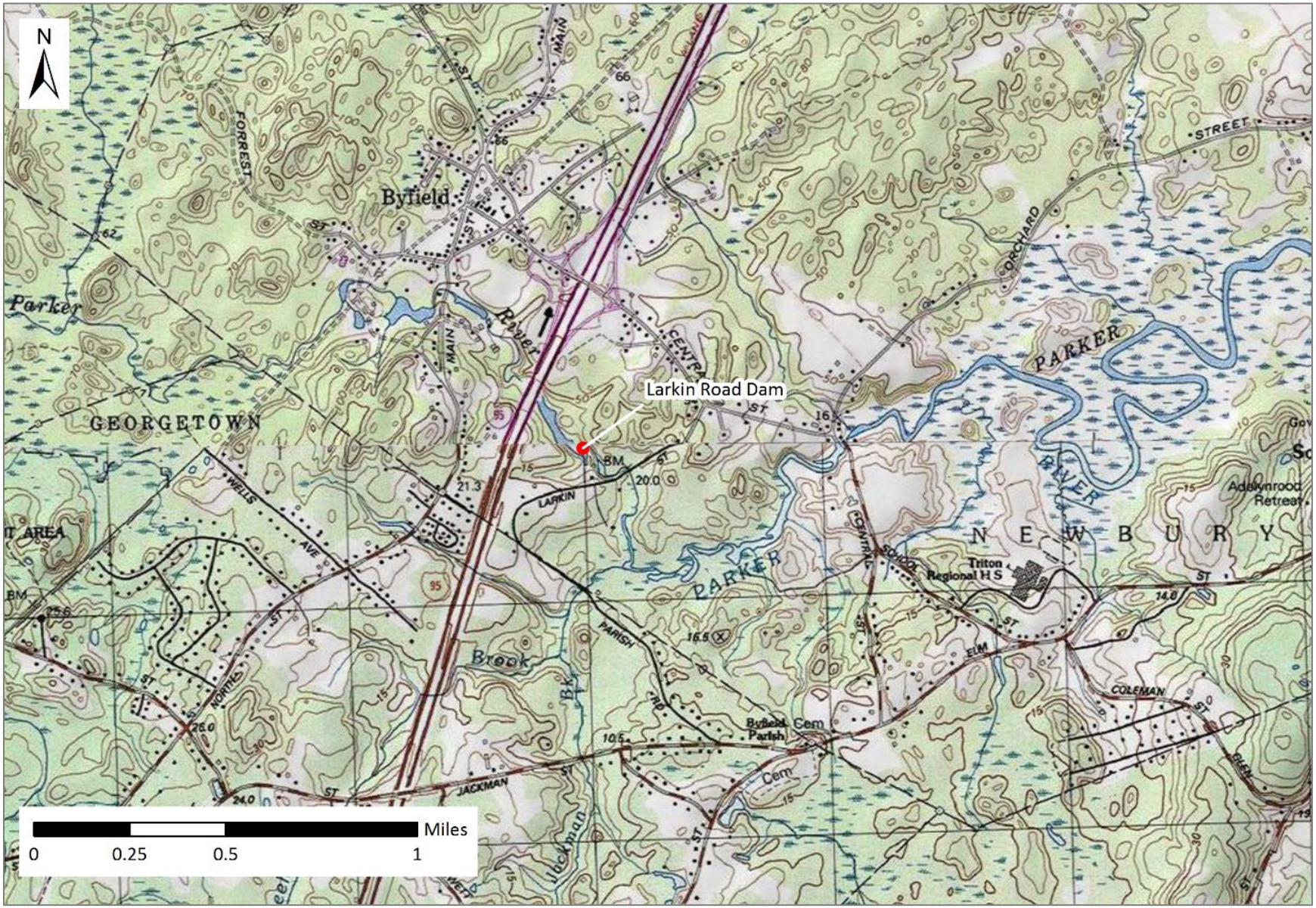


Figure 2: Project Area Key Features

Figure 3: Hazardous Material Release Sites in Vicinity of Larkin Dam Impoundment

