TECHNICAL MEMORANDUM

TECHNICAL MEMORANDUM SUMMARY OF AQUATIC INVESTIGATIONS

Prepared for
Stratford Army Engine Plant
Stratford, Connecticut

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Woodward-Clyde

Woodward-Clyde
1400 Union Meeting Road
Suite 202
Blue Bell, Pennsyvania 19422-1920
K9716-5.1

Tables

Table 6-1 Summary of Chemicals Detected in Phase I Surface Water Samples
Source: Remedial Investigation Report, 1993

Table 1 Summary Scope of Work for Aquatic Habitats
Source: Remedial Investigation Work Plan, March 30, 1998

Table 2 Phase I Summary of Chemicals Detected in Sediment Samples
Source: Remedial Investigation Report, 1993

Table 6.3-1 Surficial Sediment Data Summary and Selection of COCs, Intertidal Mudflats - Metals
Source: Draft Baseline Ecological Risk Assessment, November, 1995

Figures

Figure 5.1-2 Site Plan - Phase I Sampling Locations
Source: Remedial Investigation Report, 1993

Figure 2 Aquatic Sampling Locations
Source: Remedial Investigation Work Plan, March 30, 1998

Figure 3 Oyster Tissue Sampling Locations
Source: Technical Memorandum

The purpose of this memorandum is to provide supporting documentation to facilitate the process of successfully resolving United States Environmental Protection Agency (EPA), Biological Technical Assistance Group (BTAG) and Connecticut Department of Environmental Protection (CDEP) comments on the SAEP Draft Work Plan dated March 30, 1998; and to develop a mutually acceptable path forward to address ecological components of the Remedial Investigation for the site (RI).

The objectives of this memorandum are to provide EPA and BTAG with a succinct summary of :

1) The DQOs that guided each phase of the investigation;
2) The ecologically relevant work that has already been done at the SAEP;
3) The conclusions drawn from the results of the Phase I and II investigations;
4) Data gaps to be filled as part of this investigation; and
5) Elements of the proposed field sampling and analysis plan to fill existing data gaps in the RI.

Based on the ecological conceptual site models for the site, the primary exposure pathways lead to aquatic receptors in the Housatonic River and adjacent wetland habitat. Minimal terrestrial habitat is present at the site and the pathways to terrestrial receptors are considered negligible. Exposure media for aquatic receptors include surface water, sediment and biological tissue. Therefore, field investigations to date have focused on these three exposure media.

For each of the two phases of the remedial investigation performed to date, the following sections summarize data quality objectives (DQOs), scope, results obtained and data gaps remaining at the conclusion of the phase of work. Proposed work to satisfy the identified data gaps for each exposure medium is also provided.

Elements of the investigations include surface water, sediment and biological studies. Selected data tables and maps from previous documents have been included to facilitate understanding of the results of Phase I and II. Other documentation is incorporated by reference.

2.1 PHASE I

Data Quality Objective (DQO)

The overall DQO for Phase I was to identify the nature and extent of constituents from site discharges to adjacent surface waters. Targeted detection limits were below applicable ambient water quality criteria (AWQC).

Sampling Performed

- Sampling locations are provided in Figure 5.1-2 attached
- 7 outfall sampling stations (0F001-0F007), along the shoreline adjacent to the mudflats where outfalls discharge to the mudflats
- 1 upstream reference station (IBG) located north of the site to serve as a basis for comparison with regional concentrations
- 1 station (0F-008) at the Area 8 outfall and 1 upstream from the outfall in the tidal drainageway (OF008BG) to determine whether outfall 008 is a source of contamination
- 3 intertidal mudflat low tide locations (LT01-LT03) offshore from site to determine whether constituents are present at a distance from the outfall sources
- All samples were unfiltered
- Analytes included VOC, SVOCs, metals and cyanide which were thought to be potential site-related constituents

Summary of Findings

- Findings are summarized in Table 6-1, attached
- Most samples contained visible turbidity and discoloration
- 10 VOC detected - no AWQC exceedances for VOCs with criteria
- VOCs without criteria were ≤ 15 ug/L and deemed unlikely to represent concentrations of concern for VOCs
- 7 SVOCs detected at low concentrations (1-2 ug/L)
- No AWQC exceedance for SVOCs with criteria and others deemed unlikely to represent concentrations of concern for SVOCs
- Metal results showed minor exceedances of chronic AWQC for Chromium in two outfall samples and exceedance of acute AWQC for Zinc at 3 outfall locations
- Mercury exceeded the chronic AWQC at 7 outfall locations
- Cyanide exceeded the chronic AWQC only at the 008BG location in the drainageway

- No AWQC exceedances were observed in the samples collected during low tide at the mudflat locations (LT-01 to LT-03), nor at the upstream reference location (IBG)

Data Gaps

Surface water data collected in Phase I were sufficient to characterize the nature and extent of constituents in surface water adjacent to the SAEP site. Hence, no additional surface water sampling was proposed for the Phase II field investigation.

2.2 PHASE II

No surface water sampling was performed in Phase II since surface water adjacent to the SAEP was sufficiently characterized in Phase I.

2.3 PROPOSED SURFACE WATER SAMPLING FOR CURRENT INVESTIGATION

Data Quality Objective

- Surface water characterization performed in Phase I was limited to the mudflats adjacent to the site. Additional data are needed to generally characterize surface water in the Marine Basin/Outfall 008 area
- Additional water sampling will be performed as part of the current investigation (FSP; Table 1 and Figure 2, attached) in response to concerns raised by EPA and CDEP at meetings and telecons

Proposed Sampling

- Seven surface water samples will be collected in Marine Basin (Figure 2 and Table 1, attached) to determine whether constituents from outfall 008 influence Marine Basin
- 1 reference location sample (UO2) will be collected in a suitable wetland drainage across the Housatonic River
- Criteria for selecting the location will be provided in the response to comments
- Both filtered and unfiltered samples will be collected
- Analytes will include VOCs, PAH and PCBs; metals and cyanide; trivalent Arsenic and Methyl Mercury; and field physicochemical variables
- Target detection limits will be at or below AWQCs or other applicable benchmarks so that concentrations can be assessed in terms of ecological receptors
- The resulting analytical data will be screened against AWQCs and other benchmarks to determine whether concentrations pose a threat to ecological receptors

3.1 PHASE I

Data Quality Objectives

The DQO for Phase I sediment sampling was to characterize the nature and extent of constituents in sediment near the outfalls, at several mudflat locations and at a reference location.

Sampling Performed

- Sampling locations are provided in Figure 5.1-2 attached
- Sediment samples were collected at 13 locations at 2 depths (0-12" and 12-24") and analyzed for VOC, SVOC, PCB, Cyanide and TAL Metals (Table attached).
- 7 outfall stations were located along the shoreline in the mudflats (OF001-OF008;
- 3 stations were located in the intertidal mudflats
- 1 at area 8 (OF008) outfall, and 1 at area 8 upstream (OO8BG).
- 1 reference location north of jetty (IBG).

Summary of Findings

- Findings are summarized in Table 2 , attached
- The Phase I sediment samples were collected at 0-12" and 12-24"
- The samples were not collected with regard to DQOs for ecological risk assessment, and were not focused specifically in ecological exposure pathways
- Data were not used in the ecological risk assessment for the site
- Depth of the surface samples exceed the depth of the biologically active zone
- TOC and sediment grain size data needed to facilitate ecological assessment were not collected

Data Gaps

- Phase I sediment data provided a general characterization of sediment chemistry in the SAEP site vicinity and at reference locations
- The Phase I results were not intended to be utilized for ERA purposes
- Data gaps for sediment sampling in the mudflat and in Marine Basin were identified for the Phase II field investigation to satisfy DQOs for ecological risk

3.2 PHASE II

Data Quality Objective

The DQO for Phase II sediment sampling was to identify the nature and extent of constituents in the biologically active zone of the mudflat and Marine Basin (since this zone had not been the focus of Phase I sediment investigation), and to compare the results with data from reference locations and appropriate sediment quality benchmarks for ecological risk purposes.

Sampling Performed

- Sampling locations are provided in Figure 2, attached
- Sediment samples were collected at a 0-6" depth from 33 locations as follows:
  1. Intertidal mudflat locations along 6 approximately north to south (Transects A,B,C,D,E,F) oriented along the outfalls to provide data from the mudflat area
  2. Upstream reference locations U106 and US06 and 1 downstream reference location (DS_{0-6}) to serve as a basis for comparison to regional concentrations
  3. Marine Basin location (MB-0-6) and 1 outfall 008 location (008-0-6) to determine the extent of constituents from outfall 008
- Samples were analyzed for PAHs, PCB, Metals, TOC, and grain size; chemical analytes were selected based on previous investigations.
- Analytical results were screened against sediment quality criteria and ER-Ls during ERA to identify constituents of concern.

Summary of Findings

- Phase II sediment data are summarized in Tables 6.3-1 and 6.3-2, attached
- Risks to indigenous benthic macroinvertebrates and wading birds were identified in the vicinity of outfall TB1, TC1, TD1 and at outfall 008 due to exposure to sediments contaminated with site-related constituents.

Data Gaps

While the DQOs for Phase II were met, additional data gaps were identified which had to be satisfied to insure adequate risk characterization in the habitats adjacent to the SAEP site. Elevated sediment concentrations of site-related constituents immediately adjacent to the outfalls must be better delineated. Sediments adjacent to the causeway and in the outfall 008/Marine Basin area must be characterized to determine whether they pose a threat to ecological receptors. Bioavailability of sediment associated constituents must be evaluated to determine whether the concentration measured pose a threat to ecological receptors.

3.3 PROPOSED SEDIMENT SAMPLING FOR CURRENT INVESTIGATION

Data Quality Objectives

The DQOs for sediment sampling for the current RI are

- Better delineate the area adjacent to the outfalls where sediment constituents exceed applicable ecological risk based benchmarks
- Determine whether sediments adjacent to Causeway may pose a threat to receptors
- Determine the extent of elevated sediment concentrations in the Marine Basin/outfall 008 area.
- Evaluate sediment constituent bioavailability

Proposed Sampling

- Sampling locations are provided in Figure 2, attached
- 17 locations in the mudflats area to better delineate sediments adjacent to outfalls
- 6 locations adjacent to the Causeway to determine whether these sediments pose a threat to ecological receptors
- 7 locations are proposed for the outfall 008/Marine Basin area to determine the extent of site-related constituents
- 1 upstream reference location to serve as a basis for comparison with regional concentrations
- Sediment chemical analysis will include: VOCs, PAHs and PCBs; TAL metals and cyanide; As, Cr and Hg speciation; AVS/SEM; grain size distribution; and TOC
- Chemical analytes are based on previous phases of investigation
- Benthic community analysis, toxicity testing, and bioaccumulation testing will be performed at selected locations (Table 1, attached) to provide data for the assessment of bioavailability
- Sediment benchmarks to be used in the investigation will be included in the response to comments
- Criteria for selection of the reference locations will be included in the response to comments

4.1 PHASE I

Biological sampling was beyond the scope of the Phase I investigation. Hence, no DQOs for biological sampling were developed.

4.2 PHASE II

Data Quality Objectives

The DQOs for Phase II biological sampling were to:

- Identify the presence of COCs in oyster tissue collected from the site and compare the results to oysters from reference locations and to regional tissue data to determine whether biological tissues could pose a threat to predators consuming the tissues
- Characterize and compare benthic macroinvertebrate community structure in the mudflats and near outfall 008 with reference location data to determine whether communities in the site vicinity have been impacted by site-related activities
- Perform solid phase sediment toxicity to identify whether mudflat area 008 and Marine Basin sediments have a potential effect on benthic macroinvertebrates

Sampling Performed

- 5 composite samples of oyster tissue were collected from site areas; 4 areas were sampled along the intertidal shoreline of the mudflats and on both sides of the Causeway (IFT-1 to IFT-5) and 1 sample (HRT-1) was collected upstream from the site, north of the jetty (Figure 3, attached)
- Triplicate samples from each area were analyzed for PCB's, metals and lipids
- Benthic macroinvertebrate community structure analysis was performed at seven locations along the mudflat transects, at outfall 008, at 1 location in Marine Basin, and 2 upstream reference locations (Figure 2, attached).
- Solid phase toxicity testing using *Ampelisca abdita* was performed on sediments from 10 locations in the mudflat area, 1 location in Marine Basin, 1 location at outfall 008, 2 upstream reference locations and 1 downstream reference location.

Summary of Findings

- Metal levels in oysters from the site were generally consistent with those measured at the reference location and approximately comparable to what would be expected in this area based on Mussel Watch data (Table 6.4-2, Draft BERA).

- PCB levels were highly variable, but generally consistent with Mussel Watch data. The highest detected PCB level in oysters occurred in samples collected near the location of the highest sediment PCB levels (mudflat outfall area).
- Benthic communities located near the shoreline at transect sampling point TAI, TBI, TDI and outfall 008 had the least similarity to the reference location (Table 6.4-1 Draft BERA).
- Lowest percent survival of test species generally occurred near the mudflat shoreline area and at outfall 008 (Table 6.4.3 Draft BERA). This result is consistent with the benthic macroinvertebrate community analysis results for these areas.

Data Gaps

Based on the Phase II investigation, data gaps were identified which require additional data collection to allow adequate ecological risk characterization of aquatic habits adjacent to the site. The area of sediments adjacent to the outfalls that may pose a threat to benthic macroinvertebrates needs to be better delineated. The potential for bioaccumulation of constituents in benthic macroinvertebrate and fish are unknown. Additional benthic macroinvertebrate data are needed to determine whether communities in areas of high constituent concentrations are different than communities in areas of reduced constituent concentrations.

4.3 PROPOSED BIOLOGICAL SAMPLING FOR CURRENT INVESTIGATION

Data Quality Objectives

The DQOs for biological sampling for the current RI are

- To qualitatively characterize fish populations in the mudflat and Marine Basin area
- Evaluate the extent of benthic macroinvertebrate sediment toxicity and
- Assess the potential ecological threat from exposure to aquatic feeding birds to aquatic biological tissues

Proposed Sampling

- Sampling locations are provided in Table 1 and Figure 2, attached
- Sediment toxicity and bioaccumulation testing will be performed on samples from 8 mudflat transect locations to provide data to evaluate the potential threat posed by sediments to aquatic biota.
- Sediment toxicity, bioaccumulation testing and benthic community analysis will be performed on 2 locations by the Causeway area, 3 locations for the 008 outfall area, 4 locations in the Marine Basin, and 1 upstream reference location to collect data from areas identified in Phase II which has not been sampled previously.

- A minimum of six replicate fish samples of a suitable prey species will be collected in the mudflats area and Marine Basin; and at 1 upstream reference location to assess the potential threat to piscivorous receptors.
- Analytes include PCBs, TAL metals, percent lipids and percent moisture; chemical analytes were selected based on data collected in Phase II and known transport mechanisms of the respective constituents

TABLE 6-1
SUMMARY OF CHEMICALS DETECTED IN PHASE I SURFACE WATER SAMPLES
STRATFORD ARMY ENGINE PLANT
STRATFORD, CT

LOCATOR	01-SW	02-SW	03-SW	04-SW	05-SW	06-SW	07-SW	08-SW	LT1-SW	LT2-SW	LT3-SW	08-BG-SW	IBG-SW		
LAB SAMPLE NUMBER	1447401	1447402	1447403	1447404	1447405	1447406	1447409	1447410	1448901	1448902	1448903	1447411	1448904		
COLLECT DATE	10/22/92	10/22/92	10/22/92	10/22/92	10/22/92	10/22/92	10/22/92	10/22/92	10/23/92	10/23/92	10/23/92	10/22/92	10/23/92	AWQC	
	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Acute	Chronic
VOCs (ug/L)															
1, 1, 1 -Trichloroethane							15	13				2		31,200	
1,1-Dichloroethane				4			13					5		113,000	
1,1-Dichloroethene				5			3								
1,2-Dichloroethene (total)	2	10		6		12	48			1		8		224,000	
Benzene												1		5,100	700
Bromodichloromethane							5	2							
Carbon Disulfide			1										2		
Chloroform							15	11				2			
Tetrachloroethene												5			
Toluene									1						5,000
Trichloroethene				2			8	4				2		2,000	
Vinyl Chloride												8			
Xylene (total)									2						
PAHs (ug/L)															
2-Methylnaphthalene							1								
4-Metholphenol							1								
4-Nitrophenol								2						4,850	
Benzoic Acid							1								
Fluorene							1								
Naphthalene							1		1					2,350	
Phenanthrene							1								

TABLE 6-1
SUMMARY OF CHEMICALS DETECTED IN PHASE I SURFACE WATER SAMPLES
STRATFORD ARMY ENGINE PLANT
STRATFORD,CT

LOCATOR	01-SW	02-SW	03-SW	04-SW	05-SW	06-SW	07-SW	08-SW	LT1-SW	LT2-SW	LT3-SW	08-BG-SW	IBG-SW		
LAB SAMPLE NUMBER	1447401	1447402	1447403	1447404	1447405	1447406	1447409	1447410	1448901	1448902	1448903	1447411	1448904		
COLLECT DATE	10/22/92	10/22/92	10/22/92	10/22/92	10/22/92	10/22/92	10/22/92	10/22/92	10/23/92	10/23/92	10/23/92	10/22/92	10/23/92	AWQC	
	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Acute	Chronic
Metals (mg/L)															
Aluminum	0.293	4.75	7.7	0.12	0.654	0.331	1.28	0.077	0.243	0.179	0.096	0.086	0.154		
Antimony	0.055	0.071	0.065	0.068	0.062	0.089			0.077	0.107	0.102	0.044	0.122		
Arsenic										0.006	0.008				0.0013
Barium	0.02	0.035	0.046	0.032	0.023	0.02	0.016		0.012			0.063			
Cadmium	0.003								0.004					0.043	0.0093
Calcium	178	182	192	218	236	208	21	14.1	129	208	273	149	253		
Chromium		0.062	0.11		0.015	0.006			0.007	0.008					0.05
Cobalt			0.006							0.005					
Copper	0.013	0.144	0.214		0.018	0.011	0.006	0.026	0.015	0.012	0.006	0.014	0.007		
Iron	0.501	8.91	15	0.364	1.5	1.42	0.443	0.045	0.241	0.187	0.133	12.6	0.279		
Lead			0.02	0.052						0.02				0.14	0.0056
Magnesium	569	604	658	759	843	704	7		381	675	915	410	840		
Manganese	0.049	0.328	0.456	0.155	0.406	0.417	0.05		0.035	0.025	0.018	1.12	0.035		
Mercury	0.0003	0.0006	0.0006	0.0002	0.0003	0.0002		0.0002				0.0002		0.0021	2.5E-05
Nickel										0.034				0.075	0.008
Potassium	183	188	202	226	251	220	3.61	4.07	122	214	292	130	267		
Sodium	4740	4990	5370	6200	6880	5800	81.3	181				3450			
Vanadium	0.008	0.023	0.037		0.012	0.007			0.011	0.014	0.012		0.016		
Zinc	0.015	0.154	0.23	0.016	0.011	0.011	0.294			0.008		0.021		0.095	0.086
Cyanide (total)							0.01								0.001

TABLE 1
SUMMARY SCOPE OF WORK
FOR AQUATIC HABITATS
REMEDIAL INVESTIGATION
STRATFORD ARMY ENGINE PLANT

	Intertidal Mudflats																	Causeway						Outfall 008/Marine Basin							Ref.
DATA SET[1]	TA01	TA03	TA05	TA06	TA07	TB06	TB07	TC06	TC07	TD01	TD03	TD05	TD06	TD07	TE01	TE03	TE05	TG01	TG02	TG03	TG04	TH01	TH02	008-01	008-02	008-03	MB01	MB02	MB03	MB04	U01
Surface Water Chemistry																								X	X	X	X	X	X	X	X
Surficial Sediment Chemistry 0 - 6"				X	X	X	X	X	X				X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X
Sediment Chemistry at Depth				X	X	X	X	X	X				X	X																	
Bathymetry / Lithology	X	X	X							X	X	X			X	X	X								X		X	X			X
Physicochemical Parameters				X	X	X	X	X	X				X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X
Sediment Toxicity Testing				X	X	X	X	X	X				X	X					X			X		X	X	X	X	X	X	X	X
Bioaccumulation Testing				X	X	X	X	X	X				X	X					X			X									
Benthic Community Analyses																			X			X		X	X	X	X	X	X	X	X
Finfish Tissue Analyses	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→										→	→	→	→	X
Shellfish Tissue Analyses																											→	→	→	→	X

Note: Arrows indicate samples to be collected throughout area at stations to be field identified.

(1)Analytes and methods specified in Table 2.

TABLE 2
SAEP PHASE I - SUMMARY OF CHEMICALS DETECTED IN SEDIMENT SAMPLES

LOCATOR	01-12-24	02-12-24	03-12-24	04-12-24	05-12-24	06-12-24	07-12-24	08-12-24	01-0-12	02-0-12	03-0-12		
LAB SAMPLE NLJN113ER	1453510	1453502	1453504	1453506	1453604	1453602	1453508	1453606	1453509	1453501	1453503		
COLLECT DATE	10/28/92	10/28/92	10/28/92	10/28/92	10/27/92	10/27/92	10/28/92	10/27/92	10/28/92	10/28/92	10/28/92		
	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	ER-L	ER-M OME
Volatiles (ug/kg)													
Chlorobenzene		12											
Ethylbenzene		89								170			
Methylene Chloride	14	36	16	16	11	8	23	7	57	120	57		
Toluene		15								59			
Xylene (total)		190								380			
Sernivolatiles (ug/kg)													
1,2,4-Trichlorobenzene													
2,4-Dinitrotoluene													
2-Chloronaphthalene	24												
2-Methylnaphthalene	20	250	7									70	670
4-Metholphenol													
Acenaphthene	78	110	12		34			230		140	37	16	500
Acenaphthylene	160				20			160			62	44	640
Anthracene	280	160	340	15	57	7		280	62	140	89	85.3	1100
Benzo(a)anthracene	1200	710	200	36	140	45		410	200	300	360	261	1600
Benzo(a)pyrene	730	520	110		82	15		310	170	220	300	430	1600
Benzo(b)fluoranthene	980	730	120		83	26		340		310	280	1700	9600
Benzo(g,h,i)perylene	360									140	120	1700	9600
Benzo(k)fluoranthene	470	460	110		62	18		260		280	240	1700	9600
Benzoic Acid	29						65						
bis(2-Ethylhexyl)phthalate	630	3600	370	66	370	73	42	420	620	5600	620		
Butylbenzylphthalate		450							370	620			
Chrysene	1900	1200	360	65	170	47		710	370	600	580	384	2800
Di-n-butylphthalate	68	4000	760		2000	2800			24	2100	3400		
Di-n-octylphthalate					14								
Dibenz(a,h)anthracene													
Dibenzofuran	36	52	9		21			66			12		
Diethylphthalate	55												
Fluoranthene	2000	1400	530	110	420	70	12	990	620	700	930	600	5100
Fluorene	120	160								130	45	19	540
Indeno(1,2,3-cd)pyrene	420									150	150	1700	9600
n-Nitroso-di-n-propylamine													
n-Nitrosodiphenylamine	300							1100	63				
Naphthalene		190								160		160	2100
Phenanthrene	1200	870		27	160	24		500	230	620	410	240	1500
Pyrene	2400		620	160	300	65	11	700	740	330	1000	665	2600

TABLE 2
SAEP PHASE I - SUMMARY OF CHEMICALS DETECTED IN SEDIMENT SAMPLES

LOCATOR	01-12-24	02-12-24	03-12-24	04-12-24	05-12-24	06-12-24	07-12-24	08-12-24	01-0-12	02-0-12	03-0-12			
LAB SAMPLE NUMBER	1453510	1453502	1453504	1453506	1453604	1453602	1453508	1453606	1453509	1453501	1453503			
COLLECT DATE	10/28/92	10/28/92	10/28/92	10/28/92	10/27/92	10/27/92	10/28/92	10/27/92	10/28/92	10/28/92	10/28/92			
	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	ER-L	ER-M	OME
PCBs (ug/kg)														
Aroclor-1248	1300	65000								70000	4500			
Aroclor-1254														
Aroclor-1260								1400						
Total PCBs												22.7	180	
Metals (mg/kg)														
Aluminum	9600	8200	5800	15100	11500	5440	8490	8950	18600	11100	9530			
Antimony	14.6				28.5	12	15.1	26.5	28.5			2	25	
Arsenic	6.4	6.8	0.005	5.4	4.9	2.6	6.3	8.6	7.3	4.9	6.2	8.2	70	8
Barium	77.2	59	21.9	42.2	64.8	18.2	42.7	56.3	68.8	209	69.7			
Beryllium									1.2	4.7				
Cadmium	2.6	7.6						5		3.4	3	1.2	9.6	1
Calcium	4000	1930	1080	3840	9800	783	1650	5490	3570	17500	7200			
Chromium	267	408	97.2	75.5	455	43.1	26.1	1580	308	537	391	81	370	25
Cobalt	9.7	28.2	6.3	9.5	21.4	5.7	7.7	9.6	15	55.9	19.4			
Copper	539	181	54	271	272	58.5	16.8	404	587	431	266	34	270	25
Iron	18300	20400	13600	26600	31300	12200	20600	17200	32500	32000	26100			
Lead	52	76.6	14.8	42.7	66.2	10.2	6.01	81.7	173	155	97.4	46.7	218	50
Magnesium	5000	5250	3530	8720	7120	2510	4690	4650	10100	8010	8300			
Manganese	257	269	156	366	1200	130	294	403	497	993	697			
Mercury	0.44	0.41		0.31	0.4	0.16		0.28	0.87	1.4	0.57	0.15	0.71	0.3
Nickel	31.4	118	12.2	28.4	249	9.2	12.2	191	117	789	301	20.9	51.6	25
Potassium	1740	1750	1370	3700	3150	1010	1840	1190	5100	2550	1890			
Silver	12.9								23	9.3	5	1	3.7	
Sodium	5150	4320	2130	10100	4260	2230	2680	984	17400	7870	7390			
Vanadium	84.7	71.6	19.9	37.3	40.8	17.1	21.3	28.2	59.5	781	122			
Zinc	306	278	106	229	155	60.8	62.6	235	453	525	332	150	410	100
Cyanide (total)														

TABLE 2
SAEP PHASE I - SUMMARY OF CHEMICALS DETECTED IN SEDIMENT SAMPLES

LOCATOR	04-0-12	05-0-12	06-0-12	06-0-12RE	07-0-12	08-0-12	LT1-0-12	LT1-12-24	LT2-0-12	LT2-12-24	LT3-0-12		
LAB SAMPLE NUMBER	1453505	1453603	1453601	1453601	1453507	1453605	1448907	1448908	1448909	1448910	1448911		
COLLECT DATE	10/28/92	10/27/92	10/27/92	10/27/92	10/28/92	10/27/92	10/23/92	10/23/92	10/23/92	10/23/92	10/23/92		
	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	ER-L	ER-M OME
Volatiles (ug/kg)													
Chlorobenzene													
Ethylbenzene													
Methylene Chloride	17		6		8		25	44	32	35	32		
Toluene													
Xylene (total)													
Sernivolatiles (ug/kg)													
1,2,4-Trichlorobenzene					21								
2,4-Dinitrotoluene													
2-Chloronaphthalene													
2-Methylnaphthalene				190					11			70	670
4-Metholphenol									26				
Acenaphthene		16		1500	9		15		26		98	16	500
Acenaphthylene				200	17				14		17	44	640
Anthracene		31		3200	18	520	95		99		240	85.3	1100
Benzo(a)anthracene		91		5600	<	440	450	69	250		630	261	1600
Benzo(a)pyrene				3200	31	300	200		140		320	430	1600
Benzo(b)fluoranthene		94		2500	34	300	170		150		300	1700	9600
Benzo(g,h,i)perylene				1700			110				210	1700	9600
Benzo(k)fluoranthene		54		2700	28	330	180		130		260	1700	9600
Benzoic Acid	20				42								
bis(2-Ethylhexyl)phthalate	68	220		460	110	1600	75	130	1400	390	200		
Butylbenzylphthalate					31		700	92					
Chrysene		120		6300		700	540	76	360		750	384	2800
Di-n-butylphthalate		4400			10		5500	5700	2600	3600	1200		
Di-n-octylphthalate				32		28	27						
Dibenz(a,h)anthracene				540									
Dibenzofuran				830	4						35		
Diethylphthalate					6						<		
Fluoranthene	24	220		13000	110	1000	1000	81	720		1300	600	5100
Fluorene				1700							82	19	540
Indeno(1,2,3-cd)pyrene				1900							220	1700	9600
n-Nitroso-di-n-propylamine											<		
n-Nitrosodiphenylamine						1300	110	<	170		61		
Naphthalene				700							<	160	2100
Phenanthrene		120		11000	65	3100	460	36	260		840	240	1500
Pyrene	33	120		11000	130	690	980	110	640		980	665	2600

TABLE 2
SAEP PHASE I - SUMMARY OF CHEMICALS DETECTED IN SEDIMENT SAMPLES

LOCATOR	04-0-12	05-0-12	06-0-12	06-0-12 RE	07-0-12	08-0-12	LTI-0-12	LTI-12-24	LT7-0-12	LT2-12-24	LT3-0-12			
LAB SAMPLE NUMBER	1453505	1453603	1453601	1453601	1453507	1453605	1448907	1448908	1448909	1448910	1448911			
COLLECT DATE	10/28/92	10/27/92	10/27/92	10/27/92	10/28/92	10/27/92	10/23/92	10/23/92	10/23/92	10/23/92	10/23/92			
	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	ER-L	ER-M	OME
PCBs (ug/kg)														
Aroclor-1248					290		640		5600					
Aroclor-1254						1100								
Aroclor-1260														
Total PCBs												22.7	180	
Metals (mg/kg)														
Aluminum	5850	4950	5130		4990	8730	14000	14800	9720	14700	9970			
Antimony						69.7	17.1	16	26.4	15	15.8	2	25	
Arsenic	3.7	2.2	3.6		4.5	6.1	7.07	4.54	5.35	4.68	4.44	8.2	70	8
Barium	32.7	14.5	39.9		42.4	74.1	52.5	33.8	40.6	32.3	30.2			
Beryllium							0.85	0.45	0.4					
Cadmium						27.4			1.2			1.2	9.6	1
Calcium	1520	1360	1420		860	19300	3010	4220	3200	4740	2920			
Chromium	57.7	79.5	169		121	4300	286	81.5	185	24.5	288	81	370	25
Cobalt	5.7	6.8	7.1		6.5	13.7	13.2	14.2	19.9	12.9	11.7			
Copper	66.2	74.8	121		64.6	1070	610	246	289	10.2	310	34	270	25
Iron	13500	12000	12400		13700	19100	25400	26100	19000	24000	18100			
Lead	13	33.2	56.2		12.7	189	89.6	17.4	32.6	5.6	26.6	46.7	218	50
Magnesium	3700	3600	3120		2200	19200	7530	8800	6200	8620	5780			
Manganese	320	139	142		102	772	323	312	249	303	239			
Mercury		0.31	0.63		0.18	0.4	0.612	0.268	0.282		0.347	0.15	0.71	0.3
Nickel	26.2	58	68.3		38.8	217	53.9	28.3	118	29.8	55.5	20.9	51.6	25
Potassium	1320	1140	886		912	1300	3430	3780	2880	3260	2740			
Silver						8.2	26.8		3.5			1	3.7	
Sodium	4360	4340	4120		1550	2840	11800	10200	6440	6460	4750			
Vanadium	17.5	21.2	19.5		19.3	34.6	43.9	38.4	73.9	34.1	29.1			
Zinc	75.1	1116	129		125	338	405	174	200	65.1	205	150	410	100
Cyanide (total)						4.6								

TABLE 2
SAEP PHASE I - SUMMARY OF CHEMICALS DETECTED IN SEDIMENT SAMPLES

LOCATOR	LT3-12-24	08-BG-0-12	8-BG-0-12R	08-JIG-12-24	8-BG-12-24R	IBG-0-12	IBG-12-24		
LAB SAMPLE NUMBER	1448912	1453607	53607RE	1453608	53608RE	1448913	1448914		
COLLECT DATE	10/23/92	10/27/92	10/27/92	10/27/92	10/27/92	10/23/92	10/23/92		
	Result	Result	Result	Result	Result	Result	Result	ER-L	ER-M OME
Volatiles (ug/kg)									
Chlorobenzene									
Ethylbenzene									
Methylene Chloride	27		7		4	36	28		
Toluene									
Xylene (total)									
Sernivolatiles (ug/kg)									
1,2,4-Trichlorobenzene									
2,4-Dinitrotoluene		260							
2-Chloronaphthalene									
2-Methylnaphthalene								70	670
4-Metholphenol									
Acenaphthene		380		550				16	500
Acenaphthylene		120		82				44	640
Anthracene		120		130				85.3	1100
Benzo(a)anthracene		430		460				261	1600
Benzo(a)pyrene		240		270				430	1600
Benzo(b)fluoranthene		260		260				1700	9600
Benzo(g,h,i)perylene		100		130				1700	9600
Benzo(k)fluoranthene		200		220				1700	9600
Benzoic Acid									
bis(2-Ethylhexyl)phthalate	720	670		900		56	42		
Butylbenzylphthalate	560	28		<					
Chrysene		600		600				384	2800
Di-n-butylphthalate	1700	22				1200	870		
Di-n-octylphthalate				*41*					
Dibenz(a,h)anthracene									
Dibenzofuran		39		59					
Diethylphthalate									
Fluoranthene		2300		1700				600	5100
Fluorene		100						19	540
Indeno(1,2,3-cd)pyrene		150		170				1700	9600
n-Nitroso-di-n-propylamine		180							
n-Nitrosodiphenylamine		390		580					
Naphthalene								160	2100
Phenanthrene		350		190				240	1500
Pyrene	34	1700		1200				665	2600

TABLE 2
SAEP PHASE I - SUMMARY OF CHEMICALS DETECTED IN SEDIMENT SAMPLES

LOCATOR	LT3-12-24	08-BG-0-12	8-BG-0-12R	08-BG-12-24	8-BG-12-24R	IBG-0-12	IBG-12-24			
LAB SAMPLE NUMBER	1448912	1453607	53607RE	1453608	53608RE	1448913	1448914			
COLLECT DATE	10/23/92	10/27/92	10/27/92	10/27/92	10/27/92	10/23/92	10/23/92			
	Result	Result	Result	Result	Result	Result	Result	ER-L	ER-M	OME
PCBs (ug/kg)										
Aroclor-1248										
Aroclor-1254										
Aroclor-1260										
Total PCBs								22.7	180	
Metals (mg/kg)										
Aluminum	8850	7800		9750		11000	8530			
Antimony	12.9	33.2		15.9		15.1		2	25	
Arsenic	2.66	35.3		7.2		3.41	2.64	8.2	70	8
Barium	17.6	40.7		43.5		25.1	19			
Beryllium	0.36					0.4	0.36			
Cadmium		1.6						1.2	9.6	1
Calcium	2640	1580		1310		2910	2590			
Chromium	16	2550		588		20.3	14.4	81	370	25
Cobalt	8.3	11.6		11.1		13.5	10			
Copper	5.3	573		99.9		12.4	3.2	34	270	25
Iron	15800	18500		18300		20000	14800			
Lead	3.72	113		64.9		5.41	3.3	46.7	218	50
Magnesium	5240	4420		5520		6810	5150			
Manganese	182	231		213		242	181			
Mercury				0.17				0.15	0.71	0.3
Nickel	21.5	183		76.2		21.6	13.1	20.9	51.6	25
Potassium	2170	1150		1970		2840	2170			
Silver								1	3.7	
Sodium	3920	1110		971		4830	2750			
Vanadium	21.8	21.2		28.5		26.5	18.4			
Zinc	47.5	162		93.8		62.4	43.3	150	410	100
Cyanide (total)				0.27						

TABLE 6.3-1

SURFICIAL SEDIMENT DATA SUMMARY AND SELECTION OF COCs
INTERTIDAL MUDFLAT- METALS
STRATFORD ARMY ENGINE PLANT

METAL	NUMBER OF DETECTIONS	NUMBER OF SAMPLES	MINIMUM CONC. (mg/kg)	MAXIMUM CONC. (mg/kg)	REFERENCE LOCATIONS MEAN (mg/kg)	PERCENT EXCEEDING REF. MEAN	ER-L VALUE (2) (mg/kg)	PERCENT EXCEEDING ER-L	ER-M VALUE (2) (mg/kg)	PERCENT EXCEEDING ER-M	RETAIN AS COC?
Antimony	8	28	4.7 U (1)	10.3	ND	29	2	29	25	0	NO
Arsenic	28	28	0.97	8.7	2.2	89	8.2	7	70	0	NO
Beryllium	25	28	0.25 U	1	approx. 0.31	75	NONE	NA (3)	NA	NA	NO
Cadmium	25	28	0.25 U	8.2	0.4	89	1.2	75	9.6	0	YES
Chromium	28	28	7.5	916	21	93	81	86	370	11	YES
Copper	28	28	28.1	1410	49	93	34	96	270	71	YES
Lead	28	28	12.2	166	18	93	46.7	71	218	0	YES
Mercury	18	28	0.14 U	2.6	0.21	61	0.15	61	0.71	43	YES
Nickel	28	28	7.9	523	11.5	96	20.9	82	51.6	29	YES
Silver	17	28	0.61 U	63.2	0.9	61	1	61	3.7	25	YES
Zinc	28	28	45.5	568	63	96	150	75	410	29	YES

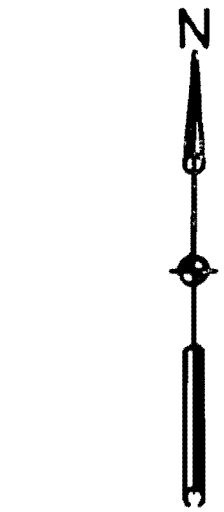
Notes:

(1) U = Undetected at the indicated detection limit

(2) ER-L = Effects Range-Low; ER-M = Effects Range-Medium; Source: Long and MacDonald, 1995; except for Antimony, from Long and Morgan, 1990.

(3) NA = Not Applicable

NOTE: SF SAMPLES WERE ONLY TESTED FOR ASBESTOS AND WERE NOT USED IN THE RISK ASSESSMENT.



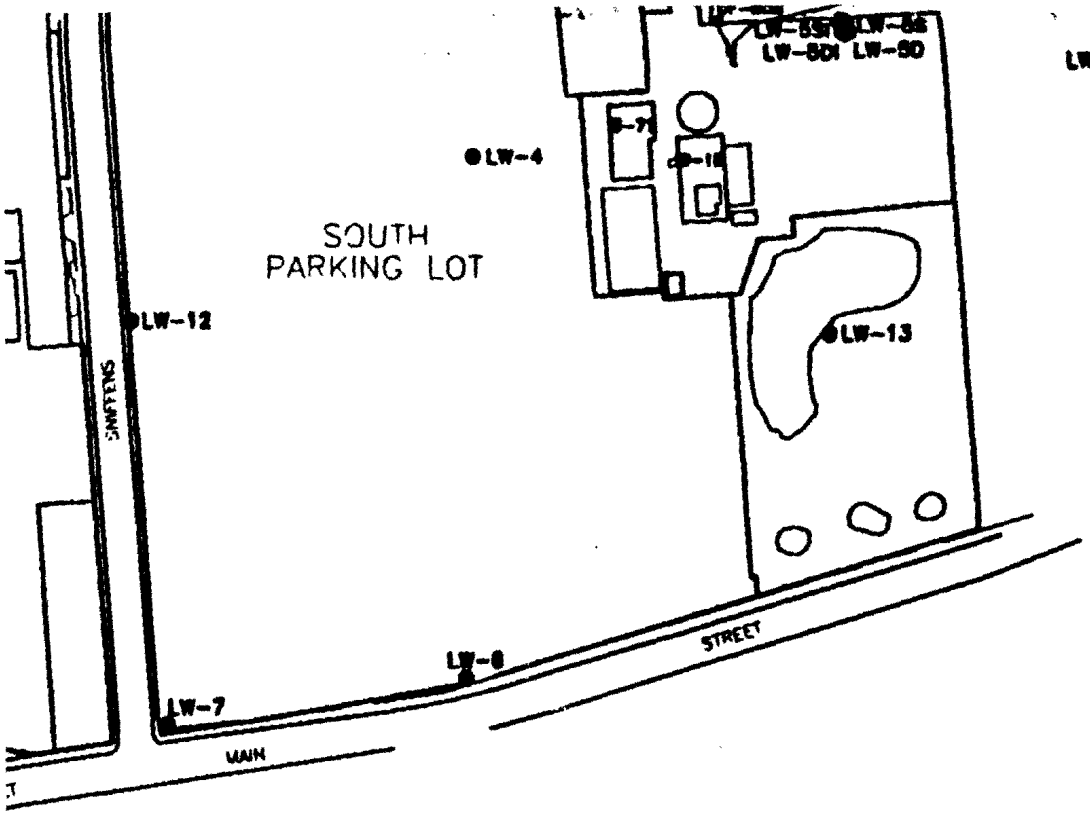
Woodward-Clyde
ENGINEERING & SCIENCES APPLIED
TO THE EARTH & ITS ENVIRONMENT

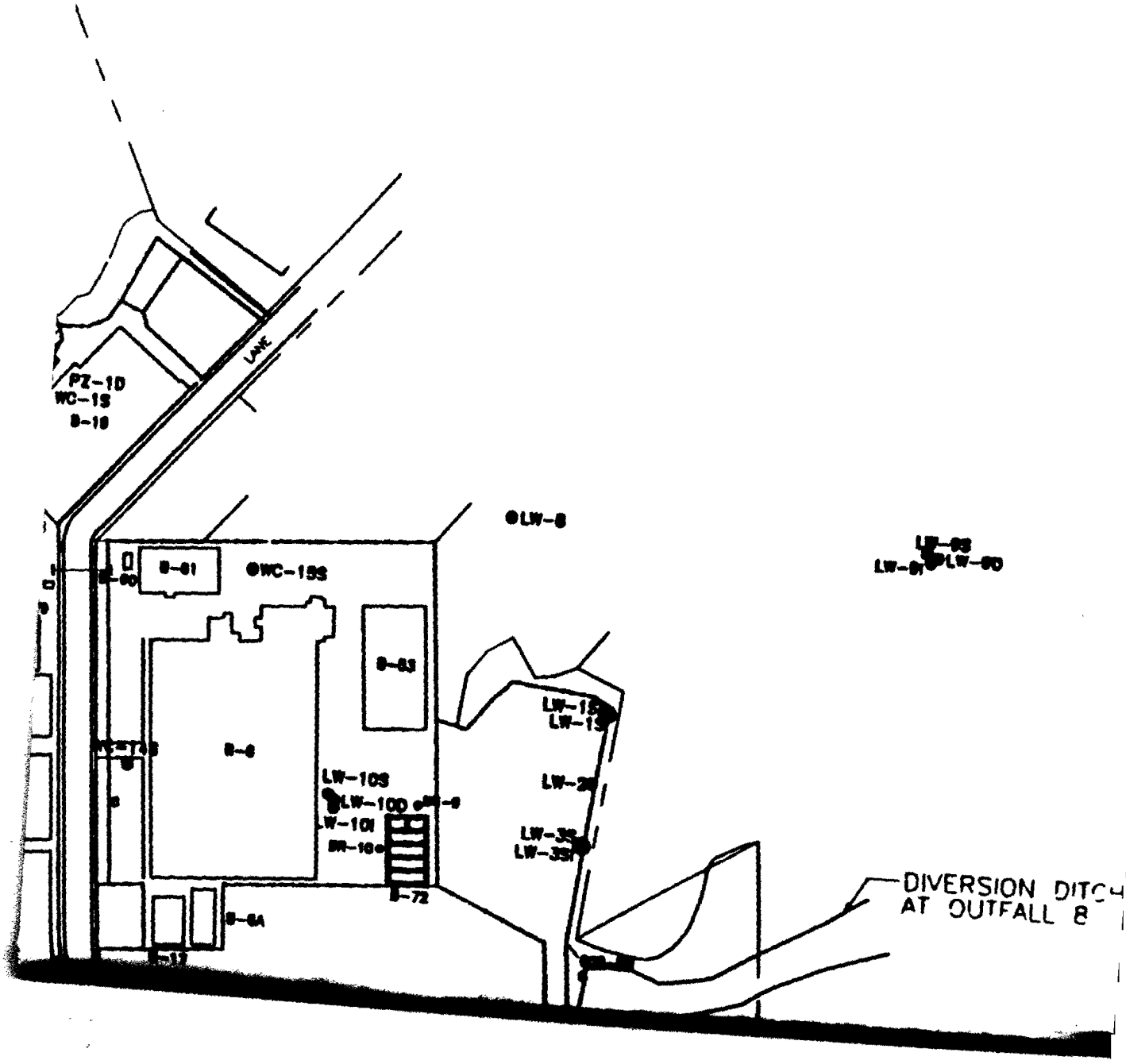
SITE PLAN – PHASE I SAMPLING LOCATIONS
STRATFORD ARMY ENGINE PLANT
STRATFORD, CONNECTICUT

