USACE CONTRACT NO. DACW33-94-D-0002
TASK ORDER NO. 020
TOTAL ENVIRONMENTAL RESTORATION CONTRACT

FINAL
ENGINEERING EVALUATION/COST ANALYSIS
FOR THE CAUSEWAY AND DIKE
STRATFORD ARMY ENGINE PLANT
Stratford, Connecticut

September 22, 2000

Prepared for

U.S. Army Corps of Engineers
New England District
Concord, Massachusetts

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Concord, Massachusetts

Prepared by:

Foster Wheeler Environmental Corporation
Boston, Massachusetts

and

Harding Lawson Associates
Portland, Maine

September 2000

Revision	Date	Prepared By	Approved By	Pages Affected
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J. Borkland				
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TABLE OF CONTENTS

TABLE OF CONTENTS
(continued)

TABLE OF CONTENTS
(continued)

LIST OF FIGURES

LIST OF TABLES

This Engineering Evaluation/Cost Analysis (EE/CA) was prepared by Foster Wheeler Environmental Corporation and Harding Lawson Associates under contract to the United States Army Corps of Engineers – New England District for the U.S. Army Tanks-Automotive and Armament Command for a Non-time-Critical Removal Action (NCRA) for the Causeway and Dike area at the Stratford Army Engine Plant (SAEP), located in Stratford, Connecticut. This EE/CA has been prepared for surface and subsurface soil. Groundwater associated with the Causeway and Dike area will be addressed in the Remedial Investigation (RI) Report and Feasibility Study for the SAEP facility. The Draft RI Report is scheduled to be submitted in the summer of 2000.

The purpose of the EE/CA is to identify removal action objectives, evaluate removal action alternatives that will achieve those objectives, and to recommend, based on the evaluation, the alternative that best meets the evaluation criteria. This document was prepared in accordance with the United States Environmental Protection Agency (USEPA) guidance for preparing EE/CAs (USEPA, 1993b) and is intended to comply with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (USEPA, 1990).

The SAEP property is zoned as light commercial, and the site has been used for development, manufacture, and assembly of aircraft or engines since 1929. In October 1995, SAEP was placed on the Base Closure and Realignment (BRAC) list, known as BRAC 95. Pursuant to the Defense Base Closure and Realignment Act of 1990, the BRAC Environmental Restoration Program mandates that environmental contamination on BRAC properties be investigated and remediated, as necessary, prior to disposal and reuse. In August 1998, SAEP was transitioned from an active production facility to caretaker status.

SAEP consists of approximately 124 acres, of which approximately 76 acres are improved land that land consist of 49 buildings, paved roadway and grounds, and five paved parking lots. Included in the improved land are an estimated 10 acres along the Housatonic River where fill was placed over tidal flats during the development of SAEP. Riparian rights are associated with the remainder of the SAEP property. The riparian rights property consist of intertidal flats of the Housatonic River. An estimated two acres of property comprise a causeway constructed in the 1930s to provide access to the river channel.

The Causeway was initially constructed and used as a means of launching seaplanes in the 1930s. Additional materials, of unknown origin, were deposited along the northern edge of the Causeway during the 1950s and 1960s. The Causeway consists of fill material that was originally deposited on the tidal flats of the Housatonic River. The fill material consists of soil (i.e., coarse to fine sand), cobbles, and construction debris (e.g., concrete, brick, and asphalt). Smaller amounts of other material (e.g., wood and rebar) were also observed during field investigation activities.

A severe flood of the Housatonic River occurred in 1948, rendering the Stratford plant's manufacturing space unusable. The Dike was constructed in 1951 to provide flood protection for the SAEP facility. Generally, the Dike fill material consists of sand and gravel with varying amounts of cobbles. Crushed stone and riprap cover the side slopes of the Dike, and an asphalt-paved road traverses a portion of the top of the Dike.

Soil analytical data collected during the 1999 pre-design investigation activities for the Causeway and Dike were compared to the Connecticut Department of Environmental Protection (CTDEP) Remediation Standard Regulation (RSR) Direct Exposure Criteria (DEC) and Pollutant Mobility Criteria (PMC). The Causeway and Dike area is proposed for future use as a recreational area, and the groundwater associated with the SAEP is classified as a GB area. Therefore, the CTDEP RSR DEC for residential exposure and the GB PMC were used in the data evaluation. Soil analytical data for asbestos were compared to the residential standard established for another project (i.e., Raymark in Stratford, CT) of 1 percent total asbestos by the polarizing light microscope (PLM) method.

At the suggestion of the CTDEP, additional soil sampling and analysis was conducted in areas of the Causeway where the initial soil data indicated that there were exceedances of the CTDEP RSR GB PMC. Soil samples were collected in May 2000 and analyzed by the Synthetic Precipitate Leaching Procedure.

Preliminary results of groundwater data collected in November 1999 from the four monitoring wells installed in the Causeway indicate the presence of low concentrations of chlorinated volatile organic compounds (VOCs) and inorganic analytes. However, the concentrations of contaminants in groundwater are below the CTDEP RSR Surface Water Protection Criteria and Volatilization Criteria. Groundwater associated with the Causeway and Dike will be addressed in the RI Report and Feasibility Study for the SAEP facility. The Draft RI Report is scheduled to be submitted in the summer of 2000.

Causeway. The contaminants in soil detected that exceed the CTDEP RSR DEC and PMC include chlorinated and fuel-related volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), polychlorinated biphenyls (PCBs), and inorganics. Asbestos was not detected in 23 of 27 samples analyzed. Four samples had a trace (less than 1 percent) visual (by PLM) estimate of asbestos content, which is less than the residential standard of 1 percent total asbestos.

Low-level radiological contaminated material has been identified at three isolated locations in the Causeway fill material. This low-level radiological contaminated material was excavated on March 15 and 16, 2000. The excavated material was containerized in thirty 55-gallon drums and transported to an appropriate off-site licensed treatment/disposal facility. Therefore, this low-level radiological material is not included in the scope of the removal action alternatives evaluated in this EE/CA.

Dike. The contaminants detected in soil that exceed the CTDEP RSR DEC and PMC include chlorinated and fuel-related VOCs, SVOCs, PCBs, and inorganics. These exceedances were detected in three isolated hand auger explorations located on the south face and edge of the Dike. Exceedances were not detected from samples collected over the remainder of the Dike. Because theses locations are not within the Dike, and the horizontal and vertical extent of contamination at these locations has not been fully defined, these areas will be addressed in the Feasibility Study for the remainder of the SAEP facility. Asbestos was not detected in 21 of the 24 samples analyzed. Three samples had a trace (less than 1 percent) visual (by PLM) estimate of asbestos content, which is less than the residential standard of 1 percent total asbestos. Therefore, the scope of the Causeway and Dike NCRA includes only the Causeway, where surface and subsurface soils exceed the CTDEP RSRs.

The objective of the Causeway and Dike NCRA is to prevent exposure to contaminated soils, and prevent leaching of contaminants in soils, in accordance with the CTDEP RSR DEC (residential exposure scenario) and PMC (GB area). Because of the exceedances of the CTDEP RSR, a removal action is appropriate to address the contaminated soil present in the Causeway. Therefore, a No Action Alternative is not being evaluated in the EE/CA. Due to the heterogeneous nature of the Causeway fill material and the large percentage of construction debris, treatment technologies, either in-situ or ex-situ, are not feasible for addressing the subsurface contamination present in the Causeway. Therefore, the general response actions considered for this NCRA are containment and removal/disposal. The following removal action alternatives are evaluated in the EE/CA:

Alternative 1	Capping with Synthetic Geomembrane
Alternative 2	Capping with Composite Cover System and Vertical Barrier
Alternative 3	Excavation and Off-site Disposal
Alternative 4	Capping with Erosion Control Cover System

The evaluation of alternatives was conducted using the effectiveness, implementability, and cost criteria set forth in the NCP and USEPA guidance (USEPA, 1993b). Based on this evaluation, Alternative 4 is the proposed removal action alternative.

Alternative 4 includes the following components:

- Demolition of Building 59 and other structures (concrete ramp and pad);
- Removal of contaminated soil hot spot areas;
- Capping the Causeway with an erosion control cover system;
- Establishing environmental land use restrictions; and
- Conducting operation and maintenance activities.

Based on the comparative analysis of the removal action alternatives evaluated in the EE/CA, Alternative 4 has been identified as the recommended removal action alternative. Alternative 4 is protective of human health and the environment, complies with federal and state applicable or relevant and appropriate requirements (ARARs), and is cost-effective. Alternative 4 does not satisfy the statutory preference for remedies that involve treatment that reduces toxicity, mobility, or volume as a principal element. Although Alternative 4 does not include active treatment technologies as a principal element, the removal of contaminated soil hot spot areas provides a reduction in the mobility of contaminants.

Alternative 4 provides both short- and long-term effectiveness, and is technically and administratively feasible. Additionally, the alternative can be implemented using standard or commonly available construction methods, services, and materials. Alternative 4 is also expected to be consistent with the RI and Feasibility Study, currently being conducted for the overall SAEP facility. Therefore, Alternative 4 is believed to provide the optimum combination of overall protection of human health and the environment and compliance with ARARs, at a reasonable cost.

1.0 INTRODUCTION

Foster Wheeler Environmental Corporation (Foster Wheeler) and Harding Lawson Associates (HLA) have been contracted through the United States Army Corps of Engineers – New England District (USACE) to complete a Non-time-Critical Removal Action (NCRA) for Operable Unit 1, the Causeway and Dike Area, at the Stratford Army Engine Plant (SAEP) under Task Order No. 020 of The New England Total Environmental Restoration Contract (TERC) (Contract No. DACW33-94-D-0002). The objectives of this Task Order are to: (1) complete additional field activities necessary to characterize physical and chemical subsurface conditions on the Causeway and Dike, (2) summarize the results of field activities in a Pre-Design Investigation Report (Foster Wheeler/HLA, 2000), and (3) document the decision process for selection of a removal action for the Causeway and Dike area in an Engineering Evaluation/Cost Analysis (EE/CA) and a Removal Action Memorandum (RAM).

1.1 PURPOSE AND SCOPE OF THE ENGINEERING EVALUATION/COST ANALYSIS

The purpose of the EE/CA is to identify removal action objectives and evaluate removal action alternatives that will achieve these objectives. The evaluation process for removal action alternatives presented in this EE/CA consists of four steps: (1) identification of removal action objectives; (2) identification of removal action alternatives; (3) evaluation of removal action alternatives; and (4) selection of the proposed remedy. The EE/CA serves as the basis for the RAM, the primary decision document substantiating the need for a removal response, and for design and implementation of the removal action.

This EE/CA has been prepared for surface and subsurface soil for the Causeway and Dike area at the SAEP. Groundwater associated with the Causeway and Dike Area is being addressed in the Remedial Investigation (RI) Report and Feasibility Study for the SAEP facility. This EE/CA was developed primarily from the information presented in the Pre-Design Investigation Report for the Causeway and Dike (Foster Wheeler/HLA, 2000).

This removal action is being conducted in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (United States Environmental Protection Agency [USEPA], 1990), and the USEPA "Guidance on Conducting Non-Time-Critical Removal Actions Under CERCLA" (USEPA, 1993b). This removal action is also being conducted in accordance with the Base Realignment and Closure (BRAC) Cleanup Plan Guidebook (Department of Defense, 1993), which was prepared for implementing President Clinton's decision to promote early reuse of closing military installations by expediting environmental cleanup.

1.2 REPORT ORGANIZATION

Section 1.0 of this document introduces the purpose and scope of the EE/CA. Section 2.0 summarizes the site characteristics, which includes the location and history of the site, existing conditions, geology and hydrogeology, and contamination assessment.

Section 3.0 discusses the scope, goals, and objectives of the removal action. The Applicable or Relevant and Appropriate Requirements (ARARs) that will govern the removal action are also included in Section 3.0.

Section 4.0 describes the removal action alternatives and evaluates the alternatives based on effectiveness, implementability, and cost. Section 5.0 provides a comparison of the alternatives relative to the evaluation criteria, and identifies the advantages and disadvantages relative to one another. Section 6.0 then presents the recommended removal action alternative, based on the evaluation and comparative analysis of the alternatives.

2.0 SITE CHARACTERIZATION

This section provides a summary of the site characteristics, which includes the location and history of the site, existing conditions, geology and hydrogeology, and contamination assessment.

2.1 SITE DESCRIPTION AND BACKGROUND

This subsection includes a description and history of the SAEP site. The USEPA has given the SAEP site the CERCLA Information System Identification Number of CTD 001181502.

2.1.1 Location

SAEP is located in Stratford, Connecticut, on the Stratford Point peninsula in the southeast corner of Fairfield County (Figure 2-1). The site lies on the borderline of the Bridgeport and Milford Quadrangles. Latitudinal and longitudinal coordinates of SAEP are approximately 41° 10' North and 73° 07' West. The site is bounded on the east by the Housatonic River, on the south and north by paved parking and open areas, and on the west by Main Street and the Sikorsky Memorial Airport.

2.1.2 Type of Facility and Operational History

The SAEP property is zoned as light commercial, and the site has been used for development, manufacture, and assembly of aircraft or engines since 1929. The plant history has been categorized into the following periods:

<u>1929 to 1939:</u> Sikorsky Aero Engineering Corporation developed and manufactured sea planes at the Stratford plant.

<u>1939 to 1948:</u> Chance Vought Aircraft located its operations at the Stratford plant in 1939, and the company became known as Vought-Sikorsky Aircraft Division. Sikorsky developed the helicopter and left the plant in 1943 because of overcrowding. Chance Vought developed the 'Corsair' for the U.S. Navy, and mass-produced Corsairs during World War II. Chance Vought vacated the Stratford Plant in 1948.

<u>1948 to 1951:</u> The Stratford plant was idle.

<u>1951 to 1976:</u> The U.S. Air Force procured the Stratford plant in 1951 and named it Air Force Plant No. 43. The Avco Corporation (AVCO) was contracted by the Air Force to operate the plant. AVCO manufactured radial engines for aircraft in the 1950s, and developed and manufactured turbine engines, primarily for aircraft, in the 1960s and 1970s.

1976 to 1995: The plant was transferred from the U.S. Air Force to the U.S. Army in 1976. At that time the plant was renamed the Stratford Army Engine Plant, although it continued under AVCO operations. AVCO was contracted by the Army to develop the AGT-1500 engine to power the Abrams tank and develop and manufacture industrial engines. AVCO merged with Textron in December 1985, and subsequently formed the Textron Lycoming Stratford Division. The contract for operation of SAEP was transferred from Textron Lycoming to AlliedSignal in 1994. AlliedSignal continued to develop, manufacture, and test turbine engines at the SAEP for both military and commercial aircraft and land vehicles until 1997.

1995: Responsibility for the jurisdiction, control, and accountability of SAEP was transferred from the U.S. Army Aviation and Troop command to the U.S. Army Tank-Automotive and Armament Command (TACOM) in September 1995. In October 1995, SAEP was placed on the BRAC list, known as BRAC 95. Pursuant to the Defense Base Closure and Realignment Act of 1990, the BRAC Environmental Restoration Program mandates that environmental contamination on BRAC properties be investigated and remediated, as necessary, prior to disposal and reuse.

1998: In August 1998, SAEP was transitioned from an active production facility to caretaker status. Since the cessation of AlliedSignal operations, the focus of activities at SAEP has been completion of an environmental assessment and cleanup of the site with the goal of future redevelopment.

2.1.3 Existing Conditions

SAEP facility. SAEP consists of approximately 124 acres, of which approximately 76 acres are improved land consist of 49 buildings, paved roadway and grounds, and five paved parking lots. Included in the improved land are an estimated 10 acres along the Housatonic River where fill was placed over tidal flats during the development of SAEP. Riparian rights are associated with the remainder of the SAEP facility. A riparian right is a right of access to, or use of, the shore, bed, or water of land on the bank of a natural watercourse. The riparian rights property consist of intertidal flats of the Housatonic River. An estimated two acres of property comprise a causeway constructed in the 1930s to provide access to the river channel.

Causeway. The Causeway was initially constructed and used as a means of launching seaplanes in the 1930s. Additional materials, of unknown origin, were deposited along the northern edge of the Causeway during the 1950s and 1960s. Building 59 was constructed to house the nose cones of missiles (without warheads), including the explosive charges used to open the nose cones. There is currently no unexploded ordnance present at the SAEP facility. The source of the fill used to construct the Causeway is unknown, but the fill contains soil, cobbles, and construction debris (e.g., concrete, brick, and asphalt). Smaller amounts of other material (e.g., wood and rebar) were also observed during field investigation activities. Analyses of ten surface soil samples collected from depths of 0 to 6 inches on non-vegetated areas of the Causeway during the Phase I RI did not indicate the presence of asbestos (ABB Environmental Services, Inc., [ABB-ES] 1996). It was also reported that paint solvents and wastes were burned on the Causeway as part of fire training operations.

Dike. A severe flood of the Housatonic River occurred in 1948, rendering the Stratford plant's manufacturing space unusable. In 1951, the U.S. Air Force purchased the plant and repaired the water-damaged buildings. Additionally, the Dike was constructed along the shoreline to provide flood protection for the facility.

Information regarding the construction of the Dike, including the material used to complete construction is generally unknown; however, aerial photographs indicate riprap material was primarily used during dike construction. Currently, an asphalt-paved road approximately 8 to 10 feet wide is placed on top of the Dike. Riprap covers each of the sloped sides of the Dike.

Future land use. Future land use at the site has been the subject of intensive study by the SAEP Local Redevelopment Authority (LRA). As reported in the "SAEP Redevelopment Plan and Implementation Strategy and Homeless Assistance Submission", the preferred land use plan developed by the LRA includes the development of approximately 800,000 square feet of building space for office, research and development, and "flex space". In addition, approximately 100,000 square feet of museum space and approximately 16 acres of parkland along the Housatonic River waterfront are proposed (RKG Associates, Inc. [RKG], 1997). The approximately 16 acres of proposed parkland (i.e., recreational area) would include a landscaped park with pathways for pedestrians and bicyclists, public water access from a new dock located at the end of the former seaplane boat ramp at the end of the Causeway, and an off-street parking area. The Causeway and Dike, which is within this proposed recreational area, is the focus of this EE/CA.

Topography. SAEP is located in the Western Highlands of Connecticut, part of the New England Physiographic Province. The local area is part of a coastal belt of dissected hilly country that extends along the coast of Connecticut. The coastal belt is characterized by uplands that range from mean sea level (MSL) to 650 feet above MSL, with an irregular, rocky coastline. Within the coastal belt, hilltops slope southward at a rate of about 50 feet per mile. Topographic features in the area mostly trend in the north-south or northeast-southwest direction, reflecting the structural trends of the local bedrock (Flint, 1968).

SAEP is situated on the Stratford Point peninsula that extends into Long Island Sound. The peninsula is relatively flat, with a slight slope toward the sound. Almost all the land at SAEP is less than 10 feet above MSL. The exception to this is a dike that was constructed along the Housatonic River in 1951 for flood protection. SAEP is within the 100-year floodplain. Based on the Flood Insurance Rate Map for the Town of Stratford, CT (Federal Emergency Management Agency; June 16, 1992), the 100-year flood elevation in the vicinity of the Causeway is 13 feet MSL.

Surface water. Surface water bodies in the site vicinity include Long Island Sound, the Housatonic River, Frash Pond, and the Marine Basin and drainage channel. Long Island Sound receives all of the region's drainage, in large part via the Housatonic River. According to the Connecticut Department of Environmental Protection (CTDEP), the following are reported tidal levels for the Housatonic River at Stratford based on the National Geodetic Vertical Datum (NGVD).

- Mean low tide level -2.7 feet NGVD
- Mean high tide level 4.1 feet NGVD
- High tide level 7 feet NGVD

Most of the SAEP surface is paved or covered with buildings; therefore, runoff during storm events is heavy. Most of the precipitation that falls on SAEP is treated and drained to the Housatonic River. Runoff at SAEP is collected by one of a network of six storm drainage systems. Each of the storm drain systems is equipped with a pumping station because of the low elevation of the site and proximity of the Housatonic River and Long Island Sound. Effluent from the storm drainage system is pumped through the Oil Abatement Treatment Plant, except in times of heavy precipitation, when some runoff is pumped directly to the Housatonic through individual outfalls.

2.1.4 Geology and Hydrogeology

This subsection summarizes the geology and hydrogeology at the SAEP, as well as the geologic conditions associated with the Causeway and Dike area.

2.1.4.1 Site Geology and Hydrogeology. The shallow geology at SAEP is characterized by four distinct units: fill material, estuarine silt, peat, reworked glacial outwash, and glacial outwash. The following is a summary of the geology and hydrogeology at the SAEP.

Fill. SAEP is mantled with sand, gravel, and debris fill associated with buildings, roads, utilities, site grading, and other structures. The fill is generally about 2 to 5 feet thick, but locally extends approximately 10 to 15 feet below the ground surface near the Dike. The fill is thicker near the Dike due to the emplacement of fill over existing intertidal sediments to extend the shoreline of the facility in the 1940s.

Estuarine silt. Typically, the silt deposits encountered in subsurface samples are characterized as fine silts with very fine sands, rich in organics, and having a sulfur dioxide smell consistent with tidal mud-flat deposits. Thickness of the silt deposits varies from as much as 30 feet to nonexistent in the direction from the Dike toward the interior of the facility. Silt deposits exist beneath the fill from the length of the Dike southwest toward the central portion of the SAEP facility. This aerial extent is consistent with the area of former intertidal flats, which were filled in the 1940s to extend the shoreline of the SAEP property further north and eastward toward the Housatonic River.

Reworked glacial outwash. Sand and gravel deposits of glacial origin underlie the fill and silt deposits. The deposits are divided into units of sand, with trace amounts of coarser material of sand and gravel with clay, silt, and cobbles. The working hypothesis for this unit is that glacial deposits have been reworked and sorted by the actions of the meandering Housatonic River. The reworked glacial outwash is thickest beneath the southwestern part of the site (along Main Street), and thins toward the Housatonic River. Distinguishing features of these deposits are trace gravel, and loosely cemented gravel zones. The bottom depth of these deposits varies between approximately 20 and 40 feet below ground surface.

Glacial outwash. Beneath the reworked glacial outwash, and above the bedrock surface, lies a fine to medium sand with some silt, interpreted to be glacial outwash. The glacial outwash contains silt/clay seams and fine silty sand lenses. The glacial outwash is generally stratified, and exhibits a fining-down sequence, which has a micaceous component. Micaceous zones are observed in the northwestern area of the site, mostly greater than 60 feet below ground surface.

Bedrock. Bedrock beneath SAEP has been identified as a black schist with greenstone. Results of the seismic refraction survey, coupled with soil boring information, indicate bedrock depths range from about 49 feet to 184 feet below ground surface beneath SAEP. These depths translate to elevations of approximately -50 to -175 feet MSL. It is apparent from seismic survey results that the bedrock surface elevation is highly variable over localized areas. Site-wide, results show that the bedrock surface has a general dip direction to the northwest, with the shallowest depths to bedrock being located along Sniffens Lane and the South Parking Lot area.

Hydrogeology. Based on data from monitoring wells installed at SAEP, groundwater flow direction is easterly towards the Housatonic River, northwesterly towards Frash Pond, and toward the drainage channel in the southern portion of SAEP. There may be a groundwater divide and buried tidal inlets on SAEP, and other buried outlets from Frash Pond may pass under SAEP. These types of features appear to be a factor controlling groundwater movement patterns and fate of potential contaminants. Very little flow-reversal, as related to tidal influences, have been measured.

Groundwater flow at the SAEP is influenced by three surface water features. The primary influence is that of the Housatonic River. Groundwater flow in the northern half of SAEP is in the direction of the Housatonic River at low tide.

A second surface water body influencing the groundwater flow at SAEP is Frash Pond, located approximately 300 feet from the northwest corner of SAEP. Frash Pond appears to be located downgradient of the northwest portion of SAEP. The airport, as well as other off-site properties, are also located upgradient of Frash Pond. Water elevations measured in monitoring wells suggest that groundwater from off-site locations south and west of the SAEP are flowing toward SAEP.

The third surface water body influencing groundwater flow at SAEP is the drainage channel located in the southern portion of SAEP. The presence of groundwater mounds in the shallow portion of the aquifer in this area of SAEP is due to the existence of a peat layer that causes a perched water condition above the peat. The area of SAEP influenced by groundwater flow to the drainage channel is limited to the former lagoon area in the vicinity of the drainage channel.

2.1.4.2 Causeway and Dike Geology. Based on the 1999 pre-design investigation activities, the shallow geology in the vicinity of the Causeway and Dike consists primarily of fill material. Figure 2-2 shows the Causeway and Dike exploration locations. Interpretive geologic profile cross-sections A-A’ and B-B’ are shown on Figures 2-3 and 2-4, respectively.

Causeway geology. The Causeway consists of fill material that was originally deposited on the tidal flats of the Housatonic River during construction of the Causeway in the 1930s. The fill material consists of soil (i.e., coarse to fine sand), cobbles, and construction debris (e.g., metal, wood, rebar, asphalt, brick, and concrete). The depth of fill is approximately 10 to 12 feet throughout the Causeway, with lesser amounts in the low area just north of Building B-59. The thickness of the fill is greatest in the central portion of the Causeway, which coincides with the area of highest topographic relief. Below the Causeway fill material is very fine sand and silt overlying coarser sands. In general, the bedrock elevation in the vicinity of the Causeway is estimated to be approximately –95 to –120 feet MSL.

Dike geology. The Dike was constructed in 1951 to provide flood protection for the SAEP facility. Crushed stone and riprap cover the side slopes of the Dike, and an asphalt-paved road traverses the top of the Dike. Generally, the fill material consists of sand and gravel with varying amounts of cobbles.

2.1.5 Surrounding Land Use, Populations, and Sensitive Ecosystems

SAEP is bounded by a paved parking lot and wetlands to the north; the Housatonic River to the east; an open field, a drainage channel, and small commercial businesses to the south; and hangar buildings, the Sikorsky Memorial Airport, several small businesses, and Frash Pond to the west.

Land Use. Historically, land in the SAEP vicinity has been used for agricultural and residential purposes. At present, local land-based agricultural activities are practically nonexistent. The primary agricultural (aquaculture) activity in the area involves growing oysters. Oysters are seeded in areas of the Housatonic River in the spring, collected in the fall, and placed in Long Island Sound to mature. The seed oyster beds are carefully managed by the State of Connecticut Department of Agriculture because of concerns regarding bioaccumulation of contaminants from the Housatonic River.

The SAEP property is zoned light industrial, and land in the vicinity of SAEP is zoned light industrial, business, commercial, or residential. Recreational facilities in the area include Short Beach Park, and nearby public wildlife areas include Nells Island and the Great Meadow Salt Marsh.

Population. The Greater Bridgeport Regional Planning Agency's population census of Stratford was 49,389 people in 1990. Slow population growth has been a trend in Stratford for nearly two decades, and the Connecticut Office of Policy and Management anticipates a continued slow or declining growth rate for Stratford through the end of the century, with a population projection of 48,650 for the year 2000, and 45,800 for the year 2010 (Woodward-Clyde Consultants [W-C], 1991).

SAEP is located about 3/4-mile southeast of Johnson Junior High School and Birdseye School. SAEP is located about 1/2-mile northwest of Short Beach Park, which had over 80,000 users reported for the year 1991. There are several businesses located west of Main Street, across from SAEP, including a small strip mall, several gas stations, and a restaurant.

Access into the plant is restricted, with a perimeter fence and security guards. Boaters, fishermen, and shell fishers could potentially access unrestricted intertidal flats within SAEP property.