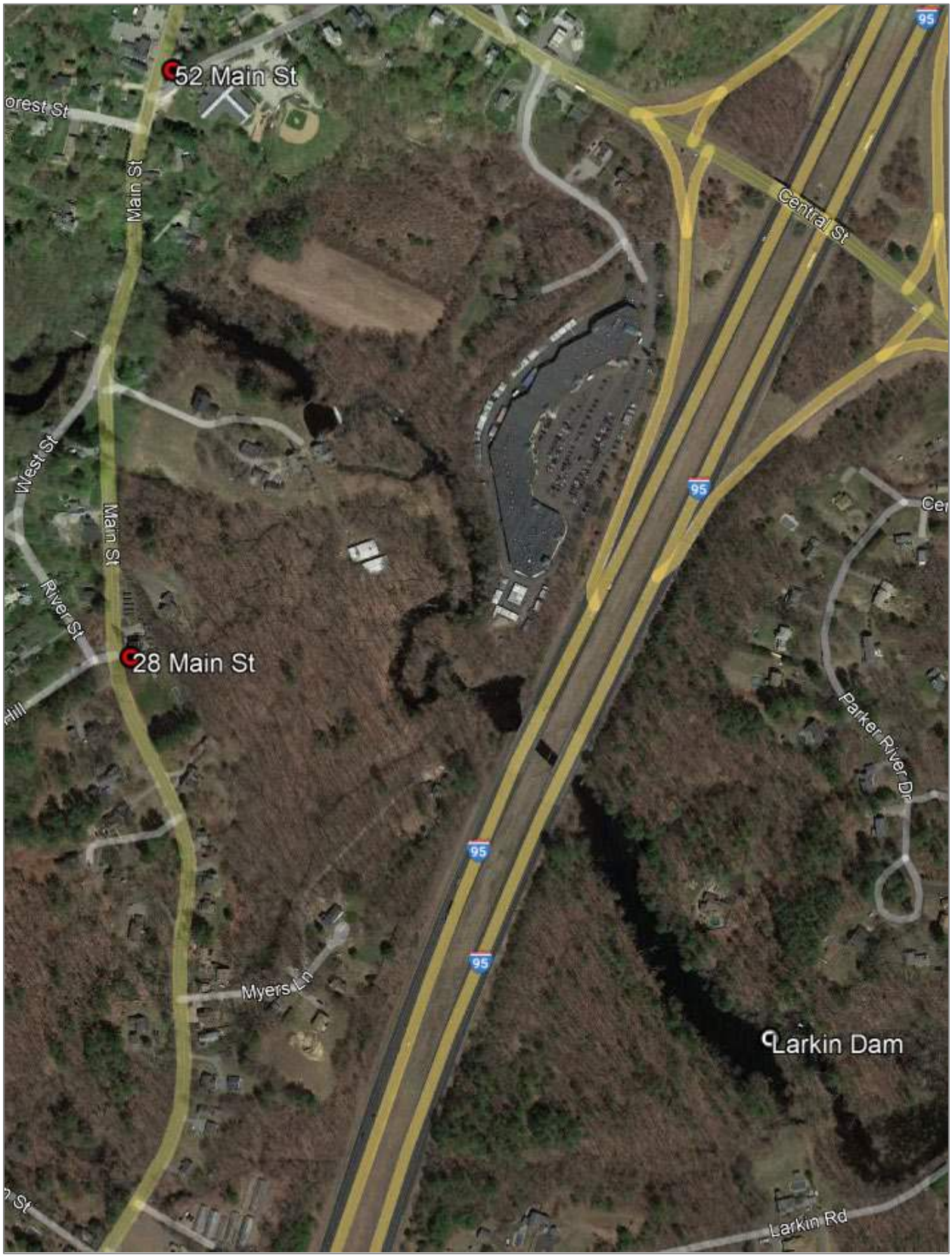


Figure 4: 2022 Sediment Probe Depths Compared to 2009 Sediment Thickness Map

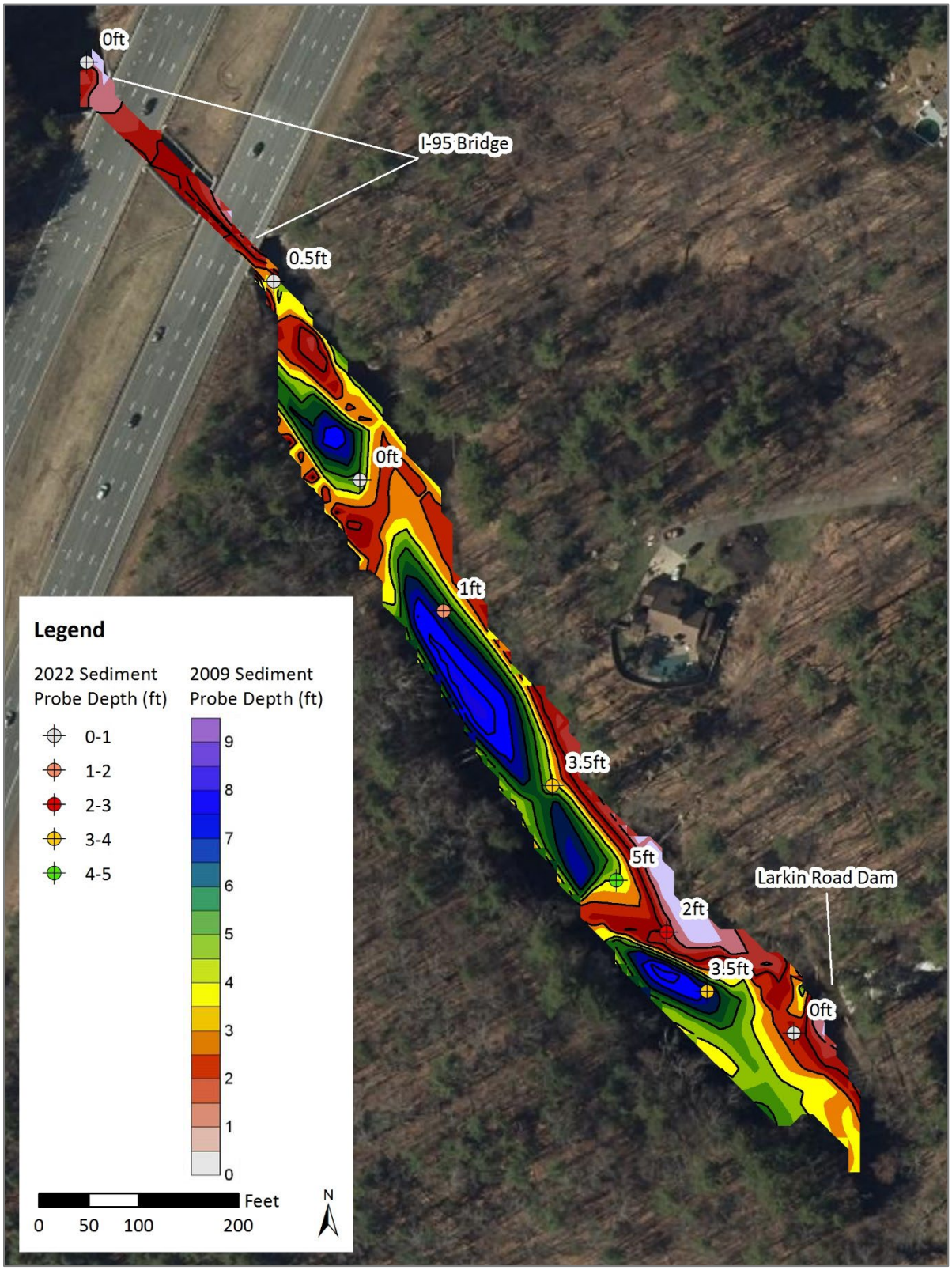