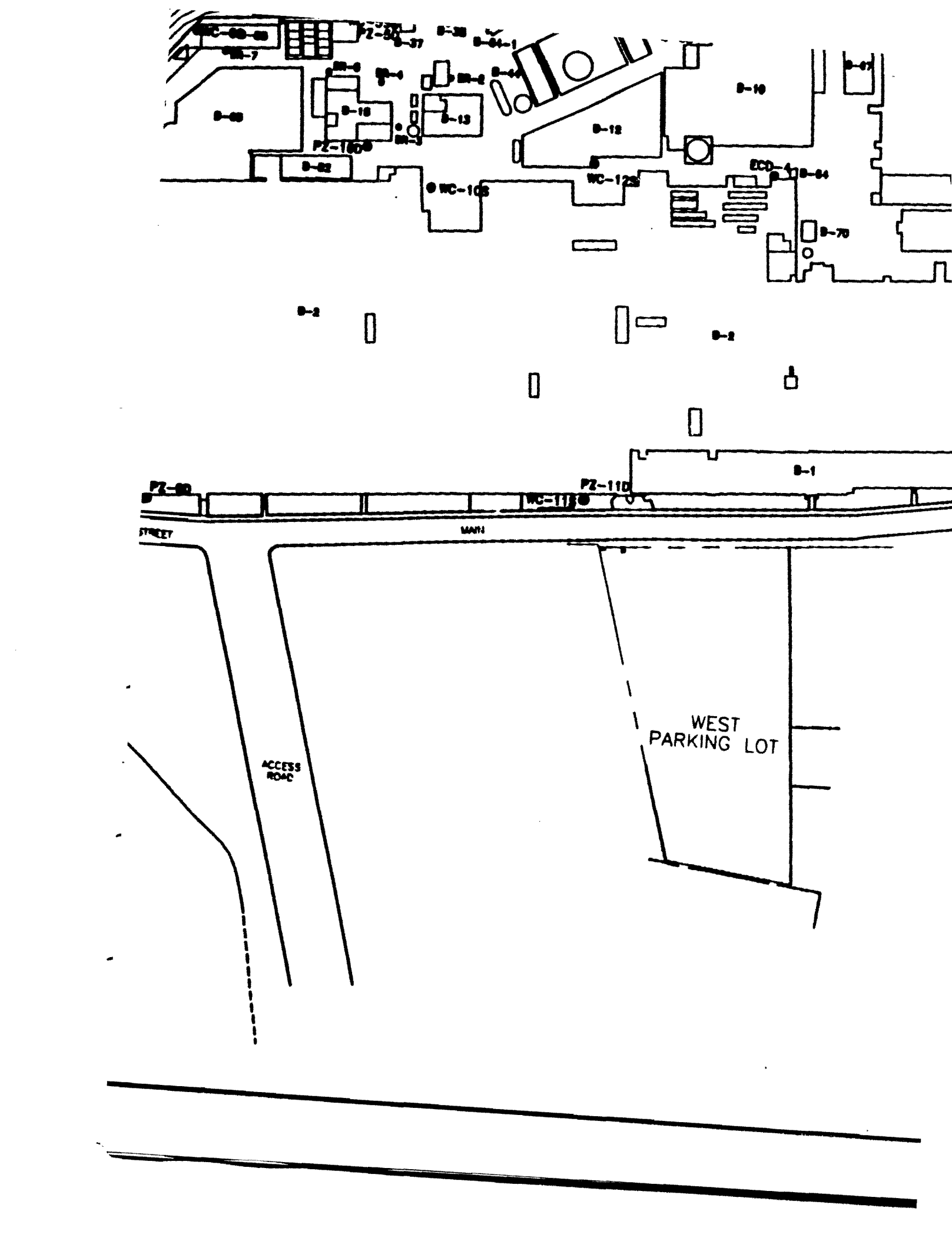
DRN BY: MVB/SCR	DATE: NOV. 1995	PROJECT NO. C3M11LL	FIG. NO. 5.1-2
CHK'D BY:	REVISION: 0		

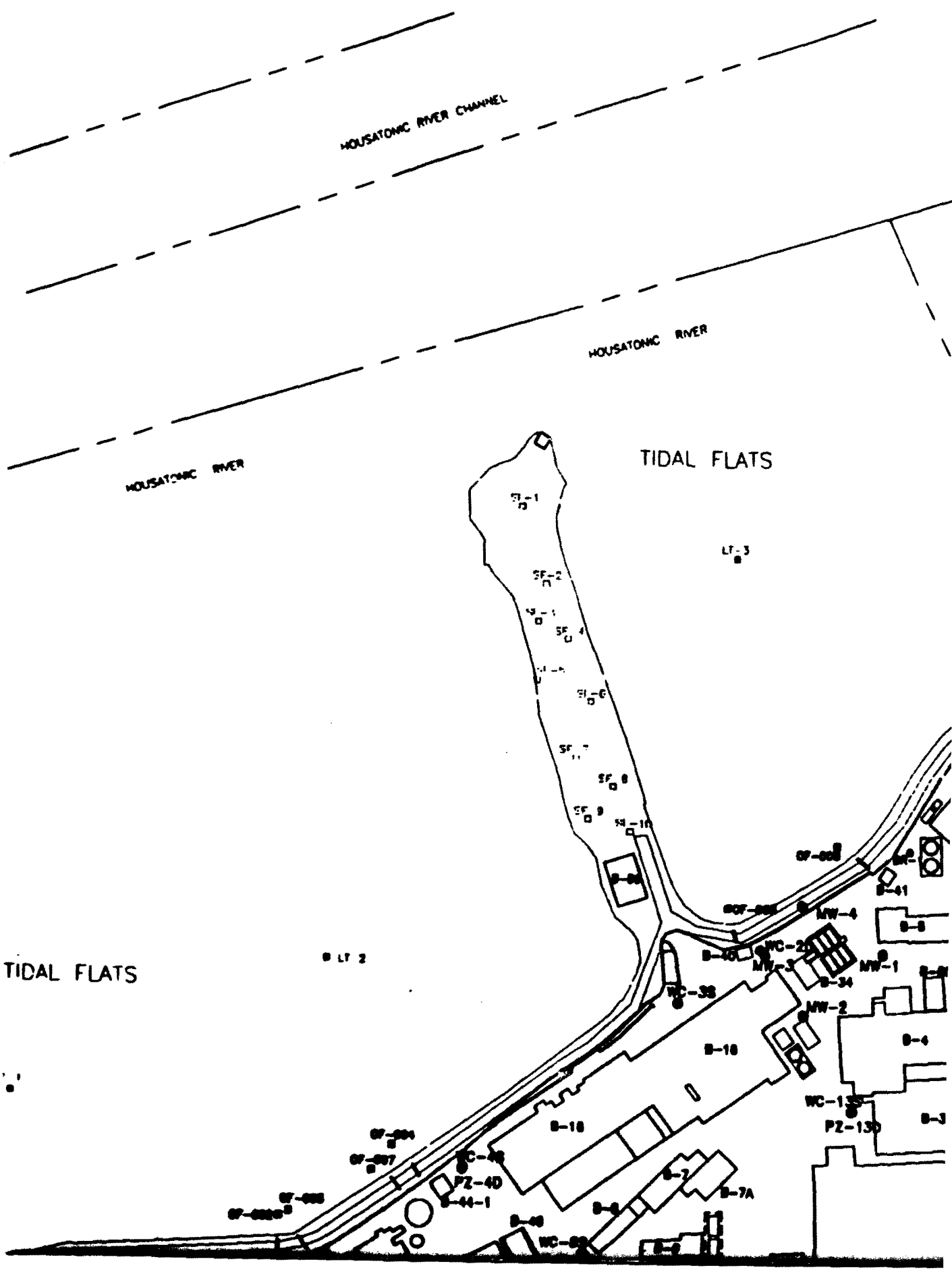
LEGEND:

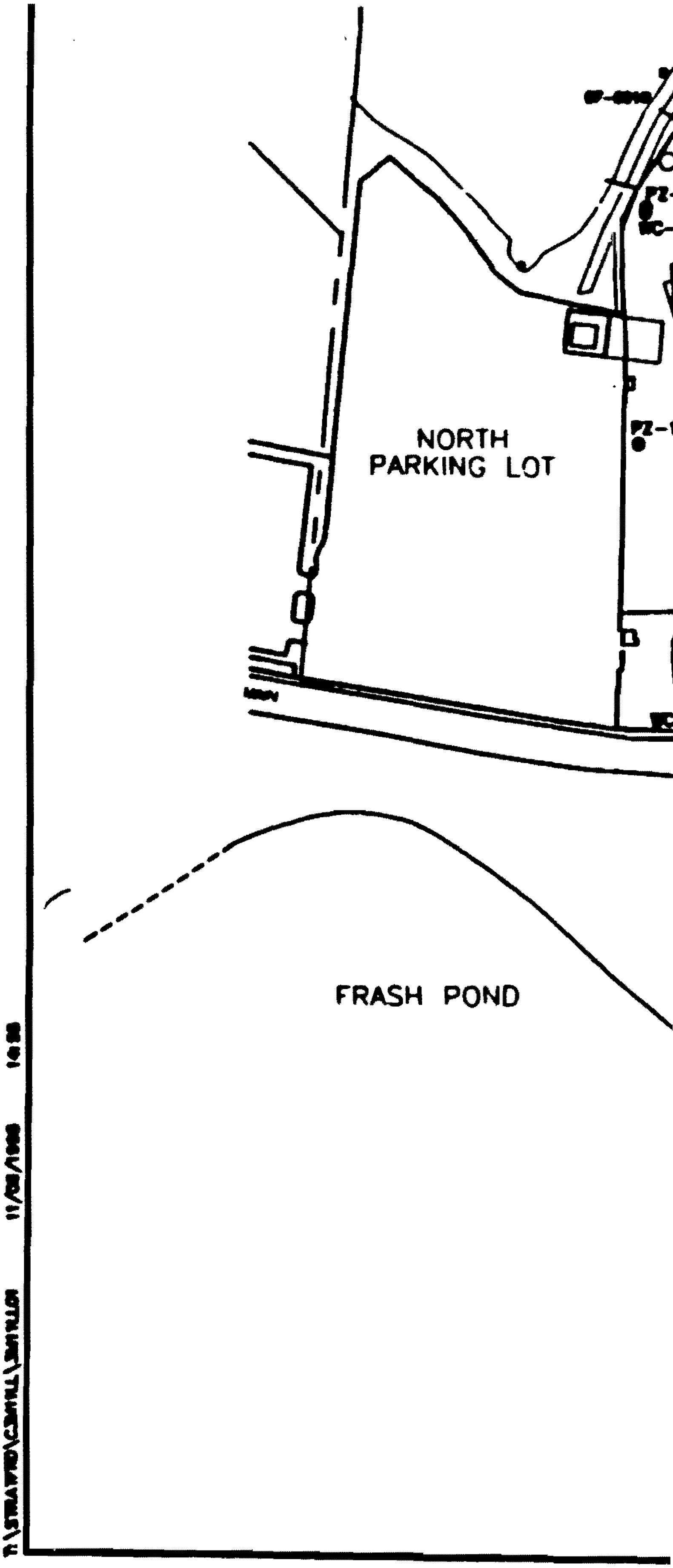
- ● MONITORING WELL LOCATION
- ● PIEZOMETER LOCATION
- • BORING LOCATION
- • SEDIMENT AND SURFACE WATER SAMPLING LOCATION
- • SURFACE SOIL SAMPLING LOCATION

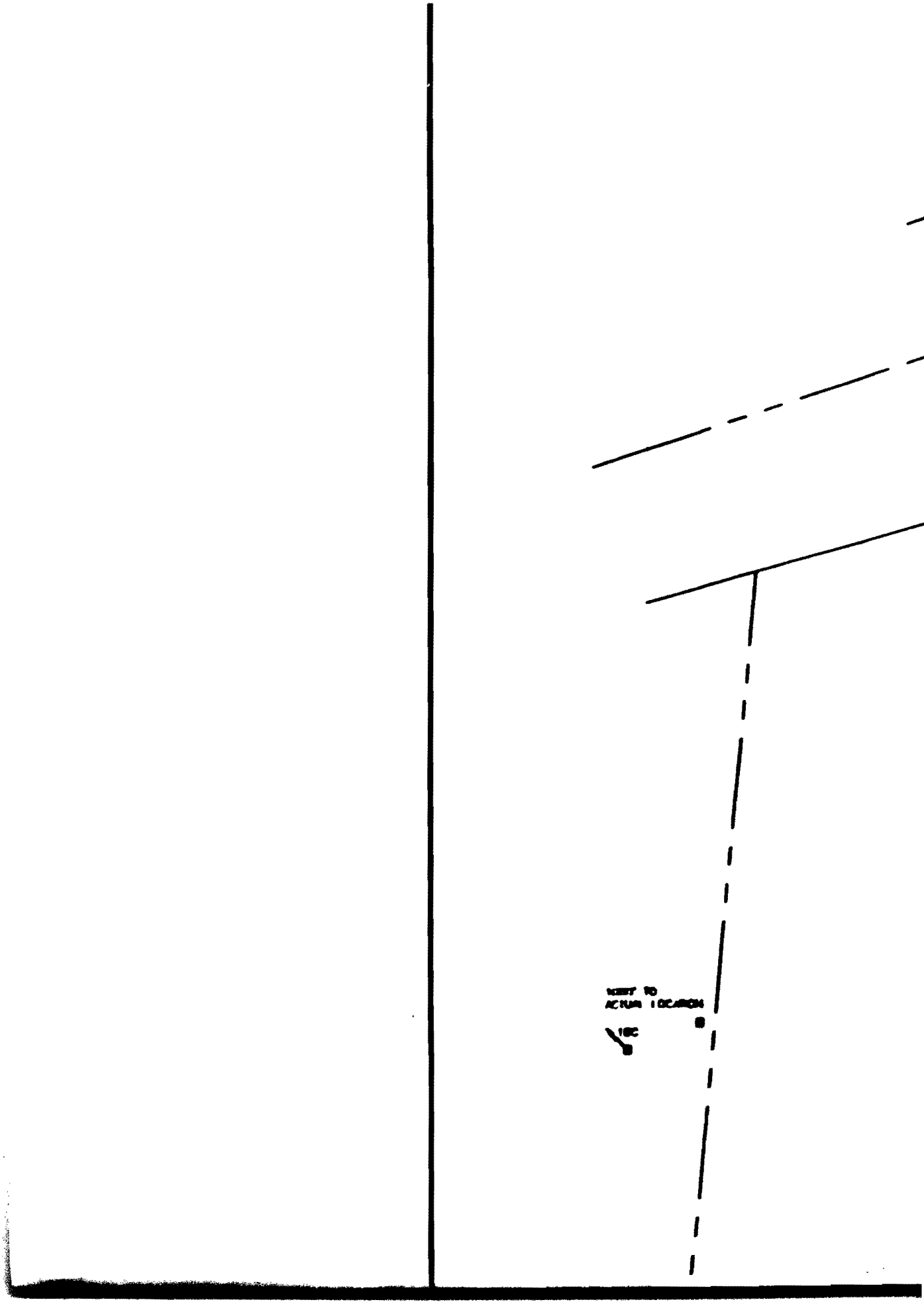

LW-4
SOUTH
PARKING LOT
LW-12
LW-13
SHAFFERS
LW-8
STREET
LW-7
MAIN

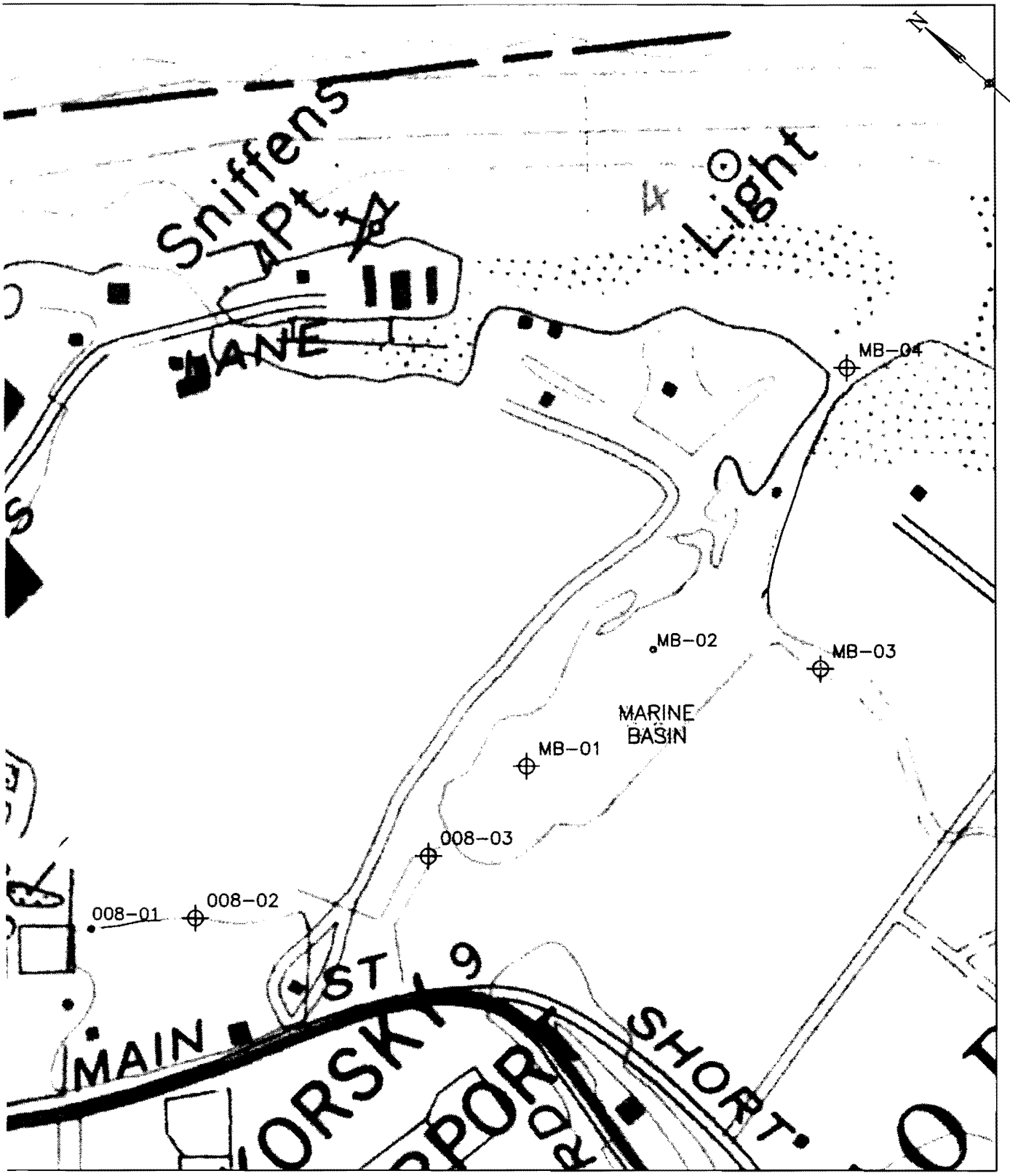

LANE
PZ-1D
WC-1S
B-1B
LW-8
B-61
WC-15S
B-63
B-6
LW-10S
LW-100
LW-101
B-72
B-6A
DIVERSION DITCH
AT OUTFALL B


B-10
B-12
B-13
B-70
B-1
B-2
PZ-110
MAIN
STREET
ACCESS ROAD
WEST PARKING LOT


HOUSATONIC RIVER CHANNEL
HOUSATONIC RIVER
HOUSATONIC RIVER
TIDAL FLATS
TIDAL FLATS
LT-3
LT-2
SF-1
SF-2
SF-6
SF-8
SF-9
SF-10
MW-4
MW-3
MW-1
MW-2
B-41
B-40
B-34
B-18
B-4
B-2
B-7A
PZ-40
PZ-13D
B-44-1


NORTH
PARKING LOT
FRASH POND



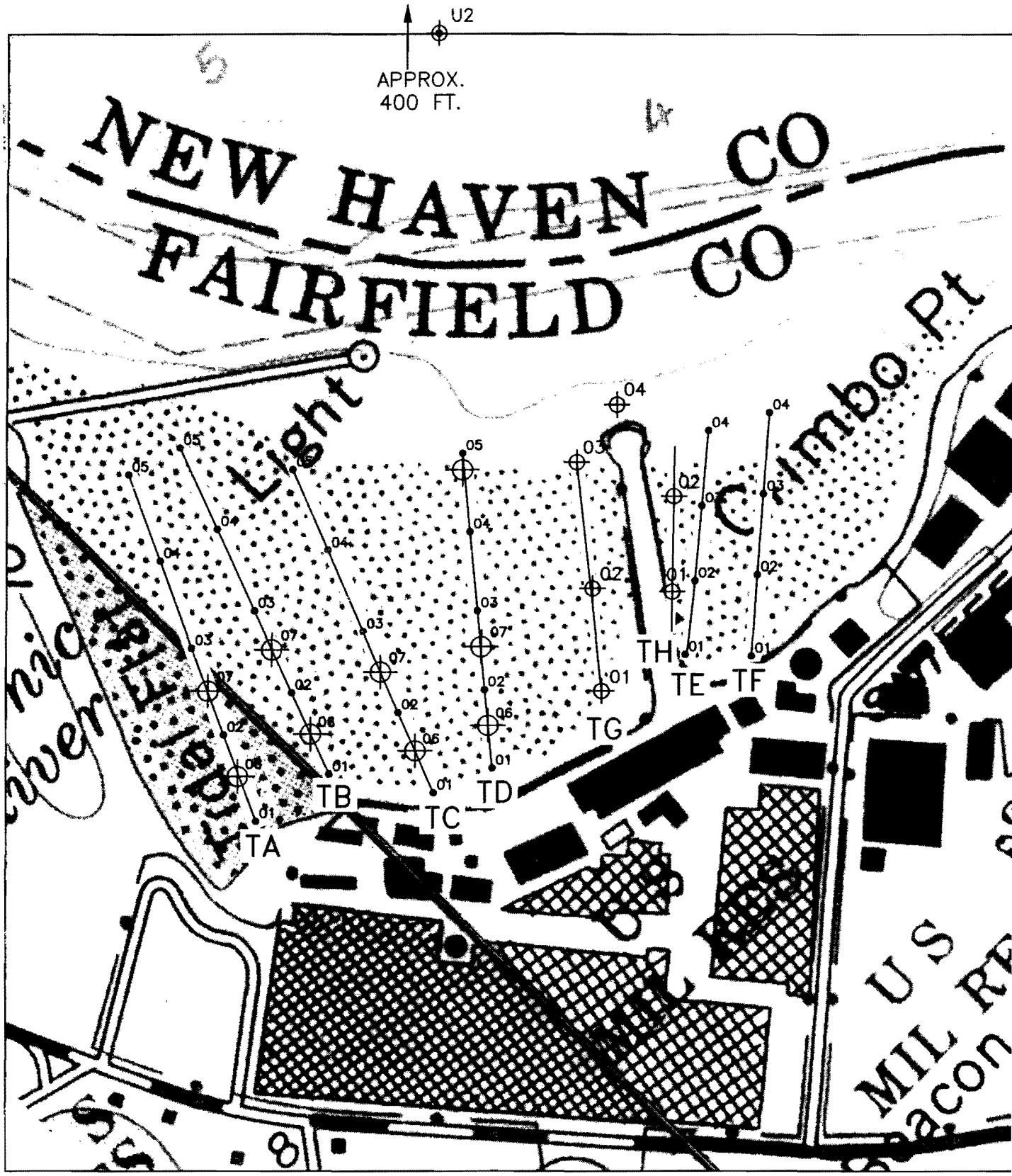


MPLING STATION

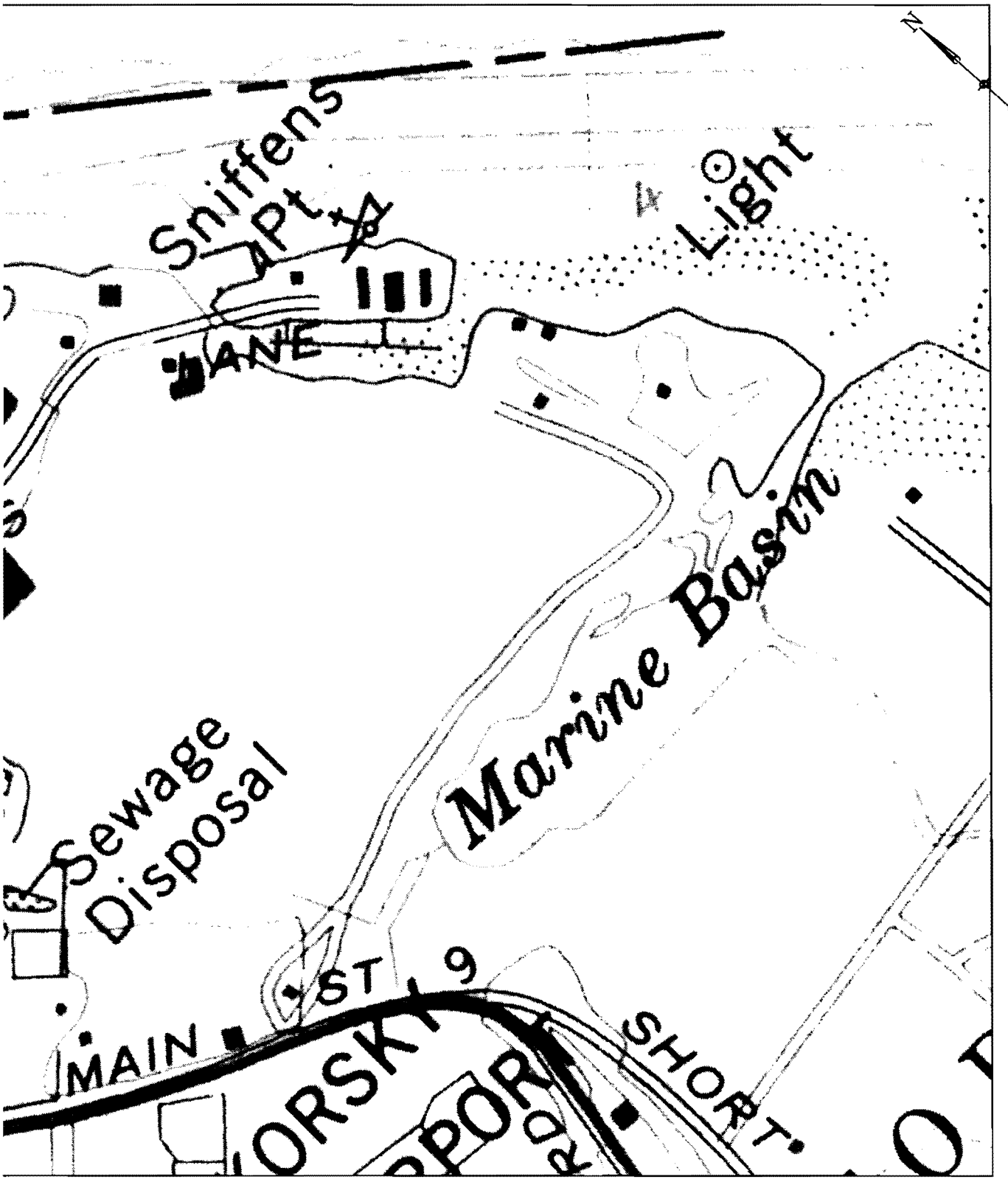
MPLING LOCATION

TIONS APPROXIMATE.

Job No. K9716	AQUATIC SAMPLING LOCATIONS REMEDIAL INVESTIGATION STRATFORD ARMY ENGINE PLANT STRATFORD, CONNECTICUT
Prepared by: TFP	
Date: 03/17/1998	FIGURE 2

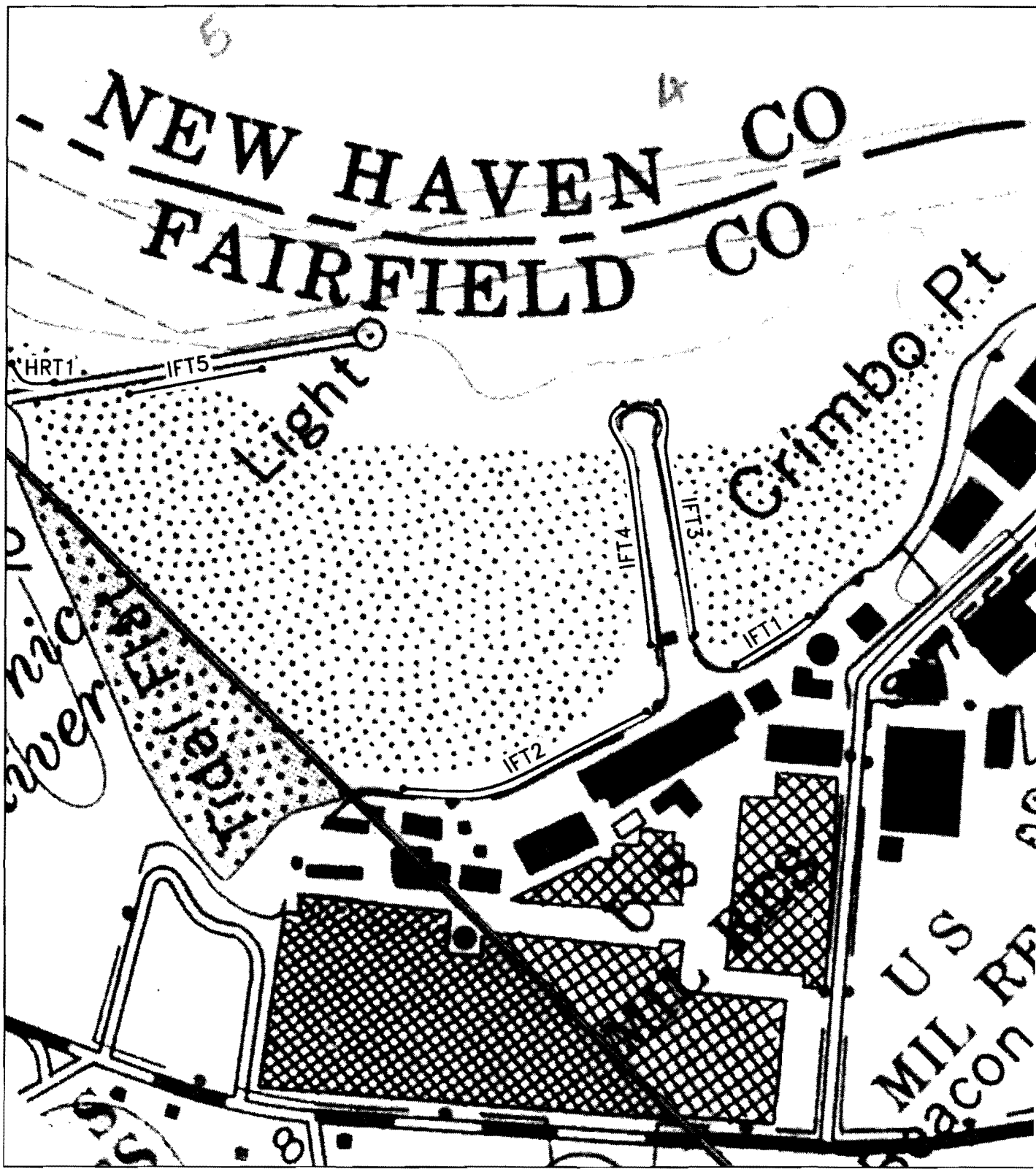

U2
APPROX.
400 FT.
NEW HAVEN CO
FAIRFIELD CO
Light
Crimbo Pt
TA
TB
TC
TD
TE-TF
TG
TH
SCALE IN FEET
0
500'
LEGEND:
PREVIOUS
PROPOSED
NOTE: STATION L

K9716.dwg



; AREA

Job No. K9716	OYSTER TISSUE SAMPLING LOCATIONS REMEDIAL INVESTIGATION STRATFORD ARMY ENGINE PLANT STRATFORD, CONNECTICUT
Prepared by: TFP	
Date: 07/13/1998	FIGURE 3


NEW HAVEN CO
FAIRFIELD CO
Light
Crimbo Pt
HRT1
IFT5
IFT4
IFT3
IFT1
IFT2
Tidal Split
SCALE IN FEET
0
500'
LEGEND
SAMP

K9716a.dwr

STATE OF CONNECTICUT

REGULATION

OF

DEPARTMENT OF ENVIRONMENTAL PROTECTION

concerning

REMEDIATION STANDARD

Section 1. The Regulations of Connecticut State Agencies are amended by adding a new section 22a-133k-1 as follows:

Section 22a-133k-1

(a) Definitions.

For the purposes of sections 22a-133k-1 through 22a-133k-3 of the Regulations of Connecticut State Agencies, the following definitions apply:

(1) "Analytical detection limit" means the minimum concentration of a substance that can be quantified consistently and reliably using methods approved by EPA and which concentration shall be (A) for a substance in ground water, equal to or less than the ground-water protection criterion for such substance determined (i) for a sample of ground water in a GA area using analytical methods specified in subpart C of 40 CFR part 141 or (ii) for a sample of ground water in a GB area using methods established pursuant to "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", SW-846, U.S. Environmental Protection Agency, Office of Solid Waste, Washington D.C. 20460; or (B) for a substance in soil, equal to or less than the residential direct exposure criteria or the applicable pollutant mobility criteria, whichever is lower using methods established pursuant to "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", SW-846, U.S. Environmental Protection Agency, Office of Solid Waste, Washington D.C. 20460.

(2) "Aquifer protection area" means an aquifer protection area as defined in section 22a-354h of the General Statutes.

(3) "Area of influence" means as "area of influence" as defined in section 22a-354b-1(a) of the Regulations of Connecticut State Agencies.

(4) "Areal extent of a ground-water plume" means the surface area beneath which ground water has been or may be polluted by a release and in which ground water one or more substances from such release is or may be present at a concentration above the analytical detection limit.

(5) "Background concentration for ground water" with respect to a particular release means the concentration of a substance in ground water (A) at the nearest location upgradient of and unaffected by the release; or (B) if such release occurred at or created a ground-water divide, at the nearest location representative of ground water quality unaffected by any release.

(6) "Background concentration for soil" means the representative concentration of a substance in soil of similar texture and composition outside the subject release area and in the general geographic vicinity of such release area, but not within any other release area.

(7) "Carcinogenic substance" means a substance defined as a "carcinogen" by federal or state agencies and for which a quantitative health risk extrapolation is available.

(8) "CFR" means the Code of Federal Regulations.

(9) "Commissioner" means the Commissioner of Environmental Protection or his designee.

(10) "Dense non-aqueous phase liquid" means a non-aqueous phase liquid that has a density greater than water at 20 degrees Celsius.

(11) "Direct Exposure Criteria" means the concentrations identified in Appendix A to sections 22a-133k-1 through 22a-133k-3 of the Regulations of Connecticut State Agencies or any alternative direct exposure criteria approved by the Commissioner pursuant to section 22a-133k-2(d) of the Regulations of Connecticut State Agencies.

(12) "Downgradient" means in the direction of the maximum rate of decrease of hydraulic head.

(13) "Downgradient area" with respect to a release of a substance means the area bounded by (A) the width of the release area of such substance perpendicular to the direction of ground-water flow, (B) two side boundary lines parallel to the downgradient direction of ground water flow extending from the two endpoints of said width to the downgradient parcel boundary, and (C) the downgradient parcel boundary extending between the two side boundary lines; excluding any portion of such downgradient area that is (i) affected by any other release of such substance or (ii) beneath an existing permanent structure.

(14) "Environmental land use restriction" means an environmental land use restriction as defined in section 22a-133q-1 of the Regulations of Connecticut State Agencies.

(15) "Environmentally isolated soil" means polluted soil which is: (A)(i) beneath an existing building or (ii) beneath another existing and permanent structure which the Commissioner has determined in writing would prevent the migration of pollutants; (B) not a continuing source of pollution; (C) not polluted with volatile organic substances or, if it is polluted with such substances, the concentration of such substances has been reduced in concentration to the maximum extent prudent; and (D) above the seasonal high water table.

(16) "EPA" means the United States Environmental Protection Agency.

(17) "Excess lifetime cancer risk" means the estimated probability that an individual's exposure to a substance could result in cancer.

(18) "GA area" means an area where the ground-water classification is GA or GAA, respectively.

(19) "GB area" means an area where the ground-water classification is GB.

(20) "Ground water" means that portion of waters as defined in section 22a-423 of the General Statutes which portion is at or below the water table.

(21) "Ground-water classification" means the ground-water classification goal or the ground-water classification, whichever is more stringent, established in the Water Quality Standards.

(22) "Ground-water divide" means a line on the water table from which the water table slopes downward in both directions away from such line.

(23) "Ground-water protection criteria" means the concentrations identified in Appendix C to sections 22a-133k-1 through 22a-133k-3 of the Regulations of Connecticut State Agencies.

(24) "Ground-water plume" means ground water which has been polluted by a release and in which ground water one or more substances from such release is present at a concentration above the analytical detection limit.

(25) "Hazard index" means the calculation of the potential for non-cancer health effects as a result of exposure to one or more substances with the same or similar modes of toxic action or toxic endpoints.

(26) "Hydraulic gradient" means the change in hydraulic head per unit distance.

(27) "Hydraulic head" means the elevation to which water rises in a piezometer or a well.

(28) "Inaccessible soil" means polluted soil which is: (A) more than four feet below the ground surface; (B) more than two feet below a paved surface comprised of a minimum of three inches of bituminous concrete or concrete, which two feet may include the depth of any material used as sub-base for the pavement; or (C)(i) beneath an existing building or (ii) beneath another existing permanent structure provided written notice that such structure will be used to prevent human contact with such soil has been provided to the Commissioner.

(29) "Industrial or commercial activity" means any activity related to the commercial production, distribution, manufacture or sale of goods or services, or any other activity which is not a residential activity as defined in subdivision (53) of this subsection.

(30) "Industrial/commercial direct exposure criteria" means the concentrations identified as industrial/commercial direct exposure criteria in Appendix A to sections 22a-133k-1 through 22a-133k-3 of the Regulations of Connecticut State Agencies.

(31) "Industrial/commercial volatilization criteria" means the concentrations identified as industrial/commercial volatilization criteria in Appendices E and F to sections 22a-133k-1 through 22a-133k-3 of the Regulations of Connecticut State Agencies.

(32) "Intermittent watercourse" means "intermittent watercourse" as defined in section 22a-38 of the General Statutes.

(33) "Light non-aqueous phase liquid" means a non-aqueous phase liquid that has a density equal to or less than water at 20 degrees Celsius.

(34) "Matrix interference effect" means the inability to measure the concentration of a substance in a sample at the analytical detection limit due to chemical interferences within the sample which interferences cannot be compensated for using methods approved by EPA.

(35) "Natural attenuation" means a decrease in concentration of a substance in ground water through operation of natural physical or chemical processes, including but not limited to adsorption, absorption, dilution, phase transfer, oxidation, organic complexation, biodegradation, dispersion and diffusion.

(36) "Non-aqueous phase liquid" means a liquid that is not dissolved in water.

(37) "Organoleptic" means the capability to produce a detectable sensory stimulus such as odor or taste.

(38) "Parcel" means a piece, tract or lot of land, together with the buildings and other improvements situated thereon, a legal description of which piece, parcel, tract or lot is contained in a deed or other instrument of conveyance.

(39) "PCB" means polychlorinated biphenyls.

(40) "PPB" means parts per billion.

(41) "PPM" means parts per million.

(42) "Person" means person as defined in section 22a-2(c) of the General Statutes.

(43) "Pollutant mobility criteria" means the concentrations identified in Appendix B to sections 22a-133k-1 through 22a-133k-3 of the Regulations of Connecticut State Agencies or any alternative pollutant mobility criteria approved by the Commissioner pursuant to subsection 22a-133k-2(d) of the Regulations of Connecticut State Agencies.

(44) "Polluted fill" means soil or sediment which contained polluting substances at the time such soil or sediment was deposited as fill material.

(45) "Polluted soil" means soil affected by a release of a substance at a concentration above the analytical detection limit for such substance.

(46) "Pollution" means pollution as defined in section 22a-423 of the General Statutes.

(47) "Potable water" means potable water as defined in section 22a-423 of the General Statutes.

(48) "Potential public water supply resource" means (A) any "potential well field" as defined in section 22a-354a of the General Statutes, or (B) any area identified by the Commissioner pursuant to section 22a-354c(b) of the General Statutes.

(49) "Prudent" means reasonable, after taking into consideration cost, in light of the social and environmental benefits.

(50) "Release" means any discharge, spillage, uncontrolled loss, seepage, filtration, leakage, injection, escape, dumping, pumping, pouring, emitting, emptying, or disposal of a substance.

(51) "Release area" means the land area at and beneath which polluted soil is located as a result of a release.

(52) "Remediation" means the containment, removal, mitigation, or abatement of pollution, a potential source of pollution, or a substance which poses a risk to human health or the environment, and includes but is not limited to the reduction of pollution by natural attenuation.

(53) "Residential activity" means any activity related to a (A) residence or dwelling, including but not limited to a house, apartment, or condominium, or (B) school, hospital, day care center, playground, or outdoor recreational area.

(54) "Residential direct exposure criteria" means the concentrations identified as residential direct exposure criteria in Appendix A to sections 22a-133k-1 through 22a-133k-3 of the Regulations of Connecticut State Agencies.

(55) "Residential volatilization criteria" means the concentrations identified as residential volatilization criteria in Appendices E and F to sections 22a-133k-1 through 22a-133k-3 of the Regulations of Connecticut State Agencies.

(56) "Seasonal high water table" means, on an annual basis, the highest plane in the ground at which plane all pore spaces are filled with water atmospheric pressure.

(57) "Seasonal low water table" means, on an annual basis, the lowest plane in the ground at which plane all pore spaces are filled with water atmospheric pressure.

(58) "Sediment" means unconsolidated material occurring in a stream channel, estuarine waters, or marine waters.

(59) "Seven day, ten year low flow" or "7Q10" means the lowest seven consecutive day mean stream discharge rate with a recurrence interval of ten (10) years.

(60) "Soil" means unconsolidated geologic material overlying bedrock, but not including sediment.

(61) "Soil water" means that portion of waters as defined in section 22a-423 of the General Statutes which portion is above the water table.

(62) "SPLP" means Synthetic Precipitation Leaching Procedure EPA Method 1312 as set forth in "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", SW-846, U.S. Environmental Protection Agency, Office of Solid Waste, Washington D.C. 20460.

(63) "Substance" means an element, compound or material which, when added to air, water, soil or sediment, may alter the physical, chemical, biological or other characteristic of such air, water, soil or sediment.

(64) "Surface-water protection criteria" means the concentrations identified in Appendix D to sections 22a-133k-1 through 22a-133k-3 of the Regulations of Connecticut State Agencies or any alternative surface-water protection criteria calculated or approved by the Commissioner in accordance with subdivision 22a-133k-3(b)(3) of the Regulations of Connecticut State Agencies.

(65) "TCLP" means Toxicity Characteristic Leaching Procedure EPA Method 1311 as set forth in "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", SW-846, U.S. Environmental Protection Agency, Office of Solid Waste, Washington D.C. 20460.

(66) "Technically practicable" means, with respect to remediation, the greatest degree of remediation that can be achieved using sound engineering and hydrogeologic practices.

(67) "Upgradient" means in the direction of maximum rate of increase of hydraulic head.

(68) "Upgradient area" with respect to a release area of a substance means the area bounded by (A) the width of the release area of such substance perpendicular to the direction of ground-water flow, (B) two side boundary lines parallel to the upgradient direction of ground-water flow extending from the two endpoints of said width to the upgradient parcel boundary, and (C) the upgradient parcel boundary extending between the two side boundary lines; excluding any portion of such upgradient area that is (i) affected by any other release of such substance or (ii) beneath an existing permanent structure.

(69) "Volatilization criteria" means the concentrations identified in Appendix E and Appendix F to sections 22a-133k-1 through 22a-133k-3 of the Regulations of Connecticut State Agencies or alternative criteria approved by the Commissioner pursuant to subdivision 22a-133k-3(c)(4) of the Regulations of Connecticut State Agencies.

(70) "Volatilization criteria for ground water" means the concentrations identified in Appendix E to sections 22a-133k-1 through 22a-133k-3 of the Regulations of Connecticut State Agencies.

(71) "Volatilization criteria for soil vapor" means the concentrations identified in Appendix F to sections 22a-133k-1 through 22a-133k-3 of the Regulations of Connecticut State Agencies.

(72) "Water table" means the plane in the ground at which plane all pore spaces are filled with water at atmospheric pressure.

(73) "Water Quality Standards" means the latest adopted Connecticut Water Quality Standards and Criteria adopted by the Commissioner pursuant to section 22a-426 of the General Statutes.

(74) "Wetland" means 'wetlands' as defined in sections 22a-38(15) and section 22a-29(2) of the General Statutes.

(75) "Zone of influence" means zone of influence as defined in section 22a-430-3(a) of the Regulations of Connecticut State Agencies.

(b) Applicability.

Sections 22a-133k-1 through 22a-133k-3, inclusive, of the Regulations of Connecticut State Agencies apply to any action taken to remediate polluted soil, surface water or a ground-water plume at or emanating from a release area which action is:

(1) required pursuant to Chapter 445 or 446k of the General Statutes, or

(2) taken pursuant to Public Act 95-183 or Public Act 95-190 including but not limited to any such action required to be taken or verified by a licensed environmental professional pursuant to such Public Acts.

Sections 22a-133k-1 through 22a-133k-3, inclusive, of the Regulations of Connecticut State Agencies do not apply within the zone of influence of a ground-water discharge permitted by the Commissioner under section 22a-430 of the General Statutes. Any person conducting a remediation in accordance with said sections 22a-133k-1 through 22a-133k-3, inclusive, of the Regulations of Connecticut State Agencies shall obtain all permits and other authorizations required by state, federal and local law and shall comply with all applicable state, federal and local laws, including without limitation the requirements of 40 CFR Part 761. In the event that any provision of sections 22a-133k-1 through 22a-133k-3, inclusive, of the Regulations of Connecticut State Agencies conflicts with any provision of any other statute or regulation, the more stringent provision shall prevail. Nothing in this subsection shall be construed as requiring any further remediation of any release which has been remediated and which remediation has been approved in writing by the Commissioner, unless the Commissioner takes action to require such remediation pursuant to any section of Chapter 446k of the General Statutes.

(c) Time frames for Issuance of Approvals by the Commissioner.

The Commissioner shall, no later than thirty days after the date of receipt of a request for his approval of any variance from or alternative criteria pursuant to sections 22a-133k-1 through 22a-133k-3, inclusive, of the Regulations of Connecticut State Agencies, provide to the requester in writing estimated time frames for the Commissioner to (1) determine whether additional information is needed for him to evaluate the request; and (2) approve or deny a complete request. In addition, no later than one hundred and eighty days following adoption of said sections 22a-133k-1 through 22a-133k-3, inclusive, of the Regulations of Connecticut State Agencies, the Commissioner shall make available general estimated written time frames for the Commissioner to approve any variance or alternative criterion pursuant to these regulations, including estimated time frames for the Commissioner to (1) determine whether additional information is needed to evaluate the request; and (2) approve or deny a complete request. In establishing estimated time frames pursuant to this subsection, the Commissioner shall take into account the complexity of the request, and the environmental and economic significance of the remediation, and shall expedite any request associated with any voluntary remediation pursuant to Public Acts 95-183 or 95-190.

(d) Public Participation.

(1) Public Hearing on Remediation. If the Commissioner determines that there is substantial public interest in any remediation proposed pursuant to section 2 of P.A. 95-190 or section 2 or 3 of P.A. 95-183, he may hold a public hearing on such proposed remediation, and he shall hold a hearing upon receipt of a petition signed by twenty-five or more persons. Notice of any such hearing shall be published in a newspaper of substantial circulation in the area of the proposed remediation at least thirty days prior to such hearing. Such hearing need not be conducted pursuant to the provisions of Chapter 54 of the General Statutes.