Drinking water sources. The Bridgeport Hydraulic Company supplies the cities of Bridgeport and Stratford with potable water from the Trap Falls Reservoir in Shelton, Connecticut, approximately 6.5 miles north-northwest (upgradient) of SAEP. In 1989, the Trap Falls Reservoir supplied drinking water to 99.9 percent of the population of Bridgeport and Stratford, including residents in the immediate area of SAEP. There are no water supply wells within a 0.5-mile radius of SAEP according to a well survey conducted by the CTDEP and the Stratford Health Department.

Historic preservation. Two prehistoric archeological sites are reportedly located on SAEP property, as well as an Indian burial site (W-C, 1991). However, these sites are not located within the Causeway and Dike area.

Sensitive ecosystems. Freshwater wetlands, intertidal flats, and tidal marshes occur both in the vicinity of SAEP and on site. Freshwater wetlands in the vicinity are associated with Frash Pond, Salby Pond, and a small acreage of land abutting the SAEP property to the north. Intertidal flats in the vicinity are located in a band along the shoreline of the Housatonic River and Long Island Sound. SAEP's riparian rights encompass an estimated 51 acres of intertidal flats. Large tidal marshes occur in the vicinity of SAEP, including the Great Meadow Salt Marsh, areas along the Housatonic River, Nells Island, and land around Sikorsky Airport.

No federally-listed threatened or endangered mammalian, amphibian, invertebrate, aquatic, or plant species have been reported to occur in the vicinity of SAEP. Two federally-listed (the piping plover and roseate tern) and 11 state-listed threatened, endangered, or special concern birds have the potential to occur in the vicinity of SAEP. The intertidal flats area of SAEP may be feeding areas for the plover and tern.

2.1.6 Meteorology

The climate of the SAEP area is strongly influenced by a land-sea breeze, which is most pronounced from spring to early autumn. The sea breeze promotes air mixing, which results in slightly higher amounts of precipitation and slightly cooler temperatures at SAEP than inland.

The prevailing wind is from the southwest at an average speed of about 11 miles per hour. Precipitation averages about 44 inches per year, with about 16 inches per year of snowfall. Average monthly temperatures range from a low of about 28° Fahrenheit (F) in January, to a high of about 73°F in July.

SAEP is located in an area that is subjected to hurricanes, and has an intermediate tornado frequency. On average, SAEP is subject to hail approximately twice each year.

2.2 PREVIOUS REMOVAL ACTIONS

No previous CERCLA removal actions have been conducted at the Causeway. A Time-Critical Removal Action was conducted in December 1998 at the Chromium Plating Facility (i.e., Building B-2). Closure activities at SAEP have been conducted in accordance with the Resource Conservation and Recovery Act (RCRA). However, these RCRA units are not located within the Causeway and Dike areas. These activities include closure of three former storage lagoons and an equalization basin. RCRA closure activities have also been initiated for the drum storage area.

2.3 SOURCE, NATURE, AND EXTENT OF CONTAMINATION

Soil samples collected during the 1999 pre-design investigation activities for the Causeway and Dike were analyzed for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), polychlorinated biphenyls (PCBs), Target Analyte List (TAL) inorganics, and asbestos. Soil samples collected above the water table were also analyzed for inorganics by the Synthetic Precipitate Leaching Procedure (SPLP). Additionally, soil samples were collected on the Causeway by the CTDEP and AlliedSignal for radionuclide analysis.

The soil analytical data collected during the 1999 pre-design investigation activities for the Causeway and Dike were compared to the CTDEP Remediation Standard Regulation (RSR) Direct Exposure Criteria (DEC) and Pollutant Mobility Criteria (PMC). The Causeway and Dike area is proposed for future use as a recreational area, and the groundwater associated with the SAEP is classified as a GB area. Therefore, the CTDEP RSR DEC for residential exposure and the GB PMC were used in the data evaluation. Soil analytical data for asbestos were compared to the residential standard established for another TERC project (i.e., Raymark in Stratford, CT) of 1 percent total asbestos by the polarizing light microscope (PLM) method. The following subsections summarize the contamination assessment for the Causeway and Dike.

Preliminary results of groundwater data collected in November 1999 from the four monitoring wells installed in the Causeway indicate the presence of low concentrations of chlorinated VOCs and inorganic analytes. However, the concentrations of contaminants in groundwater are below the CTDEP RSR Surface Water Protection Criteria and the Volatilization Criteria. Groundwater associated with the Causeway and Dike will be addressed in the RI Report and Feasibility Study for the SAEP facility. The Draft RI Report is scheduled to be submitted in the summer of 2000.

2.3.1 Causeway

A summary of the soil analytical data with concentrations exceeding the CTDEP RSR residential DEC and GB PMC is presented in Tables 2-1 and 2-2, respectively. A summary of the soil analytical data with concentrations exceeding the CTDEP RSR residential DEC and GB PMC is also shown on Figures 2-5 and 2-6, respectively. A detailed discussion of the analytical data is presented in Subsection 6.1.3 of the Pre-Design Investigation Report for the Causeway and Dike (Foster Wheeler/HLA, 2000).

At the suggestion of the CTDEP, additional soil sampling and analysis was conducted in areas of the Causeway where the initial soil data indicated that there were exceedances of the CTDEP RSR GB PMC. Soil samples were collected in May 2000, analyzed by the SPLP, and the data compared to 10-times the Groundwater Protection Criteria in accordance with the CTDEP RSR Section 22a-133k-2(c)(2)(D). This additional sampling and analysis is discussed in Subsection 4.4.1 of this EE/CA, and the analytical data is presented in an addendum to the Final Pre-Design Investigation Report for the Causeway and Dike (Foster Wheeler/HLA, 2000).

The greatest extent of soil with contaminant concentrations exceeding the CTDEP RSR DEC and PMC is largely confined to the northern one-third and southern one-third of the Causeway. The soil in the central one-third of the Causeway also has contaminant concentrations exceeding the CTDEP RSR DEC and PMC; however, the contamination is somewhat more limited.

The Causeway is approximately 2.2 acres in size, with an average depth of approximately 10 to 12 feet. Based on these dimensions, the total volume of Causeway fill material is approximately 43,000 cubic yards (cy).

<u>Chemical.</u> The contaminants detected that exceed the CTDEP RSR DEC and PMC include chlorinated and fuel-related VOCs, SVOCs, PCBs, and inorganics. The concentrations of the contaminants detected and the CTDEP RSR DEC and PMC are presented in Tables 2-1 and 2-2.

Asbestos. Results of the samples analyzed for asbestos content by the PLM method indicated that asbestos was not detected in 23 of the 27 samples collected. Four samples have a trace (less than 1 percent) (by PLM) visual estimate of asbestos content, which is less than the residential standard of 1 percent total asbestos discussed previously in Section 2.3 of this EE/CA.

Radiological. Prior to the 1999 pre-design investigation activities, the CTDEP identified four areas of particular concern (TP-DEP-11, TP-DEP-12, TP-DEP-15, and TP-DEP-17) due to locally elevated radiological readings. According to the CTDEP, these areas showed elevated readings along linear trends; in plan view these trends are much longer in one direction relative to the other. Visually, the four test pits all contained a thin layer of grayish-white “clay-like” material. These layers are at relatively shallow depths (generally 12-inches or less) within each test pit, and appear to be the source of the elevated radiological readings.

The CTDEP and AlliedSignal collected representative samples of the whitish “clay-like” material from selected locations for radionuclide analysis. The results of these samples indicate the presence of thorium-234, thorium-228, and radium-226. The data collected by the CTDEP and AlliedSignal are summarized in Tables 2-3 and 2-4, respectively.

In January 2000, a radiological survey was conducted on the Causeway to further delineate the extent of radiological contaminated material. The survey identified three areas with elevated radiological readings. These areas are in the vicinity of: (1) TP-DEP-11, TP-DEP-12, and TP-99-26; (2) TP-DEP-15; and (3) TP-DEP-17 (see Figure 2-2).

This low-level radiological contaminated material was excavated on March 15 and 16, 2000. The excavated material was containerized in thirty 55-gallon drums and transported to an appropriate off-site licensed treatment/disposal facility. Therefore, this low-level radiological material is not included in the scope of the removal action alternatives evaluated in this EE/CA.

2.3.2 Dike

A summary of the soil analytical data with concentrations exceeding the CTDEP RSR residential DEC and GB PMC is presented in Tables 2-5 and 2-6, respectively. A summary of the soil analytical data with concentrations exceeding the CTDEP RSR residential DEC and GB PMC is also shown on Figures 2-5 and 2-6, respectively. A detailed discussion of the analytical data is presented in Subsection 6.2.3 of the Pre-Design Investigation Report for the Causeway and Dike (Foster Wheeler/HLA, 2000).

Chemical. The contaminants detected that exceed the CTDEP RSR DEC and PMC include chlorinated and fuel-related VOCs, SVOCs, and inorganics. These exceedances were detected in hand auger explorations HA-99-03, HA-99-07, and HA-99-08, which are located south of the Dike (see Figures 2-5 and 2-6). Additionally, the PCB Aroclor 1260 was detected at a concentration exceeding the CTDEP RSR DEC at one boring location (DB-99-08) on the Dike, located near the entrance to the Causeway (see Figure 2-2).

Asbestos. Results of the samples analyzed for asbestos content by the PLM method indicated that asbestos was not detected in 21 of the 24 samples collected. Three samples have a trace (less than 1 percent) visual (by PLM) estimate of asbestos content, which is less than the residential standard of 1 percent total asbestos discussed previously in Section 2.3 of this EE/CA.

2.4 PRELIMINARY RISK EVALUATION

A risk assessment is being conducted for surface and subsurface soils in the Causeway and Dike area as part of the RI for the SAEP facility. The baseline risk assessment was conducted to assess the potential risks associated with current and future exposure to contaminants at the site in the absence of any remedial action. The Draft RI for the SAEP facility will not be published until the summer of 2000. Therefore, the CTDEP RSR criteria will be used in the selection and implementation of removal actions at SAEP. The CTDEP has established RSR criteria for various media, including target concentrations for indoor air and criteria for soil, groundwater, and surface water. Soil analytical data for asbestos will be compared to the residential standard established for another TERC project (i.e., Raymark in Stratford, CT) of 1 percent total asbestos by the PLM method. Detected contaminant concentrations will be compared to the RSR criteria and the residential standard of 1 percent total asbestos, and the Causeway and Dike NCRA will address areas where contaminant concentrations in surface and subsurface soils exceed these criteria.

3.0 IDENTIFICATION OF REMOVAL ACTION SCOPE, GOALS, AND OBJECTIVES

The NCP states that an appropriate removal action may be conducted at a site when a threat to human health or welfare or the environment is determined. The removal action is undertaken to abate, minimize, stabilize, mitigate, or eliminate the release or the threat of release at a site. Section 300.415 of the NCP outlines factors to be considered when determining the appropriateness of a removal action, such as high concentrations of hazardous substances, pollutants, or contaminants in soil, largely at or near the surface, that may migrate.

Once it is decided that a removal action is appropriate, a determination is made whether the removal is an “emergency”, “time-critical”, or “non-time-critical” removal. “Emergencies” are those removals in which response actions must begin within hours or days after completion of the site evaluation. “Time-critical” removals are those for which, based on a site evaluation, it is determined there are less than six months available before on-site response activities must begin. “Non-time-critical” removals are those for which it is determined there are more than six months available before removal actions must begin. The removal action for the Causeway and Dike area is considered a “non-time-critical removal action” (i.e., NCRA).

The following subsections present the scope, goals, and objectives of the removal action, including the ARARs that will govern the removal action.

3.1 STATUTORY LIMITS OF REMOVAL ACTION

CERCLA Section 104(c)(1) has established statutory limits for Superfund-financed removal actions, which require that removal actions be terminated after $2 million has been allocated for the removal or 12 months have elapsed since the removal was initiated. Funding for removal activities at SAEP will be provided through the Department of Defense and BRAC, rather than Superfund. Therefore, the CERCLA duration and cost limitations are used only as guidance for this EE/CA.

3.2 DETERMINATION OF REMOVAL ACTION SCOPE

To determine the scope of the Causeway and Dike NCRA, the data collected during pre-design field investigations (Foster Wheeler/HLA) were compared to the CTDEP RSRs. Based on the contamination assessment presented in Section 2.3, there are exceedances of the CTDEP RSRs throughout the Causeway fill material. As discussed in Section 2.3, asbestos-containing material has not been identified that exceeds the residential standard of 1 percent total asbestos. Additionally, the radiological-contaminated material identified during previous site investigations will be addressed outside the scope of this Causeway and Dike NCRA.

There are also exceedances of CTDEP RSRs at three hand auger locations south of the Dike (i.e., HA-99-03, HA-99-07, and HA-99-08) (see Figures 2-5 and 2-6). Because theses locations are not within the Dike, and the horizontal and vertical extent of contamination at these locations has not been fully defined, these areas will be addressed in the Feasibility Study for the remainder of the SAEP facility. Therefore, the scope of the Causeway and Dike NCRA includes only the Causeway, where surface and subsurface soils exceed the CTDEP RSRs.

3.3 Determination of Removal Action Schedule

Because the removal action is not financed by Superfund, it is exempt from the 12-month statutory limit. Implementation of the Causeway and Dike NCRA is anticipated to begin in late summer or fall of 2000.

3.4 Removal Action Objectives

The objective of the Causeway and Dike NCRA is to prevent exposure to contaminated soils and prevent leaching of contaminants from soils in accordance with the CTDEP RSR DEC (residential exposure scenario) and PMC (GB area).

The Causeway and Dike area is proposed for use as a recreational area, which would include a landscaped park with pathways for pedestrians and bicyclists, public water access from a new dock located at the end of the former seaplane boat ramp at the end of the Causeway, and an off-street parking area. Therefore, for shallow soil, the CTDEP RSR residential DEC will be used for the Causeway and Dike NCRA. The groundwater associated with the SAEP is classified as a GB area. Therefore, for subsurface soil, the CTDEP RSR GB PMC will be used for the Causeway and Dike NCRA.

3.5 Applicable or Relevant and Appropriate Requirements

The NCP requires that removal actions pursuant to CERCLA Section 106 attain ARARs under federal or state environmental laws or facility citing laws to the extent practicable considering the urgency of the situation and the scope of the removal action.

ARARs are federal and state human health and environmental requirements and guidelines used to (1) evaluate the appropriate extent of site cleanup; (2) define and formulate removal action alternatives; and (3) govern implementation and operation of the selected action. Only those promulgated state requirements identified by the state in a timely manner that are more stringent than federal requirements may be ARARs.

Under CERCLA Section 121(e), permits are not required for response actions conducted entirely on site. This permit exemption applies to administrative permit requirements (e.g., documentation, recordkeeping, and enforcement). However, compliance with the substantive requirements of applicable regulations must be achieved.

The NCP defines three categories of potential requirements in the remedial response process: (1) applicable requirements, (2) relevant and appropriate requirements, and (3) information to be considered. These definitions are discussed in the following paragraphs.

- **Applicable requirements** are those clean-up standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a site. An example of an applicable requirement is the use of Maximum Contaminant Level (MCL) drinking water standards for a site where groundwater contamination has affected a public water supply.

- **Relevant and appropriate requirements** are those clean-up standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that, while not applicable to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a site, address problems or situations sufficiently similar to those encountered at the site that their use is well suited to the particular site. There is discretion in this determination in that it is possible for only part of a requirement to be considered relevant and appropriate, the rest being dismissed if judged not to be relevant and appropriate in a given case. For example, MCLs for drinking water would be relevant and appropriate requirements at a site where groundwater contamination could affect a potential, rather than actual, drinking water source.

- **Information to be considered** is nonpromulgated advisories or guidance issued by the federal or state government that are not legally binding, and do not have the status of potential ARARs. However, if there are no specific ARARs for a chemical or site condition, or if existing ARARs are not deemed sufficiently protective, then guidance or advisory criteria should be identified and used to confirm protection of human health and the environment.

Development of a comprehensive inventory of ARARs involves a two-tiered analysis: establishing the applicability of an environmental regulation, and evaluating relevancy and appropriateness if the regulation is not applicable. A requirement may be “applicable” or “relevant and appropriate”, but not both.

Because of their site-specific nature, identification of ARARs requires evaluation of federal, state, and local environmental and health regulations regarding chemicals of concern, site characteristics, and proposed remedial alternatives. Requirements that pertain to the remedial response at a CERCLA site can be categorized in three distinct areas:

- **Chemical-specific ARARs** are typically health- or risk-based numerical values or methodologies that establish site-specific acceptable chemical concentrations or amounts. These values are used to develop action levels or clean-up concentrations.

- **Location-specific ARARs** involve restrictions established for specific substances or activities based on their location.

- **Action-specific ARARs** involve performance, design, or other action-specific requirements and are generally technology- or activity-based.

A discussion of chemical- and location-specific ARARs, and potential action-specific ARARs is presented in the following subsections.

3.5.1 Chemical-specific ARARs

Chemical-specific ARARs are numerical values or procedures that, when applied to a specific site, establish numerical limits for individual chemicals or groups of chemicals. These ARARs will govern the extent of site remediation by providing either actual cleanup levels or the basis for calculating such levels.

There are no promulgated federal standards for soil. However, the CTDEP RSR includes standards for soil remediation. Therefore, as stated previously in Subsection 3.4 of this EE/CA, the appropriate DEC and PMC, in accordance with the CTDEP RSR, will govern the cleanup for the Causeway and Dike NCRA. The chemical-specific ARARs are presented in Table 3-1.

3.5.2 Location-specific ARARs

Location-specific ARARs set restrictions on the concentrations of hazardous substances or the performance of activities solely because they are in special locations. These ARARs set restrictions relative to special locations such as wetlands, floodplains, sensitive ecosystems, and historical or archeological sites, and provide a basis for assessing existing site conditions. The location-specific ARARs are presented in Table 3-2.

3.5.3 Action-specific ARARs

Action-specific ARARs, unlike chemical- or location-specific ARARs, are usually technology- or activity-based limitations that direct how removal actions are conducted. The applicability of this set of requirements is directly related to the particular activities selected for the site. Evaluation of action-specific ARARs is one criterion for assessing the feasibility and effectiveness of proposed removal alternatives. The potential action-specific ARARs that may apply to the proposed removal alternatives identified in this EE/CA are presented in Table 3-3. The action-specific ARARs for the selected removal action alternative will be presented in the Causeway and Dike RAM.

4.0 IDENTIFICATION AND ANALYSIS OF REMOVAL ACTION ALTERNATIVES

Section 300.415 of the NCP provides examples of removal actions appropriate for a range of situations. These examples include:

- Fences, warning signs, or other security or site control;
- Stabilization of berms, dikes, or impoundments;
- Using chemicals and other materials to retard the spread of the release or to mitigate its effects;
- Excavation, consolidation, or removal of highly contaminated soils; and
- Containment, treatment, disposal, or incineration of hazardous materials.

Although the NCP provides examples of removal actions, it sets forth no specific requirements for identifying and evaluating removal alternatives. USEPA guidance on preparing EE/CAs suggests identifying and assessing a limited number of alternatives appropriate for addressing the removal action objectives, while considering the CERCLA preference for treatment. The guidance also suggests the use of presumptive remedy guidance to provide an immediate focus to the discussion and selection of alternatives, and limit the universe of alternatives for NCRAs (USEPA, 1993b).

Following development of a limited number of removal action alternatives, the alternatives are evaluated using the effectiveness, implementability, and cost criteria set forth in the NCP and USEPA guidance on preparing EE/CAs.

The effectiveness of each alternative is evaluated in accordance with the following criteria:

- Overall protection of human health and the environment
- Compliance with ARARs
- Long-term effectiveness
- Reduction of toxicity, mobility, or volume through treatment
- Short-term effectiveness

Implementability addresses the technical and administrative feasibility of implementing the alternative, and is evaluated in accordance with the following criteria:

- Technical feasibility
- Administrative feasibility
- Availability of services and materials
- State acceptance
- Community acceptance

State and community acceptance will be addressed following regulatory agency and public review of this EE/CA.

A cost estimate was prepared for each alternative to help in selection of a removal action. Each estimate contains the capital cost (including direct and indirect costs) and operation and maintenance (O&M) costs.

As discussed in Section 2.0 of this EE/CA, the Causeway is constructed of fill material consisting largely of construction debris (concrete, brick, and asphalt), with lesser amounts of glacial material (medium to fine sand and gravelly sand).

Due to the heterogeneous nature of the fill and the large percentage of construction debris, treatment technologies, either in-situ or ex-situ, are not feasible for addressing the subsurface contamination present in the Causeway. Therefore, the general response actions considered for this NCRA are containment and removal/disposal.

The following subsections provide a detailed description of the alternatives, and evaluate the alternatives using the effectiveness, implementability, and cost criteria. The removal action alternatives evaluated in the following subsections are:

Alternative 1 Capping with Synthetic Geomembrane
Alternative 2 Capping with Composite Cover System and Vertical Barrier
Alternative 3 Excavation and Off-site Disposal
Alternative 4 Capping with Erosion Control Cover System

4.1 Alternative 1 – Capping with Synthetic Geomembrane

The scope of Alternative 1 includes the following components:

- Demolition of Building 59 and other structures (concrete ramp and pad);
- Capping the Causeway with a synthetic geomembrane cover system;
- Covering the Causeway with a Stone/Riprap Armor;
- Establishing environmental land use restrictions; and
- Conducting O&M activities.

4.1.1 Description of the Alternative

The removal action provided under Alternative 1 consists primarily of containment of the contaminated fill material within the Causeway by constructing a low permeability (hydraulic barrier) cover system. The low-level radiological-contaminated material identified during previous site investigations has been removed, containerized, and transported to an appropriate off-site licensed treatment/disposal facility. Therefore, this radiological-contaminated material is not included in the scope of this alternative.

For this alternative, it is assumed the existing Causeway toe of slope location would be maintained. In order to maintain the location of the toe and construct the cap, the existing toe and side slope materials would be excavated and re-consolidated on top of the Causeway. It was also assumed the Causeway would be initially re-graded by cutting and filling existing material to establish base grades. In addition, Building 59 and the concrete ramp and pad would be demolished prior to cap construction.

On top of the Causeway, the cover system (from bottom to top) would consist of:

- 12-inch sand bedding/gas venting layer;
- flexible membrane liner (FML);
- 18-inch sand protection layer; and
- 36-inch thick riprap/stone armor.

The riprap armor over the entire Causeway has been provided to ensure protection of the cover from storm surge or wave action during a 100-year storm event. It has been assumed that the maximum stone size required for the armor protection would be approximately 600 pounds. The sand layers above and below the FML are provided to protect the liner. The sand layer below the FML would also include perforated piping connected to vertical vents to allow this layer to serve as a passive gas venting layer. The FML would consist of a 60-mil geomembrane material, either high-density polyethylene (HDPE), linear low-density polyethylene (LLDPE), or polyvinyl chloride (PVC). A detail of the cover system for Alternative 1 is provided on Figure 4-1.

In accordance with the CTDEP RSR, an environmental land use restriction would be required for the Causeway. The environmental land use restriction would establish restrictions on the future use of the Causeway to (1) prevent exposure to the contaminated Causeway fill material, and (2) maintain the integrity of the cover system that would be installed as part of this removal action alternative.

During preparation of the RAM (i.e., the decision document that presents the selected remedy) and the removal action design, a Declaration of Environmental Land Use Restriction would be submitted to the State of Connecticut Commissioner of Environmental Protection for review and approval. In accordance with the CTDEP RSR, the Declaration of Environmental Land Use Restriction would be accompanied by (1) a Class A-2 survey of the area subject to the restriction; (2) a decision document that includes any limitations on the use of the area subject to the restriction, as well as the reason for the restriction; and (3) a certified copy of a notice of intent to record an environmental land use restriction that has been published in a local newspaper.

O&M activities associated with this alternative would include groundwater monitoring using the four existing monitoring wells located on the Causeway, monitoring and maintenance of the cover system, and five-year site reviews. The U.S. TACOM is responsible for the jurisdiction, control, and accountability of the SAEP facility, as well as the O&M activities associated with this removal action alternative.

The description of Alternative 1 presented in this section and on Figure 4-1 is based on a "conceptual" design of the alternative. As with any removal action alternative, there are several details that would be addressed and evaluated during the detailed design of the alternative. These include, but are not limited to:

- Settlement and stability evaluation;
- Material specifications;
- Stone bedding layer and/or geotextile fabric below the riprap/stone armor;
- Size and thickness of riprap/stone armor;
- Use of alternate material for riprap/stone armor (e.g., precast concrete block mats); and
- Toe protection to prevent scour and erosion along the toe of the riprap slope.

4.1.2 Effectiveness

The effectiveness of Alternative 1 is evaluated in accordance with the following criteria:

- Overall protection of human health and the environment
- Compliance with ARARs
- Long-term effectiveness
- Reduction of toxicity, mobility, or volume through treatment
- Short-term effectiveness

Overall protection of human health and the environment. The CTDEP RSR allows use of an engineered control (e.g., cover or containment system) to isolate contaminated soil. Alternative 1 provides protection of human health and the environment primarily through engineering controls (i.e., cover system) to eliminate receptor exposure to the contaminated Causeway fill material, and institutional controls (i.e., environmental land use restrictions in accordance with CTDRP RSR) to establish restrictions on the future use of the Causeway and maintain the integrity of the cover system.

Compliance with ARARs. Alternative 1 would be designed and implemented to attain the identified federal and state ARARs.

Long-term effectiveness. Alternative 1 would provide long-term effectiveness by capping the Causeway, which will prevent exposure to the contaminated fill material and minimize the leaching of contaminants due to precipitation infiltrating through the contaminated fill material. The final elevation of the Causeway would not be above the 100-year flood elevation of 13 feet MSL; however, the riprap armor over the Causeway would provide protection of the cover from storm surge or wave action. To ensure the long-term integrity of the cap, periodic inspection and maintenance would be required. Long-term groundwater monitoring would also be conducted as part of this alternative.

Alternative 1 may not prevent water from the tidal action of the Housatonic River in contacting some of the contaminated material and potentially transporting soluble contaminants out of the limits of the cap. Potential groundwater contamination associated with the Causeway will be addressed in the Feasibility Study for the SAEP facility.

Reduction of toxicity, mobility, or volume through treatment. Alternative 1 does not include active treatment and therefore, does not satisfy the CERCLA statutory preference for treatment. Alternative 1 does not provide a reduction in the toxicity of contaminants; however, capping the contaminated Causeway fill material would minimize the leaching of contaminants due to precipitation infiltrating through the contaminated fill material.

Short-term effectiveness. The short-term effectiveness criterion addresses the effects of the alternative during implementation, including the protection of the community and site workers, environmental impacts, and the time until the response objectives are achieved.

Access to the SAEP facility is restricted. The activities associated with Alternative 1 would be conducted in areas where access is limited to trained workers. Therefore, potential risks to the community would be minimized. Alternative 1 has potential short-term risks to site workers; however, these risks would be minimized by effectively implementing an approved site-specific health and safety plan.

Alternative 1 has the potential for short-term adverse effects on ecological receptors resulting from excavation of contaminated material and installation of the cap. To prevent the migration of contaminated material out of the work area and to minimize environmental impacts, erosion and sediment control measures would be implemented. In addition, a portable dam would be installed around the Causeway to facilitate construction and to prevent adverse effects on the adjacent tidal flats.

It is anticipated that implementation of Alternative 1 could be completed in approximately ten months, at which time the response objectives would be achieved.

4.1.3 Implementability

The implementability of Alternative 1 is evaluated in accordance with the following criteria:

- Technical feasibility
- Administrative feasibility
- Availability of services and materials
- State acceptance
- Community acceptance

Technical feasibility. Alternative 1 is considered technically feasible for the Causeway. Capping of contaminated material that has been land disposed is a commonly used and reliable remediation technology. During implementation of the alternative, construction practices and schedules would need to consider the tidal/wave actions of the Housatonic River.