Figure 5: Sediment Probe Refusal Classification Map (2009)

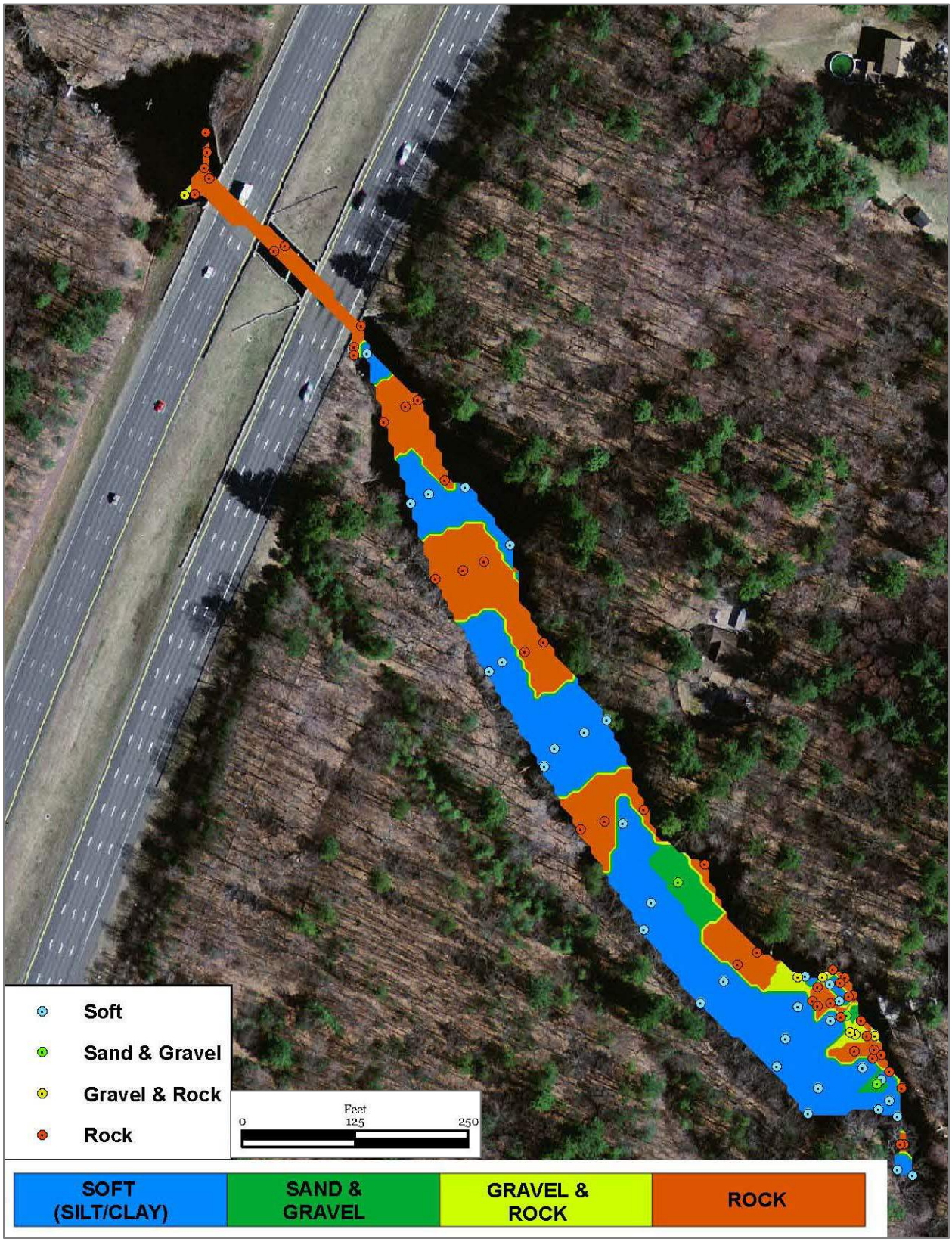


Figure 6: Sediment Sample Locations (2009 & 2010)