(2) Comment Procedures. Any public notice published or mailed pursuant to section 2 of P.A. 95-190 or section 2 or 3 of P.A. 95-183 shall provide that comments on the proposed remediation may be submitted to the Commissioner within forty-five days of the publication or mailing of such notice. The Commissioner shall forward a copy of all comments received by the date specified in the public notice and all comments made at a public hearing to the owner of the subject parcel and, if different, the person undertaking remediation at such parcel. The person undertaking remediation at the subject parcel shall, within sixty days of receiving such comments, submit to the Commissioner a written summary of all such comments and a written response to each such comment. The Commissioner shall review such summary and responses and shall adopt it as his own, adopt it with modifications, or reject it and prepare a response to each such comment. The Commissioner shall send a copy of the initial summary and responses and of his action with respect thereto to each person who submitted comments on the

remediation proposal.

(e) Periodic review.

The Commissioner shall periodically review sections 22a-133k-1 through 22a-133k-3, inclusive, of the Regulations of Connecticut State Agencies to determine whether the implementation of such regulations is successfully protecting public health and the environment from the hazards of pollution. The Commissioner shall also evaluate whether the implementation of the regulations streamlines the process of conducting remediation projects in Connecticut, based upon, among other things, his review of the number of remediation projects completed in accordance with said sections 22a-133k-1 through 22a-133k-3, inclusive, of the Regulations of Connecticut State Agencies, the number of such projects reviewed by the Commissioner pursuant to sections 2 or 3 of P.A. 95-183, the length of time required for the Commissioner's review of complete requests for approval of alternative criteria or variances, and the number of remediation projects conducted pursuant to P.A. 95-190 or sections 2 or 3 of P.A. 95-183 which projects were verified by a licensed environmental professional. Such reviews shall be conducted at intervals of no more than five years, provided that nothing in this subsection shall preclude the Commissioner, at his discretion, from conducting such a review at any time and further provided that the first such review shall be conducted no later than eighteen months after the effective date of sections 22a-133k-1 through 22a-133k-3, inclusive, of the Regulations of Connecticut State Agencies. As a result of such a periodic review, the Commissioner may conclude that the goals of this subsection and section 22a-133k of the General Statute are being met, or he may conclude that revisions to such regulations are necessary to ensure that the implementation of said sections 22a-133k-1 through 22a-133k-3, inclusive, of the Regulations of Connecticut State Agencies achieves such goals, in which case he may revise such Regulations as he deems necessary to achieve those goals.

Section 2. The Regulations of Connecticut State Agencies are amended by adding a new section 22a-133k-2 as follows:

22a-133k-2 Standards for Soil Remediation

(a) General.

Unless otherwise specified in sections 22a-133k-1 through 22a-133k-3, inclusive, of the Regulations of Connecticut State Agencies, polluted soil at a release area shall be remediated to a concentration which meets (1) (A) the direct exposure criteria set forth in subsection (b) of this section or alternative direct exposure criteria established in accordance with subdivision (2) or subdivision (7) of subsection (d) of this section; and (B) the pollutant mobility criteria set forth in subsection (c) of this section or alternative pollutant mobility criteria established in accordance with subdivision (3) or (5) of subsection (d) of this section; or (2) the background concentration for soil provided notice has been submitted to the Commissioner which notice shall be submitted on a form furnished by the Commissioner and shall include a brief description of the subject release area and of the general characteristics of soils in the vicinity of such release area; a map showing the location of such release area, and based on reasonable inquiry of other release areas in the vicinity thereof, and of all soil samples taken for the purpose of characterizing background concentration for soil; and the results of all laboratory analyses of such samples.

(b) Direct Exposure Criteria.

(1) Except as otherwise provided in this paragraph, polluted soil at a release area shall be remediated to at least that concentration at which the residential direct exposure criteria for each substance is met.

(2) (A) Polluted soil at a release area may be remediated to a concentration at which the industrial/commercial direct exposure criteria for each substance except PCB is met if (i) access to the parcel containing such release area is limited to individuals working at or people temporarily visiting the subject parcel; and (ii) an environmental land use restriction is in effect with respect to such parcel, or to the portion of such parcel containing such release area, which environmental land use restriction ensures that the parcel or restricted portion thereof is not used for any residential activity in the future and that any future use of such parcel or restricted portion thereof is limited to an industrial or commercial activity.

(B) Soil polluted with PCB at a release area may be remediated to a concentration at which the industrial/commercial direct exposure criteria for PCB is met if the parcel upon which such release area is located is (i) an outdoor electrical substation as defined in 40 CFR 761.123; or (ii) an other restricted access location as defined in said section 40 CFR 761.123 and an environmental land use restriction is in effect with respect to such parcel, or to the portion of such parcel containing such release area, which environmental land use restriction ensures that the parcel or restricted portion thereof is not used for any residential activity in the future and that any future use of such parcel or restricted portion thereof is limited to an industrial or commercial activity.

(3) The direct exposure criteria for substances other than PCB do not apply to inaccessible soil at a release area provided that if such inaccessible soil is less than 15 feet below the ground surface an environmental land use restriction is in effect with respect to the subject parcel or to the portion of such parcel containing such release area, which environmental land use restriction ensures that such soils will not be exposed as a result of excavation, demolition or other activities and that any pavement which is necessary to render such soil inaccessible is maintained in good condition unless and until such restriction is released in accordance with said section 22a-133q-1. Unless an alternative criterion has been approved in accordance with subsection 22a-133k-2(d)(7), inaccessible soil polluted with PCB may be remediated to a concentration of 10 ppm PCB by weight provided that (A) if such inaccessible soil is located on a parcel which is an other restricted access location as defined in said section 40 CFR 761.123, such soil may be remediated to a concentration of 25 ppm PCB by weight, or (B) if such inaccessible soil is located on a parcel which is an outdoor electrical substation as defined in 40 CFR 761.123, such soil may be remediated to a concentration of 25 ppm PCB by weight, or if a label or notice is visibly placed in the area in accordance with 40 CFR Part 761, to a concentration of 50 ppm PCB by weight.

(4) Additional Polluting Substances

(A) With respect to a substance at a release area for which a direct exposure criterion is not specified in sections 22a-133k-1 through 22a-133k-3, inclusive, of the Regulations of Connecticut State Agencies, the Commissioner may, after consultation with the Commissioner of Public Health, approve in writing a direct exposure criterion to apply to such substance at a particular release area. Any person requesting approval of a direct exposure criterion for such substance shall submit to the commissioner (i) a proposed risk-based direct exposure concentration for such substance calculated in accordance with subparagraph (B) or (C) of this subdivision as applicable, and (ii) the analytical detection limit for such substance. Before approving a direct exposure criterion the Commissioner shall consider the proposed risk-based direct exposure concentration for such substance, the analytical detection limit for such substance, any information about the health effects such substance may cause due to exposure pathways not accounted for in the proposed risk-based direct exposure, and any other information that the Commissioner reasonably deems necessary.

(B) The proposed residential risk-based direct exposure concentration shall be calculated using the following equations:

(i) For carcinogenic substances:

$$DEC_{RB} = \left[\frac{Risk}{CSF}\right] \times \left[\frac{BW_C \times AT}{IR_C \times ED_C \times EF \times CF} + \frac{BW_A \times AT}{IR_A \times ED_A \times EF \times CF}\right]$$

(ii) For non-carcinogenic substances:

$$DEC_{RB} = \left[RFD \times HI\right] \left[\frac{BW_C \times AT_C}{IR_C \times ED_C \times EF \times CF} + \frac{BW_A \times AT}{IR_A \times ED_A \times EF \times CF}\right]$$

(iii) The abbreviations used in subparagraphs (i) and (ii) shall be interpreted in accordance with the following table and shall be assigned the values specified therein:

Term	Description	Units	Value
DEC_{RB}	Risk-based Direct Exposure Criterion	mg/kg	calculated
Risk	Target Cancer Risk Level	unitless	1.0E-06
HI	Hazard Index	unitless	1.0
CSF	Cancer slope Factor	$(mg/kg\text{-}day)^{-1}$	substance-specific
RFD	Reference Dose	mg/kg-day	substance-specific
IR_C	Ingestion Rate, Child	mg/day	200
IR_A	Ingestion Rate, Adult	mg/day	100
EF	Exposure Frequency	days/year	365
ED_C	Exposure Duration, Child	years	6
ED_A	Exposure Duration, Adult	years	24
CF	Conversion Factor	kg/mg	0.000001
BW_C	Body Weight, Child	kg	15
BW_A	Body Weight, Adult	kg	70
AT	Averaging Time, for carcinogens	days	25550
AT_C	Averaging Time, Child for non-carcinogens	days	2190
AT_A	Averaging Time, Adult for non-carcinogens	days	8760

(C) The proposed industrial/commercial risk-based direct exposure concentration shall be calculated using the following equations:

(i) For carcinogenic substances:

$$DEC_{RB} = \left[\frac{Risk}{CSF}\right] \times \left[\frac{BW \times AT}{IR \times ED \times EF \times CF}\right]$$

(ii) For non-carcinogenic substances:

$$DEC_{RB} = \left[RFD \times HI\right] \times \left[\frac{BW \times AT}{IR \times EF \times ED \times CF}\right]$$

(iii) The abbreviations used in subparagraphs (i) and (ii) shall be interpreted in accordance with the following table and shall be assigned the values specified therein:

Term	Description	Units	Value
DEC_{RB}	Risk-based Direct Exposure Criterion	mg/kg	calculated
Risk	Target Cancer Risk Level	unitless	1.0E-06
HI	Hazard Index	unitless	1.0
CSF	Cancer slope Factor	$(mg/kg\text{-}day)^{-1}$	substance-specific
RFD	Reference Dose	mg/kg-day	substance-specific
IR	Ingestion Rate	mg/day	50
EF	Exposure Frequency	days/year	250
ED	Exposure Duration	years	25
CF	Conversion Factor	kg/mg	0.000001
BW	Body Weight	kg	70
AT	Averaging Time, for carcinogens	days	25550
AT_A	Averaging Time, Adult for non-carcinogens	days	9125

(c) Pollutant Mobility Criteria.

(1) General.

(A) A substance, other than an inorganic substance or PCB, in soil above the seasonal low water table, or above the seasonal high water table if (i) remediation to the seasonal low water table is not technically practicable or would not result in the permanent elimination of a source of pollution or (ii) the subject soil is located in a GB area, shall be remediated to at least that concentration at which the results of a mass analysis of such soil for such substance does not exceed the pollutant mobility criterion applicable to the ground-water classification of the area at which such soil is located, except that in the circumstances identified in subdivision (2) of this subsection, remediation to achieve compliance with the pollutant mobility criteria may be conducted in accordance with the requirements established in said subdivision (2).

(B) An inorganic substance or PCB in soil above the seasonal low water table, or above the seasonal high water table if (i) remediation to the seasonal low water table is not technically practicable or would not result in the permanent elimination of a source of pollution or (ii) the subject soil is located in a GB area, shall be remediated to at least that concentration at which the results of a TCLP or SPLP analysis of such soil for such substance does not exceed the pollutant mobility criterion applicable to the ground-water classification of the area at which such soil is located, except that in the circumstances identified in subdivision (2) of this subsection, remediation to achieve compliance with the pollutant mobility criteria may be conducted in accordance with the requirements established in said subdivision (2).

(2) Specific Circumstances

(A) Polluted Soils in a GA Area.

A soil in a GA area and polluted with a substance, other than 1,2 dichlorobenzene, ethyl benzene, toluene, xylenes or total petroleum hydrocarbons, which soil is at or above the seasonal low water table, or at or above the seasonal high water table if remediation to the seasonal low water table is not technically practicable or would not result in the permanent elimination of a source of pollution, may be remediated to at least that concentration at which the results of a TCLP or SPLP analysis of such soil for such substance do not exceed the ground-water protection criterion for such substance.

(B) Soils Polluted with Volatile Organic Substances in a GA area.

A soil in a GA area polluted with a volatile organic substance, other than 1,2 dichlorobenzene, ethyl benzene, toluene, or xylenes which soil is at or above the seasonal low water table, or at or above the seasonal high water table if remediation to the seasonal low water table is not technically practicable or would not result in the permanent elimination of a source of pollution, may be remediated to at least that concentration at which the results of a TCLP or SPLP analysis of such soil for such substance do not exceed the ground-water protection criterion for such substance multiplied by ten or the results of a mass analysis of such soil for such substance do not exceed the pollutant mobility criterion for such substance multiplied by ten or by an alternative dilution or dilution and attenuation factor approved by the Commissioner in accordance with subdivision (4) of subsection (d) of this section, provided no non-aqueous phase liquids are present in the subject release area as determined in accordance with subdivision (3) of this subsection, the water table is at least fifteen feet above the surface of the bedrock and the downward vertical flow velocity is not greater than the horizontal flow velocity, and:

(i) (aa) a public water supply distribution system is available within 200 feet of the subject parcel, all adjacent parcels, and any parcel within the areal extent of the ground-water plume caused by the subject release area, (bb) the ground water within the areal extent of such ground-water plume is not used for drinking water, (cc) no public or private water supply wells exist within 500 feet of the subject release area, and (dd) the ground water affected by the subject release area is not a potential public water supply resource; or

(ii) (aa) the concentration of any volatile organic substance in a ground-water plume and within seventy-five feet of the nearest downgradient parcel boundary does not exceed the ground-water protection criterion, (bb) except for seasonal variation, the areal extent of volatile organic substances in the ground-water plume is not increasing over time and the concentration of any volatile organic substance in the ground-water plume is not increasing, except as a result of natural attenuation, at any point over time and (cc) notice of such condition is provided to the Commissioner on a form furnished by the Commissioner, which notice shall include: a brief description of the release area; a brief description of the distribution and concentration of volatile organic substances in soil and ground water; a map showing the location of the release area, and based on reasonable inquiry all other volatile organic substance release areas in the vicinity of the subject release area, all ground-water and soil monitoring points, and the areal extent of the volatile organic substance ground-water plume; and the results of all laboratory analyses conducted to determine whether the requirements of this subparagraph have been met; or

(iii) (aa) the concentration of any volatile organic substance within such ground-water plume does not exceed the ground-water protection criterion for such substance at a location downgradient of the release area, on the subject parcel, and within 25 feet of such release area, and (bb) notice of such condition is provided to the Commissioner on a form furnished by the Commissioner, which notice shall include: a brief description of the release area; a brief description of the distribution and concentration of volatile organic substances in soil and ground water; a map showing the location of the release area, and based on reasonable inquiry all other volatile organic substance

release areas in the vicinity of the subject release area, and all ground-water and soil monitoring points; and the results of all laboratory analyses conducted to determine whether the requirements of this subparagraph have been met.

(C) Inorganic, semi-volatile, PCB or pesticide contamination in a GA area.

A soil in a GA area and polluted with inorganic substances, semi-volatile substances, PCB or pesticides, which soil is at or above the seasonal low water table, or at or above the seasonal high water table if remediation to the seasonal low water table is not technically practicable or would not result in the permanent elimination of a source of pollution, may be remediated to a level at which (i)(aa) the results of a TCLP or SPLP analysis of such soil for such substance do not exceed the ground-water protection criterion for such substance multiplied by ten or by an alternative dilution or dilution and attenuation factor approved by the Commissioner in accordance with subdivision (4) of subsection (d) of this section or (bb) the results of a mass analysis of such soil for a substance do not exceed the pollutant mobility criterion for such substance multiplied by ten or by an alternative dilution or dilution and attenuation factor approved by the Commissioner in accordance with subdivision (4) of subsection (d) of this section; provided (ii) (aa) the release area and any portion thereof is located at least twenty-five feet from the nearest legal boundary of the parcel in the downgradient direction, (bb) no non-aqueous phase liquids are present in the release area as determined in accordance with subdivision (3) of this subsection, and (cc) the water table is at least fifteen feet above the surface of the bedrock.

(D) Polluted Soils in a GB area.

A substance other than total petroleum hydrocarbons in soil above the seasonal high water table in a GB area may be remediated to a level at which the results of a TCLP or SPLP analysis of such soil does not exceed the ground-water protection criterion for any such substance (i) (aa) multiplied by 10, (bb) multiplied by the ratio of the summation of the areas downgradient and upgradient of the release area to the release area, provided that such ratio does not exceed 500, or (cc) or multiplied by an alternative dilution or dilution and attenuation factor approved by the Commissioner in accordance with subdivision (5) of subsection (d) of this section; (ii) provided non-aqueous phase liquids are not present in such soil as determined in accordance with subdivision (3) of this subsection.

(E) Site specific dilution in a GB area.

(i) A substance, other than total petroleum hydrocarbons, in a soil at or above the seasonal high water table in a GB area where the background concentration for ground water for such substance is less than the applicable ground-water protection criterion, may be remediated to a level at which the results of a mass analysis of such soil for a substance do not exceed the pollutant mobility criterion applicable to such substance in a GA area multiplied by a site-specific dilution factor calculated in accordance with clause (ii) of this subparagraph, or the results of a TCLP or SPLP analysis of such soil for a substance do not exceed the ground-water protection criterion for such substance multiplied by a site-specific dilution factor calculated in accordance with clause (ii) of this subparagraph, provided (aa) no non-aqueous phase liquids are present in such soil as determined in accordance with subdivision (3) of this subsection; (bb) notice has been submitted to the Commissioner in accordance with clause (iii) of this subparagraph; and (cc) the water table in the release area is at least fifteen feet above the surface of the bedrock and the downward ground water vertical flow velocity is not greater than the ground water horizontal flow velocity.

(ii) For the purpose of clause (i) of this subparagraph, the site-specific dilution factor shall be calculated using the following formula: $DF = (1 + (Kid/IL))(1-F_{adj})$, where:

DF = site-specific dilution factor
K = hydraulic conductivity, in feet per year, of the unconsolidated aquifer

underlying the release area

i = horizontal hydraulic gradient in feet per feet

d = 15 feet

I = infiltration rate in feet per year as specified in subparagraph (iv) of this subparagraph

L = length in feet of the release area parallel to the direction of ground-water flow

F_{adj} = background concentration for ground water divided by the ground-water protection criterion for the subject substance, or, where the background concentration for ground water can not be quantified, ½ the minimum detection limit for the subject substance divided by the ground-water protection criterion for the subject substance.

(iii) A notice submitted pursuant to clause (i) of this subparagraph shall be submitted on a form prescribed and provided by the Commissioner and shall include: a brief description of the release area and the general characteristics of soils in the vicinity of the release area; a map showing the location of the release area, and based on reasonable inquiry other release areas in the vicinity containing the substance for which the site-specific dilution factor is calculated, and all monitoring points; if applicable, justification for use of a till infiltration rate other than 0.5 feet per year, and the results of all the laboratory analyses and field analyses used to determine the (aa) parameters of the equation in clause (ii) of this subparagraph and (bb) identification of geologic material for the purposes of choosing an infiltration rate in accordance with clause (iv) of this subparagraph.

(iv)

Geologic Material	Infiltration Rate (feet/year)
Stratified Drift	2.0
Till	0.5 - 1.0
Lacustrine Deposits	0.4

(3) Determining the Presence of Non-aqueous Phase Liquids in Soil. For the purpose of this subsection, the presence of non-aqueous phase liquids in soil shall be determined using the following equation: $C_{nap} = (S/2\rho_b)(K_d \rho_b + \theta_w + H'\theta_a)$, where:

C_{nap} = the concentration of an organic substance at which or above which such substance may be present in a non-aqueous phase

S = the effective solubility

ρ_b = dry soil bulk density

K_d = soil-water partition coefficient, which may be approximated by $K_{OC} \cdot f_{OC}$

K_{OC} = soil organic carbon-water partition coefficient

f_{OC} = fraction organic carbon of soil

θ_w = water-filled soil porosity (L_{water}/L_{soil})

θ_a = air-filled soil porosity (L_{air}/L_{soil})

H' = Henry's law constant (dimensionless)

H = Henry's law constant (atm-m^3/mol)

The terms defined above shall be assigned the following values:

Term	Units	Value
C_{NAP}	mg/kg	calculated
S	mg/L	chemical-specific

ρ_b	kg/L	1.5 or the lowest value measured at the subject release area
K_d	L/kg	calculated
K_{OC}	L/kg	chemical-specific
f_{OC}	g/g	0.006 or the lowest value measured at the subject release area
θ_w	L_{water}/L_{soil}	0.15
θ_a	L_{air}/L_{soil}	0.28
H'	unitless	H x 41 where 41 is a conversion factor
H	atm-m^3/mol	chemical-specific

(4) Exceptions.

(A) If at a release area (i) the ground-water classification is GB and (ii) the elevation of the water table is below the elevation of the top of bedrock, such release area shall be remediated to a concentration which meets the pollutant mobility criteria applicable to any location at which the ground-water classification is GA or GAA.

(B) The pollutant mobility criteria do not apply to environmentally isolated soil provided an environmental land use restriction is in effect with respect to the parcel, or portion thereof, containing such soil which environmental land use restriction ensures that such soil will not be exposed to infiltration of soil water due to, among other things, demolition of the building.

(C) The pollutant mobility criteria do not apply to polluted fill on a parcel if: (aa) such fill is polluted only with coal ash, wood ash, coal fragments, asphalt paving fragments, or any combination thereof; (bb) such fill is not polluted with any volatile organic substance; (cc) the concentration of each substance in any such fill is consistent with the requirements established in subsection (b) of this section; (dd) such substance is not affecting and will not affect the quality of an existing or potential public water supply

resource or an existing private drinking water supply; (ee) a public water supply distribution system is available within 200 feet of such parcel and all parcels adjacent thereto; and (ff) the placement of the fill was not prohibited by law at the time of placement.

(5) Additional Polluting Substances.

With respect to a substance for which a pollutant mobility criterion is not specified in sections 22a-133k-1 through 22a-133k-3, inclusive, of the Regulations of Connecticut State Agencies, the Commissioner may approve a pollutant mobility criterion, a dilution or dilution and attenuation factor, and a method for determining compliance with such criterion to apply to such substance at a particular release area, provided he finds that such criterion will ensure that soil water at such release area does not exceed, in a GA area, the ground-water protection criterion, or in a GB area the ground-water protection criterion multiplied by a dilution factor of 10.

(d) Alternative Soil Criteria.

(1) Requests for Approval of Alternative Soil Criteria.

(A) Any person requesting that the Commissioner approve an alternative criterion applicable to a particular release area shall submit: the name and address of the owner of the parcel at which such release area is located; the address of such release area and a brief description of its location; a detailed description of such release area; and a map at a scale of not less than 1:1200 showing the location of all release areas on such parcel, the subject release area, and describing the concentration and distribution of all substances in the soil of the subject release area, including but not limited to the substance for which an alternative criterion is sought; a detailed written report describing the justification for the proposed alternative criterion; and any other information the Commissioner reasonably deems necessary to evaluate such request.

(B) Any person requesting that the Commissioner approve an alternative pollutant mobility criterion or an alternative dilution or dilution attenuation factor shall submit, in addition to the information required by subparagraph (A) of this subdivision, a detailed description of any other release area located on the same parcel as the subject release area and which other release area (i) is affected or potentially affected by the subject release area or (ii) is affecting or potentially may affect the subject release area;

(C) Any person requesting that the Commissioner approve an alternative direct exposure criterion shall submit, in addition to the information required by subparagraph (A) of this subdivision, a detailed description of any other release area located on the same parcel as the subject release area.

(2) Alternative Direct Exposure Criteria.

With respect to a substance except PCB for which a direct exposure criterion is specified in sections 22a-133k-1 through 22a-133k-3, inclusive, of the Regulations of Connecticut State Agencies, the Commissioner may approve an alternative direct exposure criterion and an alternative method for determining compliance with such criterion provided it is demonstrated to the satisfaction of the Commissioner, after consultation with the Commissioner of Public Health that the application of such alternative criterion at the subject release area will protect human health and the environment from the risks associated with direct exposure to polluted soil by ensuring that (A) the concentration of each carcinogenic substance in such soil does not exceed a 1×10^{-6} excess lifetime cancer risk level and the concentration of each non-carcinogenic substance in such soil does not exceed a hazard index of 1; or (B) for a release area polluted with multiple substances, the cumulative excess lifetime cancer risk for all carcinogenic substances in such soil does not exceed 1×10^{-5} and the cumulative hazard index does not exceed 1 for non-carcinogenic substances in such soil with the same target organ. Any person requesting approval of an alternative direct exposure criterion shall submit to the Commissioner and the Commissioner of Public Health a risk assessment prepared in accordance with the most recent EPA Risk Assessment Guidance for Superfund or other risk assessment method approved by the Commissioner

in consultation with the Commissioner of Public Health, and shall submit any additional information specified by the Commissioner or the Commissioner of Public Health.

(3) Alternative Pollutant Mobility Criteria for GA Areas.

With respect to a substance occurring at a release area located in a GA area, and for which substance a pollutant mobility criterion is specified in sections 22a-133k-1 through 22a-133k-3, inclusive, of the Regulations of Connecticut State Agencies, the Commissioner may approve an alternative pollutant mobility criterion and an alternative method for determining compliance with such criterion, provided it is demonstrated to the Commissioner's satisfaction that the application of such alternative criterion at the subject release area will ensure that soil water at such release area will not exceed the ground-water protection criterion for such substance.

(4) Alternative Dilution or Dilution Attenuation Factor for GA Areas.

With respect to a substance occurring at a release area located in a GA area, and for which substance a pollutant mobility criterion is specified in sections 22a-133k-1 through 22a-133k-3, inclusive, of the Regulations of Connecticut State Agencies, the Commissioner may approve an alternative dilution or dilution attenuation factor, provided that it is demonstrated to the Commissioner's satisfaction that application of such dilution factor will ensure that such release area will not degrade ground-water quality and thereby prevent the achievement of the applicable ground-water remediation standards.

(5) Alternative Pollutant Mobility Criteria for GB Areas.

With respect to a substance occurring at a release area located in a GB area, and for which substance a pollutant mobility criterion is specified in sections 22a-133k-1 through 22a-133k-3, inclusive, of the Regulations of Connecticut State Agencies, the Commissioner may approve an alternative pollutant mobility criterion and an alternative method for determining compliance with such criterion at such release area, provided it is demonstrated to the Commissioner's satisfaction that the application of such criterion will ensure that soil water at the release area, after dilution with ground water derived from infiltration on the parcel, will not exceed the ground-water protection criterion for such substance.

(6) Alternative Dilution or Dilution Attenuation Factor for GB Areas.

With respect to a substance occurring at a release area located in a GB area, and for which substance a pollutant mobility criterion is specified in sections 22a-133k-1 through 22a-133k-3, inclusive, of the Regulations of Connecticut State Agencies, the Commissioner may approve an alternative dilution or dilution attenuation factor, provided that it is demonstrated to the Commissioner's satisfaction that application of such alternative dilution or dilution attenuation factor will ensure that the soil water at such release area will not cause the ground water at the nearest downgradient property boundary to exceed the ground-water protection criterion for such substance.

(7) Alternative Direct Exposure Criterion for PCB.

The Commissioner may approve an alternative direct exposure criterion for PCB including an alternative direct exposure criterion for an inaccessible soil polluted with PCB, and an alternative method for determing compliance with such criterion, provided it is demonstrated to the satisfaction of the Commissioner after consultation with the Commissioner of Public Health that the application of such alternative criterion at the subject release area will protect human health and the environment from the risks associated with direct exposure to soil polluted with PCB and is consistent with 40 CFR Part 761 and with the "Guide on Remedial Actions at Superfund Sites with PCB Contamination" (EPA Directive 9355.4-01, August 1990).

(e) Applying the Direct Exposure and Pollutant Mobility Criteria

(1) Unless an alternative method for determining compliance with a direct exposure criterion has been approved by the Commissioner in writing, compliance with a direct exposure criterion is achieved when (A) the ninety-five percent upper confidence level of the arithmetic mean of all sample results of

laboratory analyses of soil from the subject release area is equal to or less than such criterion, provided that the results of no single sample exceeds two times the applicable direct exposure criterion or (B) the results of all laboratory analyses of samples from the subject release area are equal to or less than the applicable direct exposure criterion.

(2) Unless an alternative method for determining compliance with a pollutant mobility criterion for a particular substance has been approved by the Commissioner in writing, compliance with a pollutant mobility criterion for such substance is achieved when:

(A) (i) a representative sampling program consisting of not less than twenty samples of soil located above the water table has been used to characterize the distribution and concentration of such substance at the subject release area or remaining at the subject release area following remediation, (ii) the release area has not been remediated by means of excavation and removal of polluted soil, (iii) the ninety-five percent upper confidence level of the arithmetic mean of all the sample results of laboratory analyses of soil from the subject release area for such substance is equal to or less than the applicable pollutant mobility criterion or the results of all laboratory analyses of samples from the subject release area are equal to or less than the applicable direct exposure criterion, and (iv) no single sample result exceeds two times the applicable pollutant mobility criterion;

(B) (i) a representative sampling program consisting of less than twenty samples of soil located above the water table has been used to characterize the distribution and concentration of substances remaining at the subject release area following remediation, (ii) the release area has not been remediated by means of excavation and removal of polluted soil, and (iii) the results of all laboratory analysis of samples from the subject release area for such substances are equal to or less than such pollutant mobility criterion; or

(C) (i) the subject release area has been remediated by means of excavation and removal of polluted soil, (ii) a representative sampling program consisting of samples of soil located above the water table has been used to characterize the distribution and concentration of substances remaining at the subject release area following excavation and removal, and (iii) the results of all laboratory analyses of samples from the subject release area for such substances are equal to or less than such pollutant mobility criterion.

(3) Matrix interference effects.

If any applicable criterion for a substance in soil is less than the concentration for such substance that can be consistently and accurately quantified in a specific sample due to matrix interference effects, the following actions shall be taken:

(A) (i) "Test Methods for Evaluating Solid Waste : Physical/Chemical Methods," SW-846, U.S. Environmental Protection Agency, Office of Solid Waste, Washington D.C. 20460 shall be consulted to determine if an analytical method sufficiently sensitive to achieve the applicable analytical detection limit was used to conduct the analysis of the subject substance. If there is available an alternative analytical method which is sufficient to achieve the required analytical detection limit, appropriate for the sample matrix, and has been approved by EPA or approved in writing by the Commissioner, the subject soil shall be re-analyzed for the subject substance using such alternative method.
(ii)If a sample has been analyzed by one or more analytical methods in accordance with subparagraph (A)(i) of this subdivision and the applicable analytical detection limit has not been achieved due to matrix interference effects, such method(s) shall be modified in order to compensate for such interferences, in accordance with analytical procedures specified by EPA within the scope of the analytical method.

(B) If, after re-analyzing the subject soil and attempting to compensate for matrix interference effects in accordance with to subparagraph (A) of this subdivision, any applicable criterion for a substance in soil is less than the concentration for such substance that can be consistently and accurately quantified in a specific sample due to matrix interference effects, compliance with

such criterion shall be achieved when such soil has been remediated to the lowest concentration for such substance which can be consistently and accurately quantified without matrix interference effects.

(C) A detailed summary of all measures taken to overcome matrix interference effects and a determination of the lowest alternative quantification level applicable to the analysis of such substance shall be prepared and, if requested by the Commissioner in writing, shall be submitted to the Commissioner for his review and approval.

(f) Variances.

(1) Widespread Polluted Fill.

The Commissioner may grant a variance from any of the requirements of subsection (c) of this section upon the written request of the owner of the subject parcel if the Commissioner determines that (A) geographically extensive polluted fill is present at such parcel and at other parcels in the vicinity of the subject parcel; (B) such fill is not polluted with volatile organic substances; (C) such fill is not affecting and will not affect the quality of an existing or potential public water supply resource or an existing private drinking water supply; (D) the concentration of each substance in such fill is consistent with subsection (b) of this section; (E) the placement of such fill was not prohibited by law at the time of placement; and (F) the person requesting the variance did not place the fill on the subject parcel. In determining whether to grant or deny such a variance, the Commissioner may consider the relative cost of compliance with subsection (c) of this section, how extensive the polluted fill is, what relative proportion of such fill occurs on the subject parcel, and whether the person requesting the variance is affiliated with any person responsible for such placement through any direct or indirect familial relationship or any contractual, corporate or financial relationship other than that by which such person's interest in such parcel is to be conveyed or financed.

(2) Engineered Control of Polluted Soils.

(A) Provided that an engineered control of polluted soils is implemented pursuant to subparagraphs (B) and (C) of this subsection, the requirements of subsections (a) through (e) of this section do not apply if:

(i) the Commissioner authorized the disposal of solid waste or polluted soil at the subject release area;

(ii) the soil at such release area is polluted with a substance for which remediation is not technically practicable;

(iii) the Commissioner, in consultation with the Commissioner of Public Health, has determined that the removal of such substance or substances from such release area would create an unacceptable risk to human health; or

(iv) the Commissioner has determined, after providing notice and an opportunity for a public hearing, that a proposal by the owner of the subject parcel to use an engineered control is acceptable because (aa) the cost of remediating the polluted soil at such release area is significantly greater than the cost of installing and maintaining an engineered control for such soil and conducting ground-water monitoring at such release area in accordance with subsection (g) of section 22a-133k-3, and (bb) that the significantly greater cost outweighs the risk to the environment and human health if the engineered control fails to prevent the mobilization of a substance in the soil or human exposure to such substance. The Commissioner may hold a public hearing pursuant to this section if in his discretion the public interest will be best served thereby, and he shall hold a hearing upon receipt of a petition signed by at least twenty-five persons. Notice of the subject proposal shall be provided by the owner of the subject parcel in two of the three following manners: (i) by publication in a newspaper of substantial circulation in the affected area; (ii) by placing and maintaining on the subject parcel, for at least thirty days, in a legible condition a sign which shall be not less than six feet by four feet which sign shall be clearly visible from the public highway; or (iii) by mailing notice to the owner of record of each property abutting the subject parcel at his address on the most recent grand tax list of the municipality or municipalities in which such properties are located. When notice is published or mailed, it shall include the name and address of owner of the subject parcel; the location address and/or a description of the location such parcel; a brief description of the nature of the pollution on the subject parcel; a brief description of the proposed engineered control; and a brief description of the procedures for requesting a hearing. When notice is provided by posting a sign, the sign shall include the words "Environmental remediation is proposed for this site. For further information contact..." and shall include the name and telephone number of an individual from whom any interested person may obtain information about the remediation. The owner of the subject parcel shall verify to the Commissioner in writing on a form furnished by him that notice has been given in accordance with this subsection.

(B) A request to use an engineered control shall be submitted to the Commissioner in writing and shall be accompanied by a detailed written report and plan which demonstrates that:

(i) (aa) the proposed engineered control is designed and will be constructed to physically isolate polluted soil and to minimize migration of liquids through soil, to function with minimum maintenance, to promote drainage and minimize erosion of or other damage to such control, and to accommodate settling and subsidence of the underlying soil so as to maintain the control's structural integrity and permeability; and (bb) with respect to an engineered cap, such cap has been designed and constructed to have a permeability of less than 10^{-6} cm/sec or, unless otherwise specified by the Commissioner in writing, to have the permeability specified in a closure plan implemented under sections 22a-209-1 et seq of the Regulations of Connecticut State Agencies for a release area which is a lawfully authorized solid waste disposal area;
(ii) plans for ground-water monitoring at the subject release area are adequate to ensure that any substance migrating therefrom will be detected;
(iii) plans for maintenance of the subject release area are adequate to ensure that the structural integrity, design permeability, and effectiveness of the engineered control will be maintained; such plans shall include without limitation measures to prevent run-on and run-off of storm water from eroding or otherwise damaging the engineered control and measures to repair such control to correct the effects of any settling, subsidence, erosion or other damaging events or conditions;
(iv) an environmental land use restriction is or will be in effect with respect to the parcel at which the subject release area is located, which restriction ensures that such parcel will not be used in a manner that could disturb the engineered control or the polluted soil;
(v) any other information that the Commissioner reasonably deems necessary; and
(vi) with respect to any release area subject to any of the requirements of section 22a-

209-4(i) or section 22a-449(c)-100 through 110 of the Regulations of Connecticut State Agencies, all such requirements are or will be satisfied. With respect to a release area which is not subject to any such regulations, the owner of the subject parcel shall demonstrate that he has posted or will post a surety in a form and amount approved in writing by the Commissioner, which surety during the first year after installation of the engineered control shall be equal to the cost of one year's maintenance and monitoring of the engineered control, and which in each subsequent year shall be increased in amount by adding an amount equal to the cost of one year's maintenance and monitoring, until the total amount of such surety is equal to the cost of five year's of maintenance and monitoring, which amount shall be maintained in effect for the next twenty-five years or for such other period as may be required by the Commissioner.

(C) When the Commissioner approves a request pursuant to this subsection to use an engineered control he may require that such control incorporate any measures which he deems necessary to protect human health and the environment. Any person implementing an engineered control under this subsection shall perform all actions specified in the approved engineered control proposal including the recordation of the environmental land use restriction and posting of the surety, and any additional measures specified by the Commissioner in his approval of such plan. Nothing in this subdivision shall preclude the Commissioner from taking any action he deems necessary to protect human health or the environment if an approved engineered control fails to prevent the migration of pollutants from the release area or human exposure to such pollutants.

(g) Removal of Non-aqueous Phase Liquids.

Removal of light non-aqueous phase liquids from soil and ground water shall be conducted in accordance with section 22a-449(d)-106(f) of the Regulations of Connecticut State Agencies. Any other non-aqueous phase liquid shall be contained or removed from soil and ground water to the maximum extent prudent.

(h) Use of Polluted Soil and Reuse of Treated Soil.

Any soil excavated from and/or treated at a release area during remediation shall be managed as follows:

(1) Hazardous Waste.

Treatment, storage, disposal and transportation of soil which is hazardous waste as defined pursuant to section 22a-449(c) of the General Statutes shall be carried out in conformance with the provisions of sections 22a-449(c)-101 through 110 of the Regulations of Connecticut State Agencies, and any other applicable law;

(2) Special Wastes.

In accordance with section 22a-209-8 of the Regulations of Connecticut State Agencies, the Commissioner may authorize polluted soil, which is not hazardous waste as defined pursuant to subsection 22a-449(c) of the General Statutes, to be disposed of as special wastes as defined in said section 22a-209-1.

(3) Polluted soil.

Polluted soil from a release area may be treated to achieve concentrations of substances that do not exceed either the applicable direct exposure criteria or pollutant mobility criteria. After such treatment, such soil may be reused on the parcel from which it was excavated or on another parcel approved by the Commissioner, provided that such reuse is consistent with all other provisions of sections 22a-133k-1 through 22a-133k-3, inclusive, of the Regulations of Connecticut State Agencies and:

(A) Prior to reuse, a map showing the location and depth of proposed placement of such soil is submitted to the Commissioner;
(B) Such soil is not placed below the water table;

(C) Such soil is not placed in an area subject to erosion; and
(D) Any such soil in which the concentration of any substance exceeds the pollutant mobility criteria applicable to a GA area is not placed over soil and ground water which have not been affected by a release at the parcel at which placement is proposed; and
(E) For soils polluted with PCB, the Commissioner has issued a written approval in accordance with by section 22a-467 of the General Statutes.

(4) Natural Soil.

Polluted soil may be used at any parcel of land if after treatment of such soil to reduce or remove substances: (A) any naturally-occurring substance is present therein in concentrations not exceeding background concentration for soil of such substance at the release area from which such soil is removed; and (B) no other substance is detectable in such soil at a concentration greater than its analytical detection limit.

(i) Additional remediation of soil.

Nothing in sections 22a-133k-1 through 22a-133k-3, inclusive, of the Regulations of Connecticut State Agencies shall preclude the Commissioner from taking any action necessary to prevent or abate pollution or to prevent or abate any threat to human health or the environment, including without limitation:

(1) at any location at which, despite remediation in accordance with sections 22a-133k-1 through 22a-133k-3, inclusive, of the Regulations of Connecticut State Agencies, the Commissioner determines that there is a potential ecological risk he may require that an ecological risk assessment be conducted in accordance with EPA/630/R-92/001, February 1992, "Framework For Ecological Risk Assessment" and that additional remediation be conducted to mitigate any risks identified in such assessment;
(2) at any location at which polluted soil has eroded into a surface-water body, the Commissioner may require that the effect of such polluted soil on aquatic life be assessed and that remediation to protect or restore aquatic life and surface water quality from the effects of such polluted soils be undertaken; or
(3) at any release area or parcel at which there is polluted soil containing multiple polluting substances, the Commissioner may require additional remediation to ensure that the risk posed by such substances does not exceed (A) a cumulative excess lifetime cancer risk of 10^{-5} for carcinogenic substances and (B) a cumulative hazard index of 1 for non-carcinogenic substances with the same target organ.

Section 3. The Regulations of Connecticut State Agencies are amended by adding a new section 22a-133k-3 as follows:

22a-133k-3 Ground-water Remediation Standards

(a) General.

(1) Remediation of a ground-water plume shall result in the attainment of: (A) the requirements concerning surface water protection set forth in subsection (b) of this section and the requirements concerning volatilization set forth in subsection (c) of this section; or (B) the background concentration for ground water for each substance in such plume.

(2) Remediation of a ground-water plume in a GA area shall also result in the reduction of each substance therein to a concentration equal to or less than the background concentration for ground water of such substance, except as provided in subsection (d) of this section.

(3) Remediation of a ground-water plume in a GB area shall also result in the reduction of each substance therein to a concentration such that such ground-water plume does not interfere with any existing use of the ground water.

(b) Surface-water protection criteria.

(1) Except as provided in subdivision (2) of this subsection, remediation of a ground-water plume which discharges to a surface water body shall result in the reduction of each substance therein to a concentration which is consistent with subdivision (2) of subsection (f) of this section and which is equal to or less than the surface-water protection criterion or an alternative surface-water protection criterion established in accordance with subdivision (3) of this subsection.

(2) If a ground-water plume (A) discharges to a wetland or an intermittent stream, or (B) the areal extent of such ground-water plume occupies more than 0.5%, or other percentage which is approved in writing by the Commissioner, of the upstream drainage basin of the stream to which such plume discharges measured from the intersection of stream and such ground-water plume, each substance therein shall be remediated to a concentration equal to or less than the applicable aquatic life criteria contained in Appendix D to the most recent Water Quality Standards, or equal to or less than an alternative water quality criterion adopted by the Commissioner in accordance with section 22a-426 of the General Statutes and paragraph 12b of the Water Quality Standards effective May 15, 1992.

(3) Alternative surface-water protection criteria.

Alternative surface-water criteria may be calculated in accordance with subparagraph (A) of this subdivision or may be approved in writing by the Commissioner in accordance with subparagraph (B) of this subdivision.

(A) An alternative surface-water protection criterion may be calculated for a substance in Appendix D of the most recent Water Quality Standards by multiplying the lower of the human health or aquatic life criterion for such substance in said Appendix D by $[(0.25 \times 7Q10)/Q_{plume}]$ where Q_{plume} is equal to the average daily discharge of polluted ground water from the subject ground-water plume.

(B) The Commissioner may approve an alternative surface-water protection criterion to be applied to a particular substance at a particular release area. Any person requesting such approval shall submit to the Commissioner: (i) a report on the flow rate, under seven day ten year low flow conditions, of the surface water body into which the subject ground water plume discharges (ii) a report on other surface water or ground water discharges to the surface water body within one-half mile upstream of the areal extent of the ground-water plume, (iii) a report on the instream water quality, (iv) a report on the flow rate of the ground-water discharge from such release area to the surface water body and the extent and degree of mixing of such

discharge in such surface water, and (v) and any other information the Commissioner reasonably deems necessary to evaluate such request. The Commissioner shall not approve an alternative surface-water protection criterion under this subparagraph unless the requester demonstrates that such criterion will protect all existing and proposed uses of such surface water.

(c) Volatilization criteria.

(1) Except as specified in subdivisions (2), (3), (4) and (5) of this subsection, all ground water polluted with a volatile organic substance within 15 feet of the ground surface or a building, shall be remediated such that the concentration of each such substance is equal to or less than the applicable residential volatilization criterion for ground water.

(2) If ground water polluted with a volatile organic substance is below a building used solely for industrial or commercial activity, such ground water shall be remediated such that the concentration of such substance is equal to or less than the applicable industrial/commercial volatilization criterion for ground water, provided that an environmental land use restriction is in effect with respect to the parcel or portion thereof upon which such building is located, which restriction ensures that the parcel or portion thereof will not be used for any residential purpose in the future and that any future use of the parcel or portion thereof is limited to industrial or commercial activity;

(3) (A) Remediation of a volatile organic substance to the volatilization criterion for ground water shall not be required if the concentration of such substance in soil vapors below a building is equal to or less than (i) the residential volatilization criterion for soil vapor or (ii) the industrial/commercial volatilization criterion for soil vapor, if such building is solely used for industrial or commercial activity and, an environmental land use restriction is in effect with respect to the parcel or portion thereof upon which such building is located, which restriction ensures that the parcel or portion thereof will not be used for any residential purpose in the future and that any future use of the parcel or portion thereof is limited to industrial or commercial activity.

(B) The requirements of subdivision (1), (2), and (3) of this subsection do not apply if: (i) measures acceptable to the Commissioner have been taken to prevent the migration of such substance into any overlying building, (ii) a program is implemented to maintain and monitor all such measures, and (iii) notice of such measures has been submitted to the Commissioner on a form furnished by him which notice includes (aa) a brief description of the areal extent of the ground-water plume and of the area which exceeds any such volatilization or soil vapor criterion; (bb) a brief description of the method of controlling the migration of such substance into any overlying building; (cc) a plan for the monitoring and maintenance of such control method; and (dd) a map showing all existing buildings, the areal extent of the ground-water plume, and the location of such control method.

(4) Site-specific and alternative volatilization criteria.

(A) Site-specific residential volatilization criteria for ground water or soil vapor may be calculated using the equations in Appendix G to sections 22a-133k-1 through 22a-133k-3 of the Regulations of Connecticut State Agencies.

(B) The Commissioner may approve an alternative volatilization criterion for ground water or for soil vapor to be applied to a substance at a particular release area. The Commissioner shall not approve any alternative criterion under this subparagraph unless it has been demonstrated that such criterion will ensure that volatile organic substances from such ground water or soil do not accumulate in the air of any structure used for residential activities at a concentration which, (i) for any carcinogenic substance creates a risk to human health in excess of a 10^{-6} excess lifetime cancer risk level, and for any non-carcinogenic substance does not exceed a hazard index of 1, or (ii) for a ground-water plume polluted with multiple volatile organic substances does not exceed a cumulative excess cancer risk level of 10^{-5} for carcinogenic substances, and for non-carcinogenic substances with the same target organ, the cumulative hazard index does not exceed 1.

(5) Exemption from volatilization criteria.