Technical feasibility issues associated with construction of a cover system in a tidal river environment would be addressed during design of the cover system. The Causeway is underlain by loose river sediments, which are potentially highly organic and approximately 60 feet thick. It is not anticipated that construction of the cover system would result in significant differential settlement, and therefore, the alternative does not currently include pre-loading of the Causeway prior to construction of the cover system. However, design issues include settlement, slope and global stability, and erosion of the cover system due to tidal and storm surges. Pre-design activities would include geotechnical investigation and evaluation of settlement and stability. Additionally, further evaluation of the effects of the tidal river environment on the Causeway cover system would be conducted (e.g., size and thickness of the stone/rock armor layer of the cover system to minimize potential future erosion).

Administrative feasibility. Alternative 1 is considered feasible from an administrative aspect. Although permits are not required for on-site CERCLA actions, the substantive requirements would be met. Additionally, an environmental land use restriction would be implemented for the Causeway in accordance with the CTDEP RSR.

Availability of services and materials. Alternative 1 can be implemented using standard or commonly available construction methods, services, and materials. Alternative 1 includes demolition (e.g., Building 59), earthwork activities, and installation of an FML. Experienced contractors and materials necessary for construction are readily available. Off-site licensed treatment, storage, and disposal facilities (TSDFs) for demolition debris (e.g., Building 59) are also available.

State and community acceptance. Evaluation of state and community acceptance will be completed after receipt of comments provided during both the development of the EE/CA and following the 30-day public comment period for the EE/CA. Comments and concerns raised by the state regulatory agencies and the community will be considered in the final selection of the removal action alternative in the RAM.

4.1.4 Cost

The 30-year net worth of this alternative is estimated to be $5,518,486 for capital and O&M costs. O&M costs include groundwater monitoring, monitoring and maintenance of the cover system, and five-year site reviews.

Consistent with USEPA guidance, a discount rate of seven percent before taxes and after inflation was used to prepare the cost estimate (USEPA, 1993a). The cost evaluation for this alternative is provided in Table 4-1.

The following assumptions were used in preparing the cost estimate for Alternative 1:

- The existing Causeway toe of slope location would be maintained, requiring existing toe and slope material to be excavated and re-consolidated on top of the Causeway.
- A portable dam would be used around the Causeway to facilitate construction and to prevent adverse effects on the adjacent tidal flats.
- HDPE was used for the FML.
- A maximum stone size of 600 pounds in a 3-foot thick layer was used for the riprap/stone armor. Placement of the rock would be by heavy equipment with positioning assisted by laborers to provide a relatively flat finished surface.
- A passive gas venting layer would be included below the FML.
- Pre-design activities include geotechnical investigation and evaluation for settlement, slope and global stability.
- Engineering activities include evaluation and design of the riprap/stone armor to withstand storm surges.
- The alternative could be implemented in approximately ten months.
- Unit costs are based on vendor-supplied information, recently completed projects with similar tasks and materials, and unit costs from 1999 R.S. Means Site Work Cost Data.

4.2 ALTERNATIVE 2 - CAPPING WITH COMPOSITE COVER SYSTEM AND VERTICAL BARRIER

The scope of Alternative 2 includes the following components:

- Demolition of Building 59 and other structures (concrete ramp and pad);
- Installation of a sheet pile seawall;
- Capping the Causeway with a composite cover system;
- Covering the Causeway with a Stone/Riprap Armor;
- Establishing environmental land use restrictions; and
- Conducting O&M activities.

4.2.1 Description of the Alternative

The removal action for Alternative 2 would be similar to Alternative 1, in that containment of the contaminated fill material within the Causeway is provided by constructing a low permeability (hydraulic barrier) cover system. However, the cover system for Alternative 2 is more rigorous than that provided in Alternative 1 and would satisfy the cover requirements for a RCRA hazardous waste landfill. The low-level radiological-contaminated material identified during previous site investigations has been removed, containerized, and transported to an appropriate off-site licensed treatment/disposal facility. Therefore, this radiological-contaminated material is not included in the scope of this alternative.

Like Alternative 1, it is assumed that the existing location of the Causeway toe of slope would be maintained. A sheet pile seawall would be installed at the existing toe location. It has been assumed that some of the existing fill material near the toe of slope would require excavation in order to install the sheet pile seawall. The excavated toe material would be re-consolidated on top of the Causeway. The sheet pile seawall would provide protection from tidal and wave action, serve as the limit of the cover system, and act as a hydraulic barrier. A UV-stabilized vinyl (i.e., PVC) sheet pile material was selected for this alternative because it provides excellent weatherability properties and is not degraded by marine organisms, rust, rot, or corrosion, thus providing superior service life. For added wall stability, the sheet pile wall would be tied-back into the Causeway above and below the cover system with a geogrid attached to wales. During design of the alternative, further evaluation of the PVC sheet pile seawall would be conducted. An alternate material that might be considered for the seawall is steel. However, a steel sheet pile seawall would likely need to be installed to greater depths, at significantly greater cost. Following seawall installation, the Causeway would be re-graded by cutting and filling existing material to establish base grades. In addition, Building 59 and the concrete ramp and pad would be demolished prior to cap construction.

The cover system for Alternative 2 (from bottom to top) would consist of:

- 12-inch sand bedding/gas venting layer;
- geocomposite clay liner (GCL);
- flexible membrane liner (FML);
- geocomposite drainage layer (GDL);
- 18-inch filter/sand protection layer;
- 36-inch thick riprap/stone armor.

In addition to the seawall, a riprap armor over the entire Causeway has been provided to ensure protection of the cover from storm surge or wave action during a 100-year storm event. It has been assumed that the maximum stone size required for the armor protection would be approximately 600 pounds. The hydraulic barrier layer for Alternative 2 would consist of two components, a GCL and a FML. The GCL is a hydraulic barrier made of clay (natural sodium bentonite) encapsulated between two or more layers of geotextile. GCLs are used as substitutes for compacted clay liners, which allows for a thinner cover cross-section and provides advantages in cost, ease of installation and performance. The FML would consist of a 60-mil geomembrane material, either HDPE, LLDPE, or PVC. The sand-bedding layer is provided to protect the GCL and the FML from punctures due to the nature of the existing fill material. This sand layer would also include perforated piping connected to vertical vents to allow this layer to serve as a passive gas venting layer. A GDL would be placed above the FML to facilitate drainage of the cover system and lower the hydraulic head behind the sheet pile wall. The GDL consists of a geonet sandwiched between two layers of geotextile. The GDL provides the advantage of a thinner cover cross-section and ease of construction over conventional graded aggregate and/or perforated-pipe subsurface drainage systems. A detail of the cover system for Alternative 2 is provided on Figure 4-2.

In accordance with the CTDEP RSR, an environmental land use restriction would be required for the Causeway. The environmental land use restriction would establish restrictions on the future use of the Causeway to (1) prevent exposure to the contaminated Causeway fill material and (2) maintain the integrity of the cover system that would be installed as part of this removal action alternative.

During preparation of the RAM (i.e., the decision document that presents the selected remedy) and the removal action design, a Declaration of Environmental Land Use Restriction would be submitted to the State of Connecticut Commissioner of Environmental Protection for review and approval. In accordance with the CTDEP RSR, the Declaration of Environmental Land Use Restriction would be accompanied by (1) a Class A-2 survey of the area subject to the restriction; (2) a decision document that includes any limitations on the use of the area subject to the restriction, as well as the reason for the restriction; and (3) a certified copy of a notice of intent to record an environmental land use restriction that has been published in a local newspaper.

O&M activities associated with this alternative would include groundwater monitoring using the four existing monitoring wells located on the Causeway, monitoring and maintenance of the cover system, and five-year site reviews. The U.S. TACOM is responsible for the jurisdiction, control, and accountability of the SAEP facility, as well as the O&M activities associated with this removal action alternative.

The description of Alternative 2 presented in this section and on Figure 4-2 is based on a "conceptual" design of the alternative. As with any removal action alternative, there are several details that would be addressed and evaluated during the detailed design of the alternative. These include, but are not limited to:

- Settlement and stability evaluation;
- Sheet pile serviceability and structural stability, including material type, length, driveability, weather resistance, and seam leakage;
- Material specifications;
- Stone bedding layer and/or geotextile fabric below the riprap/stone armor;
- Size and thickness of riprap/stone armor;
- Use of alternate material for riprap/stone armor (e.g., precast concrete block mats); and
- Toe protection (e.g., energy dissipation apron) to prevent scour and erosion along the toe of the sheet pile seawall due to wave reflection off the wall.

4.2.2 Effectiveness

The effectiveness of Alternative 2 is evaluated in accordance with the following criteria:

- Overall protection of human health and the environment

- Compliance with ARARs
- Long-term effectiveness
- Reduction of toxicity, mobility, or volume through treatment
- Short-term effectiveness

Overall protection of human health and the environment. The CTDEP RSR allows use of an engineered control (e.g., cover or containment system) to isolate contaminated soil. Alternative 2 provides protection of human health and the environment primarily through engineering controls (i.e., cover system) to eliminate receptor exposure to the contaminated Causeway fill material, and institutional controls (i.e., environmental land use restrictions) to establish restrictions on the future use of the Causeway and maintain the integrity of the cover system.

Compliance with ARARs. Alternative 2 would be designed and implemented to attain the identified federal and state ARARs.

Long-term effectiveness. Alternative 2 would provide long-term effectiveness by capping the Causeway, which will prevent exposure to the contaminated fill material and minimize the leaching of contaminants due to precipitation infiltrating through the contaminated fill material. The final elevation of the Causeway would not be above the 100-year flood elevation of 13 feet MSL; however, the riprap armor over the Causeway would provide protection of the cover from storm surge or wave action. To ensure the long-term integrity of the cap, periodic inspection and maintenance would be required. Long-term groundwater monitoring would also be conducted as part of this alternative.

Alternative 2 would not prevent water from the tidal action of the Housatonic River in contacting some of the contaminated material. However, the sheet pile seawall does have the ability to provide some measure of protection as a hydraulic barrier. The vinyl sheet pile seawall and associated pressure-treated timber cap and wales have a finite lifetime and therefore, would eventually require replacement to maintain the long-term effectiveness of the remedy. The composite cover system (i.e., FML and GCL barrier layer) in conjunction with the sheet pile seawall would minimize the transport of contaminants, especially from areas of the Causeway with elevated contaminant concentrations, outside the limits of the cover system. Potential groundwater contamination associated with the Causeway will be addressed in the Feasibility Study for the SAEP facility.

Reduction of toxicity, mobility, or volume through treatment. Alternative 2 does not include active treatment and therefore, does not satisfy the CERCLA statutory preference for treatment. Alternative 2 does not provide a reduction in the toxicity of contaminants. The cap and seawall components of Alternative 2 provide a reduction in the mobility of contaminants. Capping the contaminated Causeway fill material would minimize the leaching of contaminants due to precipitation infiltrating through the contaminated fill material. The sheet pile seawall provides additional protection as a barrier to minimize the potential of transporting soluble contaminants outside the limits of the cap.

Short-term effectiveness. The short-term effectiveness criterion addresses the effects of the alternative during implementation, including the protection of the community and site workers, environmental impacts, and the time until the response objectives are achieved.

Access to the SAEP facility is restricted. The activities associated with Alternative 2 would be conducted in areas where access is limited to trained workers. Therefore, potential risks to the community would be minimized. Alternative 2 has potential short-term risks to site workers; however, these risks would be minimized by effectively implementing an approved site-specific health and safety plan.

Alternative 2 has the potential for short-term adverse effects on ecological receptors resulting from excavation of contaminated material and installation of the cap. To prevent the migration of contaminated material out of the work area and to minimize environmental impacts, erosion and sediment control measures would be implemented. In addition, a portable dam would be installed around the Causeway to facilitate construction and to prevent adverse effects on the adjacent tidal flats. The sheet pile seawall would also provide an effective means to prevent the spread of contaminated material.

It is anticipated that implementation of Alternative 2 could be completed in approximately ten months, at which time the response objectives would be achieved.

4.2.3 Implementability

The implementability of Alternative 2 is evaluated in accordance with the following criteria:

- Technical feasibility
- Administrative feasibility
- Availability of services and materials
- State acceptance
- Community acceptance

Technical feasibility. Alternative 2 is considered technically feasible for the Causeway. Capping of contaminated material that has been land disposed is a commonly used and reliable remediation technology. Installation of a sheet pile seawall is also a commonly used construction technique. During implementation of the alternative, construction practices and schedules would need to consider the tidal/wave actions of the Housatonic River.

Technical feasibility issues associated with construction of a cover system in a tidal river environment would be addressed during design of the cover system. The Causeway is underlain by loose river sediments, which are potentially highly organic and approximately 60 feet thick. It is not anticipated that construction of the cover system would result in significant differential settlement, and therefore, the alternative does not currently include pre-loading of the Causeway prior to construction of the cover system. However, design issues include settlement, slope and global stability, sheet pile serviceability and structural stability, and erosion of the cover system due to tidal and storm surges. Pre-design activities would include geotechnical investigation and evaluation of settlement, structural stability, and sheet pile serviceability and stability (e.g., driveability, weather resistance, tide fluctuations, and seam leakage). Additionally, further evaluation of the effects of the tidal river environment on the Causeway cover system would be conducted (e.g., size and thickness of the stone/rock armor layer of the cover system to minimize potential future erosion).

Administrative feasibility. Alternative 2 is considered feasible from an administrative aspect. Although permits are not required for on-site CERCLA actions, the substantive requirements would be met. Additionally, an environmental land use restriction would be implemented for the Causeway in accordance with the CTDEP RSR.

Availability of services and materials. Alternative 2 can be implemented using standard or commonly available construction methods, services, and materials. Alternative 2 includes demolition (e.g., Building 59), sheet pile seawall construction, earthwork activities, and installation of a soil and geosynthetic composite cover system. Experienced contractors and materials necessary for construction are readily available. Off-site licensed TSDFs for demolition debris (e.g., Building 59) are also available.

State and community acceptance. Evaluation of state and community acceptance will be completed after receipt of comments provided during both the development of the EE/CA and following the 30-day public comment period for the EE/CA. Comments and concerns raised by the state regulatory agencies and the community will be considered in the final selection of the removal action alternative in the RAM.

4.2.4 Cost

The 30-year net worth of this alternative is estimated to be $6,899,468 for capital and O&M costs. O&M costs include groundwater monitoring, monitoring and maintenance of the cover system, and five-year site reviews.

Consistent with USEPA guidance, a discount rate of seven percent before taxes and after inflation was used to prepare the cost estimate (USEPA, 1993a). The cost evaluation for this alternative is provided in Table 4-2.

The following assumptions were used in preparing the cost estimate for Alternative 2:

- The low-level radiological-contaminated material would be removed, containerized, and transported to an off-site TSDF prior to implementation of this alternative.

- The existing Causeway toe of slope location would be maintained, requiring existing toe and slope material to be excavated and re-consolidated on top of the Causeway.
- The sheet pile seawall consists of 24-foot lengths of vinyl sheet pile with two geogrid tie-back locations and pressure-treated timber wales and cap.
- A portable dam would be used around the Causeway to facilitate construction and to prevent adverse effects on the adjacent tidal flats.
- HDPE was used for the FML.
- A maximum stone size of 600 pounds in a 3-foot thick layer was used for the riprap/stone armor. Placement of the rock would be by heavy equipment with positioning assisted by laborers to provide a relatively flat finished surface.
- A passive gas venting layer would be included below the FML.
- Pre-design activities include geotechnical investigation and evaluation for settlement, slope and global stability, and sheet pile serviceability and stability.
- Engineering activities include evaluation and design of the riprap/stone armor to withstand storm surges.
- The alternative could be implemented in approximately ten months.
- Unit costs are based on vendor-supplied information, recently completed projects with similar tasks and materials, and unit costs from 1999 R.S. Means Site Work Cost Data.

4.3 Alternative 3 - Excavation and Off-site Disposal

The scope of Alternative 3 includes the following components:

- Demolition of Building 59 and other structures (concrete ramp and pad);
- Excavation of the Causeway fill material; and
- Off-site disposal of the excavated Causeway material.

4.3.1 Description of the Alternative

The removal action provided under Alternative 3 consists of excavation and proper off-site disposal of the contaminated fill material within the Causeway. Reconstruction of the Causeway was not considered under this alternative.

The low-level radiological-contaminated material identified during previous site investigations has been removed, containerized, and transported to an appropriate off-site licensed treatment/disposal facility. Therefore, this radiological-contaminated material is not included in the scope of this alternative.

Initial activities would include demolition of Building 59 and the concrete ramp and pad. The demolition debris would be transported and disposed of at an appropriate off-site licensed TSDF.

The excavation of the fill material would begin at the end of the Causeway and progress toward the main shore. Based on available data, it appears the fill thickness is approximately 10 to 14 feet over an area of approximately 2.2 acres. The total estimated volume of fill material that would require excavation is 43,000 cy. Pre-excavation sampling and analysis for waste characterization would eliminate the need to provide for temporary stockpiling of excavated material on-site prior to transportation and disposal. Reconstruction of the Causeway with clean fill was not included under this alternative. A new section of riprap dike would be constructed at the location where the Causeway once joined the main shore.

The proposed future land use may include public water access from a new dock located at the end of the former seaplane boat ramp at the Causeway. Alternative 3 would not include reconstruction of the Causeway. Therefore, Alternative 3 may not be completely compatible with the future development of the site.

4.3.2 Effectiveness

The effectiveness of Alternative 3 is evaluated in accordance with the following criteria:

- Overall protection of human health and the environment
- Compliance with ARARs
- Long-term effectiveness
- Reduction of toxicity, mobility, or volume through treatment
- Short-term effectiveness

Overall protection of human health and the environment. Alternative 3 provides protection of human health and the environment by physically removing the contaminated Causeway fill material from the SAEP site with treatment and/or disposal of the contaminated material at appropriate licensed off-site TSDFs.

Compliance with ARARs. Alternative 3 would be designed and implemented to attain the identified federal and state ARARs.

Long-term effectiveness. Alternative 3 would provide long-term effectiveness by physically removing the contaminated Causeway fill material from the SAEP site.

Reduction of toxicity, mobility, or volume through treatment. Alternative 3 provides a reduction in mobility of contaminants by removing the contaminated fill material from the site and transporting the material to an appropriate licensed off-site TSDF. Excavation of the contaminated Causeway fill material reduces the toxicity and volume of contaminants at the site; however, the contaminated material is simply transferred to another facility (i.e., off-site TSDF).

Short-term effectiveness. The short-term effectiveness criterion addresses the effects of the alternative during implementation, including the protection of the community and site workers, environmental impacts, and the time until the response objectives are achieved.

Access to the SAEP facility is restricted. With the exception of transportation of demolition debris (e.g., Building 59) and excavated contaminated fill material, the activities associated with Alternative 3 would be conducted in areas where access is limited to trained workers. Therefore, potential risks to the community would be minimized. Alternative 3 has potential short-term risks to site workers; however, these risks would be minimized by effectively implementing an approved site-specific health and safety plan.

Alternative 3 has the potential for short-term adverse effects on ecological receptors resulting from excavation of contaminated material. To prevent the migration of contaminated material out of the work area and to minimize environmental impacts, erosion and sediment control measures would be implemented. In addition, a portable dam would be installed around the Causeway to facilitate excavation and to prevent adverse effects on the adjacent tidal flats.

It is anticipated that implementation of Alternative 3 could be completed in approximately five months, at which time the response objectives would be achieved.

4.3.3 Implementability

The implementability of Alternative 3 is evaluated in accordance with the following criteria:

- Technical feasibility
- Administrative feasibility
- Availability of services and materials
- State acceptance
- Community acceptance

Technical feasibility. Alternative 3 is considered technically feasible for the Causeway. Excavation and off-site disposal of contaminated material is a commonly used and reliable remediation technology. During implementation of the alternative, construction practices and schedules would need to consider the tidal/wave actions of the Housatonic River.

Administrative feasibility. Alternative 3 is considered feasible from an administrative aspect. Although permits are not required for on-site CERCLA actions, the substantive requirements will be met.

Availability of services and materials. Alternative 3 can be implemented using standard or commonly available construction methods, services, and materials.

Alternative 3 includes demolition (e.g., Building 59), earthwork activities, and transportation/treatment/disposal of contaminated material. Experienced contractors and materials necessary for construction are readily available. Off-site licensed TSDFs are also available for the contaminated Causeway fill material.

State and community acceptance. Evaluation of state and community acceptance will be completed after receipt of comments provided during both the development of the EE/CA and following the 30-day public comment period for the EE/CA. Comments and concerns raised by the state regulatory agencies and the community will be considered in the final selection of the removal action alternative in the RAM.

4.3.4 Cost

The total capital cost for this alternative is estimated to be $18,349,359. No O&M costs are included as part of this alternative. The cost for this alternative is highly dependent on the percentages of excavated material that are characterized for disposal as non-hazardous versus hazardous. For this cost analysis, it was assumed 50 percent of the excavated material would be non-hazardous and 50 percent would be hazardous. The cost evaluation for this alternative is provided in Table 4-3.

The following assumptions were used in preparing the cost estimate for Alternative 3:

- The low-level radiological-contaminated material would be removed, containerized, and transported to an off-site TSDF prior to implementation of this alternative.
- The volume of Causeway material to be excavated is approximately 43,000 cubic yards (12 feet deep over approximately 2.2 acres).
- Reconstruction of the Causeway is not included as a component of the alternative.
- The Causeway material to be excavated consists of 50 percent non-hazardous material and 50 percent hazardous material.
- Characterization sampling for disposal of the Causeway material would be required at a rate of approximately one sample per 200 cy and analyzed for full-suite TCLP and TCL PCBs.
- Following excavation of the Causeway fill material, confirmation sampling would be conducted at a rate of approximately one sample per 500 square feet and analyzed for full-suite VOCs, SVOCs, PCBs, inorganics, and TCLP.
- Dewatering fluids encountered during excavation activities would be routed through the on-site Oil Abatement Treatment Plant prior to discharge to surface water.
- A portable dam would be used around the Causeway to facilitate excavation and to prevent adverse effects on the adjacent tidal flats.
- The alternative could be implemented in approximately five months.

- Unit costs are based on vendor-supplied information, recently completed projects with similar tasks and materials, and unit costs from 1999 R.S. Means Site Work Cost Data.

4.4 ALTERNATIVE 4 – CAPPING WITH EROSION CONTROL COVER SYSTEM

The scope of Alternative 4 includes the following components:

- Demolition of Building 59 and other structures (concrete ramp and pad);
- Removal of contaminated soil hot spot areas;
- Capping the Causeway with an erosion control cover system;
- Establishing environmental land use restrictions; and
- Conducting O&M activities.

4.4.1 Description of the Alternative

The removal action provided under Alternative 4 consists primarily of removal of contaminated soil hot spot areas and containment of the remaining contaminated fill material within the Causeway by constructing an erosion control cover system. The low-level radiological-contaminated material identified during previous site investigations has been removed, containerized, and transported to an appropriate off-site licensed treatment/disposal facility. Therefore, this radiological-contaminated material is not included in the scope of this alternative.

At the suggestion of the CTDEP, additional soil sampling and analysis was conducted in areas of the Causeway where the initial soil data indicated that there were exceedances of the CTDEP RSR GB PMC. Soil samples were collected in May 2000, analyzed by the SPLP, and the data compared to 10-times the Groundwater Protection Criteria in accordance with the CTDEP RSR Section 22a-133k-2(c)(2)(D). Based on this data comparison, three discrete areas of the Causeway exceed the criteria of 10-times the Groundwater Protection Criteria. These areas are sample locations: CB-99-15 (0 to 2 feet bgs), TP-DEP-12 (0 to 2 feet bgs), and TP-99-10 (1 to 3 feet bgs). The analytical data is presented in an addendum to the Final Pre-Design Investigation Report for the Causeway and Dike (Foster Wheeler/HLA, 2000).

Alternative 4 includes removal of three contaminated soil hot spot areas where soil SPLP data exceeds the CTDEP RSR criteria of 10-times the Groundwater Protection Criteria. For estimating purposes, each of these areas is approximately 30 feet by 30 feet in dimension. Approximately 250 cubic yards of contaminated soil would be excavated from these hot spot areas and transported to an appropriate off-site licensed treatment/disposal facility.

Following removal of the contaminated soil hot spot areas, the Causeway would be re-graded by cutting and filling existing material to establish base grades. In addition, Building 59 and the concrete ramp and pad would be demolished prior to cover system construction.

On top of the Causeway, the cover system (from bottom to top) would consist of:

- geotextile fabric; and
- riprap/stone armor.

A layer of geotextile fabric would first be placed over the re-graded Causeway surface as an indicator layer between the Causeway fill material and the erosion control cover system. The erosion control cover system would consist of riprap armor over the entire Causeway surface; however, a smaller size material would be used for the top, center portion of the Causeway, which would provide a surface that will be more compatible with the proposed future use of the Causeway (e.g., public water access). In the future, if a walkway along the Causeway is desirable, gravel could be added to the top, center portion of the Causeway to fill the voids between the small size stone riprap, which would provide a better surface for public access.

The riprap armor has been provided to ensure protection of the Causeway from storm surge or wave action. It has been assumed that the 4-foot thick layer of riprap armor on the side slopes of the Causeway would require a maximum stone size of approximately 600 pounds. A smaller size riprap would be used for the top, center portion of the Causeway, and would consist of a layer 2-feet in thickness placed over a 2-foot thick layer of common borrow. A detail of the cover system for Alternative 4 is provided on Figure 4-3.

In accordance with the CTDEP RSR, an environmental land use restriction would be required for the Causeway. The environmental land use restriction would establish restrictions on the future use of the Causeway to (1) prevent exposure to the contaminated Causeway fill material, and (2) maintain the integrity of the cover system that would be installed as part of this removal action alternative.

During preparation of the RAM (i.e., the decision document that presents the selected remedy) and the removal action design, a Declaration of Environmental Land Use Restriction would be submitted to the State of Connecticut Commissioner of Environmental Protection for review and approval. In accordance with the CTDEP RSR, the Declaration of Environmental Land Use Restriction would be accompanied by (1) a Class A-2 survey of the area subject to the restriction; (2) a decision document that includes any limitations on the use of the area subject to the restriction, as well as the reason for the restriction; and (3) a certified copy of a notice of intent to record an environmental land use restriction that has been published in a local newspaper.

An appropriate O&M program would be implemented to ensure that the cover system remains effective in the long term. O&M activities associated with this alternative would include monitoring and maintenance of the cover system, and five-year site reviews. The

U.S. TACOM is responsible for the jurisdiction, control, and accountability of the SAEP facility, as well as the O&M activities associated with this removal action alternative.

The description of Alternative 4 presented in this section and on Figure 4-3 is based on a "conceptual" design of the alternative. As with any removal action alternative, there are several details that would be addressed and evaluated during the detailed design of the alternative. These include, but are not limited to:

- Settlement and stability evaluation;
- Material specifications; and
- Size and thickness of riprap/stone armor.

Following evaluation of these design details, a removal action design would be prepared with the intent to minimize encroachment into the intertidal flats of the Housatonic River and waterward of the high tide line, in accordance with federal and state ARARs

4.4.2 Effectiveness

The effectiveness of Alternative 4 is evaluated in accordance with the following criteria:

- Overall protection of human health and the environment
- Compliance with ARARs
- Long-term effectiveness
- Reduction of toxicity, mobility, or volume through treatment
- Short-term effectiveness

Overall protection of human health and the environment. Alternative 4 provides protection of human health and the environment primarily by (1) removal of contaminated soil hot spot areas where there is a concern regarding the leaching and mobility of contaminants in the vadose zone; (2) engineering controls (i.e., cover system) to eliminate receptors from direct exposure to the contaminated Causeway fill material; and (3) institutional controls (i.e., environmental land use restrictions in accordance with CTDRP RSR) to establish restrictions on the future use of the Causeway and maintain the integrity of the cover system.