Figure 7: Sediment Sample Locations (2022)

Table 2: Sediment Sampling Results (2022)

PARAMETERS	SCREENING THRESHOLDS			RESULTS			
	Ecological (aquatic)		Human Exposure (upland/floodplain)	Individual Sample Results			
	Freshwater		Method 1 Drinking Water	Impoundment		Downstream	Upstream
				IMP-1	IMP-2	DS-1	US-1
	TEC/TEL	PEC/PEL	S-1/GW-1				
Metals, Total (mg/kg or ppm)							
Arsenic, Total	9.79	33.0	20	6.6	7.6	6.2	6.1
Cadmium, Total	0.99	4.98	80	0.09	0.12	0.48	0.085
Chromium, Total	43.4	111	100	12	23	14	24
Chromium III			1,000	12	23	14	24
Chromium VI (Hexavalent)			100	0.55	0.65	0.85	0.495
Copper, Total	31.6	149		6	10	9.3	11
Lead, Total	35.8	128	200	17	25	190	17
Mercury, Total	0.18	1.06	20	0.05	0.066	0.089	0.022
Nickel, Total	22.7	48.6	700	9.1	17	9.6	17
Zinc, Total	121	459	1,000	42	43	54	46
PAHs (mg/kg or ppm)							
Acenaphthene	0.01	0.09	4	0.155	0.2	0.245	0.145
Acenaphthylene	0.01	0.13	2	0.155	0.2	0.245	0.145
Anthracene	0.06	0.85	1,000	0.155	0.2	0.245	0.145
Benzo(a)anthracene	0.11	1.05	20	0.155	0.2	0.245	0.145
Benzo(a)pyrene	0.15	1.45	2	0.155	0.2	0.245	0.145
Benzo(b)fluoranthene			20	0.155	0.2	0.245	0.145
Benzo(ghi)perylene			1,000	0.155	0.2	0.245	0.145
Benzo(k)fluoranthene			200	0.155	0.2	0.245	0.145
Chrysene	0.17	1.29	200	0.155	0.2	0.245	0.145
Dibenz(a,h)anthracene	0.03	0.14	2	0.155	0.2	0.245	0.145
Fluoranthene	0.42	2.23	1,000	0.155	0.2	0.245	0.145
Fluorene	0.08	0.54	1,000	0.155	0.2	0.245	0.145
Indeno(1,2,3-cd)pyrene			20	0.155	0.2	0.245	0.145
2-Methylnaphthalene			1	0.155	0.2	0.245	0.145
Naphthalene	0.18	0.56	4	0.155	0.2	0.245	0.145
Phenanthrene	0.20	1.17	10	0.155	0.2	0.245	0.145
Pyrene	0.20	1.52	1,000	0.155	0.2	0.245	0.145
Total PAHs	1.6	22.8	5,183	2.635	3.4	4.165	2.465
PCBs (mg/kg or ppm)							
PCB-8				0.000003	0.000004	0.000050	0.000003
PCB-18				0.000023	0.000033	0.000135	0.000027
PCB-28				0.000100	0.000072	0.000225	0.000013
PCB-44				0.000018	0.000023	0.000285	0.000017
PCB-52				0.000054	0.000055	0.000255	0.000015
PCB-66				0.000016	0.000020	0.000250	0.000015
PCB-101				0.000031	0.000040	0.000495	0.000029
PCB-105				0.000040	0.000025	0.000310	0.000018
PCB-118				0.000160	0.000085	0.001900	0.000110
PCB-128				0.000044	0.000055	0.000700	0.000041
PCB-138				0.000110	0.000029	0.000355	0.000088
PCB-153				0.000130	0.000110	0.000410	0.000096
PCB-170				0.000023	0.000030	0.000370	0.000022
PCB-180				0.000120	0.000095	0.000495	0.000058
PCB-187				0.000066	0.000035	0.000430	0.000025
PCB-195				0.000040	0.000050	0.000650	0.000037
PCB-206				0.000048	0.000060	0.000750	0.000045
PCB-209				0.000070	0.000090	0.001100	0.000065
Total PCBs	0.0598	0.676	1	0.001095	0.000908	0.009165	0.000721
Pesticides (mg/kg or ppm)							
4,4'-DDD			10	0.007	0.009	0.011	0.0065
Sum DDD	0.00488	0.028		0.007	0.009	0.011	0.0065
4,4'-DDE			7	0.013	0.0097	0.006	0.00345
Sum DDE	0.00316	0.0313		0.013	0.0097	0.006	0.00345
4,4'-DDT			7	0.0041	0.0055	0.0065	0.0038
Sum DDT	0.00416	0.0629		0.0041	0.0055	0.0065	0.0038
Total DDTs (calculated)	0.00528	0.572		0.0241	0.0242	0.0235	0.01375
Alachlor				0.05	0.065	0.08	0.0465
Aldrin			0.09	0.00385	0.005	0.0065	0.0036
alpha-BHC				0.019	0.025	0.031	0.0175
beta-BHC				0.016	0.021	0.0265	0.015
Chlordane	0.00324	0.0176	6	0.065	0.09	0.11	0.065
delta-BHC				0.0215	0.028	0.0355	0.02
Dieldrin	0.00190	0.0618	0.09	0.0033	0.0043	0.0055	0.00305
Endosulfan I				0.015	0.02	0.025	0.033
Endosulfan II				0.0155	0.02	0.0255	0.0145
Endosulfan Sulfate				0.0165	0.0215	0.027	0.0155
Endrin	0.00222	0.207	20	0.015	0.02	0.025	0.014