(A) The volatilization criteria do not apply to ground water polluted with volatile organic substances, where the water table is less than fifteen feet below the ground surface, if no building exists over the ground water polluted with volatile organic substances at a concentration above the applicable volatilization criteria, and (i) it has been documented that best efforts have been made to ensure that each owner of any parcel of land or portion thereof overlying such polluted ground water records an environmental land use restriction which ensures that no building is constructed over such polluted ground water; or (ii) the Commissioner has approved in writing a request demonstrating that no building can reasonably be expected to be constructed over the subject ground water or that natural attenuation or other methods of remediation will, within five years, reduce the concentration of volatile organic substances in such ground water to a concentration equal to or less than the applicable volatilization criteria.

(B) The volatilization criteria for ground water underlying an existing building do not apply to ground water polluted with volatile organic substances where the Commissioner has approved in writing and there have been implemented an indoor air monitoring program and measures to control the level of any such volatile organic substances in the air of the subject building.

(i) Any person seeking the Commissioner's approval of an indoor air monitoring program shall submit to him: a detailed written plan describing the proposed indoor air monitoring program, including but not limited to a description of the distribution and concentration of volatile organic compounds beneath the building, the location of proposed monitoring points, the proposed frequency of monitoring, the parameters to be monitored, and a description of proposed actions to be taken in the event such monitoring indicates that the monitored parameters exceed proposed specified concentrations and a proposed schedule for reporting to the Commissioner on the results of such monitoring for as long as monitoring is conducted at the site.

(ii) In approving any indoor air monitoring program pursuant to this subdivision, the Commissioner may impose any additional conditions he deems necessary to ensure that the program adequately protects human health. In the event that the Commissioner approves an indoor air monitoring program pursuant to this subparagraph, any person implementing such program shall perform all actions specified in the approved plan, and any additional measures specified by the Commissioner in his approval of such plan.

(d) Applicability of Ground-water Protection Criteria.

(1) Ground water in a GA area may be remediated to a concentration for each substance therein equal to or less than the ground-water protection criterion for each such substance if, with respect to the subject ground-water plume: (A) the background concentration for ground water is equal to or less than such ground-water protection criterion; (B) a public water supply distribution system is available within 200 feet of the subject parcel, parcels adjacent thereto, and any parcel within the areal extent of such plume; (C) such ground-water plume is not located in an aquifer protection area; and (D) such ground-water plume is not located within the area of influence of any public water supply well.

(2) If prior to any ground-water remediation the maximum concentration of a substance in a ground-water plume in a GA area is equal to or less than the ground-water protection criteria, remediation of ground water to achieve background ground-water concentration is not required, provided that the extent of the ground-water plume is not increasing over time and, except for seasonal variations, the concentration of the subject substance in such ground-water plume is not increasing at any point over time.

(3) Any ground water in a GB area and which is used for drinking or other domestic purposes shall be remediated to reduce the concentration of each substance therein to a concentration equal to or less than the applicable ground-water protection criterion until such time as the use of such ground water for

drinking or other domestic purposes is permanently discontinued.

(e) Technical Impracticability of Ground-water Remediation.

(1) Exemption from Background Due to Technical Impracticability

If remediation of a ground-water plume in a GA area to achieve compliance with subdivision (2) of subsection (a) of this section has reduced the concentration of a polluting substance to less than the ground-water protection criterion, and if further reduction of such concentration is technically impracticable, no further remediation of such ground-water plume for such substance shall be required.

(2) Variance Due to Technical Impracticability of Ground-water Remediation

The Commissioner may grant a variance from any of the requirements of this section if he finds that: non-aqueous phase liquids that cannot be contained or removed in accordance with R.C.S.A. section 22a-133k-2(g) are present; remediation to the extent technically practicable has reduced the concentration of pollutants in ground water to steady-state concentrations that exceed any applicable criteria; or achieving compliance with the applicable criteria is technically impracticable as determined using Directive No. 9234.2-25 issued September 1993 by the U.S. Environmental Protection Agency's Office of Solid Waste and Emergency Response.

(A) Any person requesting a variance pursuant to this subsection from any ground-water protection criterion shall submit: (i) information concerning the concentration of each substance in the ground-water plume with respect to which a variance is sought; (ii) information demonstrating that (aa) the extent of the ground-water plume which exceeds such ground-water protection criterion has been reduced to the extent technically practicable, or (bb) it is not technically practicable to reduce the extent of the ground-water plume; (iii) the results of a study conducted to determine the risks to human health posed by the polluted ground water remaining after such reduction; (iv) if such study shows a risk or a potential risk to human health, a plan to eliminate such risk or potential risk; (v) an application to change the ground-water classification of such polluted ground water to GB in accordance with section 22a-426 of the General Statutes; and (vi) any other information the Commissioner reasonably deems necessary to evaluate such request.

(B) Any person requesting a variance pursuant to this subsection from the requirement to remediate ground water to a concentration which does not exceed the applicable surface-water protection criteria shall submit information concerning the concentration of each substance in the ground-water plume with respect to which a variance is sought. If such information demonstrates that any such concentration exceeds any applicable surface-water protection criterion, such person shall also submit: (i) a map showing the areal extent of the ground-water plume that exceeds such surface-water protection criterion, and (ii) a plan for controlling the migration of such substance to the receiving surface water body.

(C) If the Commissioner grants a variance pursuant to this subsection from any ground-water protection criterion, the person receiving the variance shall, no later than thirty days after the date of granting of such variance, submit to the Commissioner on a form prescribed and provided by him: (i) certification that written notice of the extent and degree of such pollution has been provided to each owner of property overlying the subject ground-water plume at which it is not technically practicable to remediate a substance to a concentration equal to or less than the ground-water protection criterion; (ii) certification that written notice of the presence of pollution on each such parcel and a description of the extent and degree of such pollution has been sent to the Director of Health of the municipality or municipalities in which the ground-water plume is located; and (iii) certification that best efforts have been made to ensure that each owner of property overlying the subject ground-water plume records an environmental land use restriction which ensures that the subject ground-water plume is not used for drinking or other domestic purposes;

(D) If the Commissioner grants a variance pursuant to this subsection from the requirement to remediate ground water to a concentration which does not exceed the applicable surface-water

protection criteria, the person receiving the variance shall perform all actions specified in the plan submitted with the request for such variance, and any additional actions required by the Commissioner in his approval of such plan or granting of such variance.

(f) Applying the Criteria for Ground Water

(1) Compliance with the ground-water protection criterion for a substance in ground water or background concentration for ground water for such substance is achieved when the sampling locations are representative of the subject ground-water plume and (A) the analytical results for such substance at such all sampling locations are equal to or less than either the ground-water protection criterion for such substance or the background concentration for ground water therefor, whichever is applicable, for at least four consecutive quarterly sampling periods, or (B) a representative sampling program consisting of not less than twelve consecutive monthly samples from each such sampling location has been used to characterize the ground-water plume and the ninety-five percent upper confidence level of the arithmetic mean of all results of laboratory analyses of such samples for such substance are equal to or less than the criterion for such substance and that no single sample exceeds two times the applicable criterion for such substance.

(2) Compliance with a surface-water protection criterion for a substance in ground water is achieved when the sampling locations are representative of the subject ground-water plume and(A) the average concentration of such substance in such plume is equal to or less than the applicable surface-water protection criterion for at least four consecutive quarterly sampling periods, or (B) the concentration of such substance in that portion of such plume which is immediately upgradient of the point at which such ground-water discharges to the receiving surface-water body is equal to or less than the applicable surface-water protection criterion, provided that the areal extent of such ground-water plume is not increasing over time and that, except for seasonal variations, the concentration of the subject substance in such ground-water plume is not increasing, except as a result of natural attenuation, at any point over time.

(3) Compliance with a volatilization criterion for a substance in ground water or soil vapor is achieved when the sampling locations are representative of the subject ground-water plume or soil vapor and (A) the ninety-five percent upper confidence level of the arithmetic mean of all sample results from such locations is equal to or less than the applicable volatilization criterion for at least four consecutive quarterly sampling periods and that the result of no single sample exceeds two times the applicable volatilization criterion, or (B) the results of all laboratory analyses of samples for such substance are equal to or less than the volatilization criterion therefor.

(4) Matrix interference effects.

If any applicable criterion for a substance in ground water is less than the concentration for such substance that can be consistently and accurately quantified in a specific sample due to matrix interference effects, the following action shall be taken:

(A) (i)"Test Methods for Evaluating Solid Waste : Physical/Chemical Methods," SW-846, U.S. Environmental Protection Agency, Office of Solid Waste, Washington D.C. 20460 shall be consulted to determine if an analytical method sufficiently sensitive to achieve the applicable analytical detection limit was used to conduct the analysis of the subject substance. If there is available an alternative analytical method which is sufficient to achieve the required analytical detection limit, appropriate for the sample matrix, and has been approved by EPA or approved in writing by the Commissioner, the subject ground water shall be re-analyzed for the subject substance using such alternative method.

(ii) If a sample has been analyzed by one or more analytical methods in accordance with subparagraph (A)(i) of this subdivision and the applicable analytical detection limit has not been achieved due to matrix interference effects, such method(s) shall be modified in order to compensate for such interferences, in accordance with analytical procedures specified by EPA within the scope of the analytical method.

(B) If, after re-analyzing the subject ground water and attempting to compensate for matrix interference effects in accordance with subparagraph (A) of this subdivision, any applicable criterion for a substance in ground water is less than the concentration for such substance that can be consistently and accurately quantified in a specific sample due to matrix interference effects, compliance with such criterion shall be achieved when such ground water has been remediated to the lowest concentration for such substance which can be consistently and accurately quantified without matrix interference effects.

(C) A detailed summary of all measures taken to overcome matrix interference effects and a determination of the lowest alternative quantification level applicable to the analysis of such substance shall be prepared and, if requested by the Commissioner in writing, shall be submitted to the Commissioner for his review and approval.

(g) Ground-water Monitoring.

For any remediation which is conducted to achieve compliance with sections 22a-133k-1 through 22a-133k-3, inclusive, of the Regulations of Connecticut State Agencies, ground-water monitoring shall be conducted in accordance with this subsection.

(1) Ground-water Monitoring at GA Areas.

With respect to remediation of a release area or a ground-water plume in a GA area, a ground-water monitoring plan shall be prepared and implemented. Ground-water monitoring under such plan shall be designed to determine:

(A) the effectiveness of soil remediation in preventing the pollution of ground water by substances from the release area;
(B) the effectiveness of any remediation taken to eliminate or minimize health or safety risks identified in any risk assessment conducted in accordance with subdivision (2) of subsection (e) of this section or otherwise identified; and
(C) whether applicable requirements identified in subsection (a) of this section have been met.

(2) Ground-water Monitoring at GB Areas.

With respect to remediation of a release area or a ground-water plume in a GB area, a ground-water monitoring plan shall be prepared and implemented. Ground-water monitoring under such plan shall be designed to determine:

(A) the effectiveness of soil remediation in preventing further pollution of ground water by substances from the release area;
(B) the effectiveness of any remediation taken to eliminate or minimize identified health or safety risks associated with such release;
(C) whether applicable ground-water protection criteria, surface-water protection criteria, and volatilization criteria have been met; and
(D) whether the ground-water plume interferes with any existing use of the ground water for a drinking water supply or with any other existing use of the ground water, including but not limited to industrial, agricultural or commercial purposes.

(3) Discontinuation of Ground-water Monitoring.

(A) Unless otherwise specified in writing by the Commissioner, ground-water monitoring in a GA area may be discontinued in accordance with the following:

(i) a minimum of one year after compliance with the background concentration for ground water has been achieved in accordance with subsection (f) of this section if the background concentration for ground water of all substances in the subject ground-water plume has been maintained in all sampling events and ground-water monitoring data demonstrate that the soil remediation was effective in preventing the pollution of

ground water by any substance from the subject release area; or

(ii) a minimum of three years after compliance with the ground-water protection criteria has been achieved in accordance with subsection (f) of this section if (aa) all applicable ground-water protection criteria for all subject substances or the background concentration for ground water for all substances in the subject ground-water plume, which ever is higher, is maintained in all sampling events; (bb) ground-water monitoring data demonstrate that the soil remediation was effective in preventing the pollution of ground water by substances from the subject release area; and (cc) the volatilization and surface-water protection criteria have been met in accordance with subsection (f) of this section.

(B) Unless otherwise specified in writing by the Commissioner, ground-water monitoring in a GB area may be discontinued two years after the cessation of all remediation of such ground water or soil if the applicable surface-water protection and volatilization criteria have been met in accordance with subsection (f) of this section, and such ground water is suitable for all existing uses.

(h) Additional Polluting Substances

(1) With respect to a substance in ground water for which a ground- water protection criterion is not specified in sections 22a-133k-1 through 22a-133k-3, inclusive, of the Regulations of Connecticut State Agencies, the Commissioner may approve in writing a ground-water protection criterion to apply to such substance. Any person requesting approval of a ground-water protection criterion for such substance shall submit to the commissioner (A) a risk-based ground-water protection criterion for such substance calculated in accordance with subdivision (2) of this subsection, (B) the analytical detection limit for such substance, (C) a description of the organoleptic properties of such substance. Before approving a ground-water protection criterion the Commissioner shall consider the proposed risk-based ground-water protection criterion for such substance, the analytical detection limit for such substance, the organoleptic effects of such substance, any information about the health effects such substance may cause due to exposure pathways not accounted for in the proposed risk-based ground-water protection criterion, and any other information that the Commissioner reasonably deems necessary.

(2) The risk-based ground-water protection criterion shall be calculated using the following equations:

(A) For carcinogenic substances;

$$GWPC = \left[\frac{Risk}{CSF}\right] \times \left[\frac{BW \times AT}{IR \times EF \times ED \times CF}\right]$$

(B) For non-carcinogenic substances:

$$GWPC = \left[Rfd \times HI^{x} \left| \frac{BW \times AT}{IR \times EF \times ED \times CF \times SA} \right| \right]$$

(C) The abbreviations used in subparagraphs (A) and (B) of this subdivision shall be interpreted in accordance with the following table and shall be assigned the values specified therein:

Term	Description	Units	Value
$GWPC_{RB}$	Risk-based Ground-water protection Criterion	ug/l	calculated
Risk	Target Cancer Risk Level	unitless	1.0E-06
HI	Hazard Index	unitless	1.0
CSF	Cancer slope Factor	$(mg/kg\text{-}day)^{-1}$	substance-specific
RFD	Reference Dose	mg/kg-day	substance-specific
IR	Ingestion Rate	l/day	2
EF	Exposure Frequency	days/year	365
ED	Exposure Duration	years	70
CF	Conversion Factor	unitless	1000
BW	Body Weight	kg	70
AT	Averaging Time,	days	25550
SA	Source Allocation	unitless	0.2

(i) Additional Remediation of Ground Water.

Nothing in sections 22a-133k-1 through 22a-133k-3, inclusive, of the Regulations of Connecticut State Agencies shall preclude the Commissioner from taking any action necessary to prevent or abate pollution, or to prevent or abate any threat to human health or the environment. If the presence of any substance impairs the aesthetic quality of any ground water which is or can reasonably be expected to be a source of water for drinking or other domestic use, additional remediation shall be conducted in order to reduce the concentration of such substance to a concentration appropriate for such use.

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Appendix A to
Sections 22a-133k-1 through 22a-133k-3 of the Regulations of Connecticut State Agencies
Direct Exposure Criteria for Soil

Substance	Residential Criteria in mg/kg (ppm)	Industrial/ Commercial Criteria in mg/kg (ppm)
Volatile Organic Substances		
Acetone	500	1000
Acrylonitrile	1.1	11
Benzene	21	200
Bromoform	78	720
2-Butanone(MEK)	500	1000
Carbon tetrachloride	4.7	44
Chlorobenzene	500	1000
Chloroform	100	940
Dibromochloromethane	7.3	68
1,2-Dichlorobenzene	500	1000
1,3-Dichlorobenzene	500	1000
1,4-Dichlorobenzene	26	240
1,1-Dichloroethane	500	1000
1,2-Dichloroethane	6.7	63
1,1-Dichloroethylene	1	9.5
cis-1,2-Dichloroethylene	500	1000
trans-1,2-Dichloroethylene	500	1000
1,2-Dichloropropane	9	84
1,3-Dichloropropene	3.4	32
Ethylbenzene	500	1000

Substance	Residential Criteria in mg/kg (ppm)	Industrial/ Commercial Criteria in mg/kg (ppm)
Ethylene dibromide (EDB)	0.007	0.067
Methyl-tert-butyl-ether	500	1000
Methyl isobutyl ketone	500	1000
Methylene chloride	82	760
Styrene	500	1000
1,1,1,2-Tetrachloroethane	24	220
1,1,2,2-Tetrachloroethane	3.1	29
Tetrachloroethylene	12	110
Toluene	500	1000
1,1,1-Trichloroethane	500	1000
1,1,2-Trichloroethane	11	100
Trichloroethylene	56	520
Vinyl chloride	0.32	3
Xylenes	500	1000
Semivolatile Substances		
Acenaphthylene	1000	2500
Anthracene	1000	2500
Benzo(a)anthracene	1	7.8
Benzo(b)fluoranthene	1	7.8
Benzo(k)fluoranthene	8.4	78
Benzo(a)pyrene	1	1

Substance	Residential Criteria in mg/kg (ppm)	Industrial/ Commercial Criteria in mg/kg (ppm)
Bis(2-chloroethyl)ether	1	5.2
Bis(2-chloroisopropyl) ether	8.8	82
Bis(2-ethyl hexyl) phthalate	44	410
Butyl benzl phthalate	1000	2500
2-chlorophenol	340	2500
Di-n-butyl phthalate	1000	2500
Di-n-octyl phthalate	1000	2500
2,4-Dichlorophenol	200	2500
Fluoranthene	1000	2500
Fluorene	1000	2500
Hexachloroethane	44	410
Hexachlorobenzene	1	3.6
Naphthalene	1000	2500
Pentachlorophenol	5.1	48
Phenanthrene	1000	2500
Phenol	1000	2500
Pyrene	1000	2500
Inorganic Substances		
Antimony	27	8200
Arsenic	10	10
Barium	4700	140000

Substance	Residential Criteria in mg/kg (ppm)	Industrial/ Commercial in mg/kg (ppm)
Beryllium	2	2
Cadmium	34	1000
Chromium, trivalent	3900	51000
Chromium, hexavalent	100	100
Copper	2500	76000
Cyanide	1400	41000
Lead	500	1000
Mercury	20	610
Nickel	1400	7500
Selenium	340	10000
Silver	340	10000
Thallium	5.4	160
Vanadium	470	14000
Zinc	20000	610000
Pesticides, PCB's, and Total Petroleum Hydrocarbons (TPH)		
Alachlor	7.7	72
Aldicarb	14	410
Atrazine	2.8	26
Chlordane	0.49	2.2
Dieldrin	0.038	0.36
Endrin	20	610
2-4 D	680	20000

Substance	Residential Criteria in mg/kg (ppm)	Industrial/ Commercial in mg/kg (ppm)
Heptachlor epoxide	0.067	0.63
Heptachlor	0.14	1.3
Lindane	20	610
Methoxychlor	340	10000
Toxaphene	0.56	5.2
PCB's	1	10
TPH	500	2500

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Appendix B to
Sections 22a-133k-1 through 22a-133k-3 of the Regulations of Connecticut State Agencies
Pollutant Mobility Criteria for Soil

Substance	GA, GAA Mobility Criteria in mg/kg (ppm)	GB Mobility Criteria in mg/kg (ppm)
Volatile Organic Substances		
Acetone	14	140
Acrylonitrile	0.01	0.1
Benzene	0.02	0.2
Bromoform	0.08	0.8
2-Butanone(MEK)	8	80
Carbon tetrachloride	0.1	1
Chlorobenzene	2	20
Chloroform	0.12	1.2
Dibromochloromethane	0.01	0.1
1,2-Dichlorobenzene	3.1	3.1
1,3-Dichlorobenzene	12	120
1,4-Dichlorobenzene	1.5	15
1,1-Dichloroethane	1.4	14
1,2-Dichloroethane	0.02	0.2
1,1-Dichloroethylene	0.14	1.4
cis-1,2-Dichloroethylene	1.4	14
trans-1,2-Dichloroethylene	2	20
1,2-Dichloropropane	0.1	1.0
1,3-Dichloropropene	0.01	0.1
Ethyl benzene	10.1	10.1
Ethylene dibromide (EDB)	0.01	0.1
Methyl-tert-butyl-ether	2	20
Methyl isobutyl ketone	7	14
Methylene chloride	0.1	1.0
Styrene	2	20
1,1,1,2-Tetrachloroethane	0.02	0.2

Substance	GA, GAA Mobility Criteria in mg/kg (ppm)	GB Mobility Criteria in mg/kg (ppm)
1,1,2,2-Tetrachloroethane	0.01	0.1
Tetrachloroethylene	0.1	1
Toluene	20	67
1,1,1-Trichloroethane	4	40
1,1,2-Trichloroethane	0.1	1
Trichloroethylene	0.1	1.0
Vinyl chloride	0.04	0.40
Xylenes	19.5	19.5
Semivolatile Substances		
Acenaphthylene	8.4	84
Anthracene	40	400
Benzo(a)anthracene	1	1
Benzo(b)fluoranthene	1	1
Benzo(k)fluoranthene	1	1
Benzo(a)pyrene	1	1
Bis(2-chloroethyl)ether	1	2.4
Bis(2-chloroisopropyl)ether	1	2.4
Bis(2-ethyl hexyl)phthalate	1	11
Butyl benzl phthalate	20	200
2-chlorophenol	1	7.2
Di-n-butyl phthalate	14	140
Di-n-octyl phthalate	2	20
2,4-Dichlorophenol	1	4
Fluoranthene	5.6	56
Fluorene	5.6	56
Hexachloroethane	1	1
Hexachlorobenzene	1	1
Naphthalene	5.6	56
Pentachlorophenol	1	1
Phenanthrene	4	40
Phenol	80	800
Pyrene	4	40

Substance	GA, GAA Mobility Criteria in mg/kg (ppm)	GB Mobility Criteria in mg/kg (ppm)
Pesticides and TPH		
Alachlor	0.230	0.4
Aldicarb	1	1
Atrazine	0.2	0.2
Chlordane	0.066	0.066
Dieldrin	0.007	0.007
2-4 D	1.4	14
Heptachlor epoxide	0.02	0.02
Heptachlor	0.013	0.013
Lindane	0.02	0.04
Methoxychlor	0.8	8
Simazine	0.8	8
Toxaphene	0.33	0.6
Total Petroleum Hydrocarbon By EPA Method 418.1 or another EPA-approved method acceptable to the Commissioner	500	2500
Inorganic Substances and PCB	**GA, GAA Mobility Criteria By TCLP or by SPLP in mg/l (ppm)**	**GB Mobility Criteria By TCLP or by SPLP in mg/l (ppm)**
Antimony	0.006	0.06
Arsenic	0.05	0.5
Barium	1	10.0
Beryllium	0.004	0.04
Cadmium	0.005	0.05
Chromium, total	0.05	0.5
Copper	1.3	13
Cyanide (by SPLP only)	0.2	2
Lead	0.015	0.15
Mercury	0.002	0.02
Nickel	0.1	1.0
Selenium	0.05	0.5

Substance	GA, GAA Mobility Criteria By TCLP or by SPLP in mg/l (ppm)	GB Mobility Criteria By TCLP or by SPLP in mg/l (ppm)
Silver	0.036	0.36
Thallium	0.005	0.05
Vanadium	0.05	0.50
Zinc	5	50
PCB	0.0005	0.005

Appendix C to
Sections 22a-133k-1 through 22a-133k-3 of the Regulations of Connecticut State Agencies
Ground-Water Protection Criteria for GA and GAA Areas

Substance	Ground-water Protection Criteria in ug/l (ppb)
Volatile Organic Substances	
Acetone	700
Acrylonitrile	0.5
Benzene	1
Bromoform	4
2-Butanone(MEK)	400
Carbon tetrachloride	5
Chlorobenzene	100
Chloroform	6
Dibromochloromethane	0.5
1,2-Dichlorobenzene	600
1,3-Dichlorobenzene	600
1,4-Dichlorobenzene	75
1,1-Dichloroethane	70
1,2-Dichloroethane	1
1,1-Dichloroethylene	7
cis-1,2-Dichloroethylene	70
trans-1,2-Dichloroethylene	100
1,2-Dichloropropane	5
1,3-Dichloropropene	0.5
Ethyl benzene	700
Ethylene dibromide (EDB)	0.05
Methyl-tert-butyl-ether	100
Methyl isobutyl ketone	350
Methylene chloride	5
Styrene	100
1,1,1,2-Tetrachloroethane	1
1,1,2,2-Tetrachloroethane	0.5
Tetrachloroethylene	5

Substance	Ground-water Protection Criteria in ug/l (ppb)
Toluene	1000
1,1,1-Trichloroethane	200
1,1,2-Trichloroethane	5
Trichloroethylene	5
Vinyl chloride	2
Xylenes	530
Semivolatile Substances	
Acenaphthylene	420
Anthracene	2000
Benzo(a)anthracene	0.06
Benzo(b)fluoranthene	0.08
Benzo(k)fluoranthene	0.5
Benzo(a)pyrene	0.2
Bis(2-chloroethyl)ether	12
Bis(2-chloroisopropyl)ether	12
Bis(2-ethyl hexyl)phthalate	2
Butyl benzl phthalate	1000
2-chlorophenol	36
Di-n-butyl phthalate	700
Di-n-octyl phthalate	100
2,4-Dichlorophenol	20
Fluoranthene	280
Fluorene	280
Hexachloroethane	3
Hexachlorobenzene	1
Naphthalene	280
Pentachlorophenol	1
Phenanthrene	200
Phenol	4000
Pyrene	200

Substance	Ground-water Protection Criteria in ug/l (ppb)
Inorganic Substances	
Antimony	6
Arsenic	50
Asbestos in mfl	7 (mfl)
Barium	1000
Beryllium	4
Cadmium	5
Chromium (total)	50
Copper	1300
Cyanide	200
Lead	15
Mercury	2
Nickel	100
Selenium	50
Silver	36
Thallium	5
Vanadium	50
Zinc	5000
Pesticides, PCB and Total Petroleum Hydrocarbons	
Alachlor	2
Aldicarb	3
Atrazine	3
Chlordane	0.3
Dieldrin	0.002
2-4 D	70
Heptachlor epoxide	0.2
Heptachlor	0.4
Lindane	0.2
Methoxychlor	40
Simazine	4
Toxaphene	3

*Substance	Ground-water Protection Criteria in ug/l (ppb)
PCB's	0.5
Total Petroleum Hydrocarbon By EPA Method 418.1 or another EPA-approved method acceptable to the Commissioner	500

Appendix D to
Sections 22a-133k-1 through 22a-133k-3 of the Regulations of Connecticut State Agencies
Surface-water Protection Criteria
for Substances in Ground Water

Substance	Surface-Water Protection Criteria in ug/l (ppb)
Volatile Organic Substances	
Acrylonitrile	20
Benzene	710
Bromoform	10800
Carbon tetrachloride	132
Chlorobenzene	420000
Chloroform	14100
Dibromochloromethane	1020
1,2-Dichlorobenzene	170000
1,3-Dichlorobenzene	26000
1,4-Dichlorobenzene	26000
1,2-Dichloroethane	2970
1,1-Dichloroethylene	96
1,3-Dichloropropene	34000
Ethylbenzene	580000
Methylene chloride	48000
1,1,2,2-Tetrachloroethane	110
Tetrachloroethylene	88
Toluene	4000000
1,1,1-Trichloroethane	62000
1,1,2-Trichloroethane	1260
Trichloroethylene	2340
Vinyl chloride	15750
Semivolatile Substances	
Acenaphthylene	0.3
Anthracene	1100000
Benzo(a)anthracene	0.3
Benzo(b)fluoranthene	0.3
Benzo(k)fluoranthene	0.3

Substance	Surface Water Protection Criteria in ug/l (ppb)
Benzo(a)pyrene	0.3
Bis(2-chloroethyl) ether	42
Bis(2-chloroisopropyl) ether	3400000
Bis(2-ethyl hexyl)phthalate	59
Di-n-butyl phthalate	120000
2,4-Dichlorophenol	15800
Fluoranthene	3700
Fluorene	140000
Hexachloroethane	89
Hexachlorobenzene	0.077
Phenanthrene	0.077
Phenol	92000000
Pyrene	110000
Inorganic Substances	
Antimony	86000
Arsenic	4
Asbestos (in mfl)	7 mfl
Beryllium	4
Cadmium	6
Chromium, trivalent	1200
Chromium, hexavalent	110
Copper	48
Cyanide	52
Lead	13
Mercury	0.4
Nickel	880
Selenium	50
Silver	12
Thallium	63
Zinc	123

Substance	Surface Water Protection Criteria in ug/l (ppb)
Pesticides and PCB	
Chlordane	0.3
Dieldrin	0.1
Endrin	0.1
Heptachlor epoxide	0.05
Heptachlor	0.05
Toxaphene	1
PCB's	0.5

Appendix E to
Sections 22a-133k-1 through 22a-133k-3 of the Regulations of Connecticut State Agencies
Volatilization Criteria for Ground Water

Volatile Substance	Residential Volatilization Criteria for Ground water in parts per billion	Industrial/Commercial Volatilization Criteria for Ground water in parts per billion
Acetone	50000	50000
Benzene	215	530
Bromoform	920	3800
2-Butanone (MEK)	50000	50000
Carbon Tetrachloride	16	40
Chlorobenzene	1800	6150
Chloroform	287	710
1,2-Dichlorobenzene	30500	50000
1,3-Dichlorobenzene	24200	50000
1,4-Dichlorobenzene	50000	50000
1,1-Dichloroethane	34600	50000
1,2-Dichloroethane	21	90
1,1-Dichloroethylene	1	6
1,2-Dichloropropane	14	60
1,3-Dichloropropene	6	25
Ethyl benzene	50000	50000
Ethylene dibromide (EDB)	4	16
Methyl-tert-butyl-ether	50000	50000
Methyl isobutyl ketone	50000	50000
Methylene chloride	50000	50000
Styrene	580	2065
1,1,1,2-Tetrachloroethane	12	50
1,1,2,2-Tetrachloroethane	23	100
Tetrachloroethylene	1500	3820
Toluene	23500	50000
1,1,1-Trichloroethane	20400	50000
1,1,2-Trichloroethane	8000	19600
Trichloroethylene	219	540

Volatile Substance	Residential Volatilization Criteria for Ground water in parts per billion	Industrial/Commercial Volatilization Criteria for Ground water in parts per billion
Vinyl chloride	2	2
Xylenes	21300	50000

Appendix F to
Sections 22a-133k-1 through 22a-133k-3 of the Regulations of Connecticut State Agencies
Volatilization Criteria for Soil Vapor

Volatile Substance	Residential Volatilization Criteria for Soil Vapor in parts per million	Industrial/Commercial Volatilization Criteria for Soil Vapor in parts per million
Acetone	2400	8250
Benzene	1	113
Bromoform	1.5	6
2-Butanone (MEK)	2400	8285
Carbon Tetrachloride	1	2.7
Chlorobenzene	31	106
Chloroform	4.5	10.4
1,2-Dichlorobenzene	240	818
1,3-Dichlorobenzene	240	818
1,4-Dichlorobenzene	950	3270
1,1-Dichloroethane	850	3037
1,2-Dichloroethane	1	1
1,1-Dichloroethylene	1	1
1,2-Dichloropropane	1	1
1,3-Dichloropropene	1	1
Ethyl benzene	1650	5672
Ethylene dibromide (EDB)	1	1
Methyl-tert-butyl-ether	1000	3415
Methyl isobutyl ketone	140	480
Methylene chloride	1200	2907
Styrene	8	28
1,1,1,2-Tetrachloroethane	1	1.5
1,1,2,2- Tetrachloroethane	1	1
Tetrachloroethylene	11	27
Toluene	760	2615

Volatile Substance	Residential Volatilization Criteria for Soil Vapor in parts per million	Industrial/Commercial Volatilization Criteria for Soil Vapor in parts per million
1,1,1-Trichloroethane	1310	4520
1,1,2-Trichloroethane	40	93
Trichloroethylene	7	16
Vinyl chloride	1	1
Xylenes	500	1702

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Appendix G to
Sections 22a-133k-1 through 22a-133k-3 of the Regulations of Connecticut State Agencies
Equations, Terms and Values for Calculating Site-specific Volatilization Criteria
for Ground Water and Soil Vapor

Volatilization Criteria for Ground Water

Site-Specific Volatilization Criteria for Ground Water may be calculated using the following equations:

$$GWC = TAC / (1000 \cdot VF_{GW})$$

$$VF_{GW} = \frac{H[(D_{EFF\ WS}/L_{GW})/(ER \cdot L_B)] \cdot 1000}{1+[(D_{EFF\text{-}WS}/L_{GW})/(ER \cdot L_B)] + [(D_{EFF\text{-}WS}/L_{GW})/((D_{EFF\text{-}CRACK}/L_{CRACK}) \cdot \eta)]}$$

$$D_{EFF\ WS} = (h_{cap} + h_v) / [(h_{cap} / D_{EFF\text{-}CAP}) + (h_v / D_{EFF\text{-}S})]$$

$$D_{EFF\text{-}CAP} = D_{AIR} \cdot (\theta_{ACAP}^{3.33} / \theta_T^2) + D_{WATER}/H \cdot (\theta_{WCAP}^{3.33} / \theta_T^2)$$

$$D_{EFF\text{-}S} = D_{AIR} \cdot (\theta_{AS}^{3.33} / \theta_T^2) + D_{WATER}/H \cdot (\theta_{WS}^{3.33} / \theta_T^2)$$

$$D_{EFF\text{-}CRACK} = D_{AIR} \cdot (\theta_{ACRACK}^{3.33} / \theta_T^2) + D_{WATER}/H \cdot (\theta_{WCRACK}^{3.33} / \theta_T^2)$$

Where:

Term	Description	Units	Value
GWC	Ground Water Volatilization Criteria	ug/kg	calculated
TAC	Target Indoor Air Concentration	ug/m^3	**
VF_{GW}	Ground Water Volatilization Factor	mg/m^3	calculated
H	Henry's Law Constant	unitless	substance-specific
$D_{EFF\ WS}$	Effective Diffusion-Ground Water to Soil Surface	cm^2/s	calculated
L_{GW}	Depth to Ground Water (= $h_{CAP} + h_V$)	cm	site-specific
h_{CAP}	Thickness of Capillary Fringe	cm	site-specific
h_V	Thickness of Vadose Zone	cm	site-specific
ER_R	Residential Enclosed Space Air Exchange Rate	1/s	.00014
ER_I	Industrial Enclosed Space Air Exchange Rate	1/s	.00023

Term	Description	Units	Value
L_{BR}	Residential Enclosed Space Volume/Infiltration Area Ratio	cm	site-specific
L_{BI}	Industrial Enclosed Space Volume/Infiltration Area Ratio	cm	site-specific
$D_{EFF-CRACK}$	Effective Diffusion through Foundation Cracks	cm^2/s	calculated
L_{CRACK}	Enclosed Space Foundation or Wall Thickness	cm	site-specific
η	Areal Fraction of Cracks in Foundations / Walls	unitless	.01
$D_{EFF-CAP}$	Effective Diffusion through Capillary Fringe	cm^2/s	calculated
D_{EFF-S}	Effective Diffusion through Soil (In Vapor Phase)	cm^2/s	calculated
D_{AIR}	Diffusion Coefficient in Air	cm^2/s	8.40E-02 or chemical specific
D_{WATER}	Diffusion Coefficient in Water	cm^2/s	1.00E-05 or chemical specific
θ_{ACAP}	Volumetric Air Content in Capillary Fringe	unitless	site-specific
θ_{AS}	Volumetric Air Content in Vadose Zone	unitless	site-specific
θ_{ACRACK}	Volumetric Air Content in Foundation/Wall Cracks	unitless	site-specific
θ_{WCAP}	Volumetric Water Content in Capillary Fringe	unitless	site-specific
θ_{WS}	Volumetric Water Content in Vadose Zone	unitless	site-specific
θ_{WCRACK}	Volumetric Water Content in Foundation/Wall Cracks	unitless	site-specific
θ_T	Total Soil Porosity	unitless	site-specific

**See attached "Table of Target Air Concentrations"

Volatilization Criteria for Soil Vapor

Site-Specific Volatilization Criteria for Soil Vapor may be calculated using the following equations:

$$SSVC = TAC / (1000 \cdot VF_{SSV})$$

$$VF_{SSV} = \frac{[(D_{EFF\,S}/L_S)/(ER \cdot L_B)]}{1+[(D_{EFF\text{-}S}/L_S)/(ER \cdot L_B)] + [(D_{EFF\text{-}S}/L_S)/(D_{EFF\text{-}CRACK}/L_{CRACK})\cdot\eta]}$$

$$D_{EFF\text{-}S} = D_{AIR} \cdot (\theta_{AS}^{3.33}/\theta_T^2) + D_{WATER}/H \cdot (\theta_{WS}^{3.33}/\theta_T^2)$$

$$D_{EFF\text{-}CRACK} = D_{AIR} \cdot (\theta_{ACRACK}^{3.33}/\theta_T^2) + D_{WATER}/H \cdot (\theta_{WCRACK}^{3.33}/\theta_T^2)$$

Where:

Terms	Description	Units	Value
SSVC	Volatilization Criteria for Soil Vapor	mg/m^3-air	calculated
TAC	Target Indoor Air Concentration	ug/m^3-air	**
VF_{SSV}	Volatilization Factor for Subsurface Vapors	unitless	calculated
H	Henry's Law Constant	unitless	substance-specific
$D_{EFF\,S}$	Effective Diffusion through Soil (in Vapor Phase)	cm^2/s	calculated
L_S	Depth to Soil Vapor Sample	cm	site-specific
ER_R	Residential Enclosed Space Air Exchange Rate	1/s	.00014
ER_I	Industrial Enclosed Space Air Exchange Rate	1/s	.00023
$L_{B\,R}$	Residential Enclosed Space Volume/Infiltration Area Ratio	cm	site-specific
$L_{B\,I}$	Industrial Enclosed Space Volume/Infiltration Area Ratio	cm	site-specific
$D_{EFF\text{-}CRACK}$	Effective Diffusion through Foundation Cracks	cm^2/s	calculated
L_{CRACK}	Enclosed Space Foundation or Wall Thickness	cm	site-specific
η	Areal Fraction of Cracks in Foundations / Walls	unitless	calculated
θ_{AS}	Volumetric Air Content in Vadose Zone	unitless	site-specific
θ_{ACRACK}	Volumetric Air Content in Foundation/Wall Cracks	unitless	site-specific
θ_{WS}	Volumetric Water Content in Vadose Zone	unitless	site-specific
θ_{WCRACK}	Volumetric Water Content in Foundation/Wall Cracks	unitless	site-specific
θ_T	Total Soil Porosity	unitless	site-specific

** See attached "Table of Target Air Concentrations"

Table of Target Air Concentrations

Volatile Substance	Residential Target Indoor Air Concentration in micrograms per cubic meter	Industrial/Commercial Target Indoor Air Concentration in micrograms per cubic meter
Acetone	8.34 E02	1.17 E03
Benzene	3.25 E00	2.15 E01
Bromoform	2.21 E00	3.72 E00
2-Butanone (MEK)	1.04 E03	1.46 E03
Carbon Tetrachloride	1.00 E00	1.00 E00
Chlorobenzene	2.09 E01	2.92 E01
Chloroform	3.00 E00	3.00 E00
1,2-Dichlorobenzene	2.09 E02	2.92 E02
1,3-Dichlorobenzene	2.09 E02	2.92 E02
1,4-Dichlorobenzene	8.34 E02	1.17 E03
1,1-Dichloroethane	5.21 E02	7.30 E02
1,2-Dichloroethane	9.36 E-02	1.57 E-01
1,1-Dichloroethylene	4.87 E-02	8.18 E-02
1,2-Dichloropropane	1.28 E-01	2.15 E-01
1,3-Dichloropropene	6.58 E-02	1.10 E-01
Ethyl benzene	1.04 E03	1.46 E03
Ethylene dibromide (EDB)	1.11 E-02	1.86 E-02
Methyl-tert-butyl-ether	5.21 E02	7.30 E02
Methyl isobutyl ketone	8.34 E01	1.17 E02
Methylene chloride	6.00 E02	6.00 E02
Styrene	5.00 E00	7.17 E00
1,1,1,2-Tetrachloroethane	3.29 E-01	5.52 E-01
1,1,2,2-Tetrachloroethane	4.20 E-02	7.05 E-02
Tetrachloroethylene	1.10 E01	1.10 E01
Toluene	4.17 E02	5.84 E02

Volatile Substance	Residential Target Indoor Air Concentration in micrograms per cubic meter	Industrial/Commercial Target Indoor Air Concentration in micrograms per cubic meter
1,1,1-Trichloroethane	1.04 E03	1.46 E03
1,1,2-Trichloroethane	3.00 E01	3.00 E01
Trichloroethylene	5.00 E00	5.00 E00
Vinyl chloride	2.90 E-02	4.87 E-02
Xylenes	3.13 E02	4.38 E02

Section 4. The Regulations of Connecticut State Agencies are amended by adding a new section 22a-133q-1 as follows:

22a-133q-1 Environmental land use restrictions

(a) Definitions.

For the purpose of this section, the definitions of the terms shall be the same as the definitions of terms in section 22a-133k-1 of the Regulations of Connecticut State Agencies. In addition, the following definitions shall apply:

"Class A-2 survey" means a first survey or independent re-survey which conforms to the "Recommended Standards for Surveys and Maps in the State of Connecticut Adopted on September 24, 1992, effective January 1, 1993 by the Connecticut Association of Land Surveyors, Inc." and which has been prepared by a land surveyor licensed in the State of Connecticut; complies with the minimum detail requirements for urban land title surveys adopted by the American Land Title Association and American Congress on Surveying and Maps (such requirements shall include all optional items on Table A thereof, exclusive of Items #1 (Monumentation), #5 (Contours in Elevation), #7b-2 (Other Data), and #12; and specifically shows (1) the boundaries of the Property by course and distance, together with the metes and bounds description corresponding to such survey; (2) the location of all improvements; (3) the location and width of all easements, utility lines, rights of way and building setback lines, with references to the book and page numbers for the instruments granting the same; (4) the location of all encroachments and restrictions, if any affecting the property; (5) the location of the portion of the parcel which is the subject of the proposed environmental land use restriction and (6) the latitude and longitude of the center of the subject property.

"Environmental land use restriction" means (1) a declaration of environmental land use restriction in the form set forth in Appendix 1 to section 22a-133q-1 of the Regulations of Connecticut State Agencies, or, in the case of an environmental land use restriction approved by a licensed environmental professional pursuant to P.A. 95-190, a declaration of environmental land use restriction in the form set forth in Appendix 2 to section 22a-133q-1 of the Regulations of Connecticut State Agencies; (2) a class A-2 survey of the subject parcel or portion thereof; (3) a certificate of title demonstrating that the subordination agreement(s) required under section 22a-133o of the General Statutes as amended by P.A. 95-190 has been recorded; and (4) a copy of the decision document prepared in accordance with subsection (f) of this section.

"Licensed environmental professional" means an environmental professional licensed in accordance with section 4 of P.A. 95-183.

(b) Applicability.

This section shall govern the execution and recording of environmental land use restrictions in accordance with section 22a-133n to 22a-133s, inclusive, of the General Statutes. Except as otherwise provided by section 22a-133o of the General Statutes, no environmental land use restriction shall be effective unless and until it has (1) been submitted to the Commissioner for his review and approved by him as evidenced by his signature on the original of the instrument setting forth such restriction; and (2) been recorded on the land records in the municipality in which the subject parcel is located.

(c) Publishing Notice of an Environmental Land Use Restriction.

(1) The owner of the parcel which is the subject of a proposed environmental land use restriction shall, except as specified in subdivision (1) of this subsection, publish in at least one newspaper of general circulation in the area affected by the proposed environmental land use restriction, notice of intent to record an environmental land use restriction. Such notice shall include the name and address of such owner, the address of the parcel or a brief description of its location, a brief description of the purpose of the proposed environmental land use restriction, the name and address of an individual from whom interested persons may obtain a copy of the proposed use restriction, and a statement that public comments on the proposed environmental land use restriction may be submitted in writing to the Commissioner of Environmental

Protection, 79 Elm Street, Hartford, CT 06106 for thirty days after the date of publication of the notice.

(2) Notice of a proposed environmental land use restriction need not be published if (A) such restriction provides solely that the use of the subject parcel or portion thereof is restricted to industrial or commercial activities, and (B) the municipal zoning of such parcel limits the parcel to such use.

(d) Proposing an Environmental Land Use Restriction.

When submitting a proposed environmental land use restriction to the Commissioner for his review and approval, the owner of the affected parcel of land shall simultaneously submit:

(1) a draft declaration of environmental land use restriction in the form set forth in Appendix 1 or 2 to section 22a-133q-1 of the Regulations of Connecticut State Agencies, as applicable;
(2) a Class A-2 survey of the parcel or portion thereof which is the subject of the proposed environmental land use restriction;
(3) a proposed decision document in accordance with subsection (f) of this section; and
(4) a certified copy of the notice required by subsection (c) of this section, as such notice appeared in the newspaper or newspapers.

(e) Approval of an Environmental Land Use Restriction by the Commissioner.

After the close of the public comment period, the Commissioner shall decide whether to approve an environmental land use restriction. When making such decision the Commissioner shall consider: (1) all comments submitted; (2) whether such restriction will adequately protect human health and the environment from pollution at or emanating from the subject release area; and (3) whether such restriction conforms in all respects to the requirements of this section and sections 22a-133n through 22a-133s of the General Statutes.

(f) Decision Document.

Any environmental land use restriction approved pursuant to this section shall include a decision document prepared in accordance with this section. The decision document shall contain a detailed written description of:

(1) the type and location of pollutants present in soil or ground water on or underlying the parcel or portion thereof which is the subject of the environmental land use restriction;
(2) the provisions of the environmental land use restriction, including any limitations on the use of such parcel or portion thereof; and
(3) description of the reason for the environmental land use restriction, including an explanation why such restriction is consistent with sections 22a-133k-1 through 22a-133k-3, inclusive, of the Regulations of Connecticut State Agencies.

The decision document shall also contain a summary of all comments on the proposed environmental land use restriction received following the publication of notice in accordance with subsection (c) of this section and a brief response to each comment. The decision document shall be signed by the Commissioner or, in the case of a restriction approved pursuant to P.A. 95-190, a licensed environmental professional to indicate approval of the decision document.

(g) Approval of an Environmental Land Use Restriction by a Licensed Environmental Professional.

When an environmental land use restriction is to be approved by a licensed environmental professional in accordance with P.A. 95-190, the licensed environmental professional shall review the documents listed in subsection (e), shall prepare a written approval of such restriction, and shall retain documentation of all documents reviewed by him. A licensed environmental professional shall not approve any environmental land use restriction unless it is consistent with sections 22a-133k-1 through 22a-133k-3, inclusive, of the Regulations of Connecticut State Agencies.