Compliance with ARARs. Alternative 4 would be designed and implemented to attain the identified federal and state ARARs.

Long-term effectiveness. Alternative 4 would provide long-term effectiveness by removing the contaminated soil hot spot areas and capping the Causeway to prevent direct exposure to the contaminated fill material. The final elevation of he Causeway would not be above the 100-year flood elevation of 13 feet MSL; however, the riprap armor over the Causeway would provide protection from storm surge or wave action. To ensure the long-term integrity of the cover system, periodic inspection and maintenance would be required.

Reduction of toxicity, mobility, or volume through treatment. Alternative 4 does not include active treatment and therefore, does not satisfy the CERCLA statutory preference for treatment. However, Alternative 4 provides a reduction in the mobility of contaminants by removing the contaminated soil hot spot areas and transporting the excavated material to an appropriate licensed off-site TSDF.

Short-term effectiveness. The short-term effectiveness criterion addresses the effects of the alternative during implementation, including the protection of the community and site workers, environmental impacts, and the time until the response objectives are achieved.

Access to the SAEP facility is restricted. The activities associated with Alternative 4 would be conducted in areas where access is limited to trained workers. Therefore, potential risks to the community would be minimized. Alternative 4 has potential short-term risks to site workers; however, these risks would be minimized by effectively implementing an approved site-specific health and safety plan.

Alternative 4 has the potential for short-term adverse effects on ecological receptors resulting from excavation of contaminated material and installation of the cover system. To prevent the migration of contaminated material out of the work area and to minimize environmental impacts, erosion and sediment control measures would be implemented.

Alternative 4 includes construction of the erosion control cover system without initial excavation and re-consolidation of the existing Causeway toe and side slope material. This would result in an increase in the overall “footprint” of the Causeway, which in turn may result in adverse effects to the environment. Based on initial Causeway side slopes of 3 horizontal to 1 vertical (3:1), final side slopes of 2:1, and a 4-foot thickness of stone riprap, the area of the Causeway at the toe of slope would likely increase by approximately 0.3 acres (i.e., from approximately 2.2 acres to approximately 2.5 acres). Alternative 4, as presented in this EE/CA, results in some encroachment into the intertidal flats of the Housatonic River and waterward of the high tide line. However, based on evaluation of the design details identified in Subsection 4.4.1, a removal action design would be prepared with the intent to minimize the amount of encroachment to the extent practical.

It is anticipated that implementation of Alternative 4 could be completed in approximately seven months, at which time the response objectives would be achieved.

4.4.3 Implementability

The implementability of Alternative 4 is evaluated in accordance with the following criteria:

- Technical feasibility
- Administrative feasibility

- Availability of services and materials
- State acceptance
- Community acceptance

Technical feasibility. Alternative 4 is considered technically feasible for the Causeway. Excavation and off-site treatment/disposal of contaminated material and construction of erosion control measures are commonly used and reliable remediation technologies. During implementation of the alternative, construction practices and schedules would need to consider the tidal/wave actions of the Housatonic River.

Technical feasibility issues associated with construction of an erosion control cover system in a tidal river environment would be addressed during design of the cover system. The Causeway is underlain by loose river sediments, which are potentially highly organic and approximately 60 feet thick. It is not anticipated that construction of the cover system would result in significant differential settlement, and therefore, the alternative does not currently include pre-loading of the Causeway prior to construction of the cover system. However, design issues include settlement, slope and global stability, and erosion of the cover system due to tidal and storm surges. Pre-design activities would include geotechnical investigation and evaluation of settlement and stability. Additionally, further evaluation of the effects of the tidal river environment on the Causeway cover system would be conducted (e.g., size and thickness of the stone/rock armor layer of the cover system to minimize potential future erosion).

Administrative feasibility. Alternative 4 is considered feasible from an administrative aspect. Although permits are not required for on-site CERCLA actions, the substantive requirements would be met. Additionally, an environmental land use restriction would be implemented for the Causeway in accordance with the CTDEP RSR.

Availability of services and materials. Alternative 4 can be implemented using standard or commonly available construction methods, services, and materials. Alternative 4 includes demolition (e.g., Building 59), earthwork activities, and transportation/treatment/disposal of contaminated material. Experienced contractors and materials necessary for construction are readily available. Off-site licensed TSDFs for demolition debris (e.g., Building 59) and contaminated Causeway fill material are also available.

State and community acceptance. Evaluation of state and community acceptance will be completed after receipt of comments provided during both the development of the EE/CA and following the 30-day public comment period for the EE/CA. Comments and concerns raised by the state regulatory agencies and the community will be considered in the final selection of the removal action alternative in the RAM.

4.4.4 Cost

The 30-year net worth of this alternative is estimated to be $3,976,220 for capital and O&M costs. O&M costs include monitoring and maintenance of the cover system and five-year site reviews. Groundwater monitoring will be included in the Feasibility Study for the remainder of the SAEP facility.

Consistent with USEPA guidance, a discount rate of seven percent before taxes and after inflation was used to prepare the cost estimate (USEPA, 1993a). The cost evaluation for this alternative is provided in Table 4-4.

The following assumptions were used in preparing the cost estimate for Alternative 4:

- The existing Causeway toe of slope location would not be maintained.
- A portable dam would not be used around the Causeway.
- The Causeway fill material excavated from the contaminated soil hot spot areas consists of hazardous material.
- A geotextile fabric would be used as an indicator layer between the Causeway surface and the cover system.
- A maximum stone size of 600 pounds in a 4-foot thick layer was used for the riprap/stone armor for the side slopes of the Causeway. A 2-foot thick layer of smaller size riprap, placed over a 2-foot thick layer of common borrow was used for the top, center portion of the Causeway. Placement of the rock would be by heavy equipment with positioning assisted by laborers to provide a relatively flat finished surface.
- Pre-design activities include geotechnical investigation and evaluation for settlement, slope and global stability.
- Engineering activities include evaluation and design of the riprap/stone armor to withstand storm surges.
- The alternative could be implemented in approximately seven months.
- Unit costs are based on vendor-supplied information, recently completed projects with similar tasks and materials, and unit costs from 1999 R.S. Means Site Work Cost Data.

5.0 COMPARATIVE ANALYSIS OF REMOVAL ACTION ALTERNATIVES

This section presents a comparative analysis of the removal action alternatives described in Section 4.0 of this EE/CA. The comparative analysis is a comparison of the alternatives relative to the evaluation criteria. The purpose of the comparative analysis is to identify the advantages and disadvantages of the alternatives relative to one another, and to aid in the eventual selection of a removal alternative.

5.1 APPROACH TO THE COMPARATIVE ANALYSIS

Specific CERCLA requirements are considered when comparing alternatives for selection of a preferred site remedy. The NCP outlines the approach for performing the comparative analysis of alternatives. The recommended alternative must reflect the scope and purpose of the actions being undertaken and indicate how these actions relate to other removal and remedial actions, and the long-term response at the site. Identification of the preferred alternative and final remedy selection are based on an evaluation of the major tradeoffs among the alternatives in terms of the CERCLA evaluation criteria. The USEPA categorizes these evaluation criteria into three groups: threshold, balancing, and modifying. Each of these groups is discussed in the following subsections.

5.1.1 Threshold Criteria

The two threshold criteria described below must be met in order for the alternatives to be eligible for selection in accordance with the NCP.

- **Overall protection of human health and the environment** addresses whether or not the remedy provides adequate protection to human health and the environment and describes how risks posed through each pathway are eliminated, reduced, or controlled through treatment, engineering controls, or institutional controls.
- **Compliance with ARARs** addresses whether or not the remedy will meet all of the ARARs of federal and more stringent state environmental laws and/or provide grounds for invoking a waiver.

5.1.2 Primary Balancing Criteria

The following five criteria are utilized to compare and evaluate the elements of one alternative to another that meet the threshold criteria.

- **Long-term effectiveness and permanence** addresses the criteria that are utilized to assess alternatives for long-term effectiveness and permanence they afford, along with the degree of certainty that they will prove successful.

- **Reduction of toxicity, mobility, or volume through treatment** addresses the degree to which alternatives employ recycling or treatment that reduces toxicity, mobility, or volume, including how treatment is used to address the principal threats posed by the site.
- **Short-term effectiveness** addresses the period of time needed to achieve protection and any adverse impacts on human health and the environment that may be posed during the construction and implementation period, until cleanup goals are achieved.
- **Implementability** addresses the technical and administrative feasibility of a remedy, including the availability of materials and services needed to implement a particular option.
- **Cost** includes estimated capital costs (indirect and direct) and O&M costs.

5.1.3 Modifying Criteria

The modifying criteria are used on the final evaluation of alternatives, generally after the public comment period on the EE/CA.

- **State acceptance** addresses the state's position and key concerns related to the preferred alternative and other alternatives, and the state's comments on ARARs and to be considered information or the proposed use of waivers.
- **Community acceptance** addresses the public's general response to the alternatives described in the EE/CA.

5.2 Comparative Analysis

The following removal action alternatives were evaluated in detail in Section 4.0 and will undergo comparative analysis in this section:

Alternative 1 Capping with Synthetic Geomembrane
Alternative 2 Capping with Composite Cover System and Vertical Barrier
Alternative 3 Excavation and Off-site Disposal
Alternative 4 Capping with Erosion Control Cover System

5.2.1 Comparison of Threshold Criteria

Overall protection of human health and the environment. Alternatives 1 through 4 are protective of human health and the environment by eliminating, reducing, or controlling risks posed by the site. Alternatives 1 and 2 provide overall protection to human health and the environment by using an engineered control (e.g., capping system) to eliminate receptor exposure to the contaminated Causeway fill material, and an environmental land use restriction for the Causeway to ensure that the integrity of the capping system is maintained. Alternative 2 provides additional protection to human health and the environment over Alternative 1 because (1) the cover system includes a composite barrier (i.e., FML and GCL), rather than an FML alone; and (2) the sheet pile seawall provides additional protection as a barrier to minimize the potential of transporting soluble contaminants outside the limits of the cap. Alternative 3 also provides overall protection of human health and the environment by physically removing the contaminated Causeway fill material from the SAEP site with treatment and/or disposal of the contaminated material at appropriate licensed off-site TSDFs. Alternative 4 provides overall protection to human health and the environment by removing contaminated soil hot spot areas where there are SPLP exceedances of the CTDEP RSR criteria of 10-times the Groundwater Protection Criteria. Alternative 4 also includes an erosion control cover system that will prevent receptors from direct exposure to contaminated soil.

Compliance with ARARs. Alternatives 1 through 4 would be designed and implemented to attain their respective federal and state ARARs.

5.2.2 Comparison of Primary Balancing Criteria

Long-term effectiveness and permanence. Alternatives 1 through 4 all provide long-term effectiveness and permanence. Alternatives 1 and 2 provide long-term effectiveness by capping the Causeway, which will prevent exposure to the contaminated fill material and minimize the leaching of contaminants due to precipitation infiltrating through the contaminated fill material. Additionally, the riprap armor over the Causeway provides protection from storm surge or wave action during a 100-year storm event. Alternative 2 provides a greater level of long-term effectiveness than Alternative 1 because (1) the cover system includes a composite barrier (i.e., FML and GCL), rather than an FML alone; and (2) the sheet pile seawall provides additional protection as a barrier to minimize the potential of transporting soluble contaminants outside the limits of the cap.

Alternative 4 provides a high level of protection by removing contaminated soil hot spot areas where there are SPLP exceedances of the CTDEP RSR criteria of 10-times the Groundwater Protection Criteria. Alternative 4 also includes an erosion control cover system that would prevent receptors from direct exposure to contaminated soil and provide protection from storm surge or wave action during a 100-year storm event. An appropriate O&M program, which includes monitoring and maintenance of the cover system, must be implemented as part of Alternatives 1, 2, and 4 to ensure that the capping systems remain effective in the long term. The O&M program for Alternative 1 and 2 also includes long-term groundwater monitoring to ensure long-term effectiveness of the remedy.

Alternative 3 provides long-term effectiveness and permanence by removing the contaminated Causeway fill material from the site and transporting the material to an appropriate licensed off-site TSDF.

Reduction of toxicity, mobility, or volume through treatment. Alternatives 1 through 4 do not include active treatment and therefore, do not satisfy the CERCLA statutory preference for remedies that involve treatment that reduces toxicity, mobility, or volume as a principal element. Alternatives 1 and 2 provide a reduction in the mobility of contaminants by capping the contaminated Causeway fill material, which would minimize the leaching of contaminants due to precipitation infiltrating through the contaminated fill material. The sheet pile seawall provides additional protection as a barrier to minimize the potential of transporting soluble contaminants outside the limits of the cap, thereby providing additional reduction in the mobility of contaminants. Alternatives 1 and 2 do not provide a reduction in the toxicity or volume of contaminants.

Alternative 3 provides a reduction in mobility of contaminants by removing the contaminated fill material from the site and transporting the material to an appropriate licensed off-site TSDF. Excavation of the contaminated Causeway fill material (Alternative 3) reduces the volume of contaminants at the site; however, the contaminated material is simply transferred to another facility (i.e., TSDF). Alternative 4 provides a reduction in mobility of contaminants by removing the contaminated soil hot spot areas from the Causeway and transporting the material to an appropriate licensed off-site TSDF.

Short-term effectiveness. Alternatives 1 through 4 provide short-term effectiveness. All four alternatives are anticipated to be completed in one construction season; Alternatives 1 and 2 in approximately ten months, Alternative 3 in approximately five months, and Alternative 4 in approximately seven months. Alternatives 1 through 4 all have potential short-term risks to site workers; however, these risks can be minimized by effectively implementing an approved site-specific health and safety plan.

Alternative 3, which is anticipated to be completed in approximately five months, has a greater short-term risk to site workers due to the excavation of the contaminated Causeway soil. Alternatives 1 and 2 are anticipated to require approximately ten months to complete; however, the most significant risk to site workers would be during the consolidation of toe and side slope material and cutting and filling operations of the existing Causeway surface materials, which are anticipated to be completed in approximately four to six weeks.

Alternative 4 is anticipated to require approximately seven months to complete; however, the most significant risk to site workers would be during the removal of soil hot spot areas and cutting and filling operations of the existing Causeway surface materials, which are anticipated to be completed in approximately two weeks.

Alternatives 1, 2, and 3 are also anticipated to have some short-term adverse effects on ecological receptors resulting from excavation of contaminated material on and adjacent to the tidal flats. Designing and implementing appropriate erosion and sediment control measures, and the use of a portable dam around the Causeway construction area would minimize any adverse effects on the environment.

Alternative 4 includes construction of the erosion control cover system without initial excavation and re-consolidation of the existing Causeway toe and side slope material. This would result in an increase in the overall “footprint” of the Causeway, which in turn may result in some adverse effects to the environment. However, based on evaluation of the design details identified in Subsection 4.4.1, a removal action design would be prepared with the intent to minimize the amount of encroachment to the extent practical, which in turn would minimize any adverse effects on the environment.

Implementability. All of the alternatives are easily implemented. All equipment, materials, and services that are required for implementation of the alternatives are readily available. The CTDEP RSR allows the use of an engineered control (e.g., capping or containment system) to isolate contaminated soil. Capping (Alternatives 1 and 2) is a reliable and proven remediation technology for contaminated material that is left in place. Installation of a sheet pile seawall (Alternative 2) is also a commonly used construction technique. Alternatives 1, 2, and 4 include an environmental land use restriction to (1) prevent exposure to the contaminated Causeway fill material and (2) maintain the integrity of the cover system. The environmental land use restriction for the Causeway would be implemented in accordance with the CTDEP RSR. Excavation and off-site disposal of the Causeway fill material (Alternative 3), and removal of the contaminated soil hot spot areas (Alternative 4) requires only standard excavation equipment, and off-site TSDFs have available capacity for the treatment and/or disposal of the contaminated Causeway fill material.

The proposed future land use may include public water access from a new dock located at the end of the former seaplane boat ramp at the Causeway. Alternative 3 does not include reconstruction of the Causeway. Therefore, Alternative 3 may not be completely compatible with the future development of the site.

Cost. Based on the cost estimates presented in Section 4.0 of this EE/CA, the estimated present worth costs for the removal action alternatives are as follows:

Alternative 1	Capping with Synthetic Geomembrane	$ 5,518,486
Alternative 2	Capping with Composite Cover System and Vertical Barrier	$ 6,899,468
Alternative 3	Excavation and Off-site Disposal	$18,349,359
Alternative 4	Capping with Erosion Control Cover System	$ 3,976,220

5.2.3 Comparison of Modifying Criteria

State acceptance and Community acceptance. Evaluation of state and community acceptance will be completed after receipt of comments provided during both the development of the EE/CA and following the 30-day public comment period for the EE/CA. A Responsiveness Summary will be prepared that provides responses to comments received during the public comment period. The Responsiveness Summary will be included in the RAM, which is a decision document that presents the selected removal action alternative, explains the rationale for the selection, and provides responses to public comments and concerns raised during the public comment period for the EE/CA.

6.0 RECOMMENDED REMOVAL ACTION ALTERNATIVE

Alternative 4, Capping with Erosion Control Cover System, is the recommended alternative for the Causeway. Alternative 4 is recommended primarily because this alternative provides a high degree of overall protection to human health and the environment, as well as long-term effectiveness and permanence. Alternative 4 provides a high degree of protection by removing contaminated soil hot spot areas where there are SPLP exceedances of the CTDEP RSR criteria of 10-times the Groundwater Protection Criteria. Alternative 4 also includes an erosion control cover system that will prevent receptors from direct exposure to contaminated soil. The final elevation of the Causeway will not be above the 100-year flood elevation of 13 feet MSL; however, the riprap armor will provide protection from storm surge or wave action during a 100-year storm event. Alternative 4 allows the Causeway to be available for the proposed future use, which may include public water access at the end of the Causeway. In the future, if a walkway along the Causeway is desirable, gravel could be added to the top, center portion of the Causeway to fill the voids between the small size stone riprap, which provide a better surface for public access. Alternative 4 also includes an O&M program, which consists of monitoring and maintenance of the cover system, to ensure that the cover system remains effective in the long term.

Alternative 4 will be designed and implemented to attain federal and state ARARs. The CTDEP RSR allows the use of engineering controls (e.g., cover or containment system) to physically isolate contaminated soil and render them inaccessible. Alternative 4 also includes an environmental land use restriction for the Causeway, which would be implemented in accordance with the CTDEP RSR.

Alternative 4 will be designed and implemented using appropriate erosion and sediment control measures to minimize adverse effects on the environment.

All equipment, materials, and services required for implementation of Alternative 1 are readily available, and it is anticipated that the alternative can be completed in approximately seven months. The estimated cost of Alternative 4 is approximately $4 million, which is approximately 25 to 40 percent lower than the cost of Alternatives 1 and 2, and significantly less than the cost of Alternative 3. Alternative 4 is also expected to be consistent with the RI and Feasibility Study, currently being conducted for the overall SAEP facility. Therefore, Alternative 4 is believed to provide the optimum combination of overall protection of human health and the environment and compliance with ARARs, at a reasonable cost.

ABB-ES	ABB Environmental Services, Inc.
ARAR	Applicable or Relevant and Appropriate Requirement
AVCO	Avco Corporation
BRAC	Base Closure and Realignment
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CTDEP	Connecticut Department of Environmental Protection
cy	cubic yard
DEC	Direct Exposure Criteria
EE/CA	Engineering Evaluation/Cost Analysis
F	Fahrenheit
FML	flexible membrane liner
Foster Wheeler	Foster Wheeler Environmental Corporation
GCL	geocomposite clay liner
GDL	geocomposite drainage layer
HDPE	high-density polyethylene
HLA	Harding Lawson Associates
LLDPE	linear low-density polyethylene
LRA	Local Redevelopment Authority
MCL	Maximum Contaminant Level
MSL	mean sea level
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NCRA	Non-time-Critical Removal Action
NGVD	National Geodetic Vertical Datum
O&M	operation and maintenance
OU	Operable Unit
PCB	polychlorinated biphenyl
PLM	polarizing light microscope
PMC	Pollutant Mobility Criteria
PVC	polyvinyl chloride
RAM	Removal Action Memorandum
RCRA	Resource Conservation and Recovery Act

GLOSSARY OF ACRONYMS AND ABBREVIATIONS

RI	Remedial Investigation
RKG	RKG Associates, Inc.
RSR	Remediation Standard Regulation
SAEP	Stratford Army Engine Plant
SPLP	Synthetic Precipitate Leaching Procedure
SVOC	semivolatile organic compound
TACOM	United States Tank-Automotive and Armament Command
TAL	Target Analyte List
TERC	Total Environmental Restoration Contract
TSDF	treatment, storage, and disposal facility
USACE	United States Army Corps of Engineers – New England District
USEPA	United States Environmental Protection Agency
VOC	volatile organic compound
W-C	Woodward-Clyde Consultants

ABB Environmental Services, Inc. (ABB-ES), 1996. "Final Environmental Baseline Survey Report". Prepared for the U.S. Army Environmental Center, December 1996.

Department of Defense, 1993. "BRAC Cleanup Plan guidebook". Prepared for the Department of Defense, Fall 1993.

Flint, Richard Foster, 1968. "The Surficial Geology of the Ansonia and Milford Quadrangles. State Geological and Natural History Survey of Connecticut". A Division of the Department of Agriculture and Natural Resources. Quadrangle Report No. 23.

Foster Wheeler Environmental Corporation/Harding Lawson Associates (Foster Wheeler/HLA), 2000. "Final Pre-Design Investigation Report for the Causeway and Dike". Prepared for the U.S. Army Corps of Engineers, April 2000.

RKG Associates, Inc. (RKG), 1997. "SAEP Redevelopment Plan and Implementation Strategy and Homeless Assistance Submission". Prepared for the Stratford Army Engine Plant Local Redevelopment Authority, June 1997.

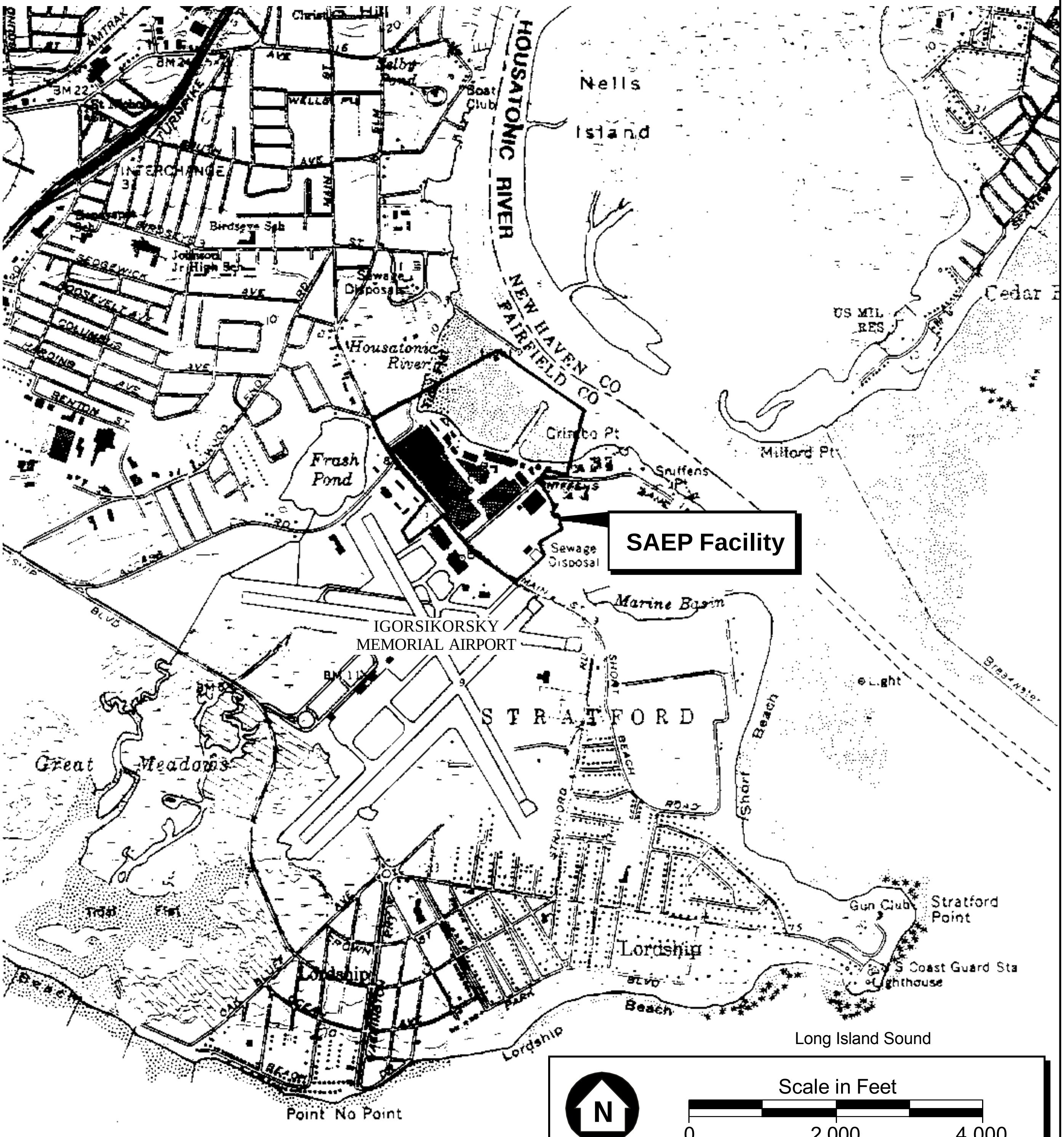
U.S. Environmental Protection Agency (USEPA), 1990. "National Oil and Hazardous Substances Pollution Contingency Plan". 40 CFR Part 300, March 1990.

U.S. Environmental Protection Agency (USEPA), 1993a. "Revisions to OMB Circular A-94 on Guidelines and discount Rates for Benefit-Cost Analysis". USEPA Office of Solid Waste and Emergency Response, OSWER Directive 9355.3-20, June 25, 1993.

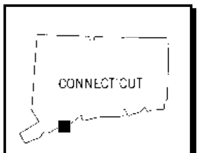
U.S. Environmental Protection Agency (USEPA), 1993b. "Guidance on Conducting Non-Time-Critical Removal Actions Under CERCLA". Office of Emergency and Remedial Response. USEPA/540-R-93-057, Washington DC, August 1993.

Woodward-Clyde Consultants (W-C), 1991. "Final Preliminary Assessment Screening, Stratford Army Engine Plant, Connecticut". Prepared for the U.S. Army Corps of Engineers, Omaha District.

Woodward-Clyde Consultants (W-C), 1996. "Phase II Remedial Investigation Report". Prepared for the U.S. Army Corps of Engineers, Omaha District.