PARAMETERS	SCREENING THRESHOLDS			RESULTS			
	Ecological (aquatic)		Human Exposure (upland/floodplain)	Individual Sample Results			
	Freshwater		Method 1 Drinking Water	Impoundment		Downstream	Upstream
				IMP-1	IMP-2	DS-1	US-1
	TEC/TEL	PEC/PEL	S-1/GW-1				
Endrin Aldehyde				0.0355	0.047	0.06	0.0335
Endrin Ketone				0.02	0.0265	0.033	0.0185
gamma-BHC (Lindane)	0.00237	0.00499		0.00415	0.0055	0.007	0.00385
Heptachlor			0.3	0.0048	0.0065	0.008	0.0045
Heptachlor Epoxide	0.00247	0.0160	0.2	0.00385	0.005	0.0065	0.0036
Hexachlorobenzene			0.7	0.02	0.0265	0.033	0.019
Methoxychlor			300	0.055	0.075	0.09	0.05
Toxaphene	0.0001			0.27	0.36	0.445	0.255
TPH and EPH (mg/kg)							
C11-C22 Aromatics, Adjusted			1,000	31	35	57	22
C9-C18 Aliphatics			1,000	9	11.5	14.5	8.5
C19-C36 Aliphatics			3,000	34	31	55	8.5
Total TPH			1,000	74	77.5	126.5	39
Physical Characteristics (%)							
Total Organic Carbon				2.4	5.2	5	2.5
Moisture				57.13	60.96	70.83	47.94
Solids				54.4	42.7	34.1	58.8
Sieve No. 4 (% passing)				#N/A	#N/A	#N/A	#N/A
Sieve No. 10 (% passing)				#N/A	#N/A	#N/A	#N/A
Sieve No. 40 (% passing)				#N/A	#N/A	#N/A	#N/A
Sieve No. 60 (% passing)				#N/A	#N/A	#N/A	#N/A
Sieve No. 200 (% passing)				#N/A	#N/A	#N/A	#N/A
Volatile Organic Compounds (mg/kg or ppm)							
Acetone			6.00	0.013	0.021	0.011	0.0098
Acrylonitrile				0.00055	0.0009	0.00115	0.00049
tert-Amyl Methyl Ether				0.0002	0.000335	0.00043	0.00018
Benzene			2.00	0.0003	0.0005	0.00065	0.00027
Bromobenzene				0.0002	0.000335	0.000425	0.00018
Bromochloromethane				0.000475	0.0008	0.001	0.00043
Bromodichloromethane			0.10	0.00027	0.00045	0.0006	0.00024
Bromoform			0.10	0.000335	0.00055	0.0007	0.000305
Bromomethane			0.50	0.0009	0.0015	0.00195	0.0008
sec-Butylbenzene				0.0005	0.0009	0.0011	0.000475
n-Butylbenzene				0.00032	0.00055	0.0007	0.00029
tert-Butylbenzene				0.000425	0.0007	0.0009	0.000385
Carbon Disulfide				0.00385	0.0065	0.008	0.00345
Carbon Tetrachloride			10.00	0.000475	0.0008	0.001	0.00043
Chlorobenzene			1.00	0.00032	0.00055	0.0007	0.00029
Chlorodibromomethane				0.000315	0.00055	0.00065	0.000285
Chloroethane				0.0007	0.00115	0.00145	0.0006
Chloroform			0.40	0.00032	0.00055	0.0007	0.00029
Chloromethane				0.00055	0.00095	0.0012	0.0005
2-Chlorotoluene				0.00027	0.000455	0.0006	0.000245
4-Chlorotoluene				0.000225	0.00038	0.000485	0.000205
1,2-Dibromo-3-chloropropane				0.000475	0.0008	0.001	0.00043
1,2-Dibromoethane				0.000365	0.0006	0.0008	0.00033
Dibromomethane				0.0004	0.00065	0.00085	0.00036
1,3-Dichlorobenzene			3.00	0.00027	0.000455	0.0006	0.000245
1,2-Dichlorobenzene			9.00	0.00024	0.0004	0.0005	0.000215
1,4-Dichlorobenzene			0.70	0.00029	0.000485	0.0006	0.00026
Dichlorodifluoromethane				0.0006	0.00095	0.00125	0.0005
1,1-Dichloroethane			0.40	0.00038	0.00065	0.0008	0.00034
1,2-Dichloroethane			0.10	0.00036	0.0006	0.00075	0.000325
1,1-Dichloroethylene			3.00	0.00039	0.00065	0.00085	0.00035
cis-1,2-Dichloroethylene			0.30	0.000305	0.0005	0.00065	0.000275
trans-1,2-Dichloroethylene			1.00	0.000365	0.0006	0.0008	0.00033
1,2-Dichloropropane			0.10	0.00031	0.0005	0.00065	0.00028
1,3-Dichloropropane				0.000285	0.000475	0.0006	0.000255
2,2-Dichloropropane				0.00045	0.00075	0.00095	0.00041
1,1-Dichloropropene				0.00055	0.0009	0.00115	0.000485
trans-1,3-Dichloropropene				0.00027	0.000455	0.0006	0.000245
Diethyl Ether				0.00039	0.00065	0.00085	0.000355
Diisopropyl Ether				0.00031	0.0005	0.00065	0.00028
1,4-Dioxane			0.20	0.0195	0.0325	0.0415	0.0175
Ethylbenzene			40.00	0.000295	0.000495	0.00065	0.000265
Hexachlorobutadiene			30.00	0.000405	0.0007	0.00085	0.000365
2-Hexanone				0.0031	0.005	0.0065	0.00285
Isopropylbenzene				0.000385	0.00065	0.00085	0.00035
p-Isopropyltoluene				0.000305	0.0005	0.00065	0.00028
m+p Xylene				0.0007	0.0012	0.00155	0.00065
Methyl Acetate				0.0008	0.00135	0.00175	0.00075