(h) Subordination Agreements.

Whether the Commissioner or a licensed environmental professional approves an environmental land use restriction, prior to recording such environmental land use restriction on the municipal land records, the owner of the subject parcel shall submit to the Commissioner for his review and written approval: (1) copies of each subordination agreement, properly executed, required under section 22a-133o of the General Statutes; or (2) a certificate of title indicating that each person holding an interest in such parcel or any part thereof, including without limitation each mortgagee, lessee, lienor and encumbrancer, has irrevocably subordinated such interest to the environmental land use restriction.

(i) Recording an Environmental Land Use Restriction.

After the Commissioner or a licensed environmental professional, as applicable, has approved an environmental land use restriction in accordance with this section, the owner of the subject parcel shall record such restriction in accordance with this section and all other applicable law.

(j) Mailing Notice of an Environmental Land Use Restriction.

After an environmental land use restriction has been recorded, the owner of the subject parcel shall send, by certified mail, return receipt requested, a copy of such environmental land use restriction to (1) the chief administrative officer in the town where the parcel is located; (2) the chairman of the municipal planning, zoning or planning and zoning commission; (3) the local director of health; and (4) any person who submitted comments on such environmental use restriction.

(k) Release.

The owner of any parcel which is subject to an environmental land use restriction recorded in accordance with this section may request that the Commissioner release such parcel, in whole or in part, from the limitations of such restriction. If the Commissioner grants such request, the owner of such parcel shall, in accordance with law, record such release on the land records in the municipality where such parcel is located. No release of an environmental land use restriction shall be effective unless and until it has been submitted to the Commissioner for his review and approved by him as evidenced by his signature on the original of the instrument setting forth such release, and has been recorded on the land records of the municipality in which such parcel is located.

(l) Effect of Court Ruling on Environmental Land Use Restriction.

In the event that a court of competent jurisdiction rules that any portion of an environmental land use restriction recorded pursuant to this section is invalid, the owner of the subject parcel shall submit a copy of such restriction and such ruling to the Commissioner. The Commissioner shall review such restriction, and if he determines that such restriction would not have been approved without the invalid portion, he shall give notice that the environmental land use restriction is terminated as evidenced by his signature on in instrument setting forth such termination, and shall record such instrument on the land records of the municipality where such parcel is located. Promptly thereafter, the owner of the subject parcel shall take actions consistent with sections 22a-133k-1 through 22a-133k-3, inclusive, of the Regulations of Connecticut State Agencies to remediate the subject parcel or portion thereof. If the Commissioner determines in writing that the environmental land use restriction would have been approved without the invalid portion, the valid portion of the environmental land use restriction shall remain in full force and effect.

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Appendix 1 to
Section 22a-133q-1 of the Regulations of Connecticut State Agencies
Form of Environmental Land Use Restriction for Commissioner's Approval

Instructions: Any environmental land use restriction pursuant to R.C.S.A. section 22a-133q-1 shall be in the following form. The appropriate information shall be inserted in the blanks shown, and the appropriate language shall be selected from the choices shown in brackets, or if none of the choices addresses the specific circumstance, substitute language shall be inserted.

DECLARATION OF ENVIRONMENTAL LAND USE RESTRICTION
AND GRANT OF EASEMENT

This Declaration of environmental land use restriction and Grant of Easement is made this day of , 1995 , between ("the Grantor") and the Commissioner of Environmental Protection of the State of Connecticut ("the Grantee").

WITNESSETH:

WHEREAS, Grantor is the owner in fee simple of certain real property (the "Property") known as [Address/Location located in the Town of in County] [designated as Lot , Block on the tax map of the Town of in County], more particularly described on Exhibit A which is attached hereto and made a part hereof; and

WHEREAS, the Grantee has determined that the environmental land use restriction set forth below is consistent with regulations adopted by him pursuant to Section 22a-133k of the Connecticut General Statutes; and

WHEREAS, the Grantee has determined that this environmental land use restriction will effectively protect public health and the environment from the hazards of pollution; and

WHEREAS, the Grantee's written approval of this Environmental land use restriction is contained in the document attached hereto as Exhibit B (the "Decision Document") which is made a part hereof; and

WHEREAS, the property or portion thereof identified in the class A-2 survey ("the Subject Area") which survey is attached hereto as Exhibit C which is made a part hereof, contains pollutants and

WHEREAS, to prevent exposure to or migration of such pollutants and to abate hazards to human health and the environment, and in accordance with the Decision Document, the Grantor desires to impose certain restrictions upon the use, occupancy, and activities of and at the Subject Area, and to grant this environmental land use restriction to the Grantee on the terms and conditions set forth below; and

WHEREAS, Grantor intends that such restrictions shall run with the land and be binding upon and enforceable against Grantor and Grantor's successors and assigns;

NOW, THEREFORE, Grantor agrees as follows:

1. Purpose. In accordance with the Decision Document, the purpose of this Environmental land use restriction is to assure [that the Subject Area is not used for residential activities], [that ground water at the Subject Area is not utilized for drinking purposes], [that humans are not exposed to soils at the Subject Area polluted with substances in concentrations exceeding the direct exposure criteria established in R.C.S.A. sections 22a-133k-1 through 22a-133k-3, inclusive], [that water does not infiltrate soils at the Subject Area polluted with substances in concentrations exceeding the pollutant mobility criteria established in R.C.S.A. sections 22a-133k-1 through 22a-133k-3, inclusive] [that buildings are not constructed over soils or ground water at the Subject Area polluted with substances in concentrations exceeding the volatilization criteria established in R.C.S.A. sections 22a-133k-1 through 22a-133k-3, inclusive], [that the engineered control described in Exhibit D attached hereto is not disturbed and is properly maintained to prevent human exposure to soils at the Subject Area polluted with substances in concentrations exceeding the direct exposure criteria

established in R.C.S.A. sections 22a-133k-1 through 22a-133k-3, inclusive, and/or that water does not infiltrate soils at the Subject Area polluted with substances in concentrations exceeding the pollutant mobility criteria established in R.C.S.A. sections 22a-133k-1 through 22a-133k-3, inclusive.]

2. Restrictions Applicable to the Subject Area: In furtherance of the purposes of this environmental land use restriction, Grantor shall assure that use, occupancy, and activity of and at the Subject Area are restricted as follows:

[A. Use. No residential use of the Subject Area shall be permitted.

B. Ground water. Ground water at the Subject Area shall not be used for drinking or other domestic purposes.

C. Disturbances. Soil at the Subject Area shall not be disturbed in any manner, including without limitation,

D. Construction. No building shall be constructed on the Subject Area.]

3. Except as provided in Paragraph 4 below, no action shall be taken, allowed, suffered, or omitted if such action or omission is reasonably likely to:

i. Create a risk of migration of pollutants or a potential hazard to human health or the environment; or

ii. Result in a disturbance of the structural integrity of any engineering controls designed or utilized at the Property to contain pollutants or limit human exposure to pollutants.

4. Emergencies. In the event of an emergency which presents a significant risk to human health or the environment, the application of Paragraph 3 above may be suspended, provided such risk cannot be abated without suspending such Paragraph and the Grantor:

i. Immediately notifies the Grantee of the emergency;

ii. Limits both the extent and duration of the suspension to the minimum reasonably necessary to adequately respond to the emergency;

iii. Implements all measures necessary to limit actual and potential present and future risk to human health and the environment resulting from such suspension; and

iv. Implements a plan approved in writing by the Grantee, on a schedule approved by the Grantee, to ensure that the Subject Area is remediated in accordance with R.C.S.A. sections 22a-133k-1 through 22a-133k-3, inclusive, or restored to its condition prior to such emergency.

5. Release of Restriction; Alterations of Subject Area. Grantor shall not make, or allow or suffer to be made, any alteration of any kind in, to, or about any portion of any of the Subject Area inconsistent with this Environmental land use restriction unless the Grantor has first recorded the Grantee's written approval of such alteration upon the land records of [name of municipality where Subject Area is located]. The Grantee shall not approve any such alteration and shall not release the Property from the provisions of this environmental land use restriction unless the Grantor demonstrates to the Grantee's satisfaction that Grantor has remediated the Subject Area in accordance with R.C.S.A. sections 22a-133k-1 through 22a-133k-3, inclusive.

6. Grant of Easement to the Grantee. Grantor hereby grants and conveys to the Grantee, his agents, contractors, and employees, and to any person performing pollution remediation activities under the direction thereof, a non-exclusive easement (the "Easement") over the Subject Area and over such other parts of the Property as are necessary for access to the Subject Area or for carrying out any actions to abate a threat to human health or the environment associated with the Subject Area. Pursuant to this Easement, the Grantee, his agents, contractors, and employees, and any person performing pollution remediation activities under the direction thereof, may enter upon and inspect the Property and perform such investigations and actions as the Grantee deems necessary for any one or more of the following purposes:

i. Ensuring that use, occupancy, and activities of and at the Property are consistent with this environmental land use restriction;

ii. Ensuring that any remediation implemented complies with R.C.S.A. sections 22a-133k-1 through 22a-133k-3, inclusive;

iii. Performing any additional investigations or remediation necessary to protect human health

and the environment;

[iv. Ensuring the structural integrity of any engineering controls described in this Environmental land use restriction and Grant of Easement and their continuing effectiveness in containing pollutants and limiting human exposure to pollutants.]

7. Notice and Time of Entry onto Property. Entry onto the Property by the Grantee pursuant to this Easement shall be upon reasonable notice and at reasonable times, provided that entry shall not be subject to these limitations if the Grantee determines that immediate entry is necessary to protect human health or the environment.

8. Notice to Lessees and Other Holders of Interests in the Property. Grantor, or any future holder of any interest in the property, shall cause any lease, grant, or other transfer of any interest in the Property to include a provision expressly requiring the lessee, grantee, or transferee to comply with this environmental land use restriction and Grant of Easement. The failure to include such provision shall not affect the validity or applicability to the Property of this environmental land use restriction and Grant of Easement.

9. Persons Entitled to Enforce Restrictions. The restrictions in this environmental land use restriction on use, occupancy, and activity of and at the Property shall be enforceable in accordance with section 22a-133p of the General Statutes.

10. Severability and Termination. If any court of competent jurisdiction determines that any provision of this environmental land use restriction or Grant of Easement is invalid or unenforceable, such provision shall be deemed to have been modified automatically to conform to the requirements for validity and enforceability as determined by such court. In the event that the provision invalidated is of such nature that it cannot be so modified, the provision shall be deemed deleted from this instrument as though it had never been included herein. In either case, the remaining provisions of this instrument shall remain in full force and effect. Further, in either case, the Grantor shall submit a copy of this restriction and of the judgement of the Court to the Grantee in accordance with R.C.S. A. section 22a-133q-1(l). This environmental land use restriction shall be terminated if the Grantee provides notification pursuant to R.C.S.A. section 22a-133q-1(l).

11. Binding Effect. All of the terms, covenants and conditions of this environmental land use restriction and grant of easement shall run with the land and shall be binding on the Grantor, the Grantor's successors and assigns, and each owner and any other party entitled to possession or use of the Property during such period of ownership or possession.

12. Terms Used Herein. The definitions of terms used herein shall be the same as the definitions contained in sections 22a-133k-1 and 22a-133o-1 of the Regulations of Connecticut State Agencies as such sections existed on the date of execution of this environmental land use restriction..

STATE OF CONNECTICUT
REGULATION
OF
DEPARTMENT OF ENVIRONMENTAL PROTECTION

Appendix 2 to
Section 22a-133q-1 of the Regulations of Connecticut State Agencies
Form of Environmental Land Use Restriction for Licensed Environmental Professional's Approval

Instructions: Any environmental land use restriction pursuant to R.C.S.A. section 22a-133q-1 shall be in the following form. The appropriate information shall be inserted in the blanks shown, and the appropriate language shall be selected from the choices shown in brackets, or if none of the choices addresses the specific circumstance, substitute language shall be inserted.

DECLARATION OF ENVIRONMENTAL LAND USE RESTRICTION
AND GRANT OF EASEMENT

This Declaration of environmental land use restriction and Grant of Easement is made this day of , 1995 , between ("the Grantor") and the Commissioner of Environmental Protection of the State of Connecticut ("the Grantee").

WITNESSETH:

WHEREAS, Grantor is the owner in fee simple of certain real property (the "Property") known as [Address/Location located in the Town of in County] [designated as Lot , Block on the tax map of the Town of in County], more particularly described on Exhibit A which is attached hereto and made a part hereof; and

WHEREAS, remediation of the Property has been conducted in accordance with Public Act 95-190; and

WHEREAS, the Licensed Environmental Professional whose signature appears below has determined that the environmental land use restriction set forth below is consistent with regulations adopted by the Commissioner of Environmental Protection pursuant to Section 22a-133k of the Connecticut General Statutes; and

WHEREAS, the Licensed Environmental Professional whose signature appears below has determined that this environmental land use restriction will effectively protect public health and the environment from the hazards of pollution; and

WHEREAS, the written approval of this Environmental land use restriction by the Licensed Environmental Professional whose signature appears below is contained in the document attached hereto as Exhibit B (the "Decision Document") which is made a part hereof; and

WHEREAS, the property or portion thereof identified in the class A-2 survey ("the Subject Area") which survey is attached hereto as Exhibit C which is made a part hereof, contains pollutants; and

WHEREAS, to prevent exposure to or migration of such pollutants and to abate hazards to human health and the environment, and in accordance with the Decision Document, the Grantor desires to impose certain restrictions upon the use, occupancy, and activities of and at the Subject Area, and to grant this environmental land use restriction to the Grantee on the terms and conditions set forth below; and

WHEREAS, Grantor intends that such restrictions shall run with the land and be binding upon and enforceable against Grantor and Grantor's successors and assigns;

NOW, THEREFORE, Grantor agrees as follows:

1. Purpose. In accordance with the Decision Document, the purpose of this Environmental land use restriction is to assure [that the Subject Area is not used for residential activities], [that ground water at the Subject Area is not utilized for drinking purposes], [that humans are not exposed to soils at the Subject

Area polluted with substances in concentrations exceeding the direct exposure criteria established in R.C.S.A. sections 22a-133k-1 through 22a-133k-3, inclusive], [that water does not infiltrate soils at the Subject Area polluted with substances in concentrations exceeding the pollutant mobility criteria established in R.C.S.A. sections 22a-133k-1 through 22a-133k-3, inclusive] [that buildings are not constructed over soils or ground water at the Subject Area polluted with substances in concentrations exceeding the volatilization criteria established in R.C.S.A. sections 22a-133k-1 through 22a-133k-3, inclusive], [that the engineered control described in Exhibit D attached hereto is not disturbed and is properly maintained to prevent human exposure to soils at the Subject Area polluted with substances in concentrations exceeding the direct exposure criteria established in R.C.S.A. sections 22a-133k-1 through 22a-133k-3, inclusive, and/or that water does not infiltrate soils at the Subject Area polluted with substances in concentrations exceeding the pollutant mobility criteria established in R.C.S.A. sections 22a-133k-1 through 22a-133k-3, inclusive].

2. Restrictions Applicable to the Subject Area: In furtherance of the purposes of this environmental land use restriction, Grantor shall assure that use, occupancy, and activity of and at the Subject Area are restricted as follows:

[A. Use. No residential use of the Subject Area shall be permitted.

B. Ground water. Ground water at the Subject Area shall not be used for drinking or other domestic purposes.

C. Disturbances. Soil at the Subject Area shall not be disturbed in any manner, including without limitation,

D. Construction. No building shall be constructed on the Subject Area.]

3. Except as provided in Paragraph 4 below, no action shall be taken, allowed, suffered, or omitted if such action or omission is reasonably likely to:

i. Cause migration of pollutants or create a potential hazard to human health or the environment; or

ii. Result in a disturbance of the structural integrity of any engineering controls or other structures designed or utilized at the Property to contain pollutants or limit human exposure to pollutants.

4. Emergencies. In the event of an emergency which presents a significant risk to human health or the environment, the application of Paragraph 3 above may be suspended, provided such risk cannot be abated without suspending such Paragraph and the Grantor:

i. Immediately notifies the Grantee of the emergency;

ii. Limits both the extent and duration of the suspension to the minimum reasonably necessary to adequately respond to the emergency;

iii. Implements all measures necessary to limit actual and potential present and future risk to human health and the environment resulting from such suspension; and

iv. Implements a plan approved in writing by the Grantee, on a schedule approved by the Grantee, to ensure that the Subject Area is remediated in accordance with R.C.S.A. sections 22a-133k-1 through 22a-133k-3, inclusive, or restored to its condition prior to such emergency.

5. Release of Restriction; Alterations of Subject Area. Grantor shall not make, or allow or suffer to be made, any alteration of any kind in, to, or about any portion of any of the Subject Area inconsistent with this Environmental land use restriction unless the Grantor has first recorded the Grantee's written approval of such alteration upon the land records of [name of municipality where Subject Area is located]. The Grantee shall not approve any such alteration and shall not release the Property from the provisions of this environmental land use restriction unless the Grantor demonstrates to the Grantee's satisfaction that Grantor has remediated the Subject Area in accordance with R.C.S.A. sections 22a-133k-1 through 22a-133k-3, inclusive.

6. Grant of Easement to the Grantee. Grantor hereby grants and conveys to the Grantee, his agents, contractors, and employees, and to any person performing pollution remediation activities under the direction thereof, a non-exclusive easement (the "Easement") over the Subject Area and over such other parts of the Property as are necessary for access to the Subject Area or for carrying out any actions to abate a threat to human health or the environment associated with the Subject Area. Pursuant to this Easement, the Grantee, his agents, contractors, and employees, and any person performing pollution remediation activities

under the direction thereof, may enter upon and inspect the Property and perform such investigations and actions as the Grantee deems necessary for any one or more of the following purposes:

I. Ensuring that use, occupancy, and activities of and at the Property are consistent with this environmental land use restriction;

ii. Ensuring that any remediation implemented complies with R.C.S.A. sections 22a-133k-1 through 22a-133k-3, inclusive;

iii. Performing any additional investigations or remediation necessary to protect human health and the environment;

[iv. Ensuring the structural integrity of any engineering controls described in this Environmental land use restriction and Grant of Easement and their continuing effectiveness in containing pollutants and limiting human exposure to pollutants.]

7. Notice and Time of Entry onto Property. Entry onto the Property by the Grantee pursuant to this Easement shall be upon reasonable notice and at reasonable times, provided that entry shall not be subject to these limitations if the Grantee determines that immediate entry is necessary to protect human health or the environment.

8. Notice to Lessees and Other Holders of Interests in the Property. Grantor, or any future holder of any interest in the property, shall cause any lease, grant, or other transfer of any interest in the Property to include a provision expressly requiring the lessee, grantee, or transferee to comply with this environmental land use restriction and Grant of Easement. The failure to include such provision shall not affect the validity or applicability to the Property of this environmental land use restriction and Grant of Easement.

9. Persons Entitled to Enforce Restrictions. The restrictions in this environmental land use restriction on use, occupancy, and activity of and at the Property shall be enforceable in accordance with section 22a-133p of the General Statutes.

10. Severability and Termination. If any court of competent jurisdiction determines that any provision of this environmental land use restriction or Grant of Easement is invalid or unenforceable, such provision shall be deemed to have been modified automatically to conform to the requirements for validity and enforceability as determined by such court. In the event that the provision invalidated is of such nature that it cannot be so modified, the provision shall be deemed deleted from this instrument as though it had never been included herein. In either case, the remaining provisions of this instrument shall remain in full force and effect. Further, in either case, the Grantor shall submit a copy of this restriction and of the judgement of the Court to the Grantee in accordance with R.C.S. A. section 22a-133q-1(1). This environmental land use restriction shall be terminated if the Grantee provides notification pursuant to R.C.S.A. section 22a-133q-1(l).

11. Binding Effect. All of the terms, covenants and conditions of this environmental land use restriction and grant of easement shall run with the land and shall be binding on the Grantor, the Grantor's successors and assigns, and each owner and any other party entitled to possession or use of the Property during such period of ownership or possession.

12. Terms Used Herein. The definitions of terms used herein shall be the same as the definitions contained in sections 22a-133k-1 and 22a-133o-1 of the Regulations of Connecticut State Agencies as such sections existed on the date of execution of this environmental land use restriction.

Section 5. Section 22a-209-1 of the Regulations of Connecticut State Agencies is repealed and the following is substituted in lieu thereof:

Sec. 22a-209-1. Definitions

"AASHTO specification" means a standard of performance for buried structures set forth in "Standard Specifications for Transportation Materials," published by the American Association of State Highway and Transportation Officials in 1989, 14TH edition.

"All weather access" means that affected roads or land surface can support operation of vehicles for the transportation of solid waste and vehicles for the maintenance of solid waste facilities under all normal climatic conditions, provided that snow is removed and flooding is precluded.

"Alter" (1) when referring to a solid waste facility which has no permit, means to change the existing configuration or method of operation of the facility in any manner, including but not limited to adding to the volume of solid waste deposited at the facility; (2) when referring to a solid waste facility which holds a permit, means to change the approved configuration or method of operation of the facility in any manner, including but not limited to adding to the approved volume of solid waste deposited at the facility.

"Asbestos" means actinolite, amosite, antnophyllite, chrysotile, crocidolite, tremolite, or any material which contains the above, all or part of which is in a friable state.

"ASTM specification" means a standard for pipes or other construction materials set forth in "Annual Book of ASTM Standards," published by the American Society of Testing Materials in 1989.

"Base flood" means a flood that has a one percent or greater chance of recurring in any year or a flood of a magnitude equaled or exceeded once in 100 years on the average over a significantly long period. If the Commissioner deems it necessary for a particular location, the base flood shall represent a less common occurrence as specified by him or her.

"Bird hazard" means an increase in the likelihood of bird/aircraft collisions that may cause damage to the aircraft or injury to its occupants.

"Bulky waste" means landclearing debris and waste resulting directly from demolition activities other than clean fill.

"Cell construction method" means the spreading, compacting and daily covering of solid wastes through use of the area, ramp, or trench methods of landfilling.

"Certified operator" means the solid waste facility operator or an employee of the such operator who is present on site and oversees or carries out the daily operation of the facility, and whose qualifications are approved in accordance with Section 22a-209-6 of the Regulations of Connecticut State Agencies.

"Certified soil scientist" means a person who has been certified as a soil scientist by the Board of Directors of the Society of Soil Scientists of Southern New England.

"Clean fill" means (1) natural soil (2) rock, brick, ceramics, concrete, and asphalt paving fragments which are virtually inert and pose neither a pollution threat to ground or surface waters nor a fire hazard AND (3) POLLUTED SOIL AS DEFINED IN SUBDIVISION (45) OF SUBSECTION (a) OF SECTION 22a-133k-1 OF THE REGULATIONS OF CONNECTICUT STATE AGENCIES WHICH SOIL HAS BEEN TREATED TO REDUCE THE CONCENTRATION OF POLLUTANTS TO LEVELS WHICH DO NOT EXCEED THE APPLICABLE POLLUTANT MOBILITY CRITERIA AND DIRECT EXPOSURE CRITERIA ESTABLISHED IN SECTIONS 22a-133k-1 THROUGH 22a-133k-3 OF THE REGULATIONS OF CONNECTICUT STATE AGENCIES AND WHICH SOIL IS REUSED IN ACCORDANCE WITH R.C.S.A. SUBDIVISION (3) OF SUBSECTION (h) OF SECTION 22a-133k-2 OF SUCH REGULATIONS.

"Cover material" means soil, or other suitable material as approved by the Commissioner, which is used to cover compacted solid waste in a solid or special waste disposal area. Any soils used shall be classified as GM, silty gravels, poorly graded gravel-sand-silt mixtures; GC, clayey gravels, poorly graded gravel-sand-clay mixtures; SM, silty sands, poorly graded sand-silt mixtures; SC, clayey sands, poorly graded sand-clay mixtures; ML, inorganic silts and very fine sands, rock flour, silty or clayey fine sands with slight plasticity in accordance with the unified soil classification system.

"Dewater" means to subject material to a process that removes water.

"Dioxin sampling well" means a stainless steel ground water monitoring well installed within the area of predicted leachate plume from any portion of a solid waste facility at which residue is disposed.

"Facility plan" means the engineering studies and proposals to build, establish, alter, operate, monitor and close a solid waste facility, required by Section 22a-209-4(b)(2) of the Regulations of Connecticut State Agencies.

"Floodplain" means the lowland and relatively flat areas adjoining inland and coastal waters, including flood-prone areas of offshore islands, which are inundated by the base flood.

"Friable" means readily crumbled, pulverized or reduced to powder, when dry, by hand pressure.

"Geotextile" means a woven or nonwoven fabric or film which is utilized for the engineering management of soil and water.

"Groundwater" means water present in the zone of saturation.

"Groundwater monitoring well" means a dug, driven or drilled well used to determine groundwater elevation, direction of groundwater flow, or the quality of groundwater.

"Hazardous Waste" means any waste material which may pose a present or potential hazard to human health or the environment when improperly treated, stored, transported or disposed of or otherwise managed, including hazardous waste identified in accordance with Section 3001 of the Resource Conservation and Recovery Act of 1976 (42 USC 6901 et seq.) as amended.

"Leachate" means that liquid which results from ground or surface water which has been in contact with solid waste and has extracted material, either dissolved or suspended, from the solid waste.

"Lift" means a horizontal layer of cells within a solid waste disposal area at which the cell construction method is utilized.

"Lower explosive limit" means the lowest percent by volume of gas which will propagate a flame in air at 25° C and atmospheric pressure.

"Maximum high water table" means the highest elevation reached by the upper level of the ground water as determined by an engineering evaluation conducted in accordance with test methods approved by the Commissioner.

"Monocell" means a variation of the cell construction method whereby only a single type of solid waste is disposed of in any individual cell.

"Mottling indicator" means a residual trace of reduced or oxidized iron left on soil strata as the result of fluctuations in groundwater elevation.

"Mulch" means a protective cover of organic material placed over soil to preserve soil moisture, prevent erosion, or promote the growth of plants.

"Municipal solid waste" means solid waste from residential, commercial, industrial and institutional sources, excluding solid waste consisting of significant quantities of hazardous waste as defined in Section 22a-115 of the General Statutes, landclearing debris, biomedical waste, sewage sludge and scrap metal.

"NATURAL SOIL" MEANS SOIL IN WHICH ALL SUBSTANCES NATURALLY OCCURRING THEREIN ARE PRESENT IN CONCENTRATIONS NOT EXCEEDING THE CONCENTRATIONS OF SUCH SUBSTANCE OCCURRING NATURALLY IN THE ENVIRONMENT AND IN WHICH SOIL NO OTHER SUBSTANCE IS ANALYTICALLY DETECTABLE. FOR THE PURPOSE OF THIS DEFINITION, SUBSTANCE SHALL HAVE THE SAME MEANING AS IN SECTION 22a-133k-1 OF THE REGULATIONS OF CONNECTICUT STATE AGENCIES.

"New municipal solid waste disposal area" means a solid waste facility or expansion thereof, other than a vertical expansion, for the disposal of municipal solid waste, for which facility or expansion a completed application under Sections 22a-430 and 22a-208a of the General Statutes is received by the Commissioner after the effective date of Section 22a-209-14 of the Regulations of Connecticut State Agencies.

"Open dump" means a site at which solid waste is disposed of in a manner which does not comply with Subtitle D of the Resource Conservation and Recovery Act of 1976, (42 USC 6901 et seq.), as amended, and regulations promulgated thereunder.

"Operator" means a person who is ultimately responsible for maintaining the solid waste facility in conformance with applicable statutes and regulations and the facility permits.

"Pan lysimeter" means a leachate collection device for sampling leachate from monocells within a solid waste disposal area.

"Person" means any individual, firm, partnership, association, syndicate, company, trust, corporation, municipality, agency or political or administrative subdivision of the state, or other legal entity of any kind.

"Public airport" means an airport open to the public without prior permission and without restrictions within the physical capacities of available facilities.

"Recharge" means water which enters a geologic formation.

"Regional solid waste disposal area" means a solid waste disposal area used for the disposal of solid waste generated in more than one municipality.

"Residue" means bottom ash, air pollution control residue, and other residues from the combustion process at resource recovery facilities, municipal solid waste incinerators, and biomedical waste incinerators.

"Resources recovery facility" means a volume reduction plant, as defined by Section 22a-207 of the General Statutes as amended, utilizing processes aimed at reclaiming the material or energy values from solid wastes.

"Rip-rap" means a loose assemblage of broken or whole stones utilized to dissipate the velocity and energy of moving water.

"Scarification" means the process of raking, harrowing or otherwise disturbing a soil surface to allow infiltration of water or other material.

"Solid waste boundary" means the outermost perimeter of the solid or special waste (projected in the horizontal plane) as it would exist at completion of the permitted disposal activity at a solid waste or special waste disposal area.

"Special waste disposal area" means a solid waste disposal area at which special wastes, as defined in this section, are disposed of.

"Special wastes" means the following wastes, so long as they are not hazardous waste pursuant to section 22a-115 of the General Statutes or radioactive material subject to section 22a-148 of the General Statutes: (1) water treatment, sewage treatment or industrial sludges, liquid, solids and contained gases; fly-ash and casting sands or slag; and contaminated dredge spoils; (2) scrap tires; (3) bulky waste, as defined in this section; (4) asbestos; (5) residue; and (6) biomedical waste.

"Standard proctor density" means the maximum weight per unit volume of earthen material which has been compacted by a specific weight and procedure, at an optimum soil moisture, according to a laboratory engineering test developed by Proctor.

"State Solid Waste Management Plan" means the State plan adopted pursuant to Section 22a-211 of the Connecticut General Statutes, as amended.

"Stormwater" means precipitation runoff.

"Transfer station" means a volume reduction plant, as defined by Section 22a-207 of the General Statutes, as amended, that is a central collection point for the solid waste generated within a municipality or group of municipalities, where solid wastes received are transferred to a vehicle for removal to another solid waste facility.

"Underdrainage" means a system of pipes, structures, stone, pumps, wells, or other devices utilized to lower or divert groundwater.

"Vector" means as insect or rodent or other animal (not human) which can transmit infectious diseases from one person or animal to another person or animal.

"Vertical expansion" means an expansion of an existing solid waste disposal area such that future disposal of municipal solid waste will take place only where solid waste has previously been disposed of and is still present.

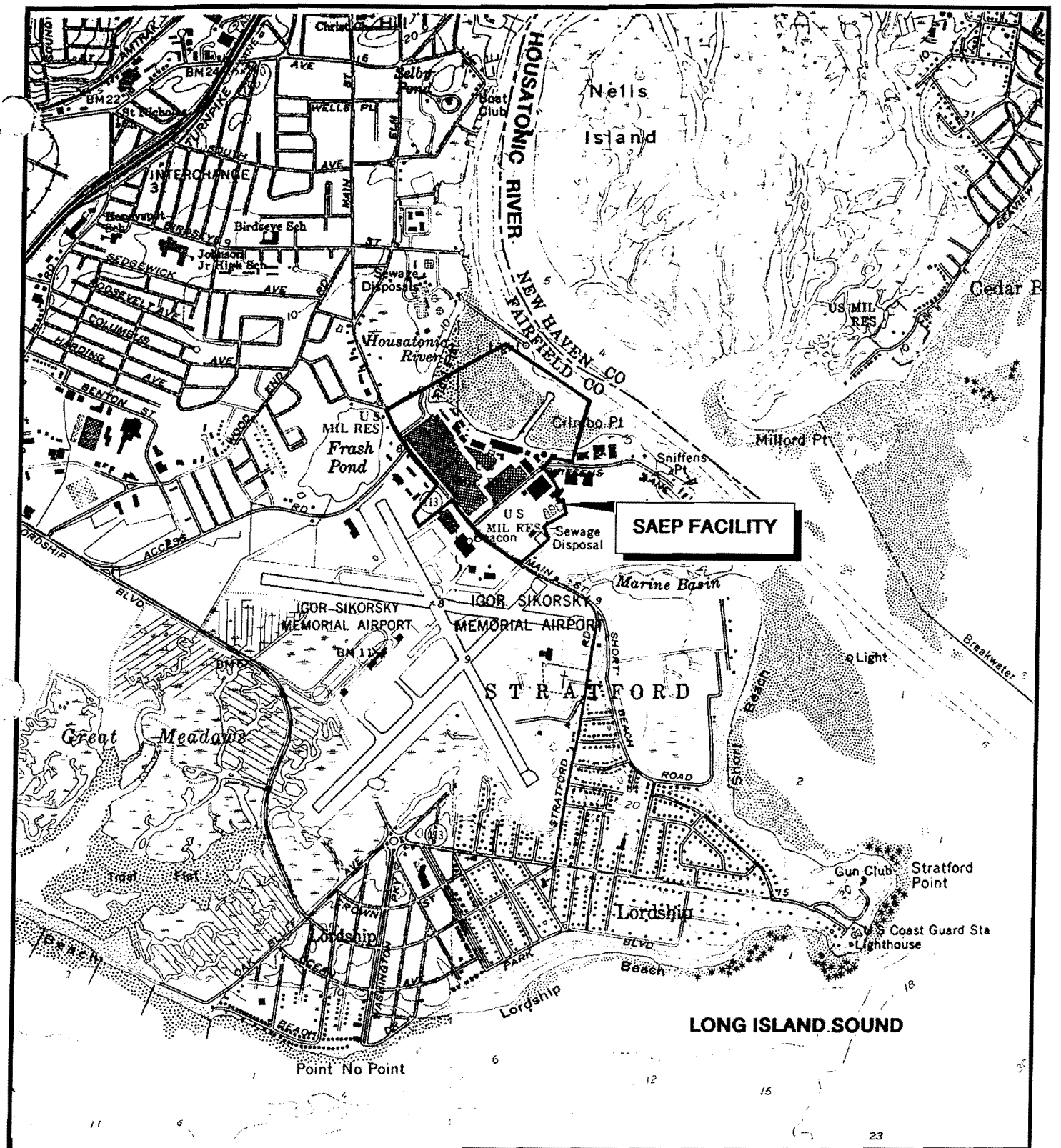
"Washout" means the carrying away of solid waste by waters of the base flood.

"Water Quality Standards" means the water quality standards and water quality Classifications Map published by the Connecticut Department of Environmental Protection, February, 1987.

"Water table" means that surface of a body of unconfined groundwater at which the pressure is equal to that of the atmosphere.

"Working face" means that portion of a solid waste or special waste disposal area where the waste is deposited, spread and compacted prior to the placement of cover material.

"Zone of influence" means the area in which, assuming the absence of any means at a solid waste facility to collect or treat leachate, groundwater may be altered in quality due to discharge of leachate from any portion of such facility.



MAP SOURCE:
FROM BRIDGEPORT & MILFORD, CT. USGS QUADRANGLE MAP, 1970 & 1960, PHOTOREVISED 1984.

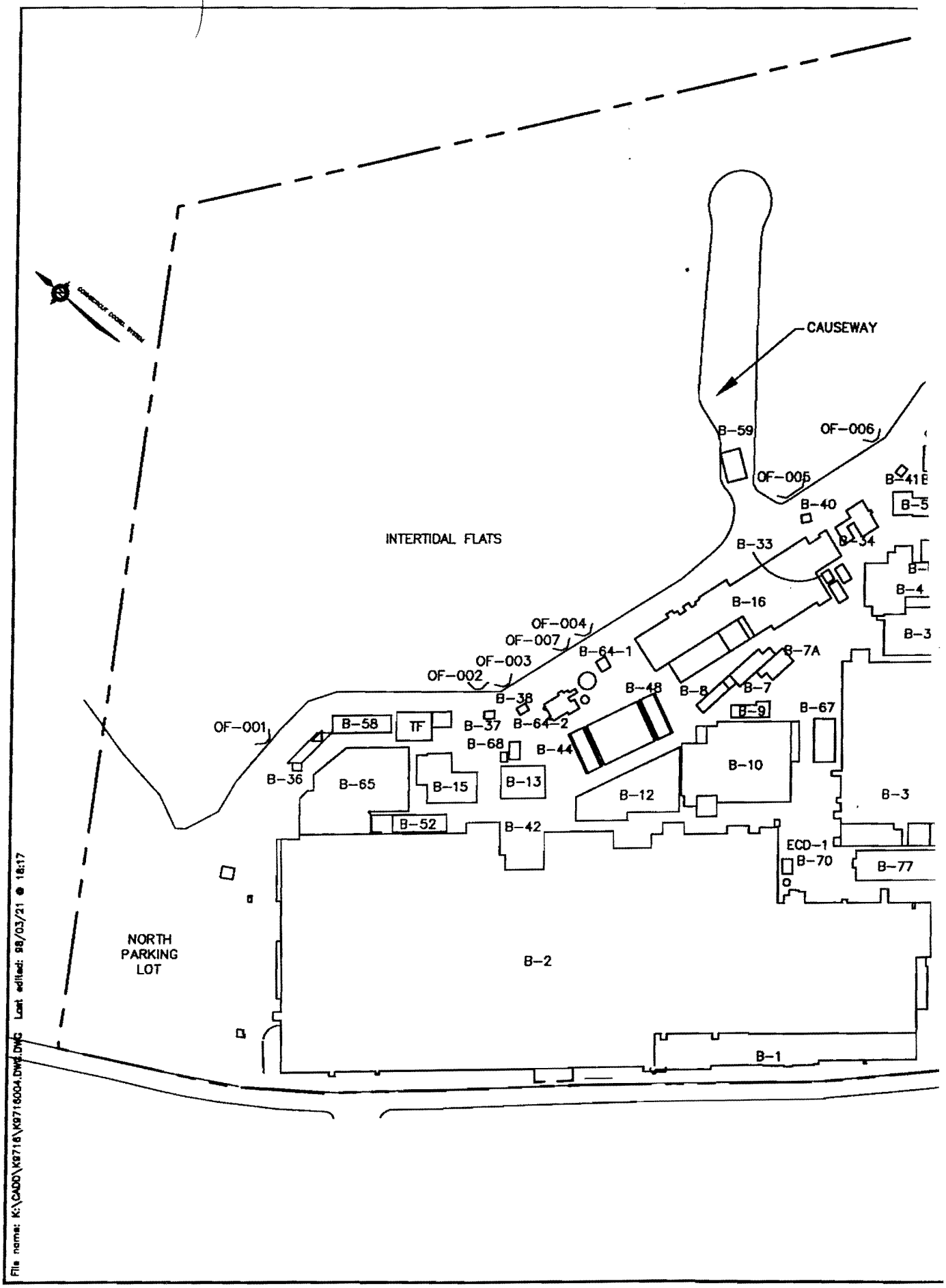
0 1000 2000 FT
SCALE

CT

WOODWARD—CLYDE CONSULTANTS
ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS

FACILITY LOCATION
STRATFORD ARMY ENGINE PLANT
STRATFORD, CONNECTICUT

DR. BY: BAS	DATE: JANUARY 1993	PROJ. NO:	FIGURE NO.:
CK'D BY: MEJ	DATE: JANUARY 1993	89C114NN	1


CONCRETE DOCK PIER
CAUSEWAY
INTERTIDAL FLATS
NORTH PARKING LOT
B-59
OF-006
OF-005
B-40
B-33
B-16
OF-004
OF-007
OF-003
OF-002
B-64-1
B-7A
B-38
B-48
B-8
B-7
B-9
B-67
OF-001
B-58
TF
B-37
B-64-2
B-68
B-44
B-10
B-36
B-65
B-15
B-13
B-12
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ECD-1
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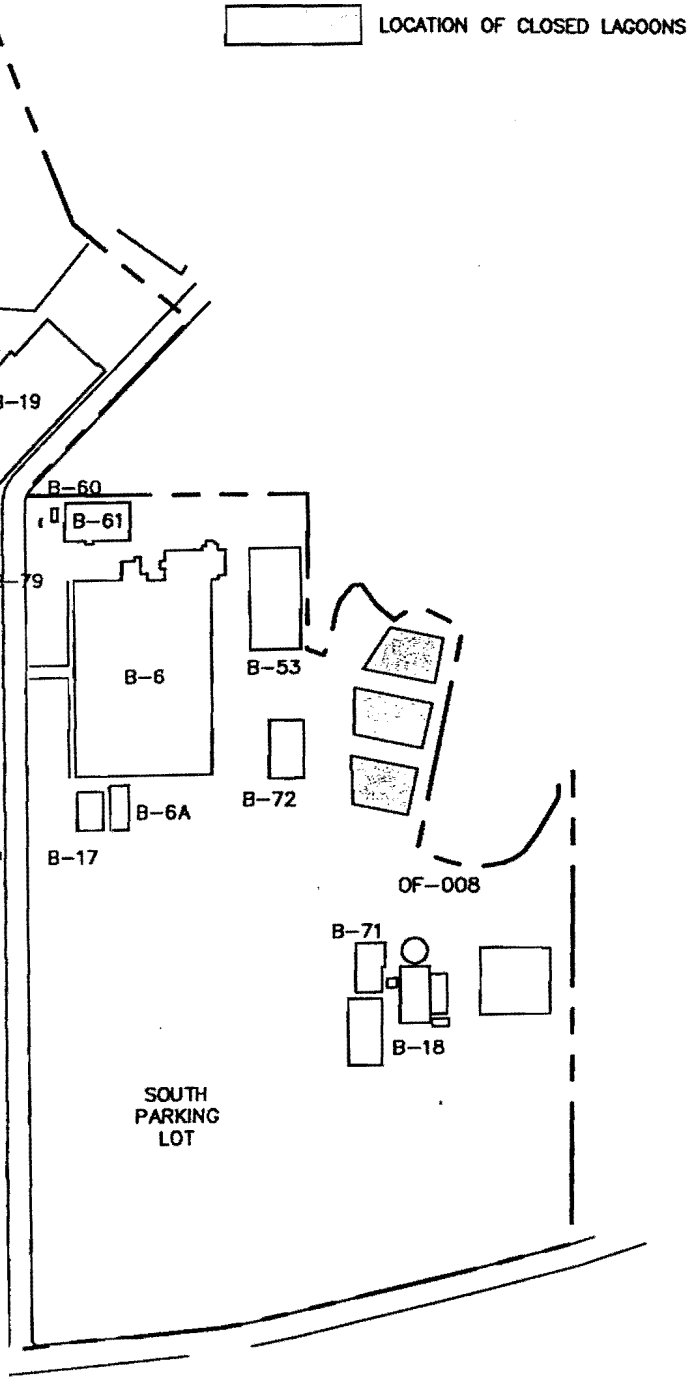


BUILDING NUMBER	BUILDING NAME
B-1	MAIN ADMINISTRATIVE & GOVERNMENT OFFICES
B-2	MANUFACTURING OPERATIONS
B-3	RESEARCH & DEVELOPMENT ENGINEERING
B-3A	ENGINEERING LABORATORIES
B-4	STORES AND AGT-1500 REPAIR
B-5	FUEL SYSTEM TEST
B-6	ENGINE ENVIRONMENTAL & COMPONENT TEST
B-6A	ENGINE MECHANICAL COMPONENT TEST
B-7	ENGINE FUEL SYSTEM TEST
B-7A	ENGINE FUEL SYSTEM TEST
B-8	VOLATILE STORAGE
B-9	AUTOMOTIVE MAINTENANCE
B-10	RECUPERATOR MANUFACTURE
B-12	MAINTENANCE DEPARTMENT
B-13	SCRAP & MATERIAL RECLAMATION
B-15	LUBRICATION STORAGE & FIRE HOUSE
B-16	PRODUCTION & DEVELOPMENTAL TEST CELLS
B-17	ENGINEERING TEST FACILITY
B-18	CHEMICAL WASTE TREATMENT PLANT (CWTP)
B-19	COMPONENT TEST FACILITY
B-33	COOLING TOWER PUMP STATION
B-34	FUEL PUMPING STATION
B-36	STORM DRAIN PUMPING STATION (OF-001)
B-37	STORM DRAIN PUMPING STATION (OF-002)
B-38	STORM DRAIN PUMPING STATION (OF-003)
B-40	STORM DRAIN PUMPING STATION (OF-004)
B-41	STORM DRAIN PUMPING STATION (OF-005)
B-42	SPRINKLER BOOST PUMP STATION (400K GAL.)
B-43	FUEL PUMPING STATION
B-44	STORES & CARPENTER SHOP
B-48	ENGINE CONTAINER REBUILD
B-52	STORES & ADJUNCT TO B-2
B-53	SURPLUS EQUIPMENT STORAGE
B-58	QUALITY & TESTING FACILITY
B-59	ENGINEERING STORAGE
B-60	HI-PRESSURE NATURAL GAS PUMPING STATION
B-61	REFRIGERATION PLANT
B-63	CWTP PUMPING STATION
B-64-1	OIL ABATEMENT PLANT PUMP HOUSE
B-64-2	OIL ABATEMENT TREATMENT PLANT (OATP)
B-65	STORAGE FACILITY
B-67	GENERAL STORES
B-68	EMERGENCY GENERATOR
B-69	USACE RESIDENT ENGINEER
B-70	CYANIDE DESTRUCTION FACILITY (CDF)
B-71	CWTP SOLIDS HANDLING
B-72	FUEL PUMPING STATION
B-77	OFFICE
B-79	SSE BUILDING

0 150 300 600

SCALE (FEET)