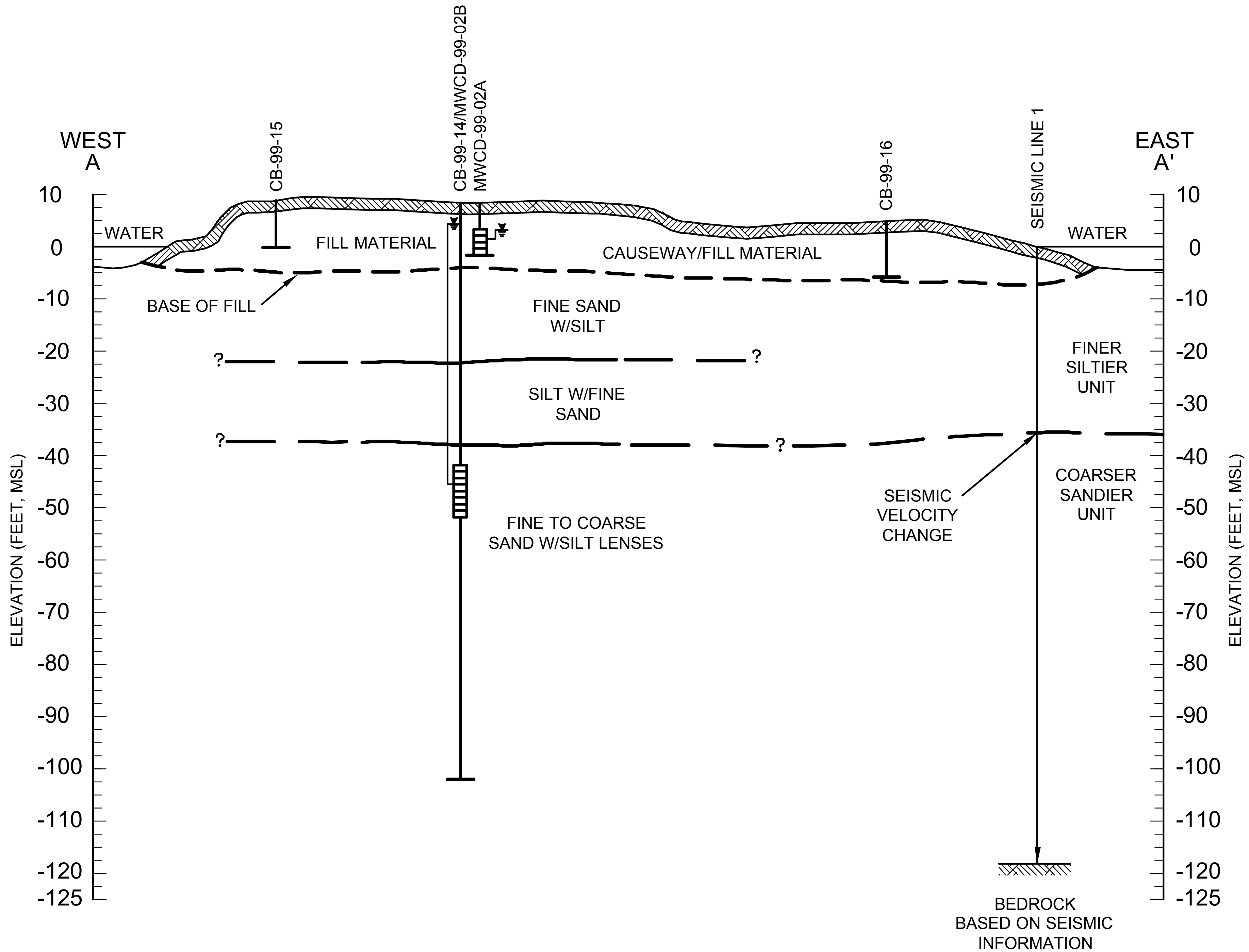
Source: USGS Quadrangle, 7.5 Minute Series.
Woodward-Clyde Consultants, 1991. Final PAS.



Quadrangle Location

Harding Lawson Associates Engineering and Environmental Services	**SITE LOCATION MAP**	
STRATFORD ARMYENGINEPLANT STRATFORD, CONNECTICUT	ENGINEERINGEVALUATION/ COST ANALYSIS	
	47254	**FIGURE 2-1**

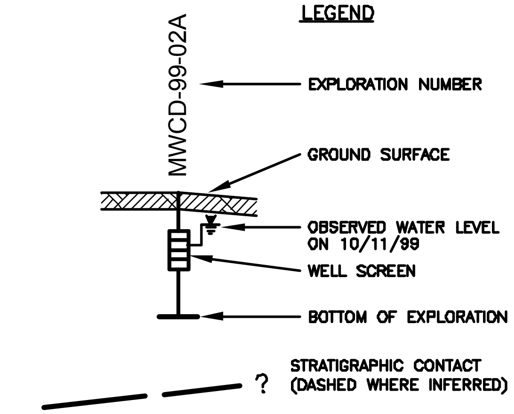
FIGURE 2-2
CAUSEWAY AND DIKE EXPLORATION LOCATIONS
ENGINEERING EVALUATION/COST ANALYSIS
STRATFORD ARMY ENGINE PLANT
Harding Lawson Associates



CROSS-SECTION A-A'

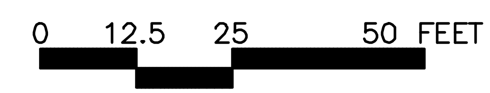
SEE FIGURE 2-2 FOR LOCATION OF PROFILE

LEGEND



WATER ELEVATIONS ON 10/11/99

LOCATION	WATER DEPTH BELOW RISER	RISER ELEVATION	WATER ELEVATION
MWCD-99-02A	6.92'	10.47'	3.55'
MWCD-99-02B	5.00'	10.33'	5.33'



SCALE: 1"=25' HORIZ.
1"=25' VERT.
VERTICAL EXAGGERATION 1:1

FIGURE 2-3
INTERPRETIVE GEOLOGIC PROFILE
CROSS-SECTION A-A'
ENGINEERING EVALUATION/COST ANALYSIS
STRATFORD ARMY ENGINE PLANT

Harding Lawson Associates

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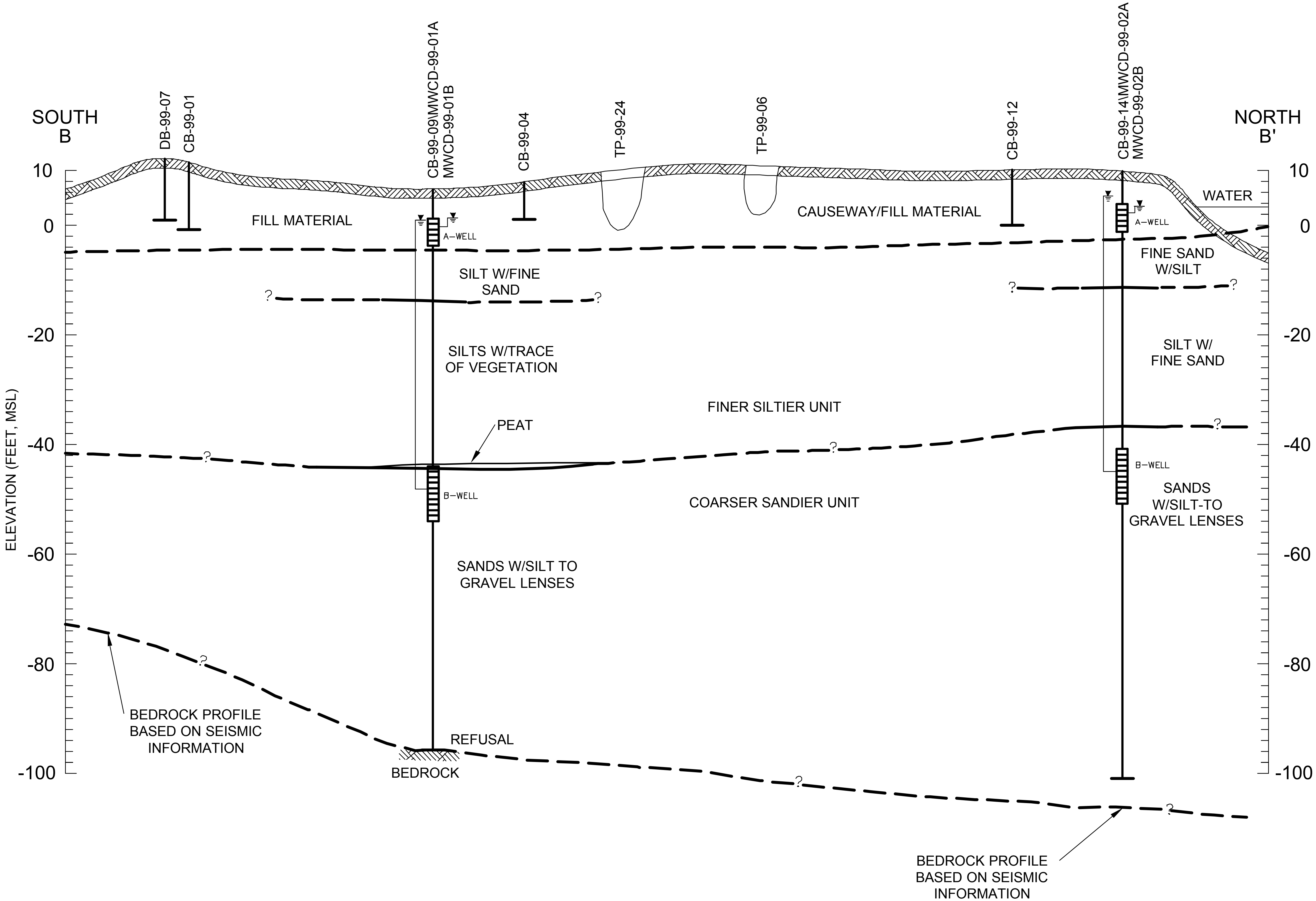

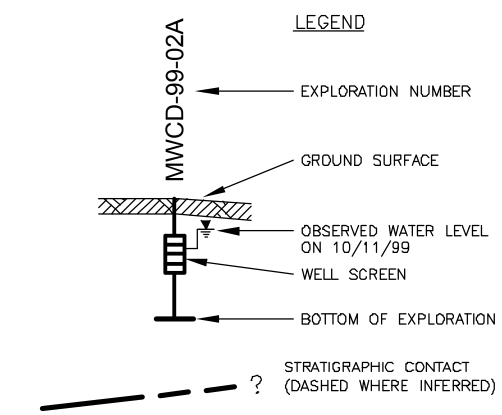

WATER ELEVATIONS ON 10/11/99

LOCATION	WATER DEPTH BELOW RISER	RISER ELEVATION	WATER ELEVATION
MWCD-99-01A	6.22'	7.95'	1.73'
MWCD-99-01B	7.07'	8.14'	1.07'
MWCD-99-02A	6.92'	10.47'	3.55'
MWCD-99-02B	5.00'	10.33'	5.33'

0 40 80 160 FEET

SCALE: 1"=80' HORIZ.
1"=20' VERT.
VERTICAL EXAGGERATION 4:1

CROSS-SECTION B-B'

SEE FIGURE 2-2 FOR LOCATION OF PROFILE

FIGURE 2-4
INTERPRETIVE GEOLOGIC PROFILE
CROSS-SECTION B-B'
ENGINEERING EVALUATION/COST ANALYSIS
STRATFORD ARMY ENGINE PLANT

Harding Lawson Associates

G:\PROJECTS\TERCS\PROJECTS\D020\OU2\CAUSEWAY\FIGURES\47254CS24.DWG 2-02-2000 DEL

FIGURE 2-5
EXCEEDANCES OF DIRECT EXPOSURE CRITERIA FOR SOIL
ENGINEERING EVALUATION/COST ANALYSIS
STRATFORD ARMY ENGINE PLANT
Harding Lawson Associates

CB-99-15		1'-3'	7'-9'
Acenapthene	84	--	190
Anthracene	400	--	520J
Benzo(a)Anthracene	1	50	1200J
Benzo(a)Pyrene	1	43	880J
Benzo(b)Fluoranthene	1	35	940J
Benzo(k)Fluoranthene	1	32J	880J
Carbazole	1	6.9	310
Chrysene	1	46	1,200
Dibenzofuran	5.6	6.9	130
Fluoranthene	56	120	2700
Fluorene	56	--	250J
Indeno(1,2,3-CD)Pyrene	1	30	350
Naphthalene	56	--	97J
Phenanthrene	40	100	2400
Pyrene	40	93	1800J

CB-99-14		1'-3'/1'-3' DUP
Benzo(a)Anthracene	1	1.5/2.2
Benzo(a)Pyrene	1	2.3/3.3
Benzo(b)Fluoranthene	1	2.4/3.2
Benzo(k)Fluoranthene	1	1.4/2.9
Chrysene	1	1.6/2.4
Indeno(1,2,3-CD)Pyrene	1	2.2/2.6

CB-99-13		7'-9'/7'-9' DUP
Tetrachloroethene	1	37/28

TP-99-10		3'-5'
Benzo(a)Anthracene	1	9.4
Benzo(a)Pyrene	1	8
Benzo(b)Fluoranthene	1	7.2
Benzo(k)Fluoranthene	1	7.2
Carbazole	1	1.6
Chrysene	1	9.2
Indeno(1,2,3-CD)Pyrene	1	9.2
Tetrachloroethene	1	2.1J
Trichloroethene	1	2.3J

CB-99-11		0'-2'
Benzo(k)Fluoranthene	1	1.1J
Trichloroethene	1	2J

TP-99-06		6'-8'
Trichloroethene	1	1.2J
Aroclor-1260	1	11

HA-99-07		0'-1'
1,1,1-Trichloroethane	40	340
1,1-Dichloroethane	14	120J
1,1-Dichloroethene	1.4	12J
2-Methylnapthalene	9.8	25
Benzene	0.2	3.8J
Tetrachloroethene	1	1200
Toluene	67	180J
Trichloroethene	1	560
Vinyl Chloride	0.4	36J
Xylene (total)	19.5	26J
bis(2-Ethylhexyl)Phthalate	11	96
cis-1,2-Dichloroethene	14	3300

CB-99-04		0'-2'	5'-7'
Tetrachloroethene	1	--	2.7J
Trichloroethene	1	3.4J	1.2J
Vinyl Chloride	0.4	--	24
cis-1,2-Dichloroethene	14	--	120

CB-99-12		8'-10'
Benzo(a)Anthracene	1	22J
Benzo(a)Pyrene	1	19J
Benzo(b)Fluoranthene	1	17J
Benzo(k)Fluoranthene	1	18J
Chrysene	1	20
Dibenz(a,b)Anthracene	1	8.1
Fluoranthene	56	58
Phenanthrene	40	60
Pyrene	40	46

TP-DEP-12		1'-3'
Trichloroethene	1	4J
Vanadium	0.5	1.07
Vinyl Chloride	0.4	1.9J

CB-99-03		2'-4'/2'-4' DUP	4'-6'
2-Methylnapthalene	9.8	--	45
Methylene Chloride	1	1J/3.3J	--
Vanadium	0.5	--	5.92

CB-99-02		5'-7'
Methylene Chloride	1	--
Tetrachloroethene	1	81
Trichloroethene	1	4.3J
cis-1,2-Dichloroethene	14	100

TP-DEP-11		0'-1'
Hexachlorobenzene	1	1.4
Tetrachloroethene	1	2.9
Trichloroethene	1	8.8
Vanadium	0.5	0.807

CB-99-08		1'-3'/1'-3' DUP
Trichloroethene	1	--/8.4J

CB-99-09		10'-12'
Benzo(a)Anthracene	1	1.2J
Benzo(a)Pyrene	1	1J
Benzo(b)Fluoranthene	1	1J
Crysene	1	1.3

CB-99-01		0'-2'	9'-11'
Methylene Chloride	1	1.4	1.9
Trichloroethene	1	--	3J

HA-99-03		0'-1'
Benzo(a)Anthracene	1	13
Benzo(a)Pyrene	1	13
Benzo(b)Fluoranthene	1	9.9
Benzo(k)Fluoranthene	1	12
Carbazole	1	4.2
Chrysene	1	14
Indeno(1,2,3-CD)Pyrene	1	9

LEGEND

- SF-1 — EXISTING WOODWARD-CLYDE ASBESTOS SURFACE SOIL SAMPLING LOCATION (APPROXIMATE)
- MWCD-99-01A — EXISTING HLA CAUSEWAY/DIKE MONITORING WELLS
- TP-99-22 — EXISTING HLA TEST PIT LOCATIONS
- CB-99-01 — EXISTING HLA CAUSEWAY BORING
- DB-99-01 — EXISTING HLA DIKE BORING
- HA-99-01 — EXISTING HAND AUGERS
- B-53 — BUILDING DESIGNATIONS
- CHAINLINK FENCE
- SAEP PROPERTY BOUNDARY
- LIMITS OF PRE-DESIGN INVESTIGATION
- A — A' GEOLOGIC PROFILE LOCATION

- DUP — DUPLICATE SAMPLE
- -- — LESS THAN REPORTING EXCEEDANCES
- J — VALUE IS ESTIMATED
- BGS — BELOW GROUND SURFACE

LOCATION IDENTIFIER → CB-99-07; SAMPLING INTERVAL (BGS) → 0'-2'/0'-2' DUP; COMPOUND → Arsenic; REMEDIATION STANDARD REGULATION (RSR) CRITERION → 10; CONCENTRATION (mg/kg) → 10.7/10.9

ALL CONCENTRATIONS REPORTED IN MILLIGRAMS PER KILOGRAM (mg/kg) EXCEPT FOR VANADIUM WHICH IS REPORTED IN MILLIGRAMS PER LITER (mg/L)

NOTES:
1. MAP IS IN CONNECTICUT STATE PLANE COORDINATES.
2. BASE MAP SOURCE: ALLIEDSIGNAL, INC.
3. ALL ELEVATION CONTOURS ARE INTERPRETIVE AND APPROXIMATE. CONTOUR INTERVAL IS 1 FOOT.

0 40 80 160 FEET
SCALE: 1"=80'

FIGURE 2-6
EXCEEDANCES OF GB POLLUTANT MOBILITY CRITERIA
ENGINEERING EVALUATION/COST ANALYSIS
STRATFORD ARMY ENGINE PLANT

Harding Lawson Associates

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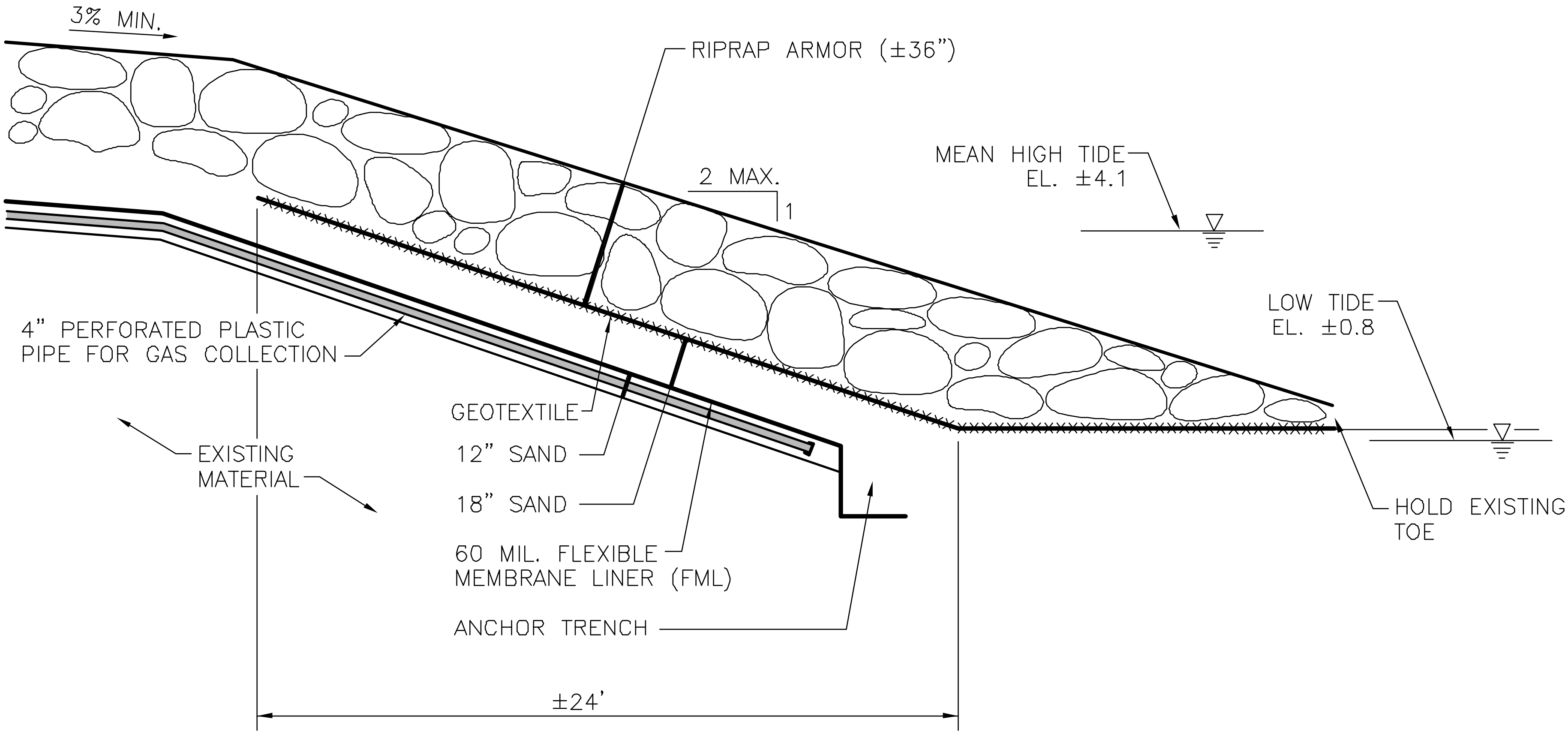

NOTE:

EXCAVATE EXISTING MATERIAL SO THAT EXISTING TOE CAN BE MAINTAINED.

ALTERNATIVE 1 – CAPPING WITH SYNTHETIC GEOMEMBRANE

N.T.S.

FIGURE 4-1
ALTERNATIVE 1
EE/CA FOR THE CAUSEWAY
NON-TIME CRITICAL REMOVAL ACTION
STRATFORD ARMY ENGINE PLANT

Harding Lawson Associates

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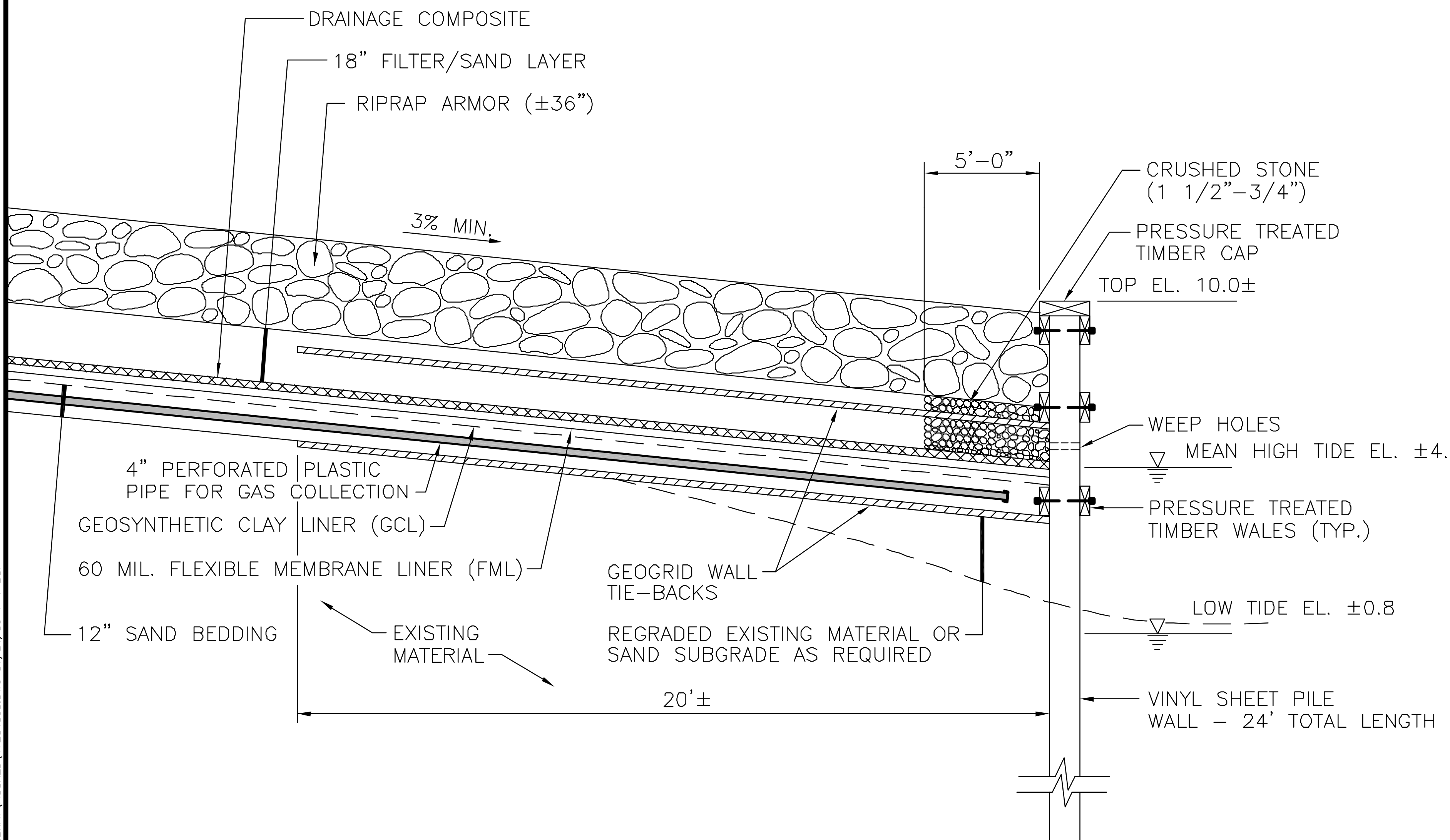

ALTERNATIVE 2 – CAPPING WITH COMPOSITE COVER SYSTEM AND VERTICAL BARRIER

N.T.S.

FIGURE 4-2
ALTERNATIVE 2
EE/CA FOR THE CAUSEWAY
NON-TIME CRITICAL REMOVAL ACTION
STRATFORD ARMY ENGINE PLANT

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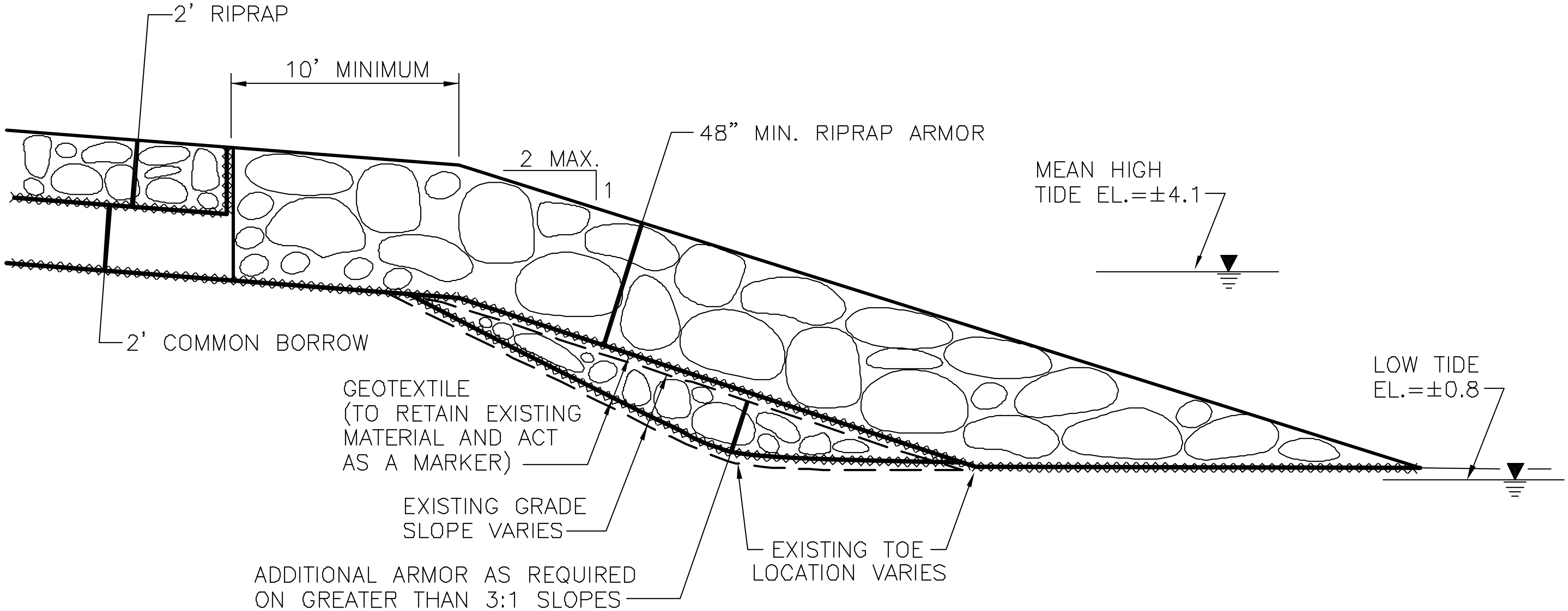

ALTERNATIVE 4 – EROSION CONTROL COVER SYSTEM

N.T.S.