PARAMETERS	SCREENING THRESHOLDS			RESULTS			
	Ecological (aquatic)		Human Exposure (upland/floodplain)	Individual Sample Results			
	Freshwater		Method 1 Drinking Water	Impoundment		Downstream	Upstream
				IMP-1	IMP-2	DS-1	US-1
	TEC/TEL	PEC/PEL	S-1/GW-1				
Methyl Cyclohexane				0.00041	0.0007	0.0009	0.00037
4-Methyl-2-pentanone			4.00	0.0023	0.00385	0.0049	0.00205
Methyl tert Butyl Ether			0.40	0.000195	0.00033	0.00042	0.00018
Methylene Chloride				0.0008	0.00135	0.00175	0.00075
2-Butanone				0.0031	0.005	0.0065	0.00285
o-Xylene				0.000235	0.000395	0.0005	0.000215
n-Propylbenzene				0.00026	0.00044	0.00055	0.000235
Styrene			3.00	0.000225	0.00038	0.000485	0.000205
tert-Butyl Alcohol				0.025	0.0425	0.055	0.023
tert-Butyl Ethyl Ether				0.00027	0.000455	0.0006	0.000245
1,1,1,2-Tetrachloroethane			0.10	0.000305	0.0005	0.00065	0.000275
1,1,2,2-Tetrachloroethane			0.01	0.000285	0.000475	0.0006	0.000255
Tetrachloroethylene			1.00	0.000365	0.0006	0.0008	0.00033
Tetrahydrofuran				0.00185	0.0031	0.00395	0.00165
Toluene			30.00	0.000285	0.000475	0.0006	0.000255
trans-1,4-Dichloro-2-butene				0.000395	0.00065	0.00085	0.00036
1,1,2-Trichloro-1,2,2-trifluoroethane				0.00036	0.0006	0.00075	0.000325
1,2,4-Trichlorobenzene			2.00	0.000265	0.000445	0.00055	0.00024
1,3,5-Trichlorobenzene				0.000275	0.00046	0.0006	0.000245
1,1,1-Trichloroethane			30.00	0.000435	0.00075	0.00095	0.000395
1,1,2-Trichloroethane			0.10	0.00025	0.00042	0.00055	0.000225
Trichloroethylene			0.30	0.00036	0.0006	0.00075	0.000325
Trichlorofluoromethane				0.00026	0.00044	0.00055	0.000235
1,2,3-Trichloropropane				0.00055	0.00095	0.00125	0.0005
1,2,4-Trimethylbenzene				0.00036	0.0006	0.0008	0.00033
1,3,5-Trimethylbenzene				0.00029	0.000485	0.0006	0.00026
Vinyl Chloride			0.30	0.00035	0.0006	0.00075	0.000315

Key

X	Exceeds freshwater Threshold Effects Concentration (TEC)
X	Exceeds freshwater Probable Effects Concentration (PEC)
X	Exceeds Massachusetts Contingency Plan (MCP) Method 1, S-1/GW-1 standards
X	Exceeds Toxicity Characteristic Leaching Procedure (TCLP) threshold
X	Below the laboratory detection limit (DL); a value of 1/2 the detection limit is provided

Notes: PAHs reported as Semivolatile Organic Compounds by GC/MS (Selective Ion Monitoring). Total PAHs are calculated by summing values. TEC values are expected to be exceeded in a developed watershed, but are provided in this table for reference.