SITE MAP

STRATFORD ARMY ENGINE PLANT
STRATFORD, CONNECTICUT

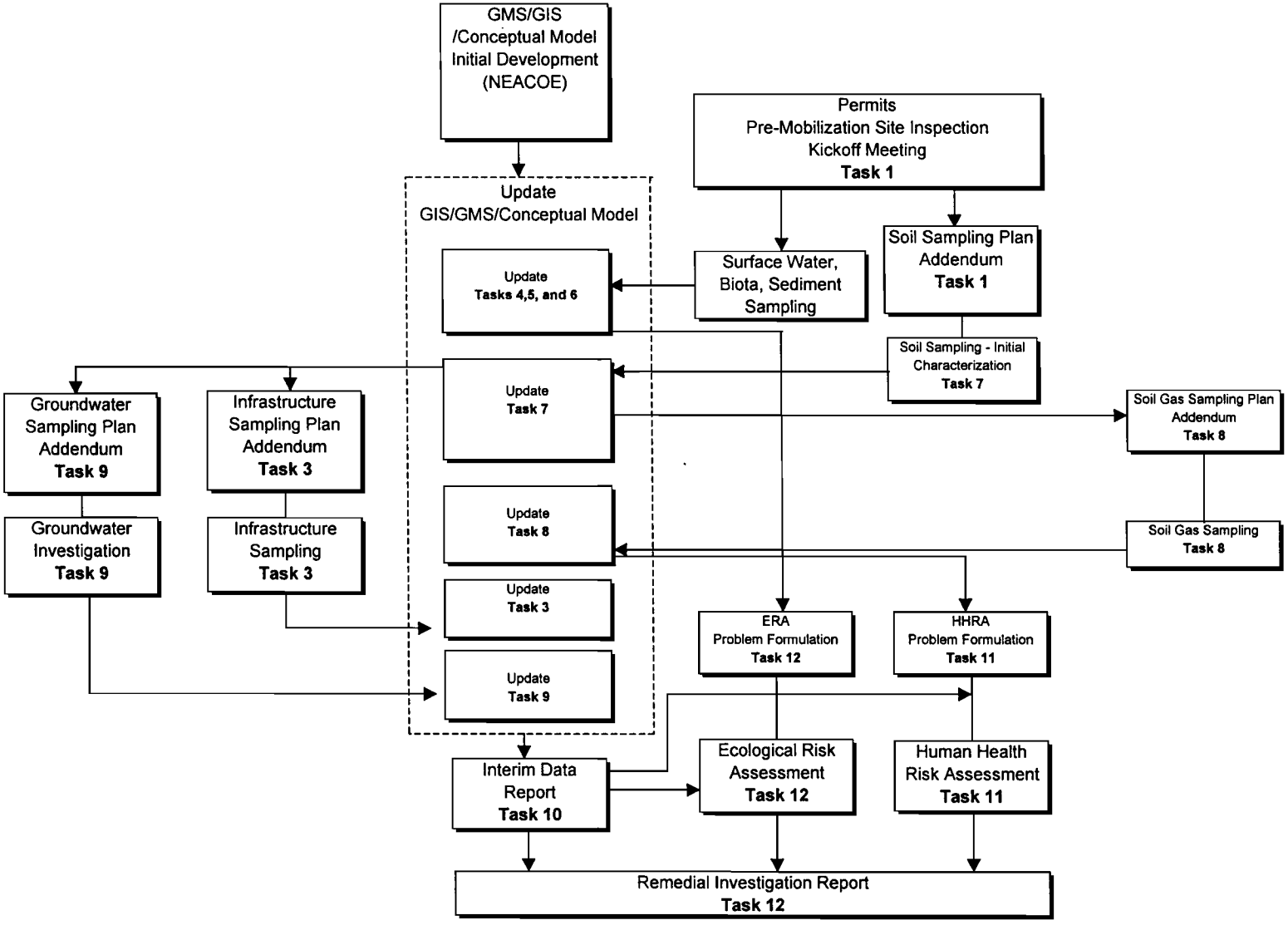
WOODWARD-CLYDE CONSULTANTS

ENGINEERING & SCIENCES APPLIED TO THE EARTH & ITS ENVIRONMENT
OMAHA, NEBRASKA

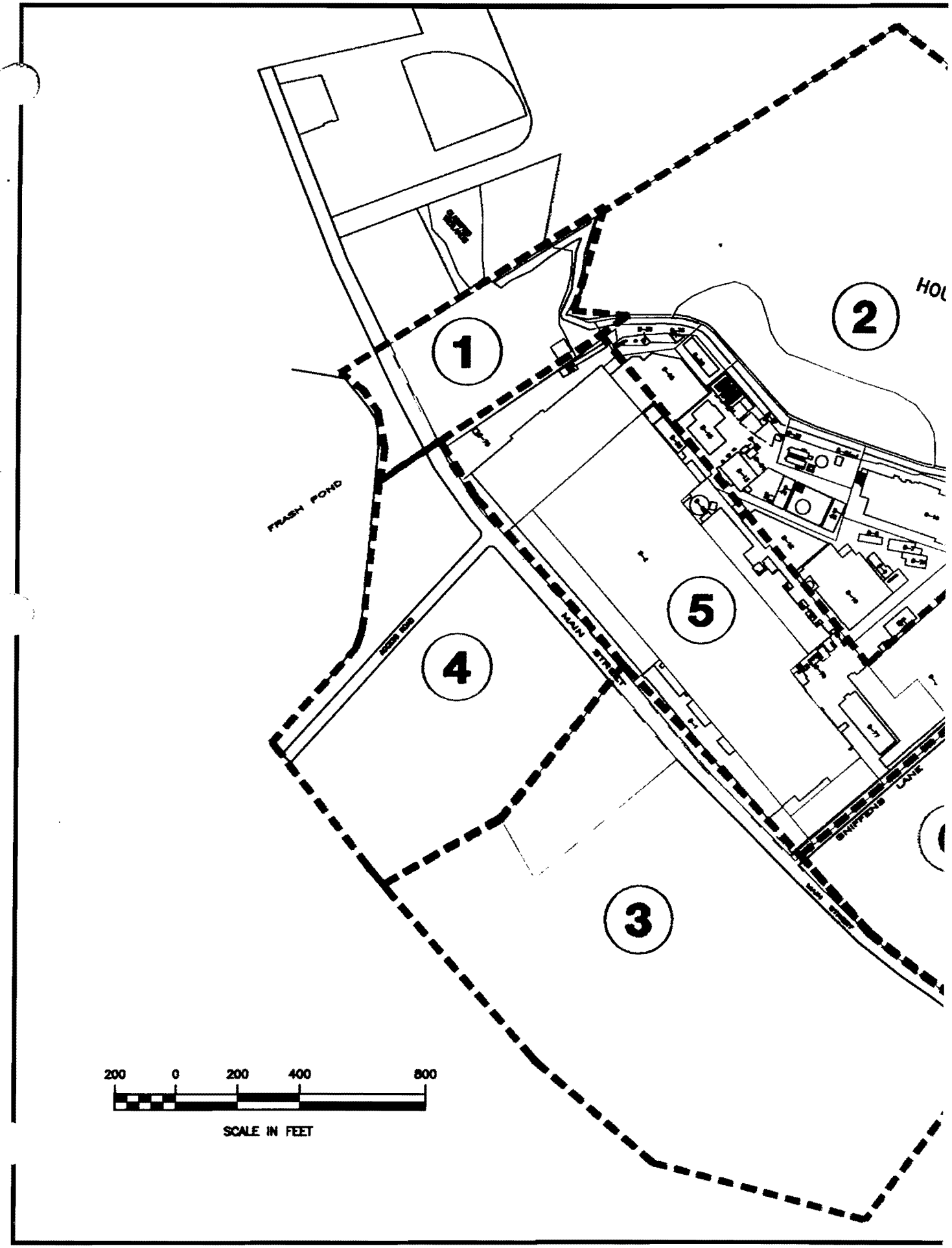
DR. BY	JL	SCALE	1" = 300'	DWG. NO. K9716004	PROJ. NO. K9716
CK'D. BY	SH	DATE	MAR 21, 1998	FIG. NO.	2

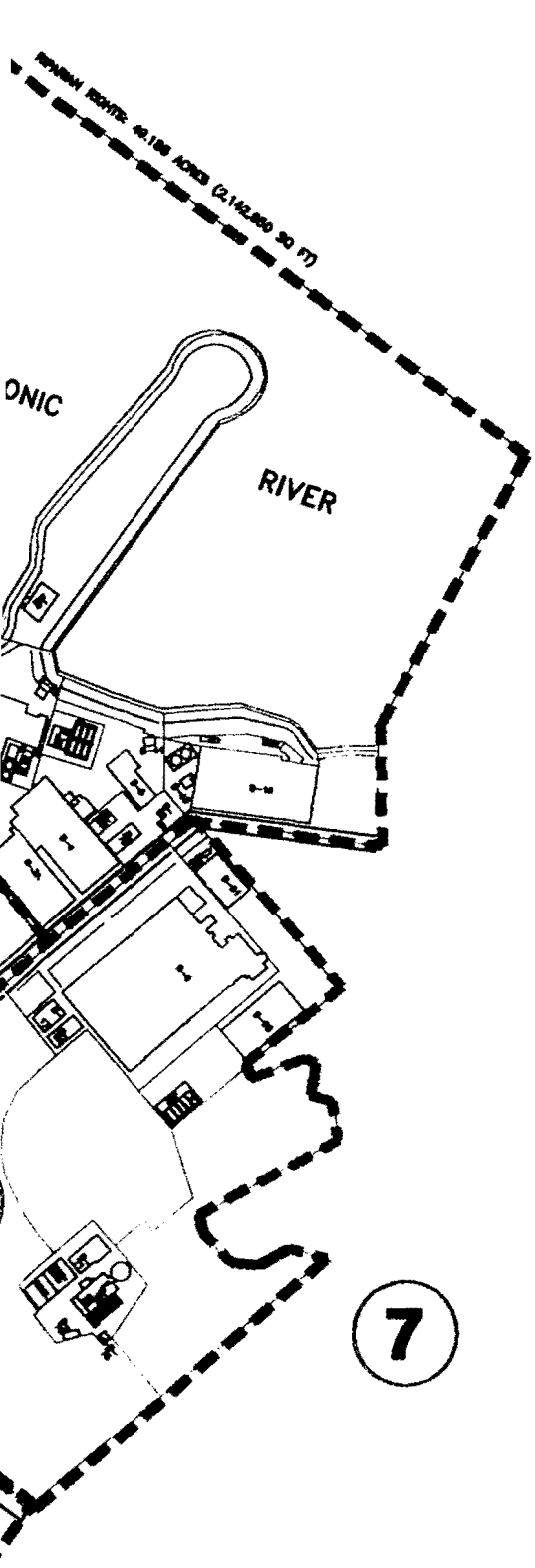
FIGURE 3

STRATFORD ARMY ENGINE PLANT REMEDIAL INVESTIGATION
TASK FLOW SUMMARY



i:projects\K9716\Workplan\fig3


1
2
3
4
5
FRASH POND
MAIN STREET
SNIFFENS LANE
200 0 200 400 800
SCALE IN FEET



LEGEND

- Building designations
- Fence
- Sea Wall
- SAEP Property Boundary
- Groundwater Investigation Area Boundary
- 6 — Groundwater Investigation Area Number

Notes:

1. Map is in Connecticut State Plane Coordinates.
2. Base map source: AlliedSignal, Inc.

CLIENT	US Army Corps of Engineers			
PROJ	Stratford Army Engine Plant			
REVISION NO		DES BY		
SCALE	AS SHOWN	DR BY	LAL	3-6-98
FILE	SAEP/CERFA.DWG	CHK BY	AS	

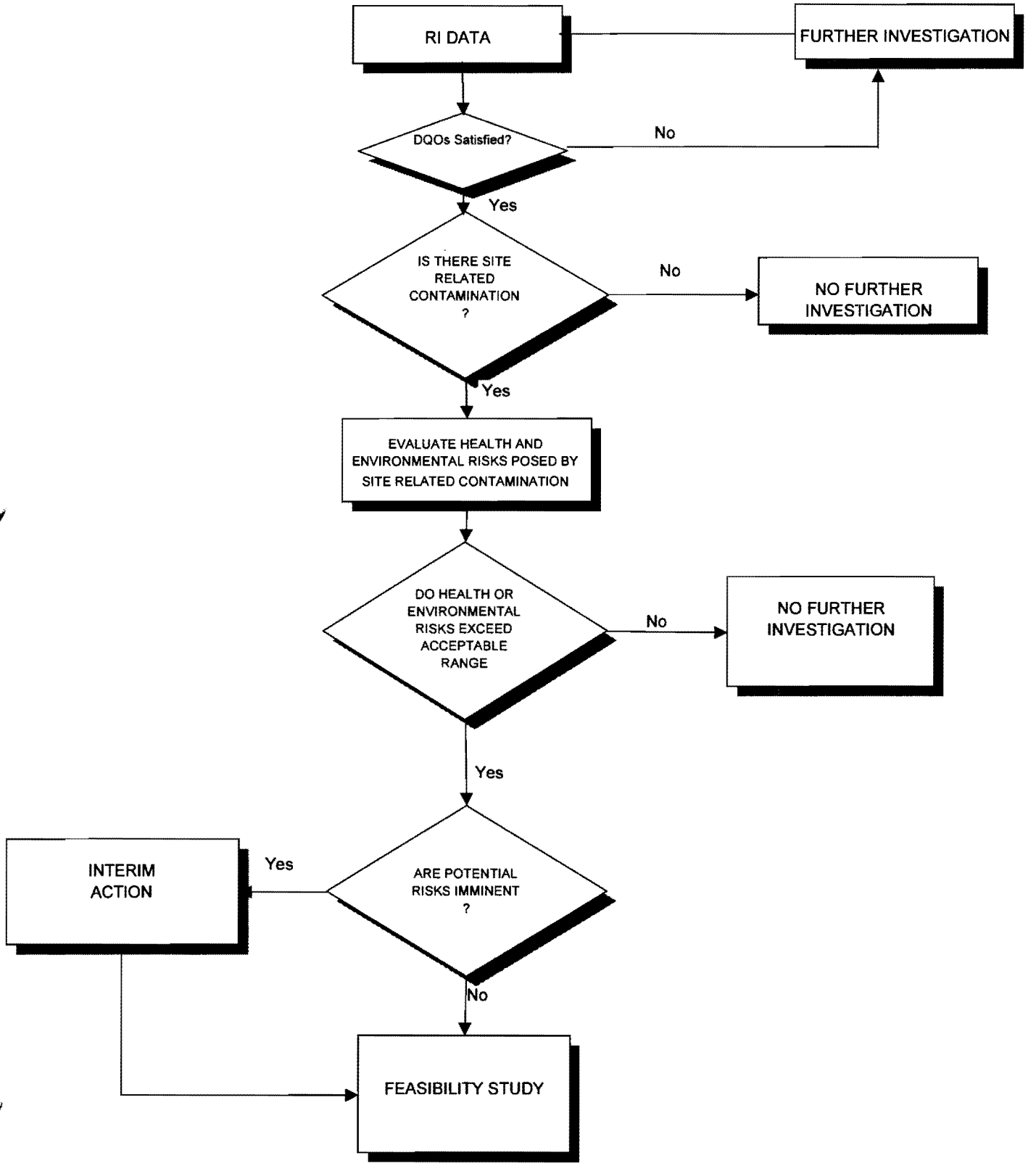
TITLE: GROUNDWATER INVESTIGATION AREAS

Woodward-Clyde Federal Services

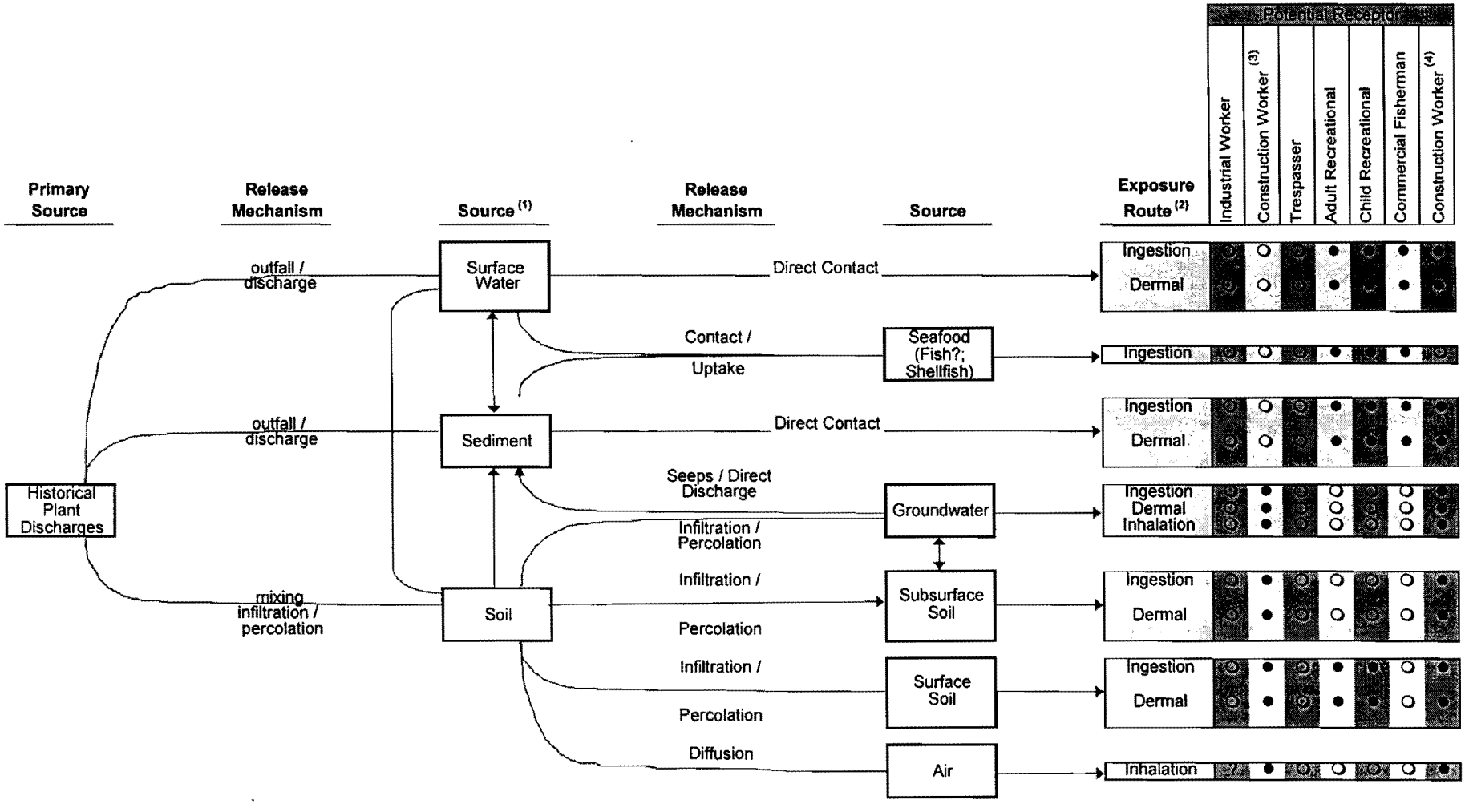
PROJ NO K9716

FIG. 4

FIGURE 5
RISK ASSESSMENT APPROACH
DECISION DIAGRAM



I:\projects\K9716\workplan(rev)/Fig5



Notes:

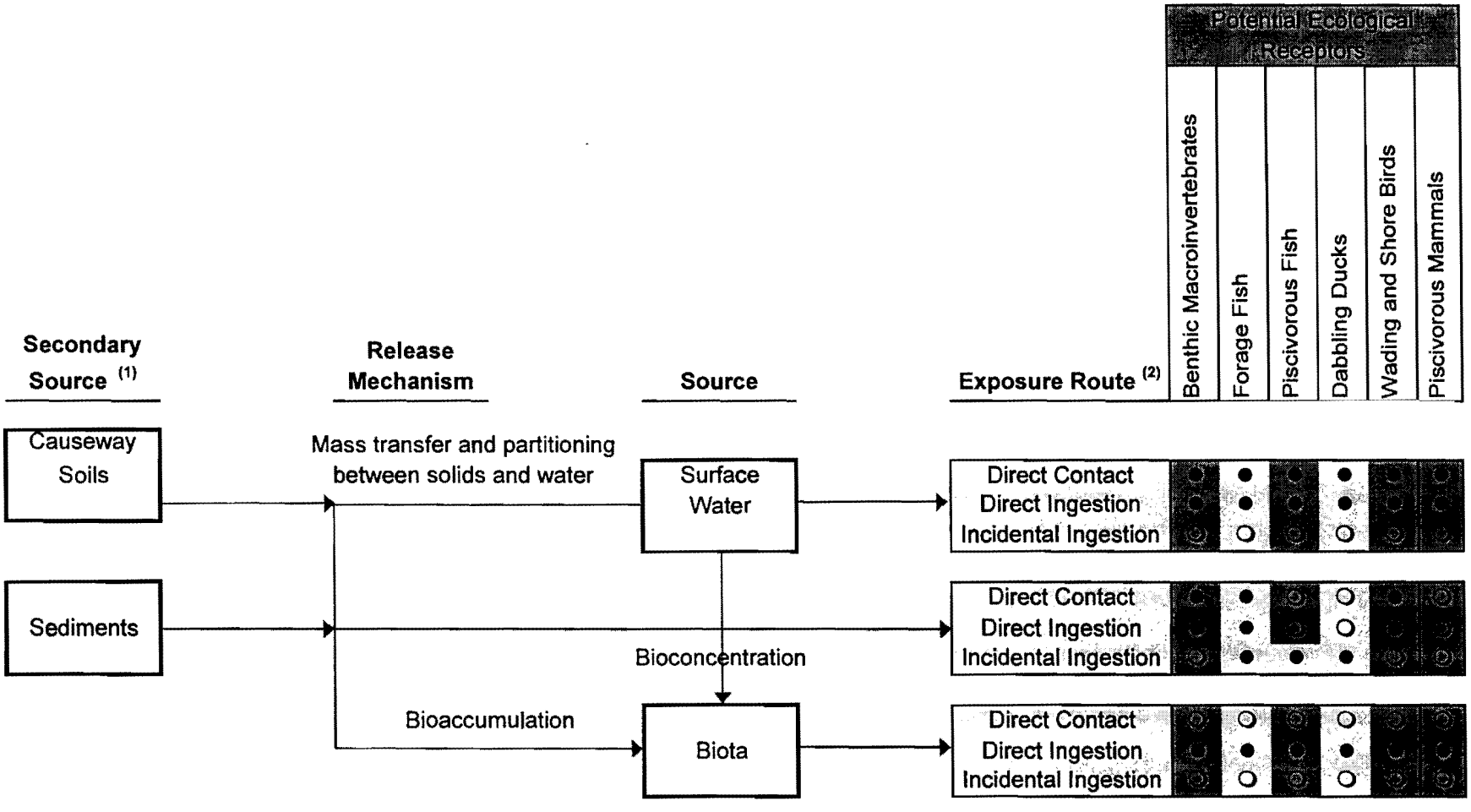
(1) The Ecological Conceptual Models (Figures 7 and 8) describe potential pathways from these secondary sources to ecological receptors

(2) O Incomplete exposure route
● Complete exposure route
? Unknown - additional data required

(3) Construction / Excavation Worker (industrial portion of site)

(4) Excavation (non-industrial portion of site)

FIGURE 6
PRELIMINARY CONCEPTUAL SITE MODEL
HUMAN HEALTH
STRATFORD ARMY ENGINE PLANT
STRATFORD, CONNECTICUT



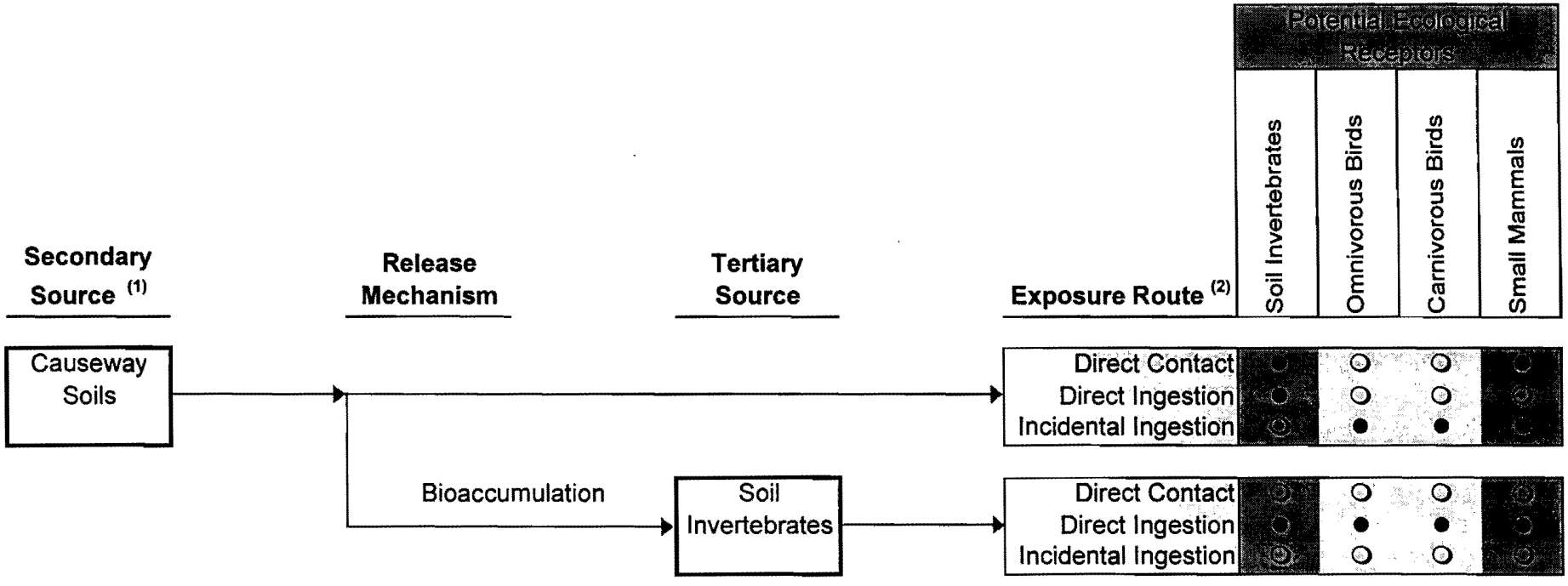
Notes:

(1) See Figure 6

(2) ● Complete exposure route

○ Incomplete exposure route

FIGURE 7
PRELIMINARY CONCEPTUAL SITE MODEL
AQUATIC PATHWAYS
STRATFORD ARMY ENGINE PLANT
STRATFORD, CONNECTICUT



Notes:

(1) See Figure 6

(2) ● Complete exposure route
○ Incomplete exposure route

(3) Causeway Soils is the only area where receptors may contact soils since since the remainder of the site is paved or covered with structures.

FIGURE 8
PRELIMINARY CONCEPTUAL SITE MODEL
TERRESTRIAL PATHWAYS
STRATFORD ARMY ENGINE PLANT
STRATFORD, CONNECTICUT

The identification of data gaps and the development of data quality objectives (DQOs) involve gathering and evaluating information to ensure that data collection activities are focused on obtaining the information needed to make decisions on remedial actions or answer the relevant questions leading up to such decisions. The data gaps/DQO process ensures that all future work at the site -- from field investigations, to interim remedial actions, to selection, design and implementation of final remedial actions -- is based on the most appropriate set of information obtained in the most cost-effective way, and that time and effort are not wasted on loosely defined objectives.

5.1 DATA GAPS

As part of the RIWP planning process, a comprehensive assessment of data gaps in the existing site data was performed. This assessment was based on a conceptual understanding of site conditions, which are summarized in Section 2 (Site Description and History) and Section 3 (Previous Investigations).

Table 1 summarizes the data gaps, translated into "data requirements", needed to fulfill the objectives of the RI (see Section 4.2). This table, which is organized by environmental media of concern and site areas needing sampling, provides brief statements of how the data obtained will be used, i.e., how the data will fill data gaps to achieve project objectives.

5.2 DATA QUALITY OBJECTIVES

Also during the RIWP planning process, DQO Statements (typically in the form of questions) are developed that, in turn, guide the development of a site-specific data collection and analysis program. DQO Statements can be qualitative or quantitative. The DQO Statements identify the type and/or quality of data required to characterize a site to the extent needed to: 1) select the most appropriate remedial action that will be protective of human health and the environment; and, 2) satisfy all applicable regulatory requirements.

The data gaps presented in Table 1 are expanded into qualitative DQOs in Table 2. These DQOs are the basis for the data collection program contained in Section 6 - Work Plan Approach. Section 6 also discusses sampling/analysis options considered and identifies known or suspected sources/areas of contamination and, hence, critical sampling areas. Potential contaminants of concern were previously discussed in Section 3.

Quantitative DQOs such as detection limits and the data quality parameters of accuracy and precision are discussed in the QAPP contained in Appendix A. Conceptual site models for both human health and ecological risk assessments are provided in Sections 6.11 and 6.12, respectively. These conceptual site models include contamination sources, release mechanisms, migration pathways, and potential receptors.

This section provides a description of the overall approach to the RI. The RI comprises fourteen tasks:

- Task 1 - Pre-Mobilization Activities
- Task 2 - GIS/GMS Model
- Task 3 - Infrastructure Evaluation
- Task 4 - Surface Water
- Task 5 - Sediment Sampling
- Task 6 - Biota Sampling
- Task 7 - Soil Sampling
- Task 8 - Soil Gas Sampling
- Task 9 - Groundwater Investigation
- Task 10 - Interim Data Report
- Task 11 - Human Health Risk Assessment
- Task 12 - Ecological Risk Assessment
- Task 13 - RI Report
- Task 14 - Monthly Progress Reports

The RI scope of work is summarized in Table 3. Details on the field activities to be conducted are provided in Appendix A which includes the Field Sampling Plan (FSP) and Quality Assurance Project Plan (QAPP). A Site Safety and Health Plan (SSHP) for field activities is provided in Appendix B.

A Task Flow Summary for the RI scope of work is presented in Figure 3. As shown in the figure, central to the scope of work is the development of a GIS database which will supply the input needed by the DOD GMS to produce a comprehensive conceptual model for the Site. The comprehensive conceptual model for the Site will be used for evaluating data as it is obtained, planning subsequent sampling, reporting results, and evaluating progress in terms of DQOs. The GIS/GMS/conceptual model will be updated as data becomes available through the RI. At the completion of all field work, an Interim Data Report will be produced. The Interim Data Report will form a basis for an evaluation of DQOs with the goal of obtaining concurrence that all DQOs have been satisfied and, therefore, an RI Report can be produced.

Initially, permits for conducting the work will be applied for and pre-mobilization site inspection and kickoff meetings will be conducted (Task 1). The pre-mobilization site inspection needs to be completed before a Soil Sampling Plan Addendum can be prepared and the initial characterization soil sampling can take place (Task 7).
The characterization of potential source areas is key to the RI scope of work. For this reason, the soil sampling program occurs first so that potential source areas for soil gas, groundwater, and infrastructure sampling can be identified and evaluated. Infrastructure, soil gas, and groundwater sampling are all based, in part, on results of the soil sampling and, therefore, occur only after

information from soil sampling is obtained and the GIS/GMS/conceptual model are updated and the respective Sampling Plan Addenda are prepared. A Human Health Risk Assessment Interim Deliverable (for the Human Health Risk Assessment) and a Problem Formulation deliverable (for the Ecological Risk Assessment) will be prepared and submitted at the beginning of the risk assessment process to provide all concerned parties an opportunity to comment and agree on specifics of the approach before conducting the actual risk assessment. Figure 5 of the Field Sampling Program includes a schedule with planned interim deliverables.

6.1 TASK 1: PRE-MOBILIZATION ACTIVITIES

Task 1 consists of the following subtasks:

Subtask 1.1 - Permits

Subtask 1.2 - Subcontractor Bid Procurement

Subtask 1.3 - Pre-Mobilization Activities

Subtask 1.4 - Utility Clearance

Subtask 1.5 - Soil Sampling Plan Addendum

Subtask 1.6 - Submit Soil Sampling Plan Addendum

6.1.1 Subtask 1.1: Permits

Applications will be made for permits required to conduct the RI activities as discussed in Section 4.3.1.

6.1.2 Subtask 1.2: Subcontractor Bid Procurement

Subcontractor bids will be solicited in accordance with federal procurement requirements. Bids will be solicited from drilling, analytical laboratory, and surveying subcontractors. Bids will only be solicited from surveyors and drillers that are licensed and certified to operate in the State of Connecticut, as appropriate. Analytical laboratories will be USACE-validated.

6.1.3 Subtask 1.3: Pre-Mobilization Activities

This task includes pre-mobilization activities, a Site inspection, and a kick-off meeting. A review of background information and an initial site reconnaissance were conducted as part of the development of the RIWP to identify potential areas of concern to be investigated. The purpose of the review of previous reports and W-C files was to utilize existing information to the extent possible in identifying potential areas of concern to be investigated. The purpose of the initial site reconnaissance was to verify previously identified potential areas of concern, identify other potential environmental issues not previously identified, and identify any open issues requiring further evaluation. However, because the plant was in the process of closing operations, a number of the buildings were still occupied by machinery at the time of the initial site reconnaissance. It was, therefore, not possible to fully evaluate all potential locations of sumps and pits or other areas into which spills could have migrated and collected. Also, a

number of structures containing residual material were scheduled to be cleaned as part of vacating the plant. For these reasons, pre-mobilization site inspection will be conducted to supplement information obtained during the initial site reconnaissance. The objective of the pre-mobilization site inspection is to:

- Inspect previously identified potential areas of concern (e.g., evaluate integrity of sumps and pits and condition of building floors) to confirm the need to sample based on presence or former presence of hazardous materials and potential for release to the environment.
- Determine precise sampling locations and mark and number these locations with spray paint. Rough locations based on field measurements will be indicated on CADD plans to be provided by plant services. (Precise as-built locations in the appropriate coordinate system will be surveyed later.)
- Identify any special access considerations or requirements for these locations and communicate these to plant personnel and the selected drilling subcontractor. If possible, a representative from the drilling subcontractor will be present.
- Obtain additional information and locate potential areas of concern not located during the initial site reconnaissance but identified in the RIWP.
- Inspect areas not previously accessible because of machinery, particularly in those buildings partially occupied during the initial site reconnaissance (e.g., Building B-2). Evaluate the potential for sampling these areas as additional areas of concern.
- Establish the availability and need for site support (e.g., work areas, water and electricity hook-ups, access to all work areas).
- Establish the location of decontamination pad areas and staging areas for investigation-derived waste (IDW).

A meeting will be held between W-C and the appropriate plant personnel to review the RIWP activities, identify support required of plant personnel, review plant procedures and rules that apply to W-C and its subcontractors, and establish procedures for coordinating activities between W-C and other groups at the plant conducting remediation activities.

6.1.4 Subtask 1.4: Utility Clearance

Utility clearance for sampling locations will be an on-going process as sampling points are being defined, modified, or added during the course of the RI. W-C will rely on plant personnel and a utility clearance subcontractor to provide clearance for sampling locations on-site. The Connecticut central-clearinghouse ("DIGSAFE") will be contacted at least two full working days prior to the start of intrusive activities. During this subtask, initial contact will be made with plant personnel responsible for identifying potential subsurface interference by utilities and plant infrastructure and the procedure for clearing sampling locations for subsurface utilities with plant personnel will be established. Available CADD plans will be reviewed and plans required by W-C for full coverage of the areas to be sampled will be identified. In addition, other utilities that may have services beneath the Site will be contacted for markouts.

6.1.5 Subtask 1.5: Soil Sampling Plan Addendum

A summary of the results of the pre-mobilization site inspection will be compiled. The Soil Sampling Plan Addendum will summarize and document additional information on sampling locations obtained as a result of the pre-mobilization site inspection and the kickoff meeting. Any additions or deletions to the RIWP locations will be indicated. Rationale for any additions, deletions, or other changes will be provided.

A large scale working sketch of the soil sampling locations for field use based on rough measurements made during the pre-mobilization site inspection will be prepared. This plan will be available for reference on-site; precise as-built locations in the appropriate coordinate system for inclusion in the GIS and import into the GMS will be surveyed later.

6.1.6 Subtask 1.6: Submit Soil Sampling Plan Addendum

The Soil Sampling Plan Addendum will be submitted to TACOM, USACE, CDEP, and USEPA. This submittal will be for informational purposes only to document any changes from the proposed scope in the RIWP.

6.2 TASK 2: GIS/GMS MODEL

USACE will develop, setup and maintain the GIS/GMS model for the Site. However, W-C will coordinate and oversee the development, setup and maintenance of the GIS/GMS modeling effort. A brief description of the collaborative process is described below. The GIS software (ESRI ArcView) will be used to organize and manage the data obtained from the RI and provide a basis of evaluating progress with regard to satisfying DQOs by providing graphical output. The GMS platform will be used for developing and updating a comprehensive conceptual model for the Site and for conducting groundwater modeling.

Information from the surface water, sediment, biota, soil, infrastructure, and groundwater monitoring well sampling will be entered into GIS/GMS on an on-going basis by USACE personnel. This information will be supplied by W-C on an on-going during the project. The GIS data will be used to setup a GMS comprehensive conceptual model of the Site by USACE in coordination with W-C. The GMS will be used as a basis for evaluating the Site conceptually as well as more quantitative evaluations (e.g., groundwater flux calculations to surface water bodies and modeling performed during the FS). As the GIS/GMS is updated, the entire data set will be evaluated in terms of the DQOs (i.e., has the data gap been filled and the DQO satisfied or is more sampling needed?).

6.2.1 Review of Existing Information and Data

All available field data, laboratory data, and contractor reports relating to previous investigations at the SAEP will be reviewed for data completeness, relevance, and usability. Data will be categorized into that which may easily be manipulated for input into GIS and that which is descriptive or conceptual in nature. USACE will setup/develop/input both historic and current GIS data sets.

6.2.2 Data Manipulation

Data designated for input into the GIS database will be compiled by W-C into an appropriate electronic input format for reading directly into GIS through a database (e.g., Access). This task will require formatting of data tables and compiling surveyed well location data with geological layer information and chemical data. USACE will provide the electronic input format for the various data sets that will be generated during this project.

6.2.3 GIS Setup

The GIS will be setup with appropriate coordinates, elevations, and basemaps for use with the GMS modeling platform. USACE will provide standardized input/output formats and will be responsible for electronic storage of the data.

6.2.4 GMS Data Input and Conceptual Model Development

Existing data collected during the Phase I and Phase II field investigation activities will be compiled into the GMS modeling platform by USACE. These data will include boring log stratigraphy from well logs; groundwater elevation data; chemical data from surface water, sediment, biota, soil, indoor air, and groundwater sampling; location of wells and surface water bodies; and ground surface conditions for groundwater recharge. The resulting GMS geological and hydrogeological conceptual model will be collaboratively reviewed by both USACE and W-C personnel for comparison with Site processes.

6.3 TASK 3: INFRASTRUCTURE EVALUATION

Task 3 consists of the following subtasks:

Subtask 3.1 - Evaluate Existing Infrastructure Information (Soil Borings)

Subtask 3.2 - Coordinate with Plant Close-out of Infrastructure

Subtask 3.3 - Evaluate Existing Infrastructure Information (Residue Sampling)

Subtask 3.4 - Develop Infrastructure Sampling Plan Addendum

Subtask 3.5 - Submit Infrastructure Sampling Plan Addendum

Subtask 3.6 - Review by Agencies/Evaluation of Comments by W-C

Subtask 3.7 - Meeting/Teleconference (Infrastructure Sampling Plan Addendum)

Subtask 3.8 - Sampling

Subtask 3.9 - Analytical Laboratory Analysis

Subtask 3.10 - Data Validation

Subtask 3.11 - Update GIS/GMS

The SAEP has a complex system of sanitary, stormwater, and chemical wastewater drainage systems, in addition to numerous process and utility lines (gas, electrical, argon, water,

compressed air, condensate, and fire lines). This complex infrastructure at the Site is of significance to the objectives of the RI from three perspectives:

- As potential past sources of contamination from leakage to the soil and groundwater out of the lines at joints, breaks, and other areas of weakness;
- As potential continuing sources of contamination from leakage out of the lines to soil and groundwater; and,
- As potential conduits for transport of contaminated water and/or residue originating from inflow of water or residue from contaminated areas surrounding the lines or from above the lines at joints, breaks, and other areas of weakness.

The approach to investigating the infrastructure within the scope of the RI is to

- Evaluate physical information regarding infrastructure components (i.e., location, elevation, endpoints, and condition from existing information, on-going plant closure, and limited inspection)
- Incorporate the physical information on infrastructure into the comprehensive conceptual model for the site to allow evaluation of infrastructure in relation to site operations and known and potential areas of soil and groundwater contamination, and
- Focus initial sampling (both of residue within infrastructure and soil outside of infrastructure) on the basis of this evaluation, beginning with locations more likely to represent potential sources to the environment (e.g, catch basins, pumping stations) and those likely to contain material representative of site operations (e.g., downgradient locations) before proceeding with other sampling, if needed, based on the initial sampling.

6.3.1 Subtask 3.1: Evaluate Existing Infrastructure Information (Soil Borings)

Infrastructure lines are potentially capable of acting as preferential flow paths for shallow groundwater. To evaluate their potential to act as preferential flow paths for shallow groundwater, as-built elevation information will be evaluated in reference to groundwater table elevations and nearby potential sources of contamination. If a significant potential exists, additional investigations will need to be evaluated.

If available, construction details of sanitary/storm lines will be considered when evaluating the potential for releases of NAPL or aggressive/corrosive wastes. Additionally, locations of areas of degreasers identified by plant personnel will be evaluated in relation to the infrastructure. Any additional information on degreaser locations will be provided in the Infrastructure Sampling Plan Addendum.

The infrastructure evaluation will consider historic potential or documented releases that are not part of the current system configuration. Major changes appearing to have a potential of impacting the environment will be considered to the extent possible with information in the GIS or made readily available by Plant personnel. Video inspection or other form of testing of key drainage lines may be informative and the need for detailed line testing will be evaluated and details included in the Infrastructure Sampling Plan Addendum.

Plans provided by SAEP personnel and the integrity of representative pump stations, sumps and catch basins will be evaluated. Soil sample results (both visual field screening information and analytical data) will be evaluated in relation to possible sources, including nearby drainage lines. The relationship between invert elevation, any known information on construction and history of the drainage lines, elevation and flow direction of groundwater, potential sources from plant activities, and results of soil sampling will guide decisions on whether more investigation is required related to potential releases from the drainage lines. Infrastructure leading to current and historic outfall locations will be targeted for residue evaluations. If results indicate contamination, evaluation of upgradient locations will be considered.

Chemical waste lines are a potential source of contamination through leakage to the surrounding soil and groundwater. It is assumed that, because the area has documented soil and groundwater contamination, the plating area and other areas along the eastern side of Building B-2 associated with the chemical waste lines will be remediated and that the chemical waste treatment lines will be closed in the process; there is, therefore, no need to independently address waste lines in this area within the context of the infrastructure evaluation other than as a potential historical source of contamination to the storm sewer system. Major drainage lines, however, (e.g., the main line from Building B-2 to the Chemical Waste Treatment Plant) outside of the vicinity of the main plating area have not been characterized and will, therefore, be investigated with subsurface soil sampling to evaluate potential contamination of surrounding soil and groundwater as a result of leakage from the lines. Before any sampling, depths to pipes and other structures representing potential sources will need to be determined from either plant sources or direct measurement as part of this subtask (All investigations in these areas will be coordinated with Harding Lawson Associates who are conducting an investigation in this area at the time of this RIWP).

Catch basins, sumps, and other structures that represent collection points or areas where drainage flow velocities are reduced are more likely to be sources of a release to the environment. Accordingly, W-C will evaluate plans provided by SAEP and inspect the integrity of representative larger capacity structures (e.g., pumping stations and catch basins) along major (downstream) lines identified to evaluate the potential for these structures to be sources of soil and/or groundwater contamination. Representative structures with potential for a release will be treated as potential areas of concern and soil will be sampled just outside of the structure to evaluate if the soil has been contaminated. Existing plant information will be reviewed to provide information on elevations of infrastructure in areas to be sampled by soil borings. Soil borings will conducted as part of Task 7, below.

6.3.2 Subtask 3.2: Coordinate with Plant Close-out of Infrastructure

It is assumed that the potential for subgrade process and waste lines to act as sources of contamination will be evaluated and they will be cleaned, closed, and evaluated by plant personnel as part of plant close-out. As these lines are cleaned and closed out, the potential for future releases to soil and groundwater from the subgrade and process waste lines and structures is eliminated. W-C will coordinate with plant personnel who are in the process of cleaning and closing out the lines to inspect these structures and surrounding materials to 1) evaluate their potential to act as sources of contamination; 2) evaluate preferential conduits for groundwater flow; and 3) evaluate the need to sample the soils to verify soil cleanup as access becomes

available. If these lines are found to be interacting with the groundwater flow regime, further evaluation in the form of additional soil borings, monitoring wells and/or excavations in areas with potential leakage may be considered.

Similarly, it is assumed that the infrastructure needed to maintain stormwater drainage on the Site will remain operational but that many of the internal building drainage structures connected to the stormwater system will be cleaned, closed, and evaluated by plant personnel as part of plant close-out. The potential for future releases to soil and groundwater from the stormwater drainage lines and structures is eliminated as these lines and structures are cleaned and closed-out. W-C will coordinate with plant personnel who are in the process of cleaning and closing out the stormwater drainage lines to inspect these structures and surrounding materials to evaluate their potential to act as sources of contamination and preferential conduits for groundwater flow and to evaluate the need to sample the soils to verify soil cleanup as access becomes available.

This subtask will be an on-going one as dictated by the schedule of plant close-out.

6.3.3 Subtask 3.3: Evaluate Existing Infrastructure Information (Residue Sampling)

Areas of potential sources of contaminated soil or groundwater that could potentially affect nearby sewers, or vice versa, will be identified. The invert and line elevations of the sewer system will be evaluated in relation to groundwater table elevations to evaluate the potential for these sewer lines to act as a preferential conduit for groundwater flow. In addition, the relative elevations of inverts and lines of the sewer system will be compared with contaminated source areas identified in the Phase I and Phase II investigations and this RI sampling to determine potential for the sewer to be a source and/or potential for contaminated inflow into the sewer and evaluate need to sample downgradient residue in sewers. Following this evaluation, a tiered sampling approach will be developed in which residue will be sampled in major downstream pumping stations (after inspection), and downstream of areas that are likely to have produced contamination, and upstream of areas of contaminated soil that could potentially be attributable to leakage from the infrastructure. (Administrative areas or other areas removed from potential sources will not need to be sampled.) If contaminated residue is found, then, based on an evaluation of detailed drawings and areas of contaminated soil and groundwater upstream, the need to do further sampling of the drainage system will be evaluated.

6.3.4 Subtask 3.4: Develop Infrastructure Sampling Plan Addendum

Following completion of Subtask 3.3, an Infrastructure Sampling Plan Addendum will be prepared. The Infrastructure Sampling Plan Addendum will include sampling of residue in structures, as described in the discussion for Subtask 3.3, above. Soil borings outside of structures will be addressed in the Soil Sampling Plan Addendum (Subtask 1.5) and will be conducted during Task 7.

Based on current information, collection of an estimated 20 samples will be proposed. The Infrastructure Sampling Plan Addendum will provide details on sampling locations, rationale, parameters, and methods. Any health and safety issues specific to the conduct of the Infrastructure Sampling Plan Addendum and outside of the SSHP submitted as part of the RIWP will also be addressed.

6.3.5 Subtask 3.5: Submit Infrastructure Sampling Plan Addendum

The Infrastructure Sampling Plan Addendum will be submitted to TACOM, USACE, CDEP, and USEPA for review and comment.