FIGURE 4-3
ALTERNATIVE 4
EE/CA FOR THE CAUSEWAY
NON-TIME CRITICAL REMOVAL ACTION
STRATFORD ARMY ENGINE PLANT

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TABLE 2-1
SUMMARY OF DIRECT EXPOSURE CRITERIA EXCEEDANCES - CAUSEWAY

ENGINEERING EVALUATION/COST ANALYSIS
CAUSEWAY AND DIKE NON-TIME CRITICAL REMOVAL ACTION
STRATFORD ARMY ENGINE PLANT
STRATFORD, CONNECTICUT

			CB-99-02	CB-99-05	CB-99-07DUP	CB-99-07	CB-99-08DUP	CB-99-08
	SAMPLE DEPTH (bgs)		0-2	0-2	0-2	0-2	1-3	1-3
	SAMPLE COLLECTION		9/20/99	9/21/99	9/21/99	9/21/99	9/21/99	9/21/99
Analyte	**RSR Value**	**Units**						
VOCs								
Vinyl Chloride	0.32	mg/kg						
SVOCs								
Benzo(a)Anthracene	1	mg/kg						
Benzo(a)Pyrene	1	mg/kg						
Benzo(b)Fluoranthene	1	mg/kg						
Benzo(k)Fluoranthene	8.4	mg/kg						
Hexachlorobenzene	1	mg/kg						
Indeno(1,2,3-CD)Pyrene	1	mg/kg						
PCBs								
Aroclor-1016	1	mg/kg						
Aroclor-1260	1	mg/kg	2.1					
Inorganics								
Arsenic	10	mg/kg			10.9	10.7	19.8	34.5
Beryllium	2	mg/kg		3.2			2.3	2.3
Cadmium	34	mg/kg						43.9
Lead	500	mg/kg					1,250 J	1,380 J
Thallium	5.4	mg/kg					5.4	8.3
Vanadium	470	mg/kg						

Notes:

RSR = Remediation Standard Regulation

mg/kg = milligram per kilogram

J = estimated values

VOCs = volatile organic compounds

bgs = below ground surface

DUP = duplicate sample

PCBs = polychlorinated biphenyls

SVOCs = semivolatile organic compounds

TABLE 2-1
SUMMARY OF DIRECT EXPOSURE CRITERIA EXCEEDANCES - CAUSEWAY

ENGINEERING EVALUATION/COST ANALYSIS
CAUSEWAY AND DIKE NON-TIME CRITICAL REMOVAL ACTION
STRATFORD ARMY ENGINE PLANT
STRATFORD, CONNECTICUT

			CB-99-08	CB-99-11	CB-99-14	CB-99-14DUP	CB-99-15	CB-99-16
	SAMPLE DEPTH (bgs)		3-5	0-2	1-3	1-3	1-3	1-3
	SAMPLE COLLECTION		9/21/1999-5	9/21/99	9/22/99	9/22/99	9/21/99	9/21/99
Analyte	**RSR Value**	**Units**						
VOCs								
Vinyl Chloride	0.32	mg/kg						
SVOCs								
Benzo(a)Anthracene	1	mg/kg			1.5	2.2	50	
Benzo(a)Pyrene	1	mg/kg			2.3	3.3	43	
Benzo(b)Fluoranthene	1	mg/kg			2.4	3.2	35	
Benzo(k)Fluoranthene	8.4	mg/kg					32 J	
Hexachlorobenzene	1	mg/kg						
Indeno(1,2,3-CD)Pyrene	1	mg/kg			2.2	2.6	30	
PCBs								
Aroclor-1016	1	mg/kg						
Aroclor-1260	1	mg/kg						
Inorganics								
Arsenic	10	mg/kg						15.7
Beryllium	2	mg/kg	2.1	2.6				
Cadmium	34	mg/kg						
Lead	500	mg/kg						721 J
Thallium	5.4	mg/kg	5.4					
Vanadium	470	mg/kg						

Notes:

RSR = Remediation Standard Regulation

mg/kg = milligram per kilogram

J = estimated values

VOCs = volatile organic compounds

bgs = below ground surface

DUP = duplicate sample

PCBs = polychlorinated biphenyls

SVOCs = semivolatile organic compounds

TABLE 2-1
SUMMARY OF DIRECT EXPOSURE CRITERIA EXCEEDANCES - CAUSEWAY

ENGINEERING EVALUATION/COST ANALYSIS
CAUSEWAY AND DIKE NON-TIME CRITICAL REMOVAL ACTION
STRATFORD ARMY ENGINE PLANT
STRATFORD, CONNECTICUT

			TP-99-10	TP-99-22	TP-99-23	TP-DEP-11	TP-DEP-12
	SAMPLE DEPTH (bgs)		3-5	1-3	1-3	0-1	1-3
	SAMPLE COLLECTION		9/21/99	9/22/99	9/22/99	9/21/99	9/21/99
Analyte	**RSR Value**	**Units**					
VOCs							
Vinyl Chloride	0.32	mg/kg					1.9 J
SVOCs							
Benzo(a)Anthracene	1	mg/kg	9.4				
Benzo(a)Pyrene	1	mg/kg	8				
Benzo(b)Fluoranthene	1	mg/kg	7.2				
Benzo(k)Fluoranthene	8.4	mg/kg					
Hexachlorobenzene	1	mg/kg				1.4	
Indeno(1,2,3-CD)Pyrene	1	mg/kg	4.8				
PCBs							
Aroclor-1016	1	mg/kg		1.2 J			
Aroclor-1260	1	mg/kg	1.8	1.7 J	2.2	1.6	
Inorganics							
Arsenic	10	mg/kg	10.7			11.7	
Beryllium	2	mg/kg				13.1	3.9
Cadmium	34	mg/kg				94.7	
Lead	500	mg/kg				1,510 J	
Thallium	5.4	mg/kg				6.6	
Vanadium	470	mg/kg				2,640	970

Notes:

RSR = Remediation Standard Regulation

mg/kg = milligram per kilogram

J = estimated values

VOCs = volatile organic compounds

bgs = below ground surface

DUP = duplicate sample

PCBs = polychlorinated biphenyls

SVOCs = semivolatile organic compounds

TABLE 2-2
SUMMARY OF GB POLLUTANT MOBILITY CRITERIA EXCEEDANCES - CAUSEWAY

ENGINEERING EVALUATION/COST ANALYSIS
CAUSEWAY AND DIKE NON-TIME CRITICAL REMOVAL ACTION
STRATFORD ARMY ENGINE PLANT
STRATFORD, CONNECTICUT

			CB-99-01	CB-99-01	CB-99-02	CB-99-03DUP	CB-99-03	CB-99-03	CB-99-04	CB-99-04
		SAMPLE DEPTH (bgs)	0-2	9-11	5-7	2-4	2-4	4-6	0-2	5-7
		SAMPLE COLLECTION	9/20/99	9/20/99	10/12/99	9/20/99	9/20/99	9/20/99	9/20/99	9/20/99
Analyte	**RSR Values**	**Units**								
VOCs										
cis-1,2-Dichloroethene	14	mg/kg			100					120
Methylene Chloride	1	mg/kg	1.4	1.9		3.3 J	1 J			
Tetrachloroethene	1	mg/kg			81					2.7 J
Trichloroethene	1	mg/kg		3 J	4.3 J				3.4 J	1.2 J
Vinyl Chloride	0.4	mg/kg								24
SVOCs										
2-Methylnaphthalene	9.8	mg/kg						45		
Acenaphthene	84	mg/kg								
Anthracene	400	mg/kg								
Benzo(a)Anthracene	1	mg/kg								
Benzo(a)Pyrene	1	mg/kg								
Benzo(b)Fluoranthene	1	mg/kg								
Benzo(k)Fluoranthene	1	mg/kg								
Carbazole	1	mg/kg								
Chrysene	1	mg/kg								
Dibenz(a,h)Anthracene	1	mg/kg								
Dibenzofuran	5.6	mg/kg								
Fluoranthene	56	mg/kg								
Fluorene	56	mg/kg								
Hexachlorobenzene	1	mg/kg								
Indeno(1,2,3-CD)Pyrene	1	mg/kg								
Naphthalene	56	mg/kg								
Phenanthrene	40	mg/kg								
Pyrene	40	mg/kg								
SPLP Metals										
Vanadium	0.5	mg/L						5.92		

Notes:
DUP = duplicate sample
J = estimated values
mg/kg = milligram per kilogram
mg/L = milligram per liter
RSR = Remediation Standard Regulation
PCBs = polychlorinated biphenyls
SVOCs = semivolatile organic compounds
VOCs = volatile organic compounds

TABLE 2-2
SUMMARY OF GB POLLUTANT MOBILITY CRITERIA EXCEEDANCES - CAUSEWAY

ENGINEERING EVALUATION/COST ANALYSIS
CAUSEWAY AND DIKE NON-TIME CRITICAL REMOVAL ACTION
STRATFORD ARMY ENGINE PLANT
STRATFORD, CONNECTICUT

			CB-99-08DUP	CB-99-08	CB-99-09	CB-99-11	CB-99-12	CB-99-13DUP	CB-99-13	CB-99-14DUP
		SAMPLE DEPTH (bgs)	1-3	3-5	10-12	0-2	8-10	7-9	7-9	1-3
		SAMPLE COLLECTION	9/21/99	9/21/99	9/23/99	9/21/99	9/21/99	10/12/99	10/12/99	9/22/99
Analyte	**RSR Values**	**Units**								
VOCs										
cis-1,2-Dichloroethene	14	mg/kg								
Methylene Chloride	1	mg/kg								
Tetrachloroethene	1	mg/kg						28	37	
Trichloroethene	1	mg/kg	8.4 J			2 J				
Vinyl Chloride	0.4	mg/kg								
SVOCs										
2-Methylnaphthalene	9.8	mg/kg								
Acenaphthene	84	mg/kg								
Anthracene	400	mg/kg								
Benzo(a)Anthracene	1	mg/kg			1.2 J		22 J			2.2
Benzo(a)Pyrene	1	mg/kg			1 J		19 J			3.3
Benzo(b)Fluoranthene	1	mg/kg			1 J		17 J			3.2
Benzo(k)Fluoranthene	1	mg/kg				1.1 J	18 J			2.9
Carbazole	1	mg/kg								
Chrysene	1	mg/kg			1.3		20			2.4
Dibenz(a,h)Anthracene	1	mg/kg					8.1			
Dibenzofuran	5.6	mg/kg								
Fluoranthene	56	mg/kg					58			
Fluorene	56	mg/kg								
Hexachlorobenzene	1	mg/kg								
Indeno(1,2,3-CD)Pyrene	1	mg/kg								2.6
Naphthalene	56	mg/kg								
Phenanthrene	40	mg/kg					60			
Pyrene	40	mg/kg					46			
SPLP Metals										
Vanadium	0.5	mg/L								

Notes:
DUP = duplicate sample
J = estimated values
mg/kg = milligram per kilogram
mg/L = milligram per liter
RSR = Remediation Standard Regulation
PCBs = polychlorinated biphenyls
SVOCs = semivolatile organic compounds
VOCs = volatile organic compounds

TABLE 2-2
SUMMARY OF GB POLLUTANT MOBILITY CRITERIA EXCEEDANCES - CAUSEWAY

ENGINEERING EVALUATION/COST ANALYSIS
CAUSEWAY AND DIKE NON-TIME CRITICAL REMOVAL ACTION
STRATFORD ARMY ENGINE PLANT
STRATFORD, CONNECTICUT

			CB-99-14	CB-99-15	CB-99-15	TP-99-06	TP-99-10	TP-DEP-11	TP-DEP-12
		SAMPLE DEPTH (bgs)	1-3	1-3	7-9	6-8	3-5	0-1	1-3
		SAMPLE COLLECTION	9/22/99	9/21/99	9/21/99	9/21/99	9/21/99	9/21/99	9/21/99
Analyte	**RSR Values**	**Units**							
VOCs									
cis-1,2-Dichloroethene	14	mg/kg							
Methylene Chloride	1	mg/kg							
Tetrachloroethene	1	mg/kg					2.1 J	2.9	
Trichloroethene	1	mg/kg				1.2 J	2.3 J	8.8	4 J
Vinyl Chloride	0.4	mg/kg							1.9 J
SVOCs									
2-Methylnaphthalene	9.8	mg/kg							
Acenaphthene	84	mg/kg			190				
Anthracene	400	mg/kg			520 J				
Benzo(a)Anthracene	1	mg/kg	1.5	50	1,200 J		9.4		
Benzo(a)Pyrene	1	mg/kg	2.3	43	880 J		8		
Benzo(b)Fluoranthene	1	mg/kg	2.4	35	940 J		7.2		
Benzo(k)Fluoranthene	1	mg/kg	1.4	32 J	880 J		7.2		
Carbazole	1	mg/kg		6.9	310		1.6		
Chrysene	1	mg/kg	1.6	46	1200		9.2		
Dibenz(a,h)Anthracene	1	mg/kg							
Dibenzofuran	5.6	mg/kg		6.9	130				
Fluoranthene	56	mg/kg		120	2,700				
Fluorene	56	mg/kg			250 J				
Hexachlorobenzene	1	mg/kg						1.4	
Indeno(1,2,3-CD)Pyrene	1	mg/kg	2.2	30	350		9.2		
Naphthalene	56	mg/kg			97 J				
Phenanthrene	40	mg/kg		100	2,400				
Pyrene	40	mg/kg		93	1,800 J				
SPLP Metals									
Vanadium	0.5	mg/L						0.807	1.07

Notes:
DUP = duplicate sample
J = estimated values
mg/kg = milligram per kilogram
mg/L = milligram per liter
RSR = Remediation Standard Regulation
PCBs = polychlorinated biphenyls
SVOCs = semivolatile organic compounds
VOCs = volatile organic compounds

TABLE 2-3
SUMMARY OF CTDEP RADIOLOGICAL TESTING

ENGINEERING EVALUATION/COST ANALYSIS
CAUSEWAY AND DIKE NON-TIME CRITICAL REMOVAL ACTION
STRATFORD ARMY ENGINE PLANT
STRATFORD, CONNECTICUT

CTDEP SAMPLE NUMBER	LABORATORY NUMBER	APPROXIMATE CORRESPONDING EXPLORATION LOCATION	NUCLIDE AND ACTIVITY IN pC*i*/g	
			TH-234	RA-226
SAEP-A1	19223	CB-99-05	1.3	1.47
SAEP-A1	19224	CB-99-05	0.65	0.65
SAEP-A2	19225	CB-99-12	0.689	1.05
SAEP-A3	19226	CB-99-02	1.88	5.17
SAEP-A4	19227	TP-99-10	3.02	10.8
SAEP-A5	19228	CB-99-11	0.8	0.91
SAEP-A6	19229	TP-DEP-11/12	28.3	80.7
SAEP-A7	19230	TP-DEP-15	11.2	68.5

Notes:

CTDEP = Connecticut Department of Environmental Protection
pCi/g = picocurie per gram
See Appendix I of the Pre-Design Investigation Report for the Causeway and Dike for full results
See Figure 2-2 for exploration locations

TABLE 2-4
SUMMARY OF ALLIED SIGNAL RADIOLOGICAL TESTING

ENGINEERING EVALUATION/COST ANALYSIS
CAUSEWAY AND DIKE NON-TIME CRITICAL REMOVAL ACTION
STRATFORD ARMY ENGINE PLANT
STRATFORD, CONNECTICUT

ALLIED SIGNAL SAMPLE NUMBER	APPROXIMATE CORRESPONDING EXPLORATION LOCATION	NUCLIDE AND ACTIVITY IN pC*i*/g		
		TH-234	TH-228	RA-226
AS-97	CB-99-14	17.53	30.49	53.18
AS-109	TP-DEP-11/12	23.97	55.83	108.2
AS-114	TP-DEP-15	15.30	34.92	43.24
AS-121-4	CB-99-09	NI	68.05	14.56

Notes:

NI = not identified
pC*i*/g = picocurie per gram
See Appendix I of the Pre-Design Investigation Report for the Causeway and Dike for full results
See Figure 2-2 for exploration locations.

TABLE 2-5
SUMMARY OF DIRECT EXPOSURE CRITERIA EXCEEDANCES - DIKE

ENGINEERING EVALUATION/COST ANALYSIS
CAUSEWAY AND DIKE NON-TIME CRITICAL REMOVAL ACTION
STRATFORD ARMY ENGINE PLANT
STRATFORD, CONNECTICUT

			DB-99-08	HA-99-03	HA-99-07	HA-99-08
		SAMPLE DEPTH (bgs)	2-4	0-1	0-1	0-1
		SAMPLE COLLECTION	9/14/99	9/23/99	9/23/99	9/23/99
Analyte	**RSR Value**	**Units**				
VOCs						
1,1-Dichloroethene	1	mg/kg			12 J	
cis-1,2-Dichloroethene	500	mg/kg			3,300	
Tetrachloroethene	12	mg/kg			1,200	
Trichloroethene	56	mg/kg			560	
Vinyl Chloride	0.32	mg/kg			36 J	
SVOCs						
Benzo(a)Anthracene	1	mg/kg		13		
Benzo(a)Pyrene	1	mg/kg		13		
Benzo(b)Fluoranthene	1	mg/kg		9.9		
Benzo(k)Fluoranthene	8.4	mg/kg		12		
bis(2-Ethylhexyl)Phthalate	44	mg/kg			96	
Indeno(1,2,3-CD)Pyrene	1	mg/kg		9		
PCBs						
Aroclor 1260	1	mg/kg	3.7			
Arsenic	10	mg/kg				15.7

Notes:

DUP = duplicate sample

J = estimated values

mg/kg = milligram per kilogram

RSR = Remediation Standard Regulation

PCBs = polychlorinated biphenyls

SVOCs = semivolatile organic compounds

VOCs = volatile organic compounds

TABLE 2-6
SUMMARY OF GB POLLUTANT MOBILITY CRITERIA EXCEEDANCES - DIKE

ENGINEERING EVALUATION/COST ANALYSIS
CAUSEWAY AND DIKE NON-TIME CRITICAL REMOVAL ACTION
STRATFORD ARMY ENGINE PLANT
STRATFORD, CONNECTICUT

		SAMPLE DEPTH (bgs) SAMPLE COLLECTION	HA-99-03 HA9903001XX 0-1 9/23/99		HA-99-07 HA9907001XX 0-1 9/23/99	
Analyte	**RSR Value**	**Units**				
VOCs						
1,1,1-Trichloroethane	40	mg/kg			340	
1,1-Dichloroethane	14	mg/kg			120	J
1,1-Dichloroethene	1.4	mg/kg			12	J
Benzene	0.2	mg/kg			3.8	J
cis-1,2-Dichloroethene	14	mg/kg			3,300	
Tetrachloroethene	1	mg/kg			1,200	
Toluene	67	mg/kg			180	J
Trichloroethene	1	mg/kg			560	
Vinyl Chloride	0.4	mg/kg			36	J
Xylene (total)	19.5	mg/kg			26	J
SVOCs						
Benzo(a)Anthracene	1	mg/kg	13			
Benzo(a)Pyrene	1	mg/kg	13			
Benzo(b)Fluoranthene	1	mg/kg	9.9			
Benzo(k)Fluoranthene	1	mg/kg	12			
bis(2-Ethylhexyl)Phthalate	11	mg/kg			96	
Carbazole	1	mg/kg	4.2			
Chrysene	1	mg/kg	14			
Indeno(1,2,3-CD)Pyrene	1	mg/kg	9			
2-Methylnaphthalene	9.8	mg/kg			25	

Notes:
DUP = duplicate sample
J = estimated values
mg/kg = microgram per kilogram
RSR = Remediation Standard Regulation
PCBs = polychlorinated biphenyls
SVOCs = semivolatile organic compounds
VOCs = volatile organic compounds

Table 3-1
Chemical-Specific ARARs Criteria, Advisories, and Guidance

Engineering Evaluation/Cost Analysis
Causeway and Dike Non-Time-Critical Removal Action

Stratford Army Engine Plant
Stratford, Connecticut

Media	Requirement	Status	Requirement Synopsis	Action To Be Taken to Attain ARAR
SOIL/SEDIMENT				
State	Connecticut Department of Environmental Protection (CTDEP) Remediation Standard Regulations (CGS §§ 22a-133k and 22a-133q)	Applicable	Remediation standards have been promulgated for several common organic and inorganic contaminants. These levels regulate the concentration of contaminants in soil and groundwater (Section 22a-133k-2, and Appendices A and B).	Contaminated soil will be remediated in accordance with the standards for soil remediation as specified in this regulation.
			Section 22a-133k-2(f)(2) allows the use of an engineered control to isolate contaminated soil. This section includes specific requirements for the engineered control, including but not limited to, permeability, monitoring, and maintenance. In conjunction with the engineered control, an environmental land use restriction must be implemented in accordance with Section 22a-133q-1.	An engineered control and environmental land use restriction will be implemented in accordance with these requirements.

Notes:
ARAR = Applicable or Relevant and Appropriate Requirement
CGS = Connecticut General Statutes
CTDEP = Connecticut Department of Environmental Protection

TABLE 3-2
LOCATION-SPECIFIC ARARS, CRITERIA, ADVISORIES, AND GUIDANCE

ENGINEERING EVALUATION/COST ANALYSIS
CAUSEWAY AND DIKE NON-TIME-CRITICAL REMOVAL ACTION

STRATFORD ARMY ENGINE PLANT
STRATFORD, CONNECTICUT

MEDIA	REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN ARAR
WETLAND/FLOODPLAINS				
Federal	Protection of Wetlands - Executive Order 11990 (40 CFR 6, Appendix A)	Applicable	Under this order, federal agencies are required to minimize the destruction, loss, or degradation of wetlands and preserve and enhance natural and beneficial values of wetlands.	These requirements will be met during the development of alternatives. If no practicable alternative exists, potential harm will be minimized and action taken to restore the natural and beneficial values of the wetland. In addition, remedial activities will be designed to minimize impacts to the wetlands.
	Flood Plains Management – Executive Order 11988 (40 CFR 6, Appendix A)	Applicable	Under this order, federal agencies are required to avoid long-term and short-term adverse impacts associated with the occupancy and modification of floodplains and to avoid support of floodplain development wherever there is a practicable alternative.	These requirements will be met during the development of alternatives. If no practicable alternative exists, potential adverse impacts will be minimized and action taken to restore the floodplain. In addition, remedial activities will be designed to minimize adverse impacts on the floodplains.
	Clean Water Act (CWA) Section 404(b)(i) Guidelines for Specification of Disposal Sites for Dredged or Fill Material (40 CFR 230; 33 CFR Parts 320-330)	Applicable	Section 404 of the CWA regulates the discharge of dredged or fill material into U.S. waters, including wetlands. The purpose of Section 404 is to ensure that proposed discharges are evaluated with respect to impact on the aquatic ecosystem.	Remedial activities that involve dredged or fill material discharge to a wetland will comply with these requirements.
	Rivers and Harbors Act of 1899 (33 USC 403)	Relevant and Appropriate	Section 10 of the Rivers and Harbors Act of 1899 requires authorization from the Secretary of the Army, acting through the U.S. Army Corps of Engineers (USACE), for the construction of any structure in or over any "navigable water of the U.S.", the excavation from or deposition of material in such waters, or any obstruction or alteration in such waters.	Permits are not required for on-site actions conducted under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). However, the action taken will comply with the substantive requirements of this act.
	Coastal Zone Management Act (16 USC 1451, et seq.)	Applicable	The Coastal Zone Management Act requires activities affecting the coastal zone, including lands therein and thereunder and adjacent shorelands, be conducted in accordance with approved state management programs.	Remedial activities affecting the coastal zone of the site will be conducted in accordance with these requirements.
State	Inland Wetlands and Watercourses Act (CGS §§	Applicable	This act requires that actions be taken to protect, preserve, and maintain inland wetlands and watercourses, including protecting	Remedial activities will be conducted to minimize disturbance of wetlands and

TABLE 3-2
LOCATION-SPECIFIC ARARS, CRITERIA, ADVISORIES, AND GUIDANCE

ENGINEERING EVALUATION/COST ANALYSIS
CAUSEWAY AND DIKE NON-TIME-CRITICAL REMOVAL ACTION

STRATFORD ARMY ENGINE PLANT
STRATFORD, CONNECTICUT

MEDIA	REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN ARAR
	22a-36 through 22a-45a; RCSA §§ 22a-39-1 through 22a-39-15)		the quality of the wetlands and watercourses for their conservation, economic, aesthetic, recreational, and other public and private uses and values.	watercourses, prevent loss of beneficial aquatic organisms, wildlife, and vegetation, and prevent destruction of natural habitats.
	Tidal Wetlands Regulations (CGS §§ 22a-28 through 22a-35; RCSA §§ 22a-30-1 through 22a-30-17)	Applicable	Activities within or affecting tidal wetlands are regulated.	Remedial activities will be conducted to comply with these regulations.
	Flood Management (CGS §§ 25-68b through 25-68h; RCSA §§ 25-68h-1 through 25-68h-3)	Applicable	This requirement regulates activities in floodplains to minimize flood risk and prevent flood hazards.	Remedial activities will be conducted to comply with these regulations.
	Regulation of Dredging and Erection of Structures and Placement of Fill in Tidal, Coastal, or Navigable Waters (CGS §§ 22a-359 through 22a-363(f))	Applicable	This requirement regulates dredging, the erection of structures, and placement of fill in tidal, coastal, or navigable waters waterward of the high tide line.	Remedial activities will be conducted to comply with these regulations.
	Coastal Management Act (CGS §§ 22a-90 through 22a-112)	Applicable	This act requires that actions be taken to insure that the development, preservation, or use of land and water resources of the coastal area is conducted without significantly disrupting either the natural environment or sound economic growth.	Remedial activities will be conducted to minimize adverse impacts on natural coastal resources, including the potential impact of coastal flooding and erosion and damage to and destruction of life and property.
OTHER NATURAL RESOURCES				
Federal	Fish and Wildlife Coordination Act (16 USC 661; 40 CFR 6.302)	Relevant and Appropriate	This act requires that any federal agency proposing to modify a body of water must consult with the U.S. Fish and Wildlife Service, National Marine Fisheries Service, and other related state agencies.	Notification is not required for on-site actions conducted under CERCLA. However, actions will be taken to minimize impacts to wetlands.
	National Historic Preservation Act (16 USC 470, et seq.)	Applicable	This act requires that actions be taken to preserve historic properties, recover and preserve artifacts, and minimize harm to National Historic Landmarks.	Remedial activities will comply with these requirements.