Table 3: Sediment Sampling Results (2009 & 2010)

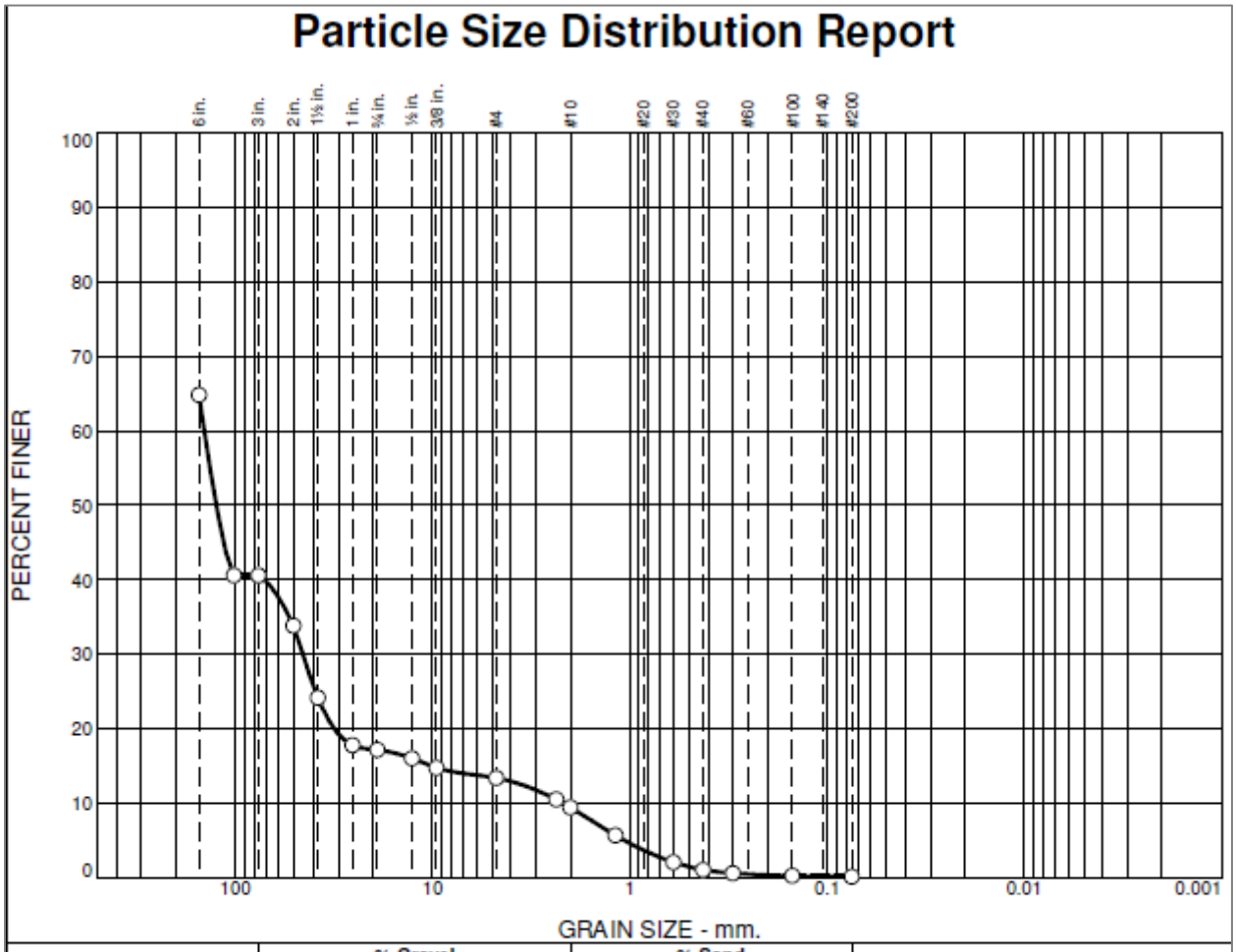
Parameter/Units	Method	Screening Benchmarks			Sample Results								
		MCP Method 1	Freshwater		2009 IMP		2009 DS	2009 US	2010 DS		Impoundment Statistics		
		S1/GW-1	TEC	PEC	SED-02	SED-03	SED-04	SED-01	SED 2010-01	SED 2010-02	Min	Max	Mean
Metals (mg/kg)													
Arsenic	6020	20	9.79	33	11	10	4.6	6.1	51	15			10.5
Cadmium	6020	2	0.99	4.98	ND	ND	ND	ND	2.6	0.75			-
Chromium	6020	30	43.4	111	24	20	16	33	54	23			22
Copper	6020	NC	31.6	149	14	10	7.1	10	42	12			12
Lead	6020	300	35.8	128	50	48	13	12	88	52			49
Mercury	7471	20	0.18	1.06	0.12	0.22	0.049	0.013	0.19	0.11			0.17
Nickel	6020	20	22.7	48.6	18	14	11	ND	44	18			16
Zinc	6020	2,500	121	459	64	62	26	40	310	120			63
SVOC (ug/kg)													
Pyrene	8270	1,000,000	195	1,520	150	270	8.4	ND	190	130			210
Benzo(a)anthracene	8270	7,000	108	1,050	82	130	ND	ND	92	71			106
Chrysene	8270	70,000	166	1,290	120	220	6.7	ND	130	110			170
Benzo(b)fluoranthene	8270	7,000	27.3	13,400	160	290	ND	ND	160	160			225
Total PAHs			1,610	22,800	1,031	1,888	24	6	1,283	1,081			1,460
Pesticides (ug/kg)													
Gamma-BHC (Lindane)	8081	NC	2.37	4.99	ND	ND	ND	ND	27	ND			-
4,4'-DDD	8081	4,000	4.88	28	ND	ND	ND	16	ND	ND			-
4,4'-DDE	8081	3,000	3.16	31.3	ND	ND	ND	9.6	ND	ND			-
4,4'-DDT	8081	3,000	4.16	62.9	ND	ND	ND	ND	ND	ND			-
Total DDTs (Sum of 4,4'-DDE, 4,4'-DDD, 4,4'-DDT)			5.28	572	-	-	-	25.6	95	-			-