6.3.6 Subtask 3.6: Review by Agencies/Evaluation of Comments by W-C

This subtask consists of review of the Infrastructure Sampling Plan Addendum by TACOM, USACE, CDEP, and USEPA and subsequent evaluation of these comments by W-C. Comments on the Infrastructure Sampling Plan Addendum will be provided to W-C as one consolidated set of comments at the mid-point of the review period schedule. W-C will evaluate the comments during the second half of the review/evaluation period schedule.

6.3.7 Subtask 3.7: Meeting/Teleconference (Infrastructure Sampling Plan Addendum)

A meeting or teleconference will be held with representatives of TACOM, USACE, CDEP , and USEPA, as required, to discuss the comments and resolve any open issues regarding the Infrastructure Sampling Plan Addendum.

6.3.8 Subtask 3.8: Sampling

Residue sampling and any other investigations included in the Infrastructure Sampling Plan Addendum will be conducted in accordance with the FSP contained in Appendix A as modified by the Infrastructure Sampling Plan Addendum. Based on current information, an estimated 20 samples will be collected. If contaminated residue is found, then, based on an evaluation of detailed drawings and areas of contaminated soil and groundwater upstream, the need to do further sampling of the drainage system will be evaluated.

6.3.9 Subtask 3.9: Analytical Laboratory Analysis

All samples will be submitted to the analytical laboratory for analysis of TCL VOCs, SVOCs, PCBs, TAL Metals, and cyanides or as modified by the Infrastructure Sampling Plan Addendum. Normal turnaround analytical laboratory results will be obtained.

6.3.10 Subtask 3.10: Data Validation

All data will be validated in accordance with the procedures specified in the QAPP contained in Appendix A.

6.3.11 Subtask 3.11: Update GIS/GMS

Information from the infrastructure sampling will be entered into the GIS/GMS, as appropriate, subject to the input limitations of the programs. The GIS/GMS will be used as a basis for evaluating the Site conceptually as well as more quantitatively. Entering the data into the GIS/GMS will allow evaluation of sampling results in relation to potential sources of contamination. It will also facilitate the graphical presentation of the site data, including the data obtained from the infrastructure sampling, within the framework of a comprehensive conceptual

model for the Site. As the GIS/GMS is updated, the comprehensive conceptual model for the Site will be evaluated in terms of the DQOs (i.e., has the nature and extent of contamination attributable to the infrastructure been defined, or is more sampling needed?).

6.4 TASK 4: SURFACE WATER SAMPLING

Task 4 consists of the following subtasks:

Subtask 4.1 - Mobilization

Subtask 4.2 - Sampling

Subtask 4.3 - Analytical Laboratory Analysis

Subtask 4.4 - Data Validation

Subtask 4.5 - Update GIS/GMS

Subtask 4.6 - Surveying

Surface water data will be collected from the Outfall 008/Marine Basin area and a minimum of three stations from a suitable reference area across the Housatonic River adjacent to Nell's Island (Figure 2a on the FSP) to determine relative concentrations of site-related constituents. Surface water data collected during the Phase I investigation demonstrated that it does not represent an important exposure medium (see Appendix C). In selection of the reference areas, they will be out of the influence of the Site. Keeping environmental factors, such as, salinity, sediment type, organic content, hydrology, depth and biota as similar as possible.

Specifically, the relative concentrations of site-related constituents found in filtered and unfiltered surface water samples will be used to assess the threat to human health from surface water in this area versus the threat posed by regional groundwater contamination using available data from monitoring wells adjacent to the Site. Site-related constituent concentrations will also be compared to ecological benchmarks to identify the potential threat to ecological resources beyond that attributable to regional surface water contamination. These data will be available to the regulatory agencies for review.

6.4.1 Subtask 4.1: Mobilization

Prior to sampling, local tide charts will be consulted to insure that the sampling is performed at the correct tidal stages. Water quality meters will be calibrated to insure valid measurements are taken. Part of the mobilization subtask will also include an inventory of onboard equipment to ensure that the work will be performed efficiently and taking all safety precautions into consideration. Water quality and Global Positioning System (GPS) meters will be calibrated in accordance with their user's manuals to insure valid measurements are taken.

6.4.2 Subtask 4.2: Sampling

The potential contribution of site-related constituents in the area of Outfall 008 and the Marine Basin will be investigated as part of the RI. Surface water data will be collected from the Outfall 008/Marine Basin area and a suitable reference area in a tidal wetland drainage located across the

Housatonic River (Figure 2a of the FSP). A suitable reference area is one which is out of the influence of the Site while possessing similar substrate, depth, salinity, hydrology and biota. Sampling will occur at or near low tide to ensure minimal dilution by tidal waters. Details on the surface water sampling program are provided in the FSP contained in Appendix A.

6.4.3 Subtask 4.3: Analytical Laboratory Analysis

Surface water samples will be analyzed for TCL VOCs, PAHs, PCBs, cyanide and TAL metals (filtered and nonfiltered). Metal speciation will also be performed for arsenic, mercury, and chromium. These parameters were selected based on the results of previous surface water analyses in the site vicinity, specific requests of the CDEP and USEPA, and on the fact that no surface water data has been collected from Marine Basin in previous investigations.

6.4.4 Subtask 4.4: Data Validation

All data will be validated in accordance with procedures specified in the QAPP contained in Appendix A.

6.4.5 Subtask 4.5: Update GIS/GMS

Information from the surface water sampling will be entered into the GIS/GMS, as appropriate. The GIS/GMS will be used as a basis for evaluating the Site conceptually as well as more quantitatively. Entering the data into the GIS/GMS will allow evaluation of sampling results in relation to potential sources of contamination. It will also facilitate the graphical presentation of the site data, including the data obtained from the surface water sampling, within the framework of a comprehensive conceptual model for the Site. As the GIS/GMS is updated, the comprehensive conceptual model for the Site will be evaluated in terms of the DQOs (i.e., do site related constituents detected in Marine Basin surface water exceeds standards?).

6.4.6 Subtask 4.6: Surveying

All sampling stations will be surveyed using a hand held GPS unit with sub meter accuracy.

6.5 TASK 5: SEDIMENT SAMPLING

Task 5 consists of the following subtasks:

Subtask 5.1 - Mobilization

Subtask 5.2 - Sampling

Subtask 5.3 - Analytical Laboratory Analysis

Subtask 5.4 - Data Validation

Subtask 5.5 - Update GIS/GMS

Subtask 5.6 - Surveying

Material provided in the Technical Memorandum (Appendix C) provides the rationale and support for much of the proposed sampling effort. Previously collected data were the primary consideration in the design of the proposed program. This approach minimizes potential for duplication of effort and conflicting results.

Sediments will be collected in the vicinity of the outfalls and adjacent to the Causeway in the mudflat area to better delineate and assess areas that may be impacted by site-related constituents. Additional stations will be located between Outfall 008 and Marine Basin since this area was not delineated in previous investigations. Sediments will be collected for chemical analyses (including AVS/SEM), toxicity testing, and benthic community analyses. Bioaccumulation testing using an appropriate infaunal organism will also be performed. These data will be used to evaluate potential risk to humans and aquatic receptors from exposure to these sediments. Effects Range-Low (ERLs) will be used for sediment chemistry benchmarks.

6.5.1 Subtask 5.1: Mobilization

Prior to sampling, local tide charts will be consulted to insure that sufficient water is present in the intertidal mudflat area to operate a vessel. Water quality and GPS meters will be calibrated in accordance with their user's manuals to insure valid measurements are taken. Part of the mobilization subtask will also include an inventory of onboard equipment to ensure that the work will be performed efficiently and taking all safety precautions into consideration.

6.5.2 Subtask 5.2: Sampling

Details on the sediment sampling program are provided in the FSP contained in Appendix A.

6.5.2.1 Lithology/Bathymetry

Lithologic and bathymetric observations will be recorded as part of the characterization of the Intertidal Mudflat area and Outfall 008/Marine Basin area, prior to sediment sampling. Observations will include surface water depth, depth of mud or noncohesive sediments (where possible), general description of grain size and color, and stratigraphy, where appropriate. A total of 12 stations (i.e., 9 in the mudflats and 3 in the Marine Basin) will be surveyed for these data as shown on Table 1 and Figure 2 (of the FSP). Incidental information will also be collected at all stations where sediment data are collected.

6.5.2.2 Sediment

Sediment samples will be collected using a properly decontaminated hand-held coring device from the surface and at depth at a total of eight stations located in the Intertidal Mudflats adjacent to the outfalls. Surficial sediments will reflect conditions in the biologically active zone, while sediments below this depth reflect historical deposition.

For the remainder of the sediment stations adjacent to the Causeway, 008/Marine/Basin area and the reference location, sediments will be collected only from the biologically active zone. All sediments will be analyzed for chemistry and physicochemical parameters. In addition, some

surficial sediments will also be analyzed for AVS/SEM, toxicity and bioaccumulation testing, and benthic community analyses.

Sediment samples will be collected with a stainless steel hand held corer, Eckman Dredge, Petite Ponar Grab sampler, shovel, or similar suitable sampling device. Sufficient sediment will be collected from each location and homogenized to perform all tests except benthic analyses.

6.5.2.3 Benthos

All benthic samples will be collected using a sampler of known surface area (e.g., petite Ponar bottom grab, sampling area 36 in2). Three replicates will be collected at each station. Pertinent field observations, such as sample time, sediment texture, color and odor, will be recorded in the field logbook.

Reference stations for collection of sediment chemistry data will be field located across the Housatonic River in drainageways of Nell's Island (Figure 2a). Available sediment background data collected as part of the Raymark Superfund Site will also be used.

6.5.3 Subtask 6.5.3: Analytical Laboratory Analysis

6.5.3.1 Sediment Chemistry

All sediment samples will have chemical analysis performed for TCL VOCs, PAHs, PCBs, TAL Metals (including arsenic, mercury, and chromium speciation), cyanide, and physicochemical parameters. AVS will be analyzed along with mercury, copper, nickel, lead, and zinc at selected stations.

Physicochemical Parameters. All samples will be analyzed for physicochemical parameters including TOC, grain size, percent moisture, and solids.

Sediment Toxicity Testing. The test organisms for the toxicity testing were selected based on their specific presence, or the presence of closely related organisms, in the study area. The following tests will be performed:

- 20-day Neanthes arenaceodentata. Endpoints: mortality, growth; and,
- 28-day Leptocheirus plumulosus. Endpoints: mortality, growth, reproduction.

6.5.3.2 Bioaccumulation Testing

As with toxicity test organisms, test organisms for bioaccumulation testing were selected based on their known occurrence in the study area. The specific laboratory protocol for the 28-day Nereis virens test has been selected based upon its reliability in the scientific community. Tissue will be analyzed for PCBs and TAL metals.

6.5.3.3 Benthic Community Analyses

Samples will be sorted under dissecting microscopes in the laboratory. Organisms recovered will be identified to the lowest practical taxon and enumerated. Metrics most likely to be used will

include density (i.e., number of individuals per square foot); richness (i.e., number of taxa per station), community loss index (i.e., measure of similarity with reference locations); and percent dominant taxon. A qualitative description of the communities observed will also be provided.

6.5.4 Subtask 5.4: Data Validation

All data will be validated in accordance with procedures specified in the QAPP contained in Appendix A. Toxicity testing and bioaccumulation reports will also be reviewed to ensure adherence to laboratory and work plan protocols.

6.5.5 Subtask 5.5: Update GIS/GMS

Information from the sediment sampling will be entered into the GIS/GMS, as appropriate. The GIS/GMS will be used as a basis for evaluating the Site conceptually as well as more quantitatively. Entering the data into the GIS/GMS will allow evaluation of sampling results in relation to potential sources of contamination. It will also facilitate the graphical presentation of the site data, including the data obtained from the sediment sampling, within the framework of a comprehensive conceptual model for the Site. As the GIS/GMS is updated, the comprehensive conceptual model for the Site will be evaluated in terms of the DQOs (i.e., has the nature and extent of sediment contamination in the intertidal mudflats and Marine Basin been characterized, or is more sampling needed?).

6.5.6 Subtask 5.6: Surveying

All sampling stations will be surveyed using a hand held GPS unit with sub meter accuracy.

6.6 TASK 6: BIOTA SAMPLING

Task 6 consists of the following subtasks:

Subtask 6.1 - Mobilization

Subtask 6.2 - Sampling

Subtask 6.3 - Analytical Laboratory Analysis

Subtask 6.4 - Data Validation

Subtask 6.5 - Update GIS/GMS

Subtask 6.6 - Surveying

Qualitative fish community surveys will be performed in the intertidal mudflat area and Outfall 008/Marine Basin area. Depending on the species identified in these areas, whole body (including offal) tissues of a recreational/commercial species and a prey species, and fillets of a recreationally or commercially important species will be retained for tissue analyses. Whole body tissues will be analyzed to determine exposure to higher trophic levels, including predatory fish, wading birds, and piscivorous mammals. Oyster tissues, or a similar shellfish consumed by humans, will also be collected from the Marine Basin area to estimate risk for the human health risk assessment as well as establish exposure to higher trophic levels from ingestion of the

shellfish tissue. Connecticut Water Quality Criteria for Aquatic Life will be used for screening historical data.

6.6.1 Subtask 6.1: Mobilization

Prior to sampling, local tide charts will be consulted to insure that sufficient water is present in the intertidal mudflat area to operate a vessel. Water quality and GPS meters will be calibrated in accordance with their user's manuals to insure valid measurements are taken. Part of the mobilization subtask will also include an inventory of onboard equipment to ensure that the work will be performed efficiently and taking all safety precautions into consideration.

6.6.2 Subtask 6.2: Sampling

Details on the biota sampling program are provided in the FSP contained in Appendix A.

6.6.2.1 Shellfish

Oysters or consumable bivalves will be collected from Marine Basin and one reference location in the wetland area across the Housatonic River. Samples will be collected manually, or using hand tools such as a decontaminated shovel, rake or other suitable collection device. A total of approximately 45g of tissue are needed (i.e., 30g for PCBs, 10g for metals, and 3g for lipids). Station locations will correspond as nearly as possible to the stations used for sediment and surface water sampling but will be dictated by presence of the bivalves.

At each location where shellfish are collected, water quality parameters including temperature, pH, dissolved oxygen, alkalinity, and hardness will be recorded. Additional field observations will also be recorded such as substrate type, odors, presence of other biota, etc.

6.6.2.2 Finfish

Fish sampling will be performed by seining or gill netting to qualitatively characterize fish populations occurring on the Intertidal Mudflats, adjacent to the SAEP site, and in the Marine Basin. Fish will also be collected from a suitable reference location. Sampling at all locations will occur during a preliminary one-day site reconnaissance. Subsequent sampling procedures will be determined following this preliminary effort.

Where it is determined that suitable species occur in adequate numbers, attempts will be made to collect a minimum of five replicate fish samples each of a prey species and an edible species. A total of approximately 45g of tissue are needed (i.e., 30g for PCBs, 10g for metals, and 3g for lipids). Whole body (including offal) fish samples will be collected of prey species, and data used as input into the Ecological Risk Assessment (ERA). Edible fillet samples will also be collected and provide input into the Human Health Risk Assessment (HHRA). The fillet samples will be taken from an important local commercial and recreational species (e.g., American shad, Atlantic herring, or tautog).

6.6.3 Subtask 6.3: Analytical Laboratory Analysis

Shellfish and fish tissues will be analyzed for PCBs, TAL metals, percent lipids, and percent moisture using methods described in the FSP contained in Appendix A. Sample handling requirements are provided in Table 2 of the FSP. SVOCs and pesticides were not included in the list of tissue analytes since previous surface water, sediment and biota tissue analysis demonstrated that they are not consistently widespread in aquatic media of the Site. Where detected, SVOCs are generally present in low concentrations. These data in combination with SVOCs not bioaccumulating at concentrations observed adjacent to the Site, warranted exclusion in the tissue analyses.

6.6.4 Subtask 6.4: Data Validation

Laboratory reports providing specific documentation of procedures and results, will be reviewed to ensure adherence to laboratory and work plan protocols.

6.6.5 Subtask 6.5: Update GIS/GMS

Information from the biota sampling will be entered into the GIS/GMS, as appropriate. The GIS/GMS will be used as a basis for evaluating the Site conceptually as well as more quantitatively. Entering the data into the GIS/GMS will allow evaluation of sampling results in relation to potential sources of contamination. It will also facilitate the graphical presentation of the site data, including the data obtained from the biota sampling, within the framework of a comprehensive conceptual model for the Site.

6.6.6 Subtask 6.6: Surveying

All sampling stations will be surveyed using a hand held GPS unit with sub meter accuracy.

6.7 TASK 7: SOIL SAMPLING

Task 7 consists of the following subtasks:

Subtask 7.1 - Mobilize Soil Sampling Subcontractor

Subtask 7.2 - Utility Clearance

Subtask 7.3 - Collect Soil Samples

Subtask 7.4 - Laboratory Analysis

Subtask 7.5 - Data Validation

Subtask 7.6 - Update GIS/GMS

Subtask 7.7 - Surveying

The basic characteristics that drive the approach to investigating soils at the Site are: 1) the relatively large size of the Site; 2) it's relatively complexity, i.e., there are numerous potential sources; 3) the relatively long and varied history of Site operations, i.e., potential for contamination sources and locations having changed over the course of the history of the Site;

and, 4) difficulty of subsurface access because of building floor slabs and numerous potential subsurface interferences, i.e., utilities and plant infrastructure.

Because of the long and varied history of operations at the Site, the potential for the existence of former sources of contamination where little or no present day evidence remains. The various data needs of the site re-use plans and the entire site should be subject to some degree of investigation to satisfy the objective of characterizing nature and extent of contamination. Because the Site is large, survey techniques that provide wide coverage at a relatively low level of data quality (screening data) to identify areas of contamination at a gross level to then be investigated using more detailed, higher data quality (and cost) methods (definitive data) were considered.

Non-intrusive survey methods (e.g., geophysical) were ruled out because of the interference from the intricate Site infrastructure and the limited information obtained by such surveys. A soil gas survey only addresses one of the class of contaminants at the Site (volatile organics). Adding a field screening for inorganics would involve collecting soil samples from the same location as the soil gas and analyzing them for inorganics using a mobile laboratory or field method such as x-ray fluorescence (XRF). However, neither of these screening methods provides data that are useable for risk assessment or for comparison to remediation standards. Given the potential difficulty in accessing subsurface soils and that analytical laboratory data will be required from all areas of the Site regardless of the results of any screening data, the strategy selected is to obtain the maximum amount of data with the highest level of quality and usability required by the RI (i.e., definitive data analytical laboratory data) over the entire Site (both identified potential areas of concern and the remainder of the Site) with a minimum number of access locations.

A mobile laboratory was also considered. A major advantage of a mobile lab is that it allows one to make decisions regarding sampling (generally for real-time delineation) without having for off-site laboratories to provide analytical results (typically 2 or more weeks at normal turnaround time). In the case of the SAEP, its large size, which adds to the complexity of the RI but also provides an advantage from the standpoint that the several rounds of sampling can be conducted without demobilizing before analytical laboratory data from an off-site laboratory becomes available. Furthermore, mobile laboratories are most cost effective in situations where analysis of a limited number of targeted parameters is needed. In the case of the SAEP RI, the data objective, as stated above, is for high quality data for a wide range of parameters. For these reasons, a mobile laboratory was not included in the scope of work.

Using information in previous investigation reports and provided by SAEP, correspondence and meetings with USEPA and CDEP regarding the Phase I and II Investigations, and the initial site reconnaissance, the need for sampling the subsurface at the various potential areas of concern identified in reports of these investigations was evaluated. The potential for sampling these areas was evaluated on the basis of:

- potential for presence of hazardous materials (e.g., activities likely to have required the use of fuels, solvents, etc.);
- evidence of actual or potential release, (e.g., analytical laboratory data, reports of spills, visible stains); and,

- potential migration pathway to the subsurface (e.g., cracked flooring, drains, sumps, pits, pipes).

Because all buildings were not vacant, the precise locations of a number of areas referred to in the information reviewed could not be determined at the time of the initial site reconnaissance. These locations will be confirmed during Task 1 – Pre-Mobilization Activities. Information on identified AOCs is provided in Table 4 of the FSP provided in Appendix A.

6.7.1 Subtask 7.1: Mobilize Soil Sampling Subcontractor

The selected soil sampling subcontractor will be contacted and scheduled to begin work at the Site. The subcontractor will make all arrangements for access and required site support for this Subtask.

6.7.2 Subtask 7.2: Utility Clearance

Utility clearance for sampling locations will be an on-going process as sampling points are being defined, modified, and added during the course of the RI. W-C will rely on plant personnel and a utility clearance subcontractor to provide clearance for sampling locations on-site. The Connecticut central-clearinghouse ("DIGSAFE") will be contacted at least two full working days prior to the start of intrusive activities.

6.7.3 Subtask 7.3: Collect Soil Samples

Details on the soil sampling program are provided in the FSP contained in Appendix A.

The soil sampling will be conducted in an iterative manner: soil borings in potential areas of concern will be sampled across the entire site during this Subtask for initial characterization. Analytical parameters will cover a wide range of potential contaminants (TCL VOCs and SVOCs, PCBs (shallow samples only), TAL Metals, and cyanide). Selected samples will be analyzed for remedial design-related parameters (e.g., TOC, grain size distribution, total petroleum hydrocarbons (TPH), and remediation parameters) based on the results of the initial characterization testing.

All soil sampling will extend to at least the water table (estimated at 4 to 11 ft below ground surface, depending on location). Deeper vertical profiling may be conducted in areas in which contamination extends below the water table. Soil samples will be obtained using Hollow-stem augers (HSA) and split-spoon advancement methods.

All boreholes will be sampled continuously. One soil sample will be submitted for analytical laboratory analysis from the zero to six inch interval below grade or any paved surface (i.e., first split spoon) or within one foot below the depth of the potential release source, if known (e.g., the depth of the bottom of a sump). A second sample will be submitted from the interval immediately above the water table. Additional samples may be collected based on visual, olfactory, or field screening evidence of contamination. Provisions will be made to split samples with other contractors on-site, subject to available sample volumes.

Although analytical laboratory data are a primary input needed for risk assessment, field observations are equally important from the perspective of evaluating potential interim remedial actions. Careful notes will be kept regarding visual, olfactory, and field screening instrument observations because, in addition to providing the basis for biasing a sample for submittal to the analytical laboratory, this will provide important information needed to define potential source areas. Any floating product at the water table or free product in the soil samples will be noted. If material is encountered that, based on field observations, appears to be potential source material (i.e., visual and olfactory evidence of contamination), selected samples may be analyzed using the Synthetic Precipitation Leaching Procedure (SPLP) for comparison with CDEP pollutant mobility criteria. In addition, potential source material that appears to be of sufficiently limited extent to potentially be excavated as part of an Interim Removal Action will be analyzed using Toxicity Characteristic Leaching Procedure (TCLP) methods.

6.7.4 Subtask 7.4: Laboratory Analysis

All samples will be submitted to the analytical laboratory for analysis in accordance with the parameters and procedures listed in the QAPP contained in Appendix A and as modified by the Soil Sampling Plan Addendum. Normal turnaround analytical laboratory results will be obtained. All samples will be extracted for possible later analysis by SPLP methodology if concentrations of any semivolatiles, PCBs, or metals exceed the SPLP-based pollutant mobility RSRs multiplied by 20 (i.e., the SPLP dilution factor).

6.7.5 Subtask 7.5: Data Validation

All data will be validated in accordance with procedures specified in the QAPP contained in Appendix A.

6.7.6 Subtask 7.6: Update GIS/GMS

Information from the soil sampling will be entered into the GIS/GMS, as appropriate. The GIS/GMS will be used as a basis for evaluating the Site conceptually as well as more quantitatively. Entering the data into the GIS/GMS will allow evaluation of sampling results in relation to potential sources of contamination. It will also facilitate the graphical presentation of the site data, including the data obtained from the soil sampling, within the framework of a comprehensive conceptual model for the Site. As the GIS/GMS is updated, the comprehensive conceptual model for the Site will be evaluated in terms of the DQOs (i.e., has the nature and extent of soil contamination attributable to the infrastructure been characterized, or is more sampling needed?).

6.7.7 Subtask 7.7: Surveying

All boring locations will be surveyed in Connecticut State Plane coordinates for tie-in to the existing Site survey. Horizontal locations will be surveyed to the nearest 0.01 foot. Surface elevations will be vertically surveyed in elevation above MSL to the nearest 0.01 foot to a consistent National Geodetic Vertical Datum (NGVD) for comparison to previous Site surveys.

6.8 TASK 8: SOIL GAS SAMPLING

Task 8 consists of the following subtasks:

Subtask 8.1 - Evaluate Soil Sampling Data/Develop Soil Gas Sampling Plan Addendum

Subtask 8.2 - Submit Soil Gas Sampling Plan Addendum

Subtask 8.3 - Review by Agencies/Evaluation of Comments by W-C

Subtask 8.4 - Meeting/Teleconference (Soil Gas Sampling Plan Addendum)

Subtask 8.5 - Sampling

Subtask 8.6 - Analytical Laboratory Analysis

Subtask 8.7 - Update GIS/GMS

The soil gas sampling will consist of the collection of approximately 40 soil gas samples collected at a depth of approximately two to five feet below grade.

6.8.1 Subtask 8.1: Evaluate Soil Sampling Data/Develop Indoor Sampling Plan Addendum

The focus of the soil gas sampling program is to evaluate those locations where VOC contamination in the subsurface soil may be volatilizing and, by some means, entering into the building air space thereby causing an indoor air quality problem. Consequently, the soil gas sampling program cannot be definitively determined until after the soil sampling program (Task 7) is performed.

Under this subtask, results of analytical testing on the soil samples collected during Task 7 will be reviewed. Based upon this review, a list of VOCs which are potentially present in the building interiors will be developed. Sampling locations will be chosen based on the reported concentrations of VOCs for the soils, historical information about manufacturing plant processes including known occurrences of spills, and visual observation. Details of the soil gas sampling locations and sampling frequency will be included in the Soil Gas Sampling Plan Addendum.

6.8.2 Subtask 8.2: Submit Soil Gas Sampling Plan Addendum

The Soil Gas Sampling Plan Addendum will be submitted to TACOM, USACE, CDEP, and USEPA for review and comment.

6.8.3 Subtask 8.3: Review by Agencies/Evaluation of Comments by W-C

This subtask consists of review of the Soil Gas Sampling Plan Addendum by TACOM, USACE, CDEP, and USEPA and subsequent evaluation of these comments by W-C. Comments on the Soil Gas Sampling Plan Addendum will be provided to W-C as one consolidated set of comments at the mid-point of the review period. W-C will evaluate the comments during the second half of the review/evaluation period.

6.8.4 Subtask 8.4: Meeting/Teleconference (Soil Gas Sampling Plan Addendum)

A meeting or teleconference will be held with representatives of TACOM, USACE, CDEP , and

USEPA, as required to discuss the comments and resolve any open issues regarding the Soil Gas Sampling Plan Addendum.

6.8.5 Subtask 8.5: Sampling

Information on the soil gas sampling program are provided in the FSP contained in Appendix A. Soil gas samples will be collected using by inserting an evacuated tube into a small borehole extending approximately two to five feet below grade. Analytical parameters and sampling locations will be determined from the soil sampling results. Indoor soil gas sampling locations and analytical parameters will be finalized based on the results of analytical testing of soil sampling from previous investigations. An estimated 40 samples will be collected from locations in buildings across the Site. Ten samples are estimated for Building B-2, five each in Buildings B-16, B-3, and B-6, and the remaining 15 samples distributed among the other buildings on-site.

6.8.6 Subtask 8.6: Analytical Laboratory Analysis

The contract laboratory will analyze the samples for the parameters specified in the FSP contained in Appendix A modified, if necessary, in the Soil Gas Sampling Plan Addendum.

6.8.7 Subtask 8.7: Update GIS/GMS

Information from the soil gas sampling will be entered into the GIS/GMS, as appropriate. The GIS/GMS will be used as a basis for evaluating the Site conceptually as well as more quantitatively. Entering the data into the GIS/GMS will allow evaluation of sampling results in relation to potential sources of contamination. It will also facilitate the graphical presentation of the site data, including the data obtained from the soil gas sampling, within the framework of a comprehensive conceptual model for the Site. As the GIS/GMS is updated, the comprehensive conceptual model for the Site will be evaluated in terms of the DQOs (i.e., do concentrations of site related constituents in soil gas exceed criteria).

6.9 TASK 9: GROUNDWATER

Task 9 consists of the following subtasks:

Subtask 9.1 - Develop Groundwater Sampling Plan Addendum

Subtask 9.2 - Submit Groundwater Sampling Plan Addendum

Subtask 9.3 - Review by Agencies /Evaluation of Comments by W-C

Subtask 9.4 - Meeting/Teleconference (Groundwater Sampling Plan Addendum)

Subtask 9.5 - Mobilize Monitoring Well Installation Subcontractor

Subtask 9.6 - Utility Clearance

Subtask 9.7 - Installation/Development of Monitoring Wells

Subtask 9.8 - Surveying

Subtask 9.9 - Monitoring Well Sampling - Round 1

Subtask 9.10 - Analytical Laboratory Analysis - Round 1

Subtask 9.11 - Data Validation Round 1

Subtask 9.12 - Monitoring Well Sampling - Round 2

Subtask 9.13 - Analytical Laboratory Analysis - Round 2

Subtask 9.14 - Data Validation - Round 2

Subtask 9.15 - Aquifer Testing

Subtask 9.16 - Update GIS/GMS

Groundwater flow and contaminant transport may be an important pathway for environmental exposure to contaminants at the SAEP. To determine 1) whether contamination originating at the Site has impacted on-site groundwater, 2) whether that contamination has migrated or may migrate to off-site locations via groundwater, 3) extent of groundwater impacts, and 4) what potential remedies may be effective in preventing or eliminating further contamination, a thorough understanding of groundwater flow and contaminant transport at and near the Site is necessary. In addition, an understanding of the groundwater interactions with the soil, sediment, and the surface water will identify or eliminate other potential exposure pathways.

General procedures for the groundwater investigation program are provided in the FSP contained in Appendix A. These procedures will be revised, if necessary, in the Groundwater Sampling Plan Addendum.

6.9.1 Subtask 9.1: Develop Groundwater Sampling Plan Addendum

To date, a number of monitoring wells have been installed at the Site. Using groundwater elevation and groundwater quality data from these wells, a preliminary conceptualization of the groundwater flow was portrayed in the Phase II Report. However, the current set of monitoring wells cannot provide sufficient data for a complete understanding of groundwater flow and contaminant transport for the following reasons:

- Current site wells are widely spaced;
- Certain areas of the Site contain no wells;
- Only a limited number of wells are in vertical clusters;
- Only three bedrock surface wells exist;
- Wells are not located in a manner that would allow for an evaluation of groundwater-surface water interactions;
- Very few off-site wells exist; and,
- No wells are located in the tidal flat area.

The Site has been divided into seven on and off-site areas critical to the determination of exposure pathways in which collection of additional groundwater information will be necessary for a complete understanding of groundwater flow and contaminant transport. This division into

seven areas is based on the conceptualization of the overall hydrologic regime at the site and an evaluation of the relative amount of groundwater information available from an area:

- Area 1 – Northern portion of the Site with potential groundwater flow from the Site to both Frash Pond and intertidal mudflats.
- Area 2 – Eastern portion of the Site with groundwater flow from the Site to the intertidal mudflats.
- Area 3 – West of the Site with groundwater flow onto the Site from the airport
- Area 4 – West of the Site with potential groundwater flow both onto the Site from off-site and, into Frash Pond from off-site, and to Frash Pond from on-site.
- Area 5 – Area in central portion of site (primarily Buildings B-2 and B-3) where no information on groundwater flow or quantity is available.
- Area 6 – Southern portion of the Site where groundwater flow is both to the intertidal mudflats and the drainage channel
- Area 7 – Area south of the Site

These areas are outlined in Figure 4 and corresponding critical issues are summarized in Table 3. Other critical issues may become apparent as the investigation proceeds.

In each of the areas monitoring wells are needed to 1) better define and quantify the groundwater flow, horizontal and vertical gradients and flow quantities in areas where data gaps exist, and 2) define the nature and extent of groundwater contamination. Understanding the groundwater flow regime will allow for an identification of receptors through an assessment of the potential for contamination originating at the Site to be conveyed to off-site locations and to surface water bodies by way of the groundwater. Understanding the groundwater quality will allow for an evaluation of risk to identified potential receptors.

Table 3 lists the estimated number of monitoring wells needed to address the issues, based on W-C's present understanding of the hydrogeology of the Site, potential sources of contamination, USEPA and CDEP comments on the Phase II Report, number of existing wells, and the objectives of monitoring the groundwater (i.e., groundwater flow or groundwater quality). These estimates are subject to change during the implementation of the RI after all existing Phase I and Phase II data, and newly obtained soil sample data are entered into the GIS/GMS.

Well clusters will have anywhere from one well (shallow water table well) to a cluster of three wells (shallow [water table], intermediate, and deep [screened at bedrock surface]) or more, depending on local hydrostratigraphy, total saturated thickness, screen length, location, existing number of wells at various depths, and sampling objective. Shallow monitoring wells with short (less than 5 ft) screen lengths to sample discrete zones of the near surface will be installed in the intertidal flats to evaluate the groundwater quality in the zone of discharge in the intertidal flats.

Based on currently available information, it is estimated that a total of 25 monitoring wells will be installed at 14 locations on the plant Site (13 shallow wells, 9 intermediate wells, and 3 deep wells). Monitoring wells will be installed at four locations in the intertidal flats with a shallow (less than 5 ft deep) and intermediate (15 to 25 ft deep) monitoring well at each location.

Passive, diffusion-type samplers ("peepers') will be considered for the purpose of optimizing monitoring well locations planned for areas of the Site within the groundwater/surface water interface once the initial GIS/GMS comprehensive conceptual model for the Site has been developed and soil sampling results (Task 7) have been entered into the GIS/GMS.

Slug-type permeability tests will be performed on newly installed monitoring wells to evaluate permeability of the water-bearing formation. Aquifer parameters will also be estimated from grain size analyses conducted on selected samples from monitoring well locations. A surface water elevation gage will be installed in the mudflats adjacent to the Site. A 72-hour tidal study, in which the variation in water levels in on-site and intertidal flats monitoring points and the Housatonic River are evaluated in relation to the tidal cycle, will be conducted. The measurement of salinity and conductivity in the various wells already installed and to be installed as part of the RI will provide data that will be used to evaluate the freshwater/saltwater interface and/or mixing zone.

All wells will be sampled for TCL VOC and SVOCs, PCBs, TAL Metals, and cyanide using low flow rate purging and sampling techniques; existing monitoring wells may need to be re-developed. Useful design-related parameters will also be analyzed for in groundwater from selected wells (e.g., pH, conductivity, salinity, total and dissolved manganese and iron, TOC, chemical oxygen demand, biological oxygen demand, eH, sulfate, sulfide, nitrate, nitrite, ammonia, alkalinity as bicarbonate, dissolved oxygen, nitrogen, chlorides, phosphates). A list of target analytes is presented in Attachment B of the Field Sampling Plan.

The extent to which installation of additional sampling points, performance of aquifer tests, collection of groundwater quality data, and analysis of tidal influences is required in each area will be better evaluated once the initial GIS/GMS comprehensive conceptual model for the Site has been developed and soil sampling results have been entered into the GIS/GMS. For this reason, the Groundwater Sampling Plan Addendum will be developed after information from the soil sampling task has been evaluated. The existence of private wells in the area will be re-visited as part of the RI, in light of any revised groundwater flow direction information obtained during the RI.

6.9.2 Subtask 9.2: Submit Groundwater Sampling Plan Addendum

The Groundwater Sampling Plan Addendum will be submitted to TACOM, USACE, CDEP, and USEPA for review and comment.

6.9.3 Subtask 9.3: Review by Agencies/Evaluation of Comments by W-C

This subtask consists of review of the Groundwater Sampling Plan Addendum by TACOM, USACE, CDEP, and USEPA and subsequent evaluation of these comments by W-C. Comments on the Groundwater Sampling Plan Addendum will be provided to W-C as one consolidated set of comments at the mid-point of the review period. W-C will evaluate the comments during the second half of the review/evaluation period.

6.9.4 Subtask 9.4: Meeting/Teleconference (Groundwater Sampling Plan Addendum)

A meeting or teleconference will be held with representatives of TACOM, USACE, CDEP , and USEPA, as required to discuss the comments and resolve any open issues regarding the Groundwater Sampling Plan Addendum.

6.9.5 Subtask 9.5: Mobilize Monitoring Well Installation Subcontractor

The selected groundwater monitoring well installation subcontractor will be contacted and scheduled to begin work at the Site.

6.9.6 Subtask 9.6: Utility Clearance

Utility clearance for sampling locations will be an on-going process as sampling points are being defined, modified, and added during the course of the RI. W-C will rely on plant personnel and a utility clearance subcontractor to provide clearance for sampling locations on-site. The Connecticut central-clearinghouse ("DIGSAFE") will be contacted at least two full working days prior to the start of intrusive activities.

6.9.7 Subtask 9.7: Installation/Development of Monitoring Wells

Based on the Groundwater Sampling Plan Addendum, additional monitoring wells will be installed at shallow (i.e., water table, total depth 10 to 15 feet bgs), intermediate (i.e., total depth 50 feet bgs), and deep (i.e., screened at bedrock surface, total depth 150 feet bgs) intervals. In addition, wells will be installed in the tidal flats to characterize groundwater flow interaction with the tidal flats, and to assess the potential for groundwater contamination to impact water quality in the flats. The feasibility of using passive diffusion-type samplers ("peepers") and installing multilevel sampling ports in small diameter wells in the flats will be assessed.

In each monitoring well cluster, the deepest monitoring well boring will be logged by a qualified geologist using split-spoon samples collected at 5-foot intervals. Samples of identified soil types will be split for submittal to a geotechnical laboratory for porosity and grain size distribution and for submittal to an analytical laboratory for analysis of TOC and for cation exchange capacity (CEC).

Wells will be developed by the drilling subcontractor at the time of installation. Development water will be appropriately handled with respect to investigation-derived wastes. (IDW).

6.9.8 Subtask 9.8: Surveying

All well locations will be surveyed in Connecticut State Plane coordinates for tie-in to the existing Site survey. Horizontal locations will be surveyed to the nearest 0.01 foot. Top of inner well casings will be vertically surveyed in elevation above MSL to the nearest 0.01 foot to a consistent NGVD for comparison to previous Site surveys.

6.9.9 Subtask 9.9: Monitoring Well Sampling - Round 1

Monitoring wells will be sampled using low flow rate purging and sampling methods for collection of groundwater samples using USEPA Region I protocol. Samples will be analyzed for appropriate contaminants and design/remediation parameters as specified in the Groundwater Sampling Plan Addendum. Collection of groundwater QA/QC samples will occur for every sampling event.

6.9.10 Subtask 9.10: Analytical Laboratory Analysis - Round 1

All Round 1 groundwater monitoring well samples will be submitted for normal turnaround analytical laboratory analysis for the parameters specified in the QAPP contained in Appendix A as modified by the Groundwater Sampling Plan Addendum.

6.9.11 Subtask 9.11: Data Validation - Round 1

Round 1 data will be validated by a qualified W-C chemist in accordance with procedures specified in the QAPP contained in Appendix A.

6.9.12 Subtask 9.12: Monitoring Well Sampling - Round 2

Monitoring wells will be sampled a second confirmatory round using low flow rate purging and sampling methods for collection of groundwater samples. Samples will be analyzed for appropriate contaminants and design/remediation parameters as specified in the Groundwater Sampling Plan Addendum modified, as necessary, based on results from the Round 1 groundwater sampling.

6.9.13 Subtask 9.13: Analytical Laboratory Analysis - Round 2

All Round 2 groundwater monitoring well samples will be submitted for normal turnaround analytical laboratory analysis for the parameters specified in the QAPP contained in Appendix A as modified by the Groundwater Sampling Plan Addendum and results from Round 1.

6.9.14 Subtask 9.14: Data Validation - Round 2

All Round 2 data will be validated by a qualified W-C chemist in accordance with procedures specified in the QAPP contained in Appendix A.

6.9.15 Subtask 9.15: Aquifer Testing

To evaluate the conductive properties of the aquifer, slug testing will be performed on all new monitoring wells. Types of test and numbers of wells to be tested will be specified in the Groundwater Sampling Plan Addendum.

Because the Site groundwater is influenced by the tidal cycle, a 72-hour evaluation of groundwater levels in selected wells and river water elevations in the tidal flats will be performed using automated data loggers. A regression of the tidal flats elevation data with the well data

will be performed to obtain an understanding of title influence on groundwater fluctuation. Tidal influence as a function of distance from the tidal flats will be evaluated to obtain a measure of tidal fluctuation in groundwater as a function of distance.

6.9.16 Subtask 9.16: Update GIS/GMS

The boring log stratigraphy, soil organic carbon information, CEC data, contaminant concentration levels, design/remediation parameters, slug test results, aquifer test results, precipitation data, and tidal dependence data will be properly formatted for input to the GIS/GMS, as appropriate, and will be used to update and refine the conceptual GIS/GMS model. Any further DQOs not already satisfied will be re-evaluated on the basis of the refined model.

An evaluation will be made of the groundwater contaminant transport pathways and the human health and ecological risk associated with the pathways. The groundwater contamination pathways that have been identified as potentially complete pathways for the purposes of risk assessment may be modeled for groundwater flow and contaminant transport using the GIS/GMS conceptual model as the basis for the groundwater model. The need for modeling will be evaluated based on the updated conceptual model.

6.10 TASK 10: INTERIM DATA REPORT

Task 10 consists of the following subtasks:

Subtask 10.1 - Prepare Interim Data Report

Subtask 10.2 - Meeting/Teleconference (Interim Data Report)

6.10.1 Subtask 10.1: Prepare Interim Data Report

The purpose of the Interim Data Report is to review the status of the comprehensive conceptual model for the Site and to evaluate if enough data have been collected to address all DQOs. Text will be kept to a minimum in the Interim Data Report; emphasis will be on graphical presentation of data. Output graphics from the GIS/GMS and/or AutoCADD will submitted for review by TACOM, USACE, CDEP, and USEPA.

6.10.2 Subtask 10.2: Meeting/Teleconference (Interim Data Report)

A meeting or teleconference will be held with representatives of TACOM, USACE, CDEP, and USEPA, as required to discuss the comments and resolve any open issues regarding the Interim Data Report.

6.11 TASK 11: HUMAN HEALTH RISK ASSESSMENT

Task 11 consists of the following subtasks:

Subtask 11.1 - Human Health Risk Assessment Problem Formulation

Subtask 11.2 - Submit Human Health Risk Assessment Interim Memorandum

Subtask 11.3 - Review by Agencies/Evaluation of Comments by W-C

Subtask 11.4 - Meeting/Teleconference (Human Health Risk Assessment Interim Memorandum)

Subtask 11.5 - Additional Components of the Human Health Risk Assessment

A baseline risk assessment (BRA) will be conducted to estimate the potential risks to human health and the environment from exposures to chemicals released from the Site. Potential human health risks will be addressed in a human health risk assessment (HHRA) component of the BRA; potential ecological risks will be assessed in an ecological risk assessment (ERA). This section discusses the basic approach of the BRA and the scope of the HHRA. The approach and scope of the ERA are discussed in Section 6.12.

The BRA estimates risks under current and likely future site use conditions, assuming no remedial action will be taken at the Site. Results of the risk assessment will be used to:

- Estimate the magnitude of potential human health and ecological risk in non-industrial portions of the Site and adjacent river that have been influenced by chemical releases from the Site;
- Identify the chemicals, environmental media and exposure pathways, that contribute the majority of site-related risk;
- Help determine whether corrective action is warranted at non-industrial portions of the Site and adjacent river, if not, to support the no action alternative; and,
- If action is warranted, to provide the basis for establishing cleanup goals that are protective of human health and the environment.

6.11.1 Conceptual Site Models

An important activity of the RI planning phase is the review of existing data and the development of conceptual site models (CSMs). Information (including previous investigations) concerning waste sources, release and transport mechanisms of waste constituents, and types and locations of potentially exposed human and ecological receptors is used to develop a conceptual understanding of the Site in terms of potential human and ecological exposure pathways.

The CSM is a schematic representation of the potential contaminant source areas, chemical release mechanisms, environmental transport media, potential intake routes and pathways, and potential human or ecological receptors. The CSMs presented in this Work Plan are based on the models previously developed in the for this site (W-C, 1995). Preliminary site conceptual models have been revised as part of this investigation to reflect changes in anticipated future site use associated with closure and subsequent reuse of the facility. The CSM has three primary purposes:

- To assist in the development of the sampling plan (i.e., sampling locations, media to be sampled, and chemicals to be sampled) so that information regarding potential human health and environmental impacts from the Site can be collected efficiently;

- To create a framework for the BRA by focusing on complete and realistic exposure pathways; and,
- To use as an aid in identifying effective cleanup measures, if necessary, that are targeted at significant contaminant sources and exposure pathways.

An exposure pathway includes four necessary elements:

- A chemical source and a mechanism of chemical release;
- An environmental transport medium (air, surface water, etc.);
- A point of potential receptor contact with the contaminated medium (exposure point); and,
- An intake route (inhalation, ingestion, dermal contact).

Exposure pathways are considered to be complete if there are potential chemical release and transport mechanisms and identified receptors for that exposure pathway. An incomplete pathway means that one of these elements is missing and, hence, exposure cannot occur. Only potentially complete pathways will be addressed in the BRA.

In the CSMs, potentially complete and significant exposure pathways, based on professional judgment on the degree of exposure and toxicity of the chemicals are indicated with solid lines. Exposure scenarios are developed based on the existing environmental setting in combination with current and potential future uses of the Site. Future use of industrial portions of the SAEP is assumed to remain industrial. As such, these industrial areas will no be evaluated in the BRA. Non-industrial portions of the Site, such as the Causeway, are likely to be used in the future for recreational purposes. Residential development is considered to be unlikely for all portions of the Site for the foreseeable future. If foreseeable future use excludes a receptor type, these receptors do not appear in the conceptual site models.

6.11.2 Subtask 11.1: Human Health Risk Assessment Problem Formulation

The HHRA will estimate the level of health risks associated with potential exposures to site-related chemicals in environmental media from non-industrial portions of the Site. Existing data from the Site and additional surface water; sediment, biota, soil, and groundwater data obtained during the field investigations, as well as modeled results, will be used to evaluate potential health risks.

The objective of the HHRA is to identify health risks specific to chemicals released from the Site. Results of the risk assessment will be used to help determine whether further evaluation, interim action, or a corrective measures study would be needed. Figure 5 illustrates the approach taken for the risk assessment. This approach and the associated methodologies for the risk assessment are described in the following sections.