TABLE 3-2
LOCATION-SPECIFIC ARARS, CRITERIA, ADVISORIES, AND GUIDANCE

ENGINEERING EVALUATION/COST ANALYSIS
CAUSEWAY AND DIKE NON-TIME-CRITICAL REMOVAL ACTION

STRATFORD ARMY ENGINE PLANT
STRATFORD, CONNECTICUT

MEDIA	REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN ARAR

Notes:

ARAR	= Applicable or Relevant and Appropriate Requirement
CERCLA	= Comprehensive Environmental Response, Compensation, and Liability Act
CFR	= Code of Federal Regulations
CGS	= Connecticut General Statutes
CWA	= Clean Water Act
RCSA	= Regulations of Connecticut State Agencies
USACE	= United States Army Corps of Engineers
USC	= United States Code

TABLE 3-3
POTENTIAL ACTION-SPECIFIC ARARS, CRITERIA, ADVISORIES, AND GUIDANCE

ENGINEERING EVALUATION/COST ANALYSIS
CAUSEWAY AND DIKE NON-TIME-CRITICAL REMOVAL ACTION

STRATFORD ARMY ENGINE PLANT
STRATFORD, CONNECTICUT

MEDIA	REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN ARAR
AIR				
Federal	CAA National Emission Standards for Hazardous Air Pollutants (NESHAP) (40 CFR Part 61, Subpart M)	Relevant and Appropriate	This requirement provides emission standards for specific pollutants for which no ambient air quality standard exists. NESHAPs have been promulgated for specific source types emitting certain pollutants, including asbestos. Subpart M establishes standards for inactive waste disposal sites and disposal of asbestos-containing material from demolition and renovation operations.	Although these standards do not directly apply to the asbestos-containing material in subsurface soil on the Causeway, these standards will be considered during design and implementation of remedial activities.
State	Connecticut Department of Environmental Protection (CTDEP) Abatement of Air Pollution (CGS Title 22a, Chapter 446c; RCSA §§ 22a-174-1, et seq.)	Applicable	These regulations require permits to construct and to operate specified types of emission sources and contain emission standards that must be met prior to issuance of a permit. Pollutant abatement controls may be required. Specific standards pertain to fugitive dust (RCSA § 22a-174-18(b)) and control of odors (RCSA § 22a-174-23)	Emission standards for fugitive dust will be met with dust control measures during excavation, transportation, and consolidation to comply with substantive requirements.
	Noise Pollution Control Act (CGS § 22a-69; RCSA §§ 22a-69-1 through 69-7.4)	Applicable	These regulations establish allowable noise levels.	Remedial activities will be conducted to comply with these regulations.

TABLE 3-3
POTENTIAL ACTION-SPECIFIC ARARS, CRITERIA, ADVISORIES, AND GUIDANCE

ENGINEERING EVALUATION/COST ANALYSIS
CAUSEWAY AND DIKE NON-TIME-CRITICAL REMOVAL ACTION

STRATFORD ARMY ENGINE PLANT
STRATFORD, CONNECTICUT

MEDIA	REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN ARAR
SURFACE WATER				
Federal	Clean Water Act (CWA) National Pollutant Discharge Elimination System (NPDES) (40 CFR Parts 122, 125, 131, and 136)	Applicable	This rule requires permits for the discharge of pollutants from any point source into U.S. waters.	Excavation dewatering fluids will be routed through the on-site Oil Abatement Treatment Plant (OATP) prior to discharge to surface water. Effluent will meet the OATP discharge limitations, monitoring requirements, and best management practices.
State	Water Pollution Control Act (CGS §§ 22a-416 through 22a-438; RCSA §§ 22a-430-1 through 22a-430-7)	Applicable	This act requires permits for any discharge of water, substance, or material into the waters of the state.	Excavation dewatering fluids will be routed through the on-site OATP prior to discharge to surface water. This activity will be conducted in accordance with the requirements of this act (e.g., monitoring requirements and discharge limitations).
SOIL/WASTE MATERIAL				
Federal	RCRA Identification and Listing of Hazardous Waste; Toxicity Characteristic (40 CFR 261.24)	Applicable	This requirement defines those wastes that are subject to regulation as hazardous waste under 40 CFR Parts 124 and 264.	Analytical results will be evaluated against the criteria and definitions of hazardous waste. The criteria and definition of hazardous waste will be referred to and utilized in development of alternatives and during remedial actions.
	RCRA Standards Applicable to Generators of Hazardous Waste (40 CFR Part 262)	Applicable	These standards govern storage, labeling, accumulation times, and disposal of hazardous waste.	Any hazardous waste generated during remedial activities will be managed in accordance with these standards.

TABLE 3-3
POTENTIAL ACTION-SPECIFIC ARARS, CRITERIA, ADVISORIES, AND GUIDANCE

ENGINEERING EVALUATION/COST ANALYSIS
CAUSEWAY AND DIKE NON-TIME-CRITICAL REMOVAL ACTION

STRATFORD ARMY ENGINE PLANT
STRATFORD, CONNECTICUT

MEDIA	REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN ARAR
	RCRA Container Storage Requirements (40 CFR Part 264, Subpart I)	Applicable	These requirements apply to owners and operators of facilities that use container storage to store hazardous waste.	If containers are used to store materials that are hazardous wastes, the containers will be managed according to these rules.
	RCRA Subtitle C, Subpart G – Closure and Post-Closure (40 CFR 264.110 – 264.120)	Relevant and Appropriate	This regulation details general requirements for closure and post-closure of hazardous waste facilities, including installation of a groundwater monitoring program.	Remedial activities associated with design, monitoring, and maintenance will meet these requirements.
State	Connecticut Department of Environmental Protection (CTDEP) Solid Waste Management (CGS Title 22a, Chapters 446d and 446k; RCSA §§ 22a-208a-1 and 22a-209-1 through 22a-209-16)	Relevant and Appropriate	This regulation specifies requirements for the design, operation, and closure of solid waste disposal facilities.	Although the Causeway is not defined as a solid waste disposal facility, the design of a cover system will meet the minimum standards of this regulation.
	CTDEP Hazardous Waste Management (CGS §§ 22a-454 and 22a-449(c); RCSA §§ 22a-449(c)-100 through 110 and 22a-449(c)-11)	Relevant and Appropriate	This regulation specifies requirements for the design, operation, and closure of hazardous waste disposal facilities. This regulation incorporates by reference the RCRA requirements for hazardous waste facilities.	The design of a cover system and management of any hazardous wastes generated during remedial activities will meet the minimum standards of this regulation.
	Guidelines for Soil Erosion and Sediment Control; The Connecticut Council on Soil and Water Conservation	To Be Considered	These guidelines provide technical and administrative guidance for the development, adoption, and implementation of erosion and sediment control program.	These guidelines will be incorporated into any remedial designs for the Causeway. Erosion and sediment control measures will be implemented during excavation, consolidation, and cover system construction activities.

TABLE 3-3
POTENTIAL ACTION-SPECIFIC ARARS, CRITERIA, ADVISORIES, AND GUIDANCE

ENGINEERING EVALUATION/COST ANALYSIS
CAUSEWAY AND DIKE NON-TIME-CRITICAL REMOVAL ACTION

STRATFORD ARMY ENGINE PLANT
STRATFORD, CONNECTICUT

MEDIA	REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN ARAR

Notes:

ARAR	=	Applicable or Relevant and Appropriate Requirement
CAA	=	Clean Air Act
CFR	=	Code of Federal Regulations
CGS	=	Connecticut General Statutes
CTDEP	=	Connecticut Department of Environmental Protection
CWA	=	Clean Water Act
NESHAP	=	National Emission Standards for Hazardous Air Pollutants
NPDES	=	National Pollutant Discharge Elimination System
OATP	=	Oil Abatement Treatment Plant
RCRA	=	Resource Conservation and Recovery Act
RCSA	=	Regulations of Connecticut State Agencies
TSDF	=	treatment, storage, and disposal facility

TABLE 4-1
ALTERNATIVE 1 - CAPPING WITH SYNTHETIC GEOMEMBRANE
CONCEPTUAL COST ESTIMATE

ENGINEERING EVALUATION/COST ANALYSIS
CAUSEWAY AND DIKE NON-TIME CRITICAL REMOVAL ACTION
STRATFORD ARMY ENGINE PLANT

Key Components: Construct Cover System
Construct RipRap Armor
Land Use Restrictions

CAPITAL AND FIXED COSTS

Item Description	Quantity	Units	Unit Cost	Present Worth
Preparation				
Pre-Design Geotech. Investigation/Evaluation	1	Lump Sum	$ 83,000.00	$ 83,000
Design and Planning	1	Lump Sum	$ 135,000.00	$ 135,000
Preparation of Plans (Work, H&S, E&S, QA/QC)	1	Lump Sum	$ 23,000.00	$ 23,000
Mobilization and Demobilization	1	Lump Sum	$ 38,418.00	$ 38,418
Portable Dam (install & remove)	1	Lump Sum	$ 583,540.00	$ 583,540
Demolition - Bldg 59, ramp, concrete	1	Lump Sum	$ 37,097.00	$ 37,097
Soil/Waste Excavation and Site Grading				
Excavate & Consolidate Toe Material in Causeway	5200	Cubic Yard	$ 12.44	$ 64,696
Initial Grading Top of Causeway	1815	Cubic Yard	$ 15.14	$ 27,478
Capping System Construction				
12-inch Sand Bedding Layer	3600	Cubic Yard	$ 31.24	$ 112,478
Gas Collection Piping	4000	Linear Feet	$ 5.86	$ 23,445
FML Installation w/ anchor trench & QC testing	2.5	Acre	$ 77,690.80	$ 194,227
18-Sand Protection Layer w/ Geotextile	5400	Cubic Yard	$ 30.27	$ 163,468
RipRap Armor (Ave = 600 lbs)	10,000	Cubic Yard	$ 125.00	$ 1,250,000
QA Soil Testing	1	Lump Sum	$ 40,000.00	$ 40,000
Sampling and Analysis	1	Lump Sum	$ 45,000.00	$ 45,000
PPC/PPE	1	Lump Sum	$ 70,000.00	$ 70,000
Office and Field Engineering/Administrative	1	Lump Sum	$ 1,205,800.00	$ 1,205,800
Land Use Restrictions	1	Lump Sum	$ 5,000.00	$ 5,000
Final Remediation Report	1	Lump Sum	$ 8,000.00	$ 8,000
TOTAL CAPITAL COSTS				$ 4,109,647

O&M COSTS

Item Description	Years	Unit Cost	Present Worth
Groundwater Monitoring	30	$ 13,800.00	$ 171,245
Cap Inspection & Maintenance	30	$ 2,500.00	$ 31,023
Five Year Site Reviews	6	$ 10,600.00	$ 50,525
O&M COSTS			$ 252,793
Subtotal			$ 4,362,439
Contingency	15%		$ 654,366
Subtotal			$ 5,016,805
Fee	10%		$ 501,681
TOTAL FOR ALTERNATIVE 1			**$ 5,518,486**
Annualized cost			$444,715

Notes: 1. This cost estimate was prepared using costs considered appropriate for typical operations associated with a TERC remedial construction project. It is intended for use in comparing the relative cost of remedial alternatives. Actual costs may differ.
2. Present worth assumes 7% annual discount rate.
3. The contingency costs and fee are standard assumptions by FW/HLA for conceptual designs.

TABLE 4-2
ALTERNATIVE 2 - CAPPING WITH COMPOSITE COVER AND VERTICAL BARRIER
CONCEPTUAL COST ESTIMATE

ENGINEERING EVALUATION/COST ANALYSIS
CAUSEWAY AND DIKE NON-TIME CRITICAL REMOVAL ACTION
STRATFORD ARMY ENGINE PLANT

Key Components:
Construct Cover System
Construct RipRap Armor
Construct Sheetpile Seawall
Land Use Restrictions

CAPITAL AND FIXED COSTS

Item Description	Quantity	Units	Unit Cost	Present Worth
Preparation				
Pre-Design Geotech. Investigation/Evaluation	1	Lump Sum	$ 95,000.00	$ 95,000
Design and Planning	1	Lump Sum	$ 189,000.00	$ 189,000
Preparation of Plans (Work, H&S, E&S, QA/QC)	1	Lump Sum	$ 23,000.00	$ 23,000
Mobilization and Demobilization	1	Lump Sum	$ 63,418.00	$ 63,418
Portable Dam (install & remove)	1	Lump Sum	$ 583,540.00	$ 583,540
Demolition - Bldg 59, ramp, concrete	1	Lump Sum	$ 37,097.00	$ 37,097
Soil/Waste Excavation and Site Grading				
Excavate & Consolidate Toe Material in Causeway	2400	Cubic Yard	$ 15.04	$ 36,098
Initial Grading Top of Causeway	1815	Cubic Yard	$ 15.14	$ 27,478
Capping System Construction				
12-inch Sand Bedding Layer	3600	Cubic Yard	$ 31.24	$ 112,478
Gas Collection Piping	4000	Linear Feet	$ 5.86	$ 23,445
GCL/FML Installation w/ anchor trench & QC testing	2.5	Acre	$ 107,418.00	$ 268,545
Drainage Composite Installation	2.3	Acre	$ 45,991.30	$ 105,780
18-inch Filter Layer	5400	Cubic Yard	$ 29.16	$ 157,478
RipRap Armor (Ave = 600 lbs)	10,000	Cubic Yard	$ 125.00	$ 1,250,000
QA Soil Testing	1	Lump Sum	$ 40,000.00	$ 40,000
Sheetpile Seawall w/Geogrid Tiebacks	1,665	Linear Feet	$ 513.62	$ 855,175
Sampling and Analysis	1	Lump Sum	$ 45,000.00	$ 45,000
PPC/PPE	1	Lump Sum	$ 70,000.00	$ 70,000
Office and Field Engineering/Administration	1	Lump Sum	$ 1,205,800.00	$ 1,205,800
Land Use Restrictions	1	Lump Sum	$ 5,000.00	$ 5,000
Final Remediation Report	1	Lump Sum	$ 8,000.00	$ 8,000
TOTAL CAPITAL COSTS				$ 5,201,332

O&M COSTS

Item Description	Years	Unit Cost	Present Worth
Groundwater Monitoring	30	$ 13,800.00	$ 171,245
Cap Inspection & Maintenance	30	$ 2,500.00	$ 31,023
Five Year Site Reviews	6	$ 10,600.00	$ 50,525
O&M COSTS			$ 252,793

Subtotal		$ 5,454,125
Contingency	15%	$ 818,119
Subtotal		$ 6,272,243
Fee	10%	$ 627,224
TOTAL FOR ALTERNATIVE 2		**$ 6,899,468**
Annualized cost		$556,003

Notes: 1. This cost estimate was prepared using costs considered appropriate for typical operations associated with a TERC remedial construction project. It is intended for use in comparing the relative cost of remedial alternatives. Actual costs may differ.
2. Present worth assumes 7% annual discount rate
3. The contingency costs and fee are standard assumptions by FW/HLA for conceptual designs.

TABLE 4-3
ALTERNATIVE 3 - EXCAVATION AND OFFSITE DISPOSAL
CONCEPTUAL COST ESTIMATE

ENGINEERING EVALUATION/COST ANALYSIS
CAUSEWAY AND DIKE NON-TIME CRITICAL REMOVAL ACTION
STRATFORD ARMY ENGINE PLANT

Key Components: Soil/Waste Excavation and Off-Site Disposal
No Causeway Restoration

CAPITAL AND FIXED COSTS

Item Description	Quantity	Units	Unit Cost	Present Worth
Preparation				
Design and Planning	1	Lump Sum	$ 81,000.00	$ 81,000
Preparation of Plans (Work, H&S, E&S, QA/QC)	1	Lump Sum	$ 23,000.00	$ 23,000
Mobilization and Demobilization	1	Lump Sum	$ 35,818.00	$ 35,818
Portable Dam (install & remove)	1	Lump Sum	$ 393,540.00	$ 393,540
Demolition - Bldg. 59, ramp, concrete	1	Lump Sum	$ 37,097.00	$ 37,097
Soil/Waste Excavation				
Excavate Soil/Waste or Debris	43000	Cubic Yard	$ 10.12	$ 435,268
Disposal of Excavated Soil and Waste				
Sampling for Waste Characterization	1	Lump Sum	$ 468,500.00	$ 468,500
Confirmation Sampling	1	Lump Sum	$ 400,000.00	$ 400,000
Transport and Disposal of Haz. Soil/Waste or Debris	32250	Ton	$ 280.00	$ 9,030,000
Transport and Disposal of Non-Haz. Soil/Waste	32250	Ton	$ 90.00	$ 2,902,500
Restoration				
Stone Dike Construction	200	Linear Feet	$ 84.00	$ 16,800
Final Remediation Report	1	Lump Sum	$ 10,000.00	$ 10,000
PPC/PPE	1	Lump Sum	$ 49,000.00	$ 49,000
Office and Field Engineering/Administration	1	Lump Sum	$ 622,900.00	$ 622,900
TOTAL CAPITAL COSTS				$ 14,505,423
Contingency	15%			$ 2,175,813
Subtotal				$ 16,681,236
Fee	10%			$ 1,668,124
TOTAL FOR ALTERNATIVE 3				**$ 18,349,359**

Notes: 1. This cost estimate was prepared using costs considered appropriate for typical operations associated with a TERC remedial construction project. It is intended for use in comparing the relative cost of remedial alternatives. Actual costs may differ.
2. The contingency costs and fee are standard assumptions by FW/HLA for conceptual designs.

TABLE 4-4
ALTERNATIVE 4 - EROSION CONTROL COVER SYSTEM
CONCEPTUAL COST ESTIMATE

ENGINEERING EVALUATION/COST ANALYSIS
CAUSEWAY AND DIKE NON-TIME CRITICAL REMOVAL ACTION
STRATFORD ARMY ENGINE PLANT
STRATFORD, CONNECTICUT

Key Components: Soil Hot Spot Removal
Construct Cover System
Land Use Restrictions

CAPITAL AND FIXED COSTS

Item Description	Quantity	Units	Unit Cost	Present Worth
Preparation				
Pre-Design Geotech. Investigation/Evaluation	1	Lump Sum	$ 83,000.00	$ 83,000
Design and Planning	1	Lump Sum	$ 135,000.00	$ 135,000
Preparation of Plans (Work, H&S, E&S, QA/QC)	1	Lump Sum	$ 23,000.00	$ 23,000
Mobilization and Demobilization	1	Lump Sum	$ 38,418.00	$ 38,418
Demolition - Bldg 59, ramp, concrete	1	Lump Sum	$ 37,097.00	$ 37,097
Soil/Waste Excavation and Site Grading				
Initial Grading Top of Causeway	1815	Cubic Yard	$ 15.14	$ 27,478
Excavation of Soil Hot Spots	250	Cubic Yard	18.15	$ 4,538
Characterization and Confirmation Sampling	1	Lump Sum	$ 17,700.00	$ 17,700
Transport and Disposal of Haz. Soil/Waste or Debris	375	Ton	$ 280.00	$ 105,000
Capping System Construction				
Geotextile Fabric	17000	Square Yard	$ 1.21	$ 20,550
24-in. Common Borrow	3456	Cubic Yard	26.90	$ 92,973
RipRap Armor	11741	Cubic Yard	$ 125.00	$ 1,467,625
QA Soil Testing	1	Lump Sum	$ 40,000.00	$ 40,000
Sampling and Analysis	1	Lump Sum	$ 45,000.00	$ 45,000
PPC/PPE	1	Lump Sum	$ 70,000.00	$ 70,000
Office and Field Engineering/Administrative	1	Lump Sum	$ 841,330.00	$ 841,330
Land Use Restrictions	1	Lump Sum	$ 5,000.00	$ 5,000
Final Remediation Report	1	Lump Sum	$ 8,000.00	$ 8,000
TOTAL CAPITAL COSTS				$ 3,061,709

O&M COSTS

Item Description	Years	Unit Cost	Present Worth
Cap Inspection & Maintenance	30	$ 2,500.00	$ 31,023
Five Year Site Reviews	6	$ 10,600.00	$ 50,525
O&M COSTS			$ 81,548
Subtotal			$ 3,143,257
Contingency	15%		$ 471,489
Subtotal			$ 3,614,745
Fee	10%		$ 361,475
TOTAL FOR ALTERNATIVE 4			**$ 3,976,220**
Annualized cost			$320,429

Notes: 1. This cost estimate was prepared using costs considered appropriate for typical operations associated with a TERC remedial construction project. It is intended for use in comparing the relative cost of remedial alternatives. Actual costs may differ.
2. Present worth assumes 7% annual discount rate.
3. The contingency costs and fee are standard assumptions by FW/HLA for conceptual designs.

RESPONSE TO REGULATORY AGENCY COMMENTS

RESPONSE TO COMMENTS ON
ENGINEERING EVALUATION/COST ANALYSIS FOR THE CAUSEWAY AND DIKE
(DATED FEBRUARY 23, 2000)
STRATFORD ARMY ENGINE PLANT
STRATFORD, CONNECTICUT

U.S. ARMY CORPS OF ENGINEERS
NEW ENGLAND DISTRICT
CONCORD, MASSACHUSETTS

by

FOSTER WHEELER ENVIRONMENTAL CORPORATION
and
HARDING LAWSON ASSOCIATES

May 2000

Response To Comments On
Engineering Evaluation/Cost Analysis For The Causeway And Dike
(Dated February 23, 2000)
Stratford Army Engine Plant
Stratford, Connecticut

Comment # **Comment/Response**

CTDEP Comments dated March 31, 2000 on Draft EE/CA Report
Causeway and Dike Area, SAEP, Stratford, CT
February 2000

General Comments

1. **Comment:** Evaluate in more detail compliance with pollutant mobility criteria (PMC) before any final decision to install an engineered control to limit infiltration through polluted soil. The following should be considered:

Leachability of organic constituents in shallow soils should be evaluated in refinement of the mass-based criteria comparisons in the reviewed documents. (See Section 22a 133k-2(c)(2)(D) of the Remediation Standard Regulations (RSRs).) It is DEP's experience that the reported levels of organic constituents, particularly semivolatile constituents, rarely leach in excess of the applicable leach test comparison criteria of 10x the groundwater protection criteria. DEP recommends confirmatory SPLP testing of organic mobility for shallow soils which exceeded the GB Pollutant Mobility Criteria (PMC).

The two shallow locations where vanadium exceeds PMC are where radioactive materials were removed. DEP recommends confirmatory testing to determine if the vanadium was also removed, through possible association with the removed material.

Many of the PMC exceedances are in deeper soil and are located within the zone of tidally controlled groundwater fluctuation. The Remediation Standard Regulations (Section 22a-133k2(c)(1)(B)) do not require remediation of soils exceeding the pollutant mobility criteria in GB class areas if they are below the fluctuating high water table.

With the above considerations a spot removal of shallow soil in the vicinity of CB-99-15, if PMC are exceeded, may suffice to address RSR PMC.

Response: The EE/CA has been revised to incorporate additional soil sampling that was completed in May 2000, which included analysis by the Synthetic Precipitate Leaching Procedure (SPLP). Based on the additional data, the EE/CA includes a fourth removal action alternative, Alternative 4 – Erosion Control Cover System. This alternative includes (1) removal of soil hot spot areas, (2) construction of a cover system consisting of geotextile fabric and riprap over the entire Causeway, and (3) an environmental land use restriction. The first major component will address the shallow soils that exceed the CTDEP RSR GB PMC. The other two major components will provide protection to receptors from direct exposure to contaminated material.

2. **Comment:** DEP requests that the EE/CA discretely address the two different objectives of the cap: first, prevent direct exposure to polluted accessible soils and second, prevent pollution of infiltrating precipitation. The regulatory requirements for approval differ substantially, as do the long-term monitoring and maintenance requirements. Consider the following:

An additional alternative focusing solely on rendering polluted soil inaccessible should be included.

If the cover may be designed solely with the objective of limitation of direct access, the proposed membrane may be replaced with a non-woven separating and warning geotextile or a warning grid, the gas venting system and geodrain layer are unnecessary, and the backfill materials need not meet the stringent specifications necessary for membrane protection.

For an engineered structure which solely limits direct access the RSR specified public notification and commissioner approval process is not mandated.

The Remediation Standard Regulations require a groundwater monitoring program to evaluate effectiveness of an engineered control, but no groundwater monitoring is specifically required for a fill placed to enhance inaccessibility.

DEP's Remediation Standard Regulations require at section 22a 133k2 (f)(2)(A)(iv) that any cost-based proposal justifying use of engineered control as a permanent remedy include the cost of groundwater monitoring, therefore the cost analysis between alternatives is not complete.

Response: The EE/CA has been revised to include a fourth removal action alternative, Alternative 4 – Erosion Control Cover System. Alternative 4 includes an erosion control cover system (i.e., geotextile fabric and riprap) to address direct exposure to contaminated material, and removal of soil hot spot areas to address pollutant mobility concerns. The EE/CA has also been revised to incorporate operation and maintenance (O&M) activities (i.e., groundwater monitoring and monitoring and maintenance of the cover system) associated with Alternatives 1 and 2. As stated in the comment, groundwater monitoring is not required for Alternative 4, which is an alternative that includes fill material placed to enhance inaccessibility.

3. **Comment.** The following cover system design elements should be included in the evaluation:

A drainage layer is needed above the Flexible Membrane Liner in proposed Alternative 1 to route infiltrating precipitation away from the cap.

The alternative 2 use of a bentonite-containing geo-composite material may not be appropriate where tidally driven groundwater influx of salt water could occur during storm surges, causing saturation and flocculation.

The final elevation of the cap relative to the 100 year storm should be identified, as a factor affecting top cover erosion resistance design.

Response: The 18-inch sand layer above the flexible membrane liner (FML) of Alternative 1 acts as both a protection/bedding layer between the FML and riprap, as well as a sand drainage layer. A drainage layer does not necessarily need to include a drainage geocomposite, as does Alternative 2, as long as the sand used for the drainage layer exhibits an acceptable hydraulic conductivity. Should Alternative 1 be selected as the removal action alternative for the Causeway, the specific composition of the 18-inch sand bedding/drainage layer would be evaluated during development of the removal action design.

A GCL material is available that consists of bentonite adhered to a geomembrane, rather than a geotextile fabric. Using this type of GCL in conjunction with an FML will prevent groundwater influx of salt water from contacting the bentonite. This issue would be further evaluated during design of Alternative 2, should the alternative be selected as the recommended removal action remedy.

The EE/CA has been revised to reflect the 100-year flood elevation in the vicinity of the Causeway, which is 13 feet mean sea level (based on the Flood Insurance Rate Map for the Town of Stratford, CT [Federal Emergency Management Agency; June 16, 1992]).

Comment #	**Comment/Response**

Additional text has also been included to discuss this issue relative to the anticipated final elevation of the Causeway for each of the removal action alternatives.

4. **Comment.** The appropriateness of the proposed activity as a final remedy should be further discussed, considering the following:

Construction of an engineered control infiltration-reducing cap within the flood zone must entail a design which functions with minimum maintenance; describe further how the cap, in the flood zone and subject to active wave energy, will meet this criterion and discuss the necessary O&M in greater detail.

The proposed rip-rap surface of the final engineered control may not fully be consistent with the proposed post-closure use as a park and water access location. Alternatives to the rip-rap surface at the flat top of the causeway landform should be considered, especially those more compatible with the proposed post-remedial use. If the final elevation is below the 100 year flood elevation, alternatives should be designed to resist deep erosion during storm surges, either by including a surface with erosion resistance or through inclusion of subsurface reinforcing layers.

The deeper identified semivolatile pollution, especially at the northern part of the causeway, should be evaluated to determined if a non-aqueous phase is present, as provided in the RSRs. If a non-aqueous phase is present Section 22a 133k-2(g) mandates removal to the maximum extent prudent. Any cap design should facilitate the future activity which might be necessary to meet this requirement in a final remedy.

Pollution is present within the zone of diurnal tidal fluctuation of groundwater, especially at the northern part of the causeway. Although alternative 2 does consider this factor, neither proposed engineering control completely isolates this pollution from the environment. If the pollution is unacceptably affecting the environment additional mitigation may be necessary in the final remedy.