- *Green shaded values indicate exceedance of PEC.*
- *Yellow shaded values indicate exceedance of TEC.*
- *MCP Method 1 S1/GW-1 criteria are applicable only to soil, and are included to assist evaluation of potential upland disposal/reuse of excavated sediment.*
- *TEC = Threshold Effects Criteria (from MacDonald et al., 2000)*
- *PEC = Probable Effects Criteria (from MacDonald et al., 2000)*
- *NC = no criteria*
- *ND =not detected at the Reporting Limit*

Table 4: Physical Analysis Sediment Sampling Results (2009 & 2010)

Parameter	Method	2009 Impoundment Sample Results		2009 Downstream Sample Results	2009 Upstream Sample Results	2010 Downstream Sample Results	2010 Downstream Sample Results
		SED-02	SED-03	SED-04	SED-01	SED-2010-01	SED- 2010-02
Total Organic Carbon		34000 mg/kg	41000 mg/kg	29000 mg/kg	ND	42000 mg/kg	41000 mg/kg
Bulk Density		89.1 lb/ft^3	92.0 lb/ft^3	102 lb/ft^3	125 lb/ft^3	65.5 lb/ft^3	69.2 lb/ft^3
Moisture Content	ASTM D2216	137%	128%	80.9%	40.1%	515%	409%
Dry Density		37.6 lb/ft^3	40.4 lb/ft^3	56.4 lb/ft^3	89.5 lb/ft^3	10.7 lb/ft^3	13.6 lb/ft^3
Porosity		0.75	0.74	0.64	0.46	0.92	0.90
Specific Gravity		2.43	2.49	2.48	2.66	2.26	2.34
D_{85}		1.261 mm	0.397 mm	0.246 mm	0.180 mm	N/A	0.0995 mm
D_{60}		N/A	0.124 mm	0.120 mm	N/A	N/A	N/A
D_{50}		N/A	0.083 mm	0.097 mm	N/A	N/A	N/A
D_{30}		N/A	N/A	N/A	N/A	N/A	N/A
D_{15}		N/A	N/A	N/A	N/A	N/A	N/A
D_{10}		N/A	N/A	N/A	N/A	N/A	N/A
% Cobble		0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
% Gravel		0.0%	0.0%	2.4%	0.3%	0.1%	0.0%
% Sand		37.6%	52.4%	60.1%	31.5%	3.0%	19.6%
% Silt and Clay		62.4%	47.6%	37.5%	68.2%	96.9%	80.4%

Figure 8: Particle Size Distribution Report for Sample Collected Directly Upstream of USGS Weir (2022)



% +3"	% Gravel			% Sand			% Fines
	Coarse	Medium	Fine	Coarse	Medium	Fine	
	22.8	3.1	5.3	7.4	1.6	0.3	0.1

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
6"	64.8		
4"	40.6		
3"	40.6		
2"	33.8		
1.5"	24.1		
1"	17.8		
0.75"	17.1		
0.5"	16.0		
0.375"	14.7		
#4	13.4		
#8	10.5		
#10	9.4		
#16	5.6		
#30	2.0		
#40	1.0		
#50	0.6		
#100	0.2		
#200	0.1		

Material Description

GRAVEL trace, coarse to med Sand, trace Leaves, Twigs, Organics

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= D_{60}= 143.3325 D_{50}= 124.8457
D_{30}= 45.4329 D_{15}= 10.1823 D_{10}= 2.1939
C_u= 65.33 C_c= 6.56

Classification

USCS= GP AASHTO=

Remarks