6.11.2.1 Approach

The HHRA will follow the guidance provided by USEPA for evaluation of public health risks for Superfund. Specific USEPA guidance to be followed for this human health risk assessment includes:

- Risk Assessment Guidance for Superfund Volume I - Human Health Evaluation Manual (USEPA, 1989b);
- Exposure Factors Handbook (USEPA, 1997a), Human Health Evaluation Manual Supplemental Guidance: "Standard Default Exposure Factors" (USEPA, 1991b);
- Superfund Exposure Assessment Manual (USEPA, 1988b);
- Risk Assessment Guidance for Superfund - Human Health Evaluation Manual (Part D, Standardized Planning, Reporting and Review of Superfund Risk Assessment) (USEPA, 1998);
- Guidance Manual for the Integrated Exposure Uptake Biokinetic Model for Lead in Children (USEPA, 1994);
- Recommendations of the Technical Review Workgroup for Lead for an Interim Approach to Assessing Risks Associated with Adult Exposure to Lead in Soil (USEPA Technical Review Workgroup for Lead, 1996); and
- Dermal Exposure Assessment: Principles and Applications (USEPA, 1992a).

The HHRA consists of eight components:

1. Site Background and Demographics (i.e., to include child demographics for the Stratford area);
2. Conceptual Site Model;
3. Identification of Chemicals of Potential Concern;
4. Exposure Assessment
5. Toxicity Assessment;
6. Human Health Risk Characterization;
7. Evaluation of Background Concentrations; and,
8. Uncertainties and Limitations.

The first three components comprise the problem formulation step which is in the following paragraphs.

6.11.2.2 Site Background and Demographics

The objective of this portion of the HHRA is to characterize the exposure setting with respect to the general physical characteristics of the Site and the populations on and near the Site. Site characteristics such as climate, vegetation, and the presence and location of surface water are identified in this step. Receptor populations are also identified and are described with respect to those characteristics that may influence exposure, such as location relative to the Site, activity patterns, and the presence of sensitive subpopulations.

6.11.2.3 Conceptual Site Model

The preliminary CSM for potential human exposure pathways is shown in Figure 6. Exposure pathways identified in the CSM define the migration pathways that chemicals might take from the chemical source area to the human receptor populations. The exposure pathway analysis will evaluate the chemical release mechanisms and transport in the environmental media and define the exposure points for human receptors.

Hazardous materials spilled or leaked to the ground from various facilities at the SAEP and outfalls are the primary potential contaminant sources. Mixing of the spilled materials with soil, and direct releases of materials through the stormwater drainage system are shown as the primary chemical release mechanisms. Other potential primary release mechanisms, such as direct contact with spills, transport by stormwater runoff, wind erosion, or volatilization to the atmosphere, are not primary release mechanisms at this site because the spilled materials have been removed, have evaporated, or have infiltrated into the soil.

Soils represent a secondary source of chemical release at the Site. Once mixed with soils, chemicals may be released to surface water by stormwater transport, to groundwater by infiltration and percolation, to the atmosphere by volatilization or wind erosion of dust, and to receptors by direct contact.

Exposures to contaminants in the industrial portions of this Site will not be evaluated in this BRA. Surface soil at the Causeway or other non-industrial portions of the Site may present a significant pathway for hypothetical future construction workers involved in excavation of soils, recreational receptors, or other occasional visitors, such as trespassers. Trespassers and other populations with minor exposures will not be evaluated separately in this HHRA, since the recreational scenario provides a conservative estimate of risks that would be protective of these populations. In the case of construction workers, exposure to subsurface soils may also represent a significant pathway. Direct contact with contaminated soils by hypothetical construction workers or recreational receptors could potentially result in complete ingestion and dermal contact pathways.

Groundwater does not currently represent a complete exposure pathway because there is no domestic or industrial use of groundwater at or downgradient of the Site. Exposure to groundwater contaminants could occur in the off-site areas as the groundwater migrates from the Site, through sediments to surface water (i.e., the tidal flats, Marine Basin), eventually discharging to the Housatonic River). If contaminants are transported to surface water, exposure to recreational receptors or commercial fishermen could occur via exposures to surface water and sediments, and ingestion of contaminated seafood. Potentially significant exposures to surface water and sediment include dermal contact and incidental ingestion of these media while fishing. In addition to recreational users and commercial fishermen, it is possible that construction workers could be exposed to sediments and surface water via direct dermal contact and incidental ingestion while working on the non-industrial portions of the Site.

In addition to the soil ingestion and dermal pathways, inhalation of chemicals volatilized from soil or groundwater represents a potentially complete air pathway for hypothetical future construction workers involved in excavation of contaminated soils. In summary, potentially complete and significant human exposure pathways are:

Hypothetical future construction workers on non-industrial portions of the Site

- incidental ingestion of soil
- dermal contact with soil
- inhalation of volatile emissions from soils
- incidental ingestion of groundwater
- dermal contact with groundwater
- inhalation of volatile emissions from groundwater
- incidental ingestion of sediment
- dermal contact with sediment
- incidental ingestion of surface water
- dermal contact with surface water

Recreational receptors (adults and children)

- incidental ingestion of soil along the Causeway and other non-industrial portions of the Site.
- dermal contact with soil along the Causeway and other non-industrial portions of the Site.
- incidental ingestion of sediments during seafood harvesting
- dermal contact with sediments during seafood harvesting
- incidental ingestion of surface water during recreational activities
- dermal contact with surface water during recreational activities
- ingestion of seafood (shellfish, possibly finfish)

Commercial fishermen

- incidental ingestion of sediments during seafood harvesting
- dermal contact with sediments during seafood harvesting
- incidental ingestion of surface water during seafood harvesting
- dermal contact with surface water during seafood harvesting
- ingestion of seafood (shellfish, possibly finfish)

6.11.2.4 Identification of Chemicals of Potential Concern

A large number of individual chemicals are associated with hazardous materials that may have been released at SAEP. Chemicals in environmental samples (e.g., soil, sediment, surface water, groundwater, biota) that are constituents of certain potentially hazardous materials that are known or suspected to have been discharged will be evaluated for the selection of chemicals of potential concern (COPCs). The selection of COPCs is important and fundamental to the risk assessment process and will be done as recommended in USEPA guidance. COPCs are all

chemicals related to SAEP activities detected in environmental media above background levels. The COPCs would not include chemicals that are identified as attributable to laboratory or field contamination in accordance with criteria from USEPA's Functional Guidelines (USEPA 1988a; 1991c) as specified in the QAPP or that do not exceed background concentrations.

6.11.2.5 Evaluation of Background Concentrations

Soils are derived from parent geologic materials as a result of physical, chemical and biological processes. The soil system is a highly heterogeneous matrix of inorganic and organic components. The relative proportions of these components are dependent upon factors influencing soil formations, such as topography, climate, depositional processes, and time. Total concentrations of metals in soils may vary depending upon location. For example, at the surface, soils are influenced by leaching, runoff, atmospheric deposition, and biotic uptake, as well as anthropogenic activity. The ranges of naturally occurring or "background" concentrations of metals in soils is greatly varied due to the composition of parent material, and therefore, care will be taken in the interpretation of metals data generated during a site investigation.

For the RI, concentrations of metals in site soils will be compared to representative background soils concentrations using a statistical approach. The maximum concentrations detected at the Site will be compared to the 95th upper tolerance limit (UTL) of the background concentrations. Using this technique, individual samples at the Site with high concentrations can be identified. For metals whose maximum detected concentration exceeds the 95 percent UTL of the background, the Site and background populations (e.g., means or medians) will be compared. Concentrations detected in soils on the Site will be compared to regional soils concentrations. Regional information to be evaluated will include data collected from neighboring sites, which will be supplied by USEPA, as well as supplemental information from the scientific literature. Site concentrations that have exceeded background levels, but are within the regional background levels, will not be included as COPCs unless it can be affirmed that the chemicals are related to past activities at the Site.

6.11.3 Subtask 11.2 - Submit Human Health Risk Assessment Interim Memorandum

An interim memorandum summarizing and describing critical data and exposure pathways and assumptions to be used in the HHRA will be submitted in order to obtain agency concurrence with the specific technical approach. The following information will be included in the memorandum:

- Results of the selection of COPCs;
- Revised CSM; and,
- Exposure parameters and assumptions which will be used to quantify exposure.

6.11.4 Subtask 11.3: Review by Agencies/ Evaluation of Comments by W-C

The interim memorandum will be submitted to TACOM, USACE, CDEP, USEPA, and the U.S. Army Center for Health Promotion and Preventive Medicine (CHPPM) for review and comment. Comments will be evaluated by W-C. Comments will be provided to W-C as one consolidated

set of comments at the mid-point of the review period. W-C will evaluate the comments during the second half of the review/evaluation period.

6.11.5 Subtask 11.4: Meeting/Teleconference (Human Health Risk Assessment Interim Memorandum)

A meeting or teleconference will be held with representatives of TACOM, USACE, CDEP , and USEPA, as required to discuss the comments and resolve any open issues regarding the interim memorandum.

6.11.6 Subtask 11.5: Additional Components of the Human Health Risk Assessment

6.11.6.1 Exposure Assessment

In addition to developing a CSM and identifying exposure scenarios and assumptions, the exposure assessment is used to develop the exposure point concentrations. The identified exposure points are those locations where humans may be exposed to COPCs. Exposure point concentrations in soils, sediments, surface water, air and biota will be estimated from the chemical analytical data. Both the average (mean) and Reasonable Maximum Exposure (RME) concentrations will be used in the exposure assessment. The RME concentration will be the lower of either the 95 percent upper confidence limit of the arithmetic mean or the maximum detected concentration, in accordance with USEPA guidance.

6.11.6.2 Toxicity Assessment

Toxicological information for hazardous chemicals most often released to the environment from hazardous waste sites is generally well documented in the scientific literature. Chemicals that have documented USEPA toxicity criteria (Reference Dose [RfD] for non-carcinogens and cancer slope factor [SF] for carcinogens) will be evaluated quantitatively in the risk assessment. Chemicals without such criteria will be evaluated qualitatively in terms of their potential contribution to risk. This risk assessment will follow the USEPA recommended hierarchy of sources for determining critical toxicity criteria (RfDs and SFs). The first source in this hierarchy is IRIS (Integrated Risk Information System) and is the primary source of toxicological information for this risk assessment. The Health Effects Assessment Summary Table (HEAST; USEPA 1997) will also be consulted for toxicity criteria where needed. For chemicals that have no published USEPA toxicity criteria, but that could be significant contributors to risk, USEPA's National Center for Environmental Assessment (NCEA) office in Cincinnati may be contacted for additional information. In addition, pertinent literature may be reviewed in order to summarize individual chemical toxicities relevant to site- and receptor-specific parameters. Toxicity information for the COPCs will be summarized briefly in toxicity profiles.

6.11.6.3 Human Health Risk Characterization

Human health risks will be evaluated for long-term (chronic) exposures, and where appropriate, short-term (subchronic) exposures, e.g., for construction workers. The potential health risks

from the various exposure routes (inhalation, ingestion, and dermal contact) to contaminated media will be included in the risk characterization.

The potential for non-carcinogenic human health effects is estimated by dividing the daily chemical intakes for each chemical by the respective RfDs. This evaluation is performed independently for each exposure pathway. The resulting ratios, termed hazard quotients, provide an estimate of the potential hazard associated with each chemical per pathway. Hazard quotients are summed for all chemicals within a pathway to provide an estimate of the pathway-specific hazard (termed the hazard index). The hazard index values for each pathway are subsequently summed to provide an estimate of the total hazard for each receptor. Where the hazard index exceeds unity (1), the hazard may be recalculated based on COPCs that affect the same organ or organ system. Carcinogenic risks are calculated by multiplying the daily average lifetime intakes by the chemical-specific cancer slope factors, which results in an estimate of the excess lifetime probability of developing cancer from the exposure. As with hazard values, cancer risks are summed to provide pathway-specific and total risks. The risk characterization of lead will be in accordance with USEPA's Integrated Exposure Uptake Biokinetic Model and Adult Lead Model.

6.11.6.4 Uncertainties and Limitations

Conservative assumptions are used in the risk assessment to avoid underestimation of potential health risks, to address potential weaknesses in the data, and to enhance confidence in the results and conclusions. Nevertheless, uncertainties are inherent in the risk assessment process. The risk estimates presented in the RI report will be accompanied by a discussion of the major sources of uncertainty in the risk assessment and identify factors that may result in either overestimation or underestimation of potential risk.

6.12 TASK 12: ECOLOGICAL RISK ASSESSMENT

Task 12 consists of the following subtasks:

- Subtask 12.1 - Problem Formulation
- Subtask 12.2 - Submit Problem Formulation Interim Deliverable
- Subtask 12.3 - Review by Agencies/Evaluation of Comments by W-C
- Subtask 12.4 - Meeting/Teleconference (Problem Formulation)
- Subtask 12.5 - Ecological Exposure, Effects and Risk Characterization

The scope of work described below for the ecological risk assessment (ERA) of the SAEP has been developed based upon the following USEPA guidance for the conduct of ecological risk assessments:

- Risk Assessment Guidance for Superfund, Volume II, Environmental Evaluation Manual (Part A)(USEPA, 1989) and EcoUpdates;
- Framework for Ecological Risk Assessment (USEPA, 1992); and,
- Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments (USEPA, 1997b).

In addition, the scope has been developed incorporating concerns and requests expressed by the USEPA and CDEP for the Site at numerous meetings and teleconferences convened between December 1996 and February 1998.

The objective of the ERA portion of the BRA for the SAEP is to use environmental and ecological data collected as part of the Phase I and Phase II investigations conducted at the Site and the current RI to assess potential aquatic and terrestrial ecological impacts attributable to the presence of site-related contaminants in environmental media. Data sets will include sediment chemistry, biological tissue chemistry, solid phase toxicity testing, benthic macroinvertebrate community analyses, qualitative fish surveys, and ground water quality/chemistry.

In the following sections, each of the major steps of the ERA will be described. These steps follow the USEPA's current approach to baseline ecological risk assessment (USEPA, 1997).

6.12.1 Subtask 12.1: Problem Formulation

The problem formulation step establishes the goals, breadth, and focus of the ERA. It includes the identification of contaminants of concern, ecosystems potentially at risk, conceptual site models, exposure characterization, hazard characterization and toxicity assessment, selection of assessment endpoints, selection of receptor species, and description of testable hypotheses.

6.12.1.1 Ecological Contaminants of Concern

The selection of ecological chemicals of concern (ECOCs) for sediments and Causeway soils will be based on a systematic evaluation to identify what site-related chemicals are the most prevalent and toxic for each environmental medium, and hence represent the greatest threat or hazard to ecological receptors. The surface water pathway has been eliminated as an important pathway based on Phase I surface water data (Appendix C).

Prevalence, concentration and toxicity information for the chemicals identified will be evaluated to ensure that the list represents chemicals posing the greatest ecological threat. The following five criteria will be used to screen sediment data to select ECOCs :

- detection in at least one matrix sample above the method or instrument detection limit (i.e., detection limits will be at or below benchmarks when possible);
- presence of chemicals in blanks or known laboratory contaminants will be considered in eliminating chemicals from inclusion on the list of ECOCs ;
- chemicals present at a frequency of detection less than 5 percent for each media will be eliminated in that media;
- Kow > 10^4 will be used to identify those chemicals with a tendency to persist in the environment or to transfer through food chains and bioaccumulate; and,
- exceedance of environmental "benchmarks" (e.g., ERL/ERMs for sediments and ORNL values for soils).

The ECOCs will include all site-related contaminants which fail the screening process. ECOCs representing the greatest ecological threat will be selected to undergo evaluation in the exposure assessment.

6.12.1.2 Ecosystems Potentially at Risk

Identification of ecosystems potentially at risk will be based upon the description of the site setting compiled during the Phase I and II investigations, and the draft ERA for the Site (W-C, 1995) which is summarized in Section 2.3 of this RIWP. These data will be supplemented with more current information as appropriate. Ecosystems being investigated include aquatic resources and, to a limited degree, terrestrial ecological resources on the Causeway. Information sources include the New York State Department of Environmental Conservation (NYSDEC), U.S. Geological Survey (USGS), U.S. Fish and Wildlife Service (USF&WS), National Oceanographic and Atmospheric Administration (NOAA), CDEP Marine Fisheries Division, CDEP Western District Wildlife, and the Connecticut Department of Agriculture - Aquaculture Division.

The purpose of this description is to characterize potentially exposed ecosystems through development of an aquatic food web, so that biological populations which represent potential receptors can be identified and incorporated into the conceptual site model for the Site. A brief description of significant natural features such as physiography, regional hydrogeology and surface water hydrology which may directly or indirectly influence site ecology will also be presented as appropriate. Information presented in previous documents will be incorporated into the ERA by reference. Any new data on the environmental setting will be included.

6.12.1.3 Conceptual Site Models

The CSMs for potential ecological exposure pathways are shown in Figures 7 and 8, respectively. For aquatic pathways, the primary source of contaminants is sediment which has come in contact with hazardous materials leaked or spilled onto site soils, or with outfall discharges. Constituents may be released to surface water by mass transfer and/or partitioning from the sediments. Constituents may also be bioaccumulated into the tissues of aquatic biota. The model will also consider the possibility that Site groundwater may have become contaminated through discharge of contaminated groundwater from an upgradient source. In this way, surface waters, biota and sediments may act as sources of exposure to other aquatic ecological receptors through the three exposure routes of direct contact, direct ingestion, and incidental ingestion.

At SAEP, any route of exposure to contaminants in the soil is considered insignificant due to the site paving and development. Given the existing site conditions, populations of terrestrial mammals and predatory birds are expected to be very small to non-existent. The only terrestrial ecological pathways for SAEP would be associated with potentially contaminated Causeway soils. Small mammals or birds, such as white-footed mice or the American robin, could be typical receptors to contaminated soil. These receptors may be exposed through direct contact, direct ingestion, and indirect ingestion of the soil.

For the various species of concern, potentially complete and significant ecological exposure pathways are summarized below. Aquatic species such as benthic macroinvertebrates, forage fish, piscivorous fish, dabbling ducks and wading birds, will also have the direct contact and ingestion or surface water as a complete but insignificant exposure pathway.

- Benthic macroinvertebrates
  - Direct contact with contaminated sediments and porewater
  - Direct and incidental ingestion of contaminated sediments
  - Direct ingestion of contaminated biota (i.e., invertebrates)
- Forage fish
  - Direct and incidental ingestion of contaminated sediments
  - Direct ingestion of contaminated biota (i.e., invertebrates)
- Piscivorous fish
  - Direct contact with surface water
  - Direct ingestion of biota (i.e., fish)
  - Incidental ingestion of sediment
- Dabbling ducks
  - Incidental ingestion of contaminated sediment
  - Direct ingestion of contaminated biota (i.e., invertebrates)
- Wading and shore birds
  - Direct contact with contaminated sediment
  - Direct ingestion of contaminated sediment
  - Direct ingestion of contaminated biota (i.e., fish, invertebrates)
- Soil invertebrates
  - Direct contact with potentially contaminated Causeway soils
  - Direct ingestion of potentially contaminated Causeway soils
- Omnivorous birds
  - No significant exposures are expected among the three potentially complete exposure pathways owing to the limited size and habitat present on the Causeway
- Small mammals
  - Direct contact with potentially contaminated Causeway soils
  - Incidental ingestion of potentially contaminated Causeway soils
  - Direct ingestion of potentially contaminated soil invertebrates

– Direct ingestion of potentially contaminated fish

Exposure characterization. The objective of the exposure characterization is to identify and examine the potential threat from ECOCs to pre-selected principle receptors of concern. The exposure characterization will rely on the CSMs to determine the media and the pathways through which receptors are exposed to site contaminants. Potential exposure pathways are dependent on the habitat and the receptor species present on the Site, the extent and magnitude of contamination, and the environmental fate and transport of ECOCs.

Hazard characterization and toxicity assessment. Toxicity profiles for each of the ECOCs will be developed using existing information relevant to the potential receptors, habitats and conditions at the SAEP. Toxicity profiles will be concise and will include published data on chemistry, environmental fate, residues in environmental media, and ecotoxicity for each of the ECOCs.

Selection of assessment endpoints. Assessment endpoints describe the attributes of the environment that are valued and to be protected. For the purposes of the risk assessment, population level attributes will be considered. Some examples of assessment endpoints for the SAEP are identified below. This list will be completed as part of the ERA:

- protection of benthic community structure;
- protection of carnivorous and piscivorous fish communities from adverse effects on growth, survival and reproductive success;
- protection of carnivorous and piscivorous wading birds from adverse effects on growth, survival and reproductive success; and,
- protection of small mammal populations from adverse effects on growth, survival and reproductive success.

Selection of receptor species. The results of the identification and characterization of ecosystems potentially at risk, and the delineation of assessment endpoints will provide input into the selection of appropriate receptor species. The selection process will be based upon, but not limited to, the following considerations:

- known occurrence in the vicinity of SAEP;
- potential or documented direct contact or exposure via bioaccumulation to site-related chemicals;
- availability of toxicological information for the species or a surrogate species;
- documented sensitivity to site-related constituents;
- listing as a threatened, endangered, or special concern species by the federal or state government when ecologically relevant to the Site;
- game species or commercially important species; and,
- key component within the site food web.

Hypothesis testing. Testable hypotheses are specific risk questions which are based upon the assessment endpoints. Based upon the mechanism of contaminant toxicity, the number of exposure pathways which may exist for an assessment endpoint, or other factors, each endpoint

can have several questions. Examples of testable hypotheses which relate to the assessment endpoints listed above are provided below. This list will be completed along with the list of assessment endpoints as part of the ERA:

- Are levels of site contaminants in sediment sufficient to cause adverse changes to the structure and/or function of benthic communities?
- Are levels of site contaminants in sediment and forage sufficient to cause adverse effects on growth, survival and reproductive success of fish communities using the Site?
- Are levels of site contaminants in sediment and forage sufficient to cause adverse effects on growth, survival and reproductive success of carnivorous and piscivorous wading birds using the Site?
- Are levels of site contaminants in soils and forage sufficient to cause adverse effects on growth, survival and reproductive success of small mammal communities using the Causeway for habitat?

6.12.2 Subtask 12.2: Submit Problem Formulation Interim Deliverable

An interim deliverable capturing the problem formulation data and assumptions, including the proposed assessment endpoints, will be submitted to USEPA and CDEP for review. This deliverable will include a schematic map of the Site showing habitats.

6.12.3 Subtask 12.3: Review by Agencies/Evaluation of Comments by W-C

The interim memorandum will be submitted to TACOM, USACE, CDEP, USEPA, CHPPM for review and comment. Comments will be evaluated by W-C. Comments will be provided to W-C as one consolidated set of comments at the mid-point of the review period. W-C will evaluate the comments during the second half of the review/evaluation period.

6.12.4 Subtask 12.4: Meeting/Teleconference (Problem Formulation)

A meeting or teleconference will be held with representatives of TACOM, USACE, CDEP, and USEPA, as required to discuss the comments and resolve any open issues regarding the interim memorandum.

6.12.5 Subtask 12.5: Ecological Exposure and Effects and Risk Characterization

Analysis of Ecological Exposure and Effects. Existing data, and data collected as part of the RI will be evaluated and interpreted in the context of the CSMs. Site-specific data will be used to replace many of the assumptions and data gaps which existed for the Site. The lower of the 95% UCL or maximum concentration will be used as the exposure point concentration in the ecological risk assessment. Uncertainties associated with field data collection and assumptions, where site-specific data were not collected, will be documented.

To characterize ecological effects, literature-based information collected and summarized in the toxicity profiles will be integrated with evidence of existing impacts identified from site-specific data sets.

Risk Characterization. As part of the risk characterization, data collected will be used to identify what general areas of the Site, if any, pose a threat to ecological receptors using the Site. Risk characterization includes both risk estimation and risk description.

Several tools will be used to develop an estimate of risk. For the aquatic pathways, the "weight-of-evidence" approach using existing ecological benchmarks, biological tissue analyses, comparison to literature toxicity values, evaluation of site-specific solid phase toxicity testing data, and assessment of indigenous benthic and fish communities will be used to assess whether or not the aquatic habitat, or portions of the habitat, have been impacted or pose a risk to aquatic biota which use the habitat.

A semi-quantitative approach will be used to evaluate the exposure of potential aquatic and terrestrial receptors to bioaccumulative chemicals in sediment and food. Concentrations in food items will be based upon site-specific biological tissue data. Food chain modeling will be performed to assess whether levels of Site contaminants in sediment, forage or soils are sufficient to cause adverse effects on growth, survival and reproductive success of receptors using these habitats.

In the event that birds and semiaquatic mammals or terrestrial receptors are potentially exposed to nonbioaccumulative site-related chemicals, an "Ecotoxicological Quotient" Method similar to the Hazard Index for human health assessments, will be used to evaluate exposure from direct ingestion of sediment and food items derived from the exposed aquatic habitat. For calculation of the EQ, the lower of either the maximum or 95% UCL will be taken to be the exposure concentration.

Uncertainty Analysis. Even when USEPA guidance is followed in performing the ERA, the assessment cannot provide a systematic, reproducible approach to evaluating ecological risks and impacts to all receptors, at all sites, for all chemicals. Owing to the multitude of variables and impacts to ecological populations rather than individuals, and to the level of professional judgment which must be exercised in ecological risk assessment, numerous uncertainties and limitations are inherent in the process and can effect the final outcome of the evaluation. The following sources of uncertainty and data gaps will be addressed in the report as appropriate: data quality; data availability; exposure assessment assumptions; toxicity assessment; and risk characterization. Literature-based toxicity data can also be a limitation with respect to assessment of otherwise complete exposure pathways.

6.13 TASK 13: RI REPORT

Task 13 consists of the following subtasks:

Subtask 13.1 - RI Report

Subtask 13.2 - Submit First Draft Report to USACE/CDEP/USEPA/TACOM

Subtask 13.3 - USACE/CDEP/USEPA/TACOM Review

Subtask 13.4 - Meeting/Teleconference (Agencies Comments on First Draft Report)

Subtask 13.5 - Address Comments

Subtask 13.6 - Revise Draft Report

Subtask 13.7 - Submit Final Report

Copies of all electronic files of the RIWP will be available to the USACE.

6.14 TASK 14: MONTHLY PROGRESS REPORTS

Project progress reports will be submitted each month. The reports, prepared in a letter-type format, will contain information that enables USACE to track the progress of the project with respect to task completion, schedule, and budget.

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TABLE 1
DATA REQUIREMENTS
REMEDIAL INVESTIGATION
STRATFORD ARMY ENGINE PLANT
STRATFORD, CONNECTICUT

ENVIRONMENTAL MEDIUM	AREA TO BE INVESTIGATED				
				Off-Site	
	Facility [1]	Intertidal Flats	Infra-structure [2]	Marine Basin	Areas West of Site [3]
Surface Water				N/E HHRA ERA REG	
Sediment (river)/ Residue (infrastructure)		N/E HHRA ERA FS REG	N/E	N/E HHRA ERA FS REG	
Fish/Shellfish		HHRA ERA		HHRA ERA	
Soil [4]	N/E HHRA ERA FS REG		N/E REG		
Soil Gas	REG				
Groundwater [4]	N/E HHRA ERA FS REG	ERA [5]	N/E	ERA [5]	N/E REG ERA [5]

N/E = Data needed to determine nature and extent of contamination
HHRA = Data needed to perform human health risk assessment
ERA = Data needed to perform ecological risk assessment
FS = Data needed to perform feasibility study
REG = Data needed to fulfill regulatory requirements

Notes:

[1] Defined as the main facility including paved areas and buildings.

[2] Investigation to be coordinated with plant close-out of process and drainage systems

[3] Includes Frash Pond and Airport

[4] Includes free product for N/E, FS, and REG data needs

[5] Will consider ecological exposure to groundwater discharging to Frash Pond, Marine Basin, and intertidal mudflats and effects of groundwater contamination attributable to Site operations on sediment, after review of groundwater flow and chemistry data obtained during the RI

TABLE 2
DATA QUALITY OBJECTIVES
REMEDIAL INVESTIGATION
STRATFORD ARMY ENGINE PLANT
STRATFORD, CONNECTICUT

MEDIUM	DATA NEED/No.	QUESTION TO BE ANSWERED/DQO
Surface Water	**N/E 1.1**	Do concentrations of site-related constituents exceed background concentrations in the Marine Basin?
	HHRA 1.2	Does surface water in Marine Basin pose a threat to human health in excess of the threat posed by regional surface water?
	ERA 1.3	Does surface water in Marine Basin pose a threat to biota in excess of the threat posed by regional surface water ?
	REG 1.4	Do site-related constituents detected in Marine Basin surface water exceed ARARs?
Sediment (river)/ Residue (infrastructure)	**N/E 2.1**	What is the nature and extent of sediment contamination in the intertidal mudflats and Marine Basin?
	N/E 2.2	What is the nature and extent of contaminated materials in the plant infrastructure? Is the infrastructure a continuing source or conduit of contamination to the environment?[2]
	HHRA 2.3	Does sediment in the intertidal mudflats and Marine Basin pose a threat to human health in excess of the threat posed by regional sediment?
	ERA 2.4	Does sediment in the intertidal mudflats and Marine Basin pose a threat to ecological receptors in excess of the threat posed by regional sediment?
	FS 2.5	Data to help evaluate the feasibility of options for remediation of sediment during the Feasibility Study
	REG 2.6	Do site-related constituents detected in the intertidal mudflats and Marine Basin exceed ARARs?
Fish/Shellfish	**HHRA 3.1**	Do fish or shellfish that inhabit the intertidal mudflats or Marine Basin area pose a threat to human health?
	ERA 3.2	Do biota which inhabit the intertidal mudflats or Marine Basin pose a threat to higher trophic level biota?

TABLE 2
DATA QUALITY OBJECTIVES
REMEDIAL INVESTIGATION
STRATFORD ARMY ENGINE PLANT
STRATFORD, CONNECTICUT

MEDIUM	DATA NEED/No.	QUESTION TO BE ANSWERED/DQO
Soil	**N/E 4.1**	What is the nature and extent of contaminated soils, free product, potential source material to groundwater contamination on-site, including environmentally isolated and inaccessible soils that may become accessible as part of future re-use of the plant area?
	N/E 4.2	What is the nature and extent of contamination attributable to infrastructure? [1]
	N/E 4.3	Data to guide selection of additional groundwater, soil gas, and infrastructure investigation locations.
	HHRA 4.4	Do contaminated surface or subsurface soils in areas to be potentially re-used for recreational purposes pose a threat to human health? [2]
	ERA 4.5	Do potentially contaminated Causeway soils pose a threat to ecological receptors?[3]
	FS 4.6	Data to help evaluate the feasibility of options for remediation of soil (including source removal, natural degradation, and ELURs) during the Feasibility Study.
	REG 4.7	Do concentrations of site-related constituents in soil exceed CDEP RSRs (industrial direct exposure, pollutant mobility, and free product)?
Soil Gas	**REG 5.1**	Do concentrations of site-related constituents in indoor air exceed CDEP RSRs for volatilization in industrial settings?
Groundwater	**N/E 6.1**	What is the nature and extent of groundwater contamination (including free product) beneath the Site? What is the relationship between flow and residual contamination in plant infrastructure and flow and contamination in the groundwater?
	N/E 6.2	Does potentially contaminated groundwater from sources attributable to the Site affect Frash Pond and areas west of the site? Are there off-site sources contributing to on-site groundwater contamination?

TABLE 2
DATA QUALITY OBJECTIVES
REMEDIAL INVESTIGATION
STRATFORD ARMY ENGINE PLANT
STRATFORD, CONNECTICUT

Groundwater ***(continued)***	**HHRA 6.3**	Does potentially contaminated groundwater pose a threat to human health?
	ERA 6.4	Does potentially contaminated groundwater pose a threat to ecological receptors that utilize the intertidal mudflats, Marine Basin, and Frash Pond?
	FS 6.5	Data to help evaluate the feasibility of options for remediation for groundwater (including limited pumping of source areas and natural attenuation) during the Feasibility Study.
	REG 6.6	Do constituents in groundwater exceed CDEP RSRs(surface water aquatic life, industrial volatilization)?

NOTES:

ARAR = Applicable or Relevant and Appropriate Requirements
CDEP = Connecticut Department of Environmental Protection
ELUR = Environmental Land Use Restriction
RSRs = Remediation Standard Regulations

ERA = Data needed to perform ecological risk assessment
FS = Data needed to perform feasibility study
HHRA = Data needed to perform human health risk assessment
N/E = Data needed to determine nature and extent of contamination RSR = Remediation Standard Regulations
REG = Data needed to fulfill regulatory requirements

- The data quality objectives address only contamination attributable to past or current plant-scale activities.

1. To be evaluated in conjunction with plant closing activities
2. Data also to be collected in other areas not proposed for recreational re-use. This data may be used for evaluating alternative risk scenarios (not in present scope of RI).
3. Sampling of causeway soils not within the present scope of the RI.

TABLE 3
SUMMARY OF REMEDIAL INVESTIGATION SCOPE OF WORK
STRATFORD ARMY ENGINE PLANT
STRATFORD, CONNECTICUT

MEDIA	AREA	TASK	OBJECTIVE	SCOPE	RATIONALE[1]
1. *Surface Water*	Marine Basin	Surface Water Chemistry	Characterize surface water quality relative to regional surface water and ecological benchmarks	Sample 7 stations and 3 reference stations[4] one time each during high tide and low tide; analyze for VOCs, PAHs, PCBs, metals, and cyanide.	N/E, 1.1; HHRA, 1.2; ERA, 1.3; REG, 1.4
2. *Sediment (river) / Residue (infrastructure)*	Mudflats	Lithology/Bathymetry	Develop a general characterization of physical parameters in the mudflat area	Visual characterization, sediment grainsize, surface water depth at high tide on 3 stations[4] each on Transect A, D, E.	FS, 2.5
		Sediment Chemistry	Characterize sediment quality relative to regional sediment and ecological benchmarks; provide input to evaluation of other data sets	Sample 8 stations and 3 reference stations[4], 0-6" and 6-24" adjacent to outfalls; 6 surface stations (0-6") around Causeway; analyze for VOCs, PAHs, PCBs, metals, AVS/SEM, CN and physicochemical parameters.	N/E, 2.1; HHRA, 2.3; ERA, 2.4; FS, 2.5; REG, 2.6
		Toxicity Testing	Determine whether sediments in these areas pose a threat to biota which use these areas; evaluate threat relative to reference areas	Sediment toxicity testing using *Neanthes arenaceodentata* and *Leptocheirus plumulosus* on samples collected from 10 stations around Causeway and outfalls and 3 reference stations[4].	ERA, 2.4
		Bioaccumulation Testing	Determine whether constituents in sediments in these areas pose a bioaccumulative threat to biota; provide input into exposure assessment	Testing using *Nereis virens* on samples collected from 10 stations around Causeway and outfalls and 3 reference stations[4].	ERA, 2.4
		Benthos	Characterize infaunal benthic communities as an indicator of habitat health	Benthic community analyses performed at 2 stations around Causeway and 3 reference locations[4].	ERA, 2.4
	Marine Basin	Lithology/Bathymetry	Develop a general characterization of physical parameters in the Marine Basin area	Visual characterization, sediment grainsize, surface water depth at high tide on 3 stations in Marine Basin.	FS, 2.5
		Sediment Chemistry	Characterize sediment quality relative to regional sediment and ecological benchmarks; provide input to evaluation of other data sets	Sample 7 stations and 3 reference stations[4], 0-6" depth from outfall 008 to the mouth of Marine Basin; analyze for VOCs, PAHs, PCBs, metals, AVS/SEM, CN physicochemical parameters.	N/E, 2.1; HHRA, 2.3; ERA, 2.4; FS, 2.5; REG, 2.6
		Toxicity Testing	Determine whether Marine Basin sediments pose a threat to biota which use these areas; evaluate threat relative to reference areas	Sediment toxicity testing using *Neanthes arenaceodentata* and *Leptocheirus plumulosus* on samples collected from 7 stations from outfall 008 to the mouth of Marine Basin and 3 reference stations[4].	ERA, 2.4
		Bioaccumulation Testing	Determine whether constituents in Marine Basin sediments pose a bioaccumulative threat to biota; input into exposure assessment	Testing using *Nereis virens* on samples collected from 10 stations around Causeway and outfalls and 3 reference stations[4].	ERA, 2.4

TABLE 3
(continued)

MEDIA	AREA	TASK	OBJECTIVE	SCOPE	RATIONALE [1]
		Benthos	Characterize infaunal benthic communities as an indicator of habitat health	Benthic community analyses performed at 7 stations from outfall 008 to the mouth of Marine Basin and 3 reference stations[4].	ERA, 2.4
	Infrastructure	Residue Chemistry	Define presence/extent of contamination	Sample sediment residue in estimated 20 structures. Samples analyzed for VOCs, SVOCs, PCBs, Metals, and CN. Scope to be re-evaluated after evaluation of plant infrastructure information and results of initial soil investigation.	N/E, 2.2
3. ***Fish/Shellfish***	Mudflats	Community Survey	Characterize fish communities as an indicator of habitat value	Qualitative survey of fish community using seining, trap nets and other devices as appropriate.	HHRA, 3.1; ERA, 3.2
		Whole Body Fish Tissues	Determine whether sediment constituents pose a bioaccumulative threat to higher trophic level ecological receptors	Analyze 6 samples of forage fish from mudflat, and 3 samples from reference location[4] for PCBs and metals.	ERA, 3.2
		Fillet Fish Tissues	Determine whether sediment constituents pose a bioaccumulative threat to humans	Analyze 6 samples of edible species fillets from mudflat, and 3 samples from reference location[4] for PCBs and metals.	HHRA, 3.1
	Marine Basin	Community Survey	Characterize fish communities as an indicator of habitat value	Qualitative survey of fish community using seining, trap nets and other devices as appropriate.	HHRA, 3.1; ERA, 3.2
		Whole Body Fish Tissues	Determine whether sediment constituents pose a bioaccumulative threat to higher trophic level ecological receptors	Analyze 6 samples of edible species fillets from Marine Basin, and 3 samples from reference location[4] for PCBs and metals.	ERA, 3.2
		Fillet Fish Tissues	Determine whether sediment constituents pose a bioaccumulative threat to humans	Analyze 6 samples of edible species fillets from Marine Basin, and 3 samples from reference location[4] for PCBs and metals.	HHRA, 3.1

TABLE 3
(continued)

		Shellfish Tissues	Determine whether sediment constituents pose a bioaccumulative threat to humans	Analyze 3 replicate samples of shellfish tissues from 3 stations in the Marine Basin, and 3 replicate samples from reference location[4] for PCBs and metals.	HHRA, 3.1
4. ***Soil***					
SURFACE	Plant Area (buildings and pavement), shoreline fill, and potential recreational re-use areas	Soil Chemistry	Characterize surface soil quality for use in risk assessment in potential recreation re-use areas. Characterize surface soil quality in plant areas for use in a human health risk assessment for entire site (not in present scope of RIWP); evaluate potential source areas of groundwater contamination, volatilization into buildings, and relation of soil contamination to plant infrastructure.	Advance 192 borings using hollow stem auger and split spoon sampling methods, obtain surface soil samples, and analyze for VOCs, SVOCs, PCBs, Metals, CN, and Remediation Parameters (selected samples).Samples for which mass concentrations exceed 20x the appropriate RSR SPLP criteria will be analyzed for by SPLP for exceeding parameters (except VOs and TPH)	N/E, 4.1 [2], 4.2, 4.3; HHRA, 4.4; ERA, 4.5; FS, 4.6; REG, 4.7
	Causeway	Soil Chemistry	Characterize surface soil quality for use in human health risk assessment. Characterize the nature of fill as a potential source of sediment contamination	Advance 8 borings using hollow stem auger/split-spoon sampling methods, obtain surface soil samples, and analyze for VOCs, SVOCs, PCBs, Metals, CN, and Remediation Parameters (selected samples). Not within present scope of this RIWP.	N/E, 4.1[2]; HHRA, 4.4; ERA, 4.5; FS, 4.6; REG, 4.7
SUB -SURFACE	Plant Area(buildings and pavement), shoreline fill, and potential recreational re-use areas	Soil Chemistry	Characterize sub-surface soil quality for use in risk assessment in potential recreation re-use areas. Characterize sub-surface soil quality in plant areas for use in a human health risk assessment for entire site (not in present scope of RIWP); evaluate potential source areas of groundwater contamination, volatilization into buildings, and relation of soil contamination to plant infrastructure.	Advance 192 borings using direct-push sampling methods, obtain subsurface soil samples, and analyze forVOCs, SVOCs, Metals, CN, and Remediation Parameters (selected samples). Samples for which mass concentrations exceed 20x the appropriate RSR SPLP criteria will be analyzed for by SPLP for exceeding parameters (except VOs and TPH).	N/E, 4.1[2], 4.2, 4.3; HHRA, 4.4; ERA, 4.5; FS, 4.6; REG, 4.7
	Causeway	Soil Chemistry	Characterize subsurface soil quality and stratigraphy. Characterize the nature of fill as a potential source of groundwater contamination.	Advance 8 borings using hollow stem auger/split-spoon sampling methods, obtain subsurface soil samples, and analyze for VOCs, SVOCs, Metals, CN, and Remediation Parameters (selected samples). Not within present scope of this RIWP.	N/E, 4.1[2]; HHRA, 4.4; ERA, 4.5; FS, 4.6; REG, 4.7
5. ***Soil Gas***	Below buildings	Soil Gas Chemistry (VOCs)	Characterize soil gas for comparison to RSRs.	Sample 40 locations; Estimated 10 beneath Building B-2, 5 locations beneath Building B-16, 5 locations beneath B-3, 5 locations beneath B-6; 15 locations distributed among remaining buildings; samples analyzed forVOCs; Scope to be re-evaluated based on field screening of buildings andVOC results of initial soil investigation.	REG 5.1

TABLE 3
(continued)

6. ***Groundwater*** PLANT AREA			Overall Objective: Characterize groundwater quality and assess flow	All areas: Scope to be re-evaluated based on surface water/sediment/soil investigations after data entry into GIS/GMS. Analysis for TCL VOCs, SVOCs, PCBs, TAL Metals, and cyanide (2 rounds) selected design/remediation parameters; slug tests; tidal study.	
	Area 1 (see Figure 4)	Groundwater Chemistry and Flow	Critical Issue: Relationship of intertidal flats to Frash Pond	1 location - 1 shallow(water table)	N/E, 6.1 [2]; N/E, 6.2; FS, 6.5; REG, 6.6
	Area 2 - plant portion (see Figure 4)	Groundwater Chemistry and Flow	Critical Issue: Relationship of on-site groundwater to the intertidal flats	5 locations – 5 shallow(water table); 3 intermediate (mid-depth); 1 deep (bedrock surface)	N/E, 6.1 [2]; HHRA, 6.3; ERA, 6.4[3]; FS, 6.5; REG, 6.6
	Area 5 (see Figure 4)	Groundwater Chemistry and Flow	Critical Issue: Groundwater flow on-site in areas where no current wells exist	4 locations – 4 shallow (water table); 2 intermediate (mid-depth); 1 deep (bedrock surface)	N/E, 6.1 [2]; HHRA, 6.3; FS, 6.5; REG, 6.6
	Area 6 (see Figure 4)	Groundwater Chemistry and Flow	Critical Issue: Relationship of on-site groundwater to the drainage ditch	1 location– 1 intermediate (mid-depth); 1 deep (bedrock surface)	N/E, 6.1 [2]; HHRA, 6.3; ERA, 6.4[3]; FS, 6.5; REG, 6.6
MUDFLATS			Overall objective: Characterize groundwater quality and assess flow	All areas: Scope to be re-evaluated based on surface water/sediment/soil investigations after data entry into GMS. Analysis for TCL VOCs, SVOCs, PCBs, TAL Metals, and cyanide (2 rounds), selected design/remediation parameters; slug tests; tidal study.	
	Area 2 – mudflat portion (see Figure 4)	Groundwater Chemistry and Flow	Critical Issue: Relationship of on-site groundwater to the intertidal flats	4 locations – 4 shallow (less than 5 ft); 4 intermediate (15-25 ft)	N/E, 6.1 [2]; HHRA, 6.3; ERA, 6.4[3]; FS, 6.5; REG, 6.6
OFF-SITE			Overall Objective: Assess off-site impacts and/or potential off-site sources	All areas: Scope to be re-evaluated based on surface water/sediment/soil investigations after data entry into GMS. Analysis for TCL VOCs, SVOCs, PCBs, TAL Metals, and cyanide (2 rounds), selected design/remediation parameters; slug tests; tidal study.	
	Area 3 (see Figure 4)	Groundwater Chemistry and Flow	Critical Issue: Relationship of on-site groundwater to off-site groundwater at the airport	1 location – 1 shallow (water table); 1 intermediate (mid-depth)	N/E, 6.2; REG, 6.6
	Area 4 (see Figure 4)	Groundwater Chemistry and Flow	Critical Issue: Relationship of off-site groundwater at the airport to Frash Pond	1 location – 1 shallow (water table); 1 intermediate (mid-depth)	N/E, 6.2; ERA,6.4[3]; REG, 6.6
	Area 7 (see Figure 4)	Groundwater Chemistry and Flow	Critical Issue: Groundwater flow south of the Site	1 location – 1 shallow (water table); 1 intermediate (mid-depth)	N/E, 6.2; ERA, 6.4[3]; REG, 6.6

NOTES:
AVS/SEM = Acid Volatile Sulfides/Simultaneously Extracted Metals
CN = Total Cyanides
design parameters = pH, conductivity, salinity, manganese, iron, chemical oxygen demand; dissolved oxygen, nitrogen, chlorides, phosphates
GMS = Groundwater Modeling System
PAHs = Polynuclear Aromatic Hydrocarbons
PCBs = Polychlorinated Biphenyls
physicochemical parameters = Total organic carbon, grain size, percent moisture, pH
remediation parameters = Total organic carbon, grain size, total petroleum hydrocarbons, cation exchange capacity
SVOCs = Semi-Volatile Organic Compounds
VOCs = Volatile Organic Compounds

(1) Includes data needed and the corresponding DQO from Table 2:

N/E	=	Data needed to determine nature and extent of contamination
HHRA	=	Data needed to perform human health risk assessment
ERA	=	Data needed to perform ecological risk assessment
FS	=	Data needed to perform feasibility study
REG	=	Data needed to fulfill regulatory requirements

(2) Includes free product as part of the N/E data need.

(3) Will consider ecological exposure to groundwater discharging to Frash Pond, Marine Basin, and intertidal mudflats and effects of groundwater contamination attributable to Site operations on sediment, after review of groundwater flow and chemistry data obtained during the RI.

(4) Station locations are shown on Figures 2 & 2a and listed on Table 1; the same reference stations will be used for mudflat and Marine Basin locations.