Response: The EE/CA has been revised to provide further discussion regarding the appropriateness of the proposed removal action alternative, including issues such as O&M activities and 100-year flood elevation.

The EE/CA has been revised to include a fourth removal action alternative, Alternative 4 – Erosion Control Cover System. This alternative includes riprap over the entire Causeway surface; however, a smaller size material will be used for the top, center portion of the Causeway, which will provide a surface that will be more compatible with the proposed future use of the Causeway (e.g., public water access). In the future, if a walkway along the Causeway is desirable, gravel could be added to the top, center portion of the Causeway to fill the voids between the smaller size riprap, which would provide a better surface for public access.

The highest concentrations of semivolatile organic compounds present in the Causeway soils were detected in a sample collected from 7 to 9 feet below ground surface (bgs) in soil boring CB-99-15, located near the northern end of the Causeway. The analytical results from this sample were used to evaluate the potential presence of a non-aqueous phase liquid (NAPL) in accordance with the CTDEP RSR Section 22a 133k-2(c)(3). The evaluation indicates that NAPL may be present at this sample location; however, NAPL was not observed at this or any other location during the Causeway soil or groundwater investigations. Additionally, the soil boring log for CB-99-15 indicates that the soil sample collected from 7 to 9 feet bgs contained pieces of asphalt and bituminous material.

As discussed in the response to Comment 1, additional SPLP soil data were collected in May 2000 to further evaluate the areas where the initial soil data indicated exceedances of the CTDEP RSR PMC for a GB area. Based on this data and evaluation, the recommended removal action alternative includes removal of contaminated soil hot spot areas in the vadose zone. As stated in Comment 1, the CTDEP RSR does not require remediation of soils exceeding the PMC in GB areas if the soils are below the fluctuating high water table. Additionally, groundwater data collected in November 1999 from the four monitoring wells installed in the Causeway indicate the presence of low concentrations of chlorinated VOCs and inorganic analytes; however, the concentrations are below the CTDEP RSR Surface Water Protection Criteria and the Industrial/Commercial Volatilization Criteria. Based on these data, it does not appear that the soil contamination present in the zone of tidal fluctuation of groundwater is migrating and therefore, is not adversely affecting the environment.

5. **Comment:** The cited criterion for asbestos direct exposure risk is specific to the Raymark project, and has not been incorporated into the RSRs. For this evaluation criterion to be applicable to the SAEP site a request must be submitted as provided in section 22a 133k-2 (b)(4).

Comment # **Comment/Response**

Response: In accordance with the Final Work Plan for the Causeway and Dike Non-Time-Critical Removal Action (reviewed and approved by the USEPA and CTDEP), and as presented in the Draft EE/CA, soil analytical data for asbestos were compared to the residential screening value of 1 percent total asbestos by the polarizing light microscope (PLM) method, used for the Raymark Site in Stratford, CT. Additionally, a cover system constructed over the Causeway would provide protection to potential receptors by preventing direct exposure.

6. **Comment:** Clearly indicate that O&M is a long term responsibility, unless waste is removed. It is appropriate to use 30 years as a basis for cost comparisons however the long term responsible party and funding mechanism should be identified.

Response: The EE/CA has been revised to more clearly state that O&M activities associated with Alternatives 1, 2, and 4 include monitoring and maintenance of the cover system. Alternatives 1 and 2 also include groundwater monitoring. The EE/CA also states that (1) the U.S. Army Tank-Automotive and Armament Command (TACOM) is responsible for the jurisdiction, control, and accountability of the SAEP facility, (2) the TACOM is responsible for O&M activities associated with the removal action alternatives presented in the EE/CA, and (3) funding for the removal activities at SAEP will be provided through the Department of Defense and BRAC.

7. **Comment:** Please note that the identification of ARARs is not complete. Attached for your use is a current listing of ARARs developed by our superfund group. It updates the list originally sent to your office May 6, 1996. Consider especially the following in development of your final EE/CA:

> Please clarify the characterization of the fill material on the north side of the causeway. Describe more fully the mix of clean fill (including brick, ceramic, asphalt, concrete, etc.) and other debris. Presence of significant quantities (over 10 cubic yards) of non-inert construction debris triggers regulation of the area as a solid waste disposal area, with need for addressing additional ARARs.
>
> Note that if the gas venting system produces more than 5 Tons/year of regulated gasses additional ARARs apply, and a passive system may not be acceptable. Retrofitting of a passive system as an active system is difficult unless the system has

been specifically designed for the retrofit.

This construction is modification of land features in a flood zone and subject to regulation accordingly.

Relocation of PCB contaminated soils as a result of construction could be interpreted as a re-use of contaminated soil subject to authorization by the regulating agencies under EPA regulations.

Response: The ARARs tables presented in the EE/CA have been revised to incorporate the USEPA and CTDEP review comments regarding the identification of ARARs.

Based on field exploration activities and observations during field investigations conducted at the Causeway, the fill material consists primarily of soil, cobbles, and other inert construction debris (e.g., concrete, brick, and asphalt). Smaller amounts of other material (e.g., wood and rebar) were also observed at some locations during field investigation activities. Although the types of debris were not quantified during investigation activities, the amount of non-inert material (e.g., wood and metal) is relatively small compared to the overall volume of fill material present at the Causeway. For clarification, the EE/CA has been revised to reflect that the Causeway consists of a heterogeneous mixture of fill that contains soil, cobbles, and construction debris (e.g., concrete, brick, and asphalt). Smaller amounts of other material (e.g., wood and rebar) were also observed at some locations during field investigation activities.

It is not anticipated that emissions from the gas venting system would produce more than five tons per years of regulated gases. The EE/CA has been revised to delete statements such as "If necessary, this passive system could later be converted to an active gas treatment system."

The ARARs tables presented in the EE/CA have been revised to include Connecticut Flood Management requirements (CGS §§ 25-68b through 25-68h and RCSA §§ 25-68h-1 through 25-68h-3), in addition to the Federal Flood Plains Management – Executive Order 11988 (40 CFR 6, Appendix A) presented in the Draft EE/CA.

The five isolated detections of PCBs are in areas that are not likely to be excavated, either during material consolidation or cutting and filling operations associated with Alternatives 1, 2, and 4. Additionally, the maximum concentration of PCBs detected is 2.2 milligrams per

Comment #	**Comment/Response**
	kilogram, which is far less than the criteria established under federal regulations. Therefore, the Toxic Substances Control Act (40 CFR 761) is not an ARAR for the Causeway EE/CA.

Comment # Comment/Response

CTDEP (Office of Long Island Sound) Comments dated April 3, 2000 on Draft EE/CA Report
Causeway and Dike Area, SAEP, Stratford, CT
February 2000

General Comments

1. **Comment:** The EE/CA includes evaluations of three alternatives; two of which involve capping and the third is removal with off-site disposal. During the briefing meeting, in response to a question I posed, it became clear that the two capping alternatives are essentially composed of an "under barrier" and an "over cap" and that these components may, to some extent, be interchanged from one alternative to the other. In other words, the under barriers considered consist of either a relatively simple hydraulic barrier, depicted in Alternative 1, or a more complex composite barrier, depicted in Alternative 2. The over caps evaluated are a riprap final cover for both the top and side slopes of the causeway, depicted in Alternative 1, or a bulkhead on the sides with riprap on top, depicted in Alternative 2. Either under barrier may be utilized with either over cap.

   This apparent flexibility is helpful because the selection of the appropriate under barrier to prevent contact with the contamination is not within OLISP's area of expertise and we defer to others to determine which under barrier is most appropriate. We are, however, concerned about the type of material used for the outermost layer(s), or over cap, placed on the causeway and/or dike and its final configuration.

   This concern springs from the causeway's location in an estuarine embayment, the Housatonic River, and the presence of intertidal flats, a protected resource, on either side of the causeway and along the waterward face of the dike. The Connecticut Coastal Management Act [CCMA, Connecticut General Statutes sections 22a-90 through 22a-112] contains enforceable policies that require the protection of intertidal flats. In order to minimize potential adverse impacts to this resource area, the final cap should be designed with sloped sides (i.e., the riprap slopes shown in Alternative 1). This would allow for wave run-up which dissipates wave energy and reduces the potential for erosion of the intertidal flat. Vertical sides, such as the bulkhead treatment shown in Alternative 2, deflect waves in many directions, including downward, which can erode the intertidal area causing unacceptable adverse impacts.

Response: The U.S. Army TACOM understands the preference by the Office of Long Island Sound Programs (OLISP) to select a "cover system" type of removal action alternative that is designed with sloped sides, rather than vertical sides. Based on discussions at the March 4, 2000 BRAC Cleanup Team (BCT) and Restoration Advisory Board (RAB) meetings, the EE/CA has been revised to include a fourth alternative, Alternative 4 – Erosion Control Cover System, which also has sloped sides.

2. **Comment:** The use of riprap side slopes will also provide a substantial area of nooks and crannies between the rocks. These interstices provide habitat for fish and other marine life, a beneficial impact that is encouraged by the CCMA. During the briefing meeting, it was suggested that perhaps interlocking concrete blocks could be used instead of riprap to provide a smooth surface. While such blocks may be appropriate on the top of causeway, they should not be used on the side slopes.

Response: Alternatives 1, 2, and 4 presented in the EE/CA include side slopes constructed of riprap. Although interlocking concrete blocks were discussed during the March 4, 2000 BCT and RAB meetings as possible construction materials for the Causeway alternatives, they are currently not being considered in the EE/CA.

3. **Comment:** The size of the rocks used to construct the riprap side slopes are of concern; the larger the individual stones, the greater the potential for wave-induced erosion of the intertidal flat and the lesser the value of the are as marine habitat. We note that the EE/CA is calling for riprap with an average size of 600 pounds. In order to minimize the potential for erosion of the intertidal flat and to maximize the habitat value, the smallest rock size possible should be used to achieve a stable structure. We respectfully request that this be reviewed and that the size of the rock be reduced if possible.

Response: The U.S. Army TACOM understands the concern of the OLISP regarding the size of the riprap material. For clarification, the EE/CA has been revised to state that the maximum stone size would be approximately 600 pounds. The riprap is not intended to be a uniform stone size. It is currently anticipated that the riprap would have a range of stone size from approximately 1-foot to 2½-feet in dimension. However, the size of the riprap will be further evaluated during detailed design of the selected alternative.

4. **Comment:** The plans contained in the EE/CA indicate that the capping work is designed to maintain the "toe of slope." While this is appropriate and commendable as a means to minimize encroachment into the intertidal flat, it is also important to maintain, to the extent practicable, the horizontal location of mean high water (4.1' NGVD), which is the landward extent of the public trust area*. The plans should be reviewed with this in mind and modified if necessary.

Response: The figures in the EE/CA have been revised to reflect a mean high tide of 4.1 feet mean sea level.

5. **Comment:** It is our understanding that the future use of the causeway area is for public access. As such, it should be an inviting place for the public to spend time. The EE/CA does not explicitly detail the treatment of the top of the causeway. However, the implication is that riprap will entirely cover this area. This final cover is not likely to be very inviting to the public nor is it likely to provide an appropriately safe walking surface. We strongly recommend that the Army work with the Town of Stratford to identify a reasonable, inviting treatment for the top of the causeway that will maintain an adequate barrier to the contaminants present in this area.

Response: The U.S. Army TACOM understands the concern of the OLISP regarding the cover system for the Causeway having a top surface that will be compatible with the potential future use as a public water access area. In regards to this concern, the recommended alternative presented in the EE/CA has been revised to include a smaller size riprap for the top, center portion of the Causeway. In the future, if a walkway along the Causeway is desirable, gravel could be added to the top, center portion of the Causeway to fill the voids between the smaller size riprap, which would provide a better surface for public access.

6. **Comment:** We note that the list of Applicable or Relevant and Appropriate Requirements (ARARs) is incomplete with respect to location-specific ARARs [Table 3-2, page 2 of 2]. Under the "State" heading, this table should include the Tidal Wetlands Act [Title 22a Chapter 440] and the statutes governing the placement of fill, structures and dredging in tidal, coastal and navigable waters [Title 22a Chapter 446i]. I have attached copies of these statutes for forwarding to the Army's consultant for their use.

Response: The Inland Wetlands and Watercourses Act, also known as the Tidal Wetlands Act, was included in Table 3-2 of the Draft EE/CA. However, the listing of the requirement

* The public trust area comprises submerged lands and waters waterward of the mean high water mark in tidal coastal or navigable waters of the State Of Connecticut. This area is held in trust by the State of Connecticut for the use and enjoyment of its citizens.

in Table 3-2 has been revised to reflect the appropriate Connecticut General Statutes and the Regulations of Connecticut State Agencies. Additionally, the Regulation of Dredging and Erection of Structures and Placement of Fill in Tidal, Coastal, or Navigable Waters (CGS §§ 22a-359 through 22a-363(f)) has been added to Table 3-2 as an "applicable" location-specific ARAR.

7. **Comment:** Finally, during the briefing meeting, we discussed the requirements for public notice of this project. The Army has indicated a willingness to include the federal coastal zone management consistency review notice as part of their general public notice. We appreciate this offer. To publish proper notice of the federal consistency component, the public notice should include language that the Army is requesting "federal coastal consistency concurrence for activities within Connecticut's coastal boundary pursuant to section 307(c)(1) of the Coastal Zone Management Act." This language will serve as both the Army's request for concurrence and public notice of such request. I would appreciate it if the Army could provide to me a copy of the public notice at the time of publication.

Response: The U.S. Army TACOM will provide a copy of the draft public notice for the Causeway EE/CA Non-Time Critical Removal Action to the CTDEP, including the OLISP, for review and comment prior to publication of the notice.

Comment # **Comment/Response**

USEPA Comments dated March 27, 2000 on Draft EE/CA Report
Causeway and Dike Area, SAEP, Stratford, CT
February 2000

ARARs Tables 3-1 through 3-3

1. **Comment:** A marked-up version of the ARARs tables is attached.

   Response: The comments on the ARARs Tables 3-1 through 3-3 have been incorporated as provided. In regards to the comment "Add reference doses and cancer slope factors as federal TBCs if they were used.", the USEPA Risk Reference Doses and Cancer Slope Factors were not used in the development of the Causeway and Dike Engineering Evaluation/ Cost Analysis (EE/CA) and therefore, are not included as chemical-specific ARARs.

General Comments

1. **Comment:** The EE/CA adheres to EPA guidance for the evaluation of remedial alternatives. The assessment of the alternatives considered is complete and objective. For the most part, the final recommendation of Alternative 1 is supported by the information presented. By incorporating the information outlined in the comments below, EPA believes the Army has provided sufficient information to support a removal action.

   Response: Comment noted.

2. **Comment:** Remedial Alternatives 1 and 2 have the potential for leaching of soil contaminants to groundwater. Therefore, these alternatives should include long-term monitoring of groundwater and cap integrity.

   Response: The EE/CA has been revised to include groundwater monitoring and monitoring and maintenance of the cover systems as operation and maintenance (O&M) activities for Alternatives 1 and 2.

Specific Comments

1. **Comment: Executive Summary, Page E-2, Causeway.** The text notes removal actions for

Comment # **Comment/Response**

the radiological-contaminated material are to be completed by the spring 2000. The text goes on to add that the radiological material will not be included in the scope of the removal action alternatives evaluated in this EE/CA. The text should address this statement in more detail and provide a date for the removal action at the Dike.

Response: The Executive Summary and Subsection 2.3.1 of the EE/CA has been revised to include a brief discussion of the removal of low-level radiological-contaminated material removed from the Causeway March 15 and 16, 2000.

2. **Comment: Page ES-3, 2nd Paragraph, Removal Action Alternatives and Page 4-2 (and throughout the report):** The titles of Alternatives 1 and 2 are not clear. EPA suggests changing to the following:

Alternative 1 Capping with Synthetic Geomembrane

Alternative 2 Capping with Composite Cover System and Vertical Barrier

Response: The titles of Alternatives 1 and 2 have been changed as requested.

3. **Comment: Page 2-4, Section 2.1.3, Existing Conditions, Surface Water, 1st paragraph:** In addition to average tidal elevations at the site, a 100-year flood elevation should be included for proper cap design for protection against wave action.

Response: A sentence has been added to Subsection 2.1.3 that states: “The 100-year flood elevation in the vicinity of the Causeway is 13 feet MSL.”

4. **Comment: Page 2-9, §2.3 ¶3** The text notes preliminary results of groundwater data collected from monitoring wells installed in the Causeway indicated low concentrations of chlorinated VOCs and inorganic analytes. The date these results were reviewed or the date these samples were taken at the Site should be provided in the text.

Response: The first sentence of the third paragraph of Section 2.3 has been revised as follows: “Preliminary results of the groundwater data collected in November 1999 from the four monitoring wells…”

5. **Comment: Page 2-11, §2.4, Preliminary Risk Evaluation** The text states that a risk evaluation is being performed for the surface and subsurface soils in the Causeway and Dike area as part of the RI. The text should discuss whether this RI and risk assessment will include the soil contaminants addressed in this document assuming that the contaminants

are left in-place.

Response: The beginning of Section 2.4 of the Draft EE/CA has been revised as follows. "A risk assessment is being conducted for surface and subsurface soils in the Causeway and Dike area as part of the RI for the SAEP facility. The baseline risk assessment was conducted to assess the potential risks associated with current and future exposure to contaminants at the site in the absence of any remedial action. The Draft RI for the SAEP facility will not be published until the spring of 2000. Therefore, the CTDEP RSR criteria will be used in the selection and implementation of removal actions at SAEP."

6. **Comment: Page 4-3, Section 4.1.1, Description of the Alternative, 3rd Paragraph and Page 4-8:**

1) 1st sentence: Add "during a 100-year storm event" after "...from storm surge or wave action."

2) 2nd sentence: The stone size should be determined based on design conditions for the worst storm event at the site. The weight of the proposed stones (i.e., 600 pounds) should not be specified without the design calculations.

3) 5th sentence: The proposed gas venting layer can't be converted to an active gas treatment system unless additional gas wells are installed above the lowest groundwater level. EPA recommends deleting the 5th sentence.

Response:

1) The sentence has been revised as requested.

2) The stone size of the riprap (i.e., approximately 600 pounds) included in the "conceptual design" presented in the Draft EE/CA was calculated based on the U.S. Army Corps of Engineers "Design of Coastal Revetments, Seawalls, and Bulkheads" (EM 1110-2-1614). As stated in the Draft EE/CA, there are several details that will be addressed and evaluated during the detailed design of the selected removal action alternative, including the size and thickness of the riprap/stone armor. The Draft EE/CA also states that for cost estimating purposes a stone size of 600 pounds in a 3-foot thick layer was used for the riprap/stone armor component of the alternatives. In support of the selected removal action alternative, pre-design activities will be conducted, which will include further evaluation of the tidal river environment on the Causeway cover system (e.g., size and thickness of the riprap/stone armor layer of the cover system to minimize potential future erosion). Design calculations, as appropriate, will be provided as part of the removal action design for the selected alternative.

Comment #	Comment/Response

3) The sentence has been deleted as requested.

7. **Comment: Page 4-4, Section 4.1.2:** the text acknowledges that Alternative 1 "...may not prevent water from the tidal action of the Housatonic River in contacting some of the contaminated material and potentially transporting soluble contaminants out of the limits of the cap," and, similarly, notes that the sheetpile wall that is proposed as part of Alternative 2 will serve to reduce this possibility. The importance of this limitation on the effectiveness of Alternative 1 relative to that of Alternative 2 should be assessed. If tidal "flushing" of the Causeway/Dike were to occur, what risks will be posed to potential receptors? Can a worst-case scenario be constructed (e.g. rapid mobilization of a suite of contaminants, followed by dilution within the river system) in order to provide some basis for weighing the importance of this potential transport pathway?

   Response: Between the 1950s and 1980s, materials of unknown origin were reportedly deposited on the Causeway. Some of these materials are likely the source of the current soil contamination present within the Causeway. Therefore, the existing Causeway fill material has been subjected to at least 20 years of "flushing" due to the tidal fluctuation of groundwater in the vicinity of the Causeway. Groundwater data collected in November 1999 from the four monitoring wells installed in the Causeway indicate the presence of low concentrations of chlorinated VOCs and inorganic analytes; however, the concentrations are below the CTDEP RSR Surface Water Protection Criteria and the Industrial/Commercial Volatilization Criteria. Based on these data, it does not appear that the soil contamination present in the zone of tidal fluctuation of groundwater is migrating and therefore, is not adversely affecting the environment.

8. **Comment: Page 4-4, §4.1.2, Long -Term Effectiveness** The text states that Alternative 1 may not prevent water from tidal action of the Housatonic River from contacting some of the contaminated material and potentially transporting soluble contaminants out of the limits of the cap. The text should discuss how this will be addressed in the remedial alternative.

   Response: See the response to Comment 7.

9. **Comment: Page 4-7, Section 4.2.1, Description of the Alternative, 2nd Paragraph:** The text indicates that UV-stabilized vinyl sheet pile material will be used. It is not clear whether the proposed PVC sheet piles can provide long-term structural stability against lateral cover loading and wave actions. Brief design calculations supporting the selection of PVC sheet piles rather than steel sheet piles should be provided in the EE/CA.

   Response: The "conceptual design" presented in the Draft EE/CA considered the use of ShoreGuard® vinyl sheet pile, which is specifically manufactured for use in constructing retaining walls and seawalls. The material is provided with a manufacturer's warranty of 50 years against rot, decay, and attack from pests. For long-term performance, the manufacturer incorporates several safety factors to account for variances in raw materials, manufacturing tolerance, and material creep failure. Additionally, the manufacturer includes a general factor of safety of 1.5 to ensure that ShoreGuard® provides long-term performance.

10. **Comment: Page 4-9, Section 4.2.2:** While the advantages of the sheetpile wall are enumerated clearly (e.g., minimization of the hydraulic connection between the Causeway and the river), a disadvantage that is not spelled out is the finite lifetime of the sheetpile structure. The wood (although pressure treated) and the vinyl will have a finite service life due to their ultimate degradation. The expected lifetime of these materials in this environment should be discussed.

    Response: A brief discussion has been added to Subsection 4.2.2, under long-term effectiveness, regarding the finite life of the vinyl sheetpile and pressure-treated lumber and that these materials would need to be replaced over time.

11. **Comment: Page 4-13, Section 4.3.1:** The text states, "Reconstruction of the Causeway with clean fill was not included under this alternative" While reconstruction does appear to be a separate issue from remediation (at least to a large extent), complete removal of the Causeway seems to be at odds with the future use scenarios (e.g., recreation) and perhaps with community interest at the site. While this is clearly acknowledged later in the EE/CA (p. 5-4, sec. 5.2.2), perhaps this issue should be noted here in section 4.3.1 as well.

    Response: The following text has been added to the end of Subsection 4.3.1: "The proposed future land use may include public water access from a new dock located at the end of the former seaplane boat ramp at the Causeway. Alternative 3 would not include reconstruction of the Causeway. Therefore, Alternative 3 may not be completely compatible with the future development of the site."

12. **Comment: Page 5-3, Section 5.2.2:** The evaluation of the balancing criterion "Reduction of toxicity, mobility, or volume through treatment" is correct in what it says about reduction of toxicity, mobility, and volume for the proposed remedial alternatives. However, the presentation is somewhat misleading as written, in that the criterion specifically addresses reduction <u>through treatment</u>, and neither isolation of contaminants beneath a cap or physical removal constitutes treatment. The EE/CA acknowledges this clearly in other sections where

Comment # Comment/Response

it is stated for example, that isolation "...does not include active treatment and therefore, does not satisfy the CERCLA statutory preference for treatment" and that, in a removal, "...the contaminated materials is simply transferred to another facility..." The fact that isolation and/or removal does not constitute "treatment" in the strictest sense should be acknowledged again here in this section (5.2.2). The qualifying statements given in the present draft should then be given as supporting arguments to the effect that some of the objectives of treatment are met by the proposed remediation schemes (e.g., capping reduces mobility; removal reduces volume on the particular site of concern). These arguments are relevant in that they mitigate to some extent the failure to meet the preference for "active treatment."

Response: The following text has been added to Subsection 5.2.2 at the beginning of the paragraph that discusses reduction of toxicity, mobility, or volume through treatment: "Alternatives 1 through 4 do not include active treatment and therefore, do not satisfy the CERCLA statutory preference for remedies that involve treatment that reduces toxicity, mobility, or volume as a principal element."

13. **Comment: Page 5-3, Section 5.2.2:** the evaluation of the balancing criterion "short-term effectiveness" simply states that all three alternatives carry some risk to site workers, but does not attempt to assess the relative risks among the alternatives considered. Such an assessment should be given in order to provide a complete basis for comparison. In particular, it is noted that Alternative 3 would appear to have the potential to mobilize far more contaminants (e.g., via airborne dust) because of the extensive excavation. On the other hand, Alternative 3 is estimated to have a shorter construction time than the other alternatives.

    Response: Text has been added to Subsection 5.2.2 to qualitatively discuss the relative risks among the alternatives, relative to short-term effectiveness.

14. **Comment: Page 5-3, §5.2.2, Long-term effectiveness and permanence:** The text states that Alternatives 1, 2, and 3 all provide long-term effectiveness. The text should discuss how long-term effectiveness is evaluated without groundwater monitoring and cap integrity monitoring.

    Response: Text has been added to Subsection 5.2.2 that discusses how groundwater monitoring and monitoring and maintenance of the cover systems (O&M activities) for Alternatives 1 and 2 will be used to evaluate the long-term effectiveness of these alternatives.

Response: Text has been added to Subsection 5.2.2 that discusses how groundwater monitoring and monitoring and maintenance of the cover systems (O&M activities) for Alternatives 1 and 2 will be used to evaluate the long-term effectiveness of these alternatives.

List of Typical State Applicable or Relevant and Appropriate Requirements For Superfund Remedial or Removal Actions November 8, 1999

Action Specific ARARs			
Requirement	Citation	Typical Status *	Synopsis of Requirement
Remediation Standard Regulations	RCSA §22a-133k 1- to 3	Applicable	These regulations were adopted on January 30, 1996, under the statutory authority provided by CGS §22a-133k. . They provide specific numeric cleanup criteria for a wide variety of contaminants in soil, ground water, surface water and soil vapor.
Reporting of Certain Significant Environmental Hazards by Owners of Contaminated Real Property	CGS §22a-6u	Applicable	After October 1, 1998, when certain conditions described in the regulation are encountered by a technical environmental professional collecting soil, water, vapor or air samples for the purposes of investigating or remediating sources of pollution to the waters of the State, certain notifications to the property owner, the client, the Commissioner, and in some cases, the local fire department are required.
Hazardous Waste Management: Generator & Handler Requirements- General Standards, Listing & Identification	RCSA §§22a-449(c)100-101	Relevant and Appropriate (Applicable to Investigation Derived Waste)	These sections establish standards for listing and identification of hazardous waste. The standards of 40 CFR §§260-261 are incorporated by reference. Chromium is not exempted from listing as a hazardous waste.
Hazardous Waste Management: Generator Standards	RCSA §22a-449(c)102	Relevant and Appropriate (Applicable to Investigation Derived Waste)	This section establishes standards for various classes of generators. The standards of 40 CFR §262 are incorporated by reference. Storage requirements given at 40 CFR §265.15 are also included.
Hazardous Waste Management: Transporter Standards	RCSA §22a-449(c)103	Offsite Requirement	This section establishes standards for hazardous waste transporters. The standards of 40 CFR §263 are incorporated by reference.
Hazardous Waste Management: TSDF Standards	RCSA §22a-449(c)104	Relevant and Appropriate (Applicable to Investigation Derived Waste)	This section establishes standards for treatment, storage, and disposal of hazardous waste, and establishes standards for closure, post closure, and ground water monitoring. The standards of 40 CFR §264 are incorporated by reference. Underground injection of hazardous wastes, and placement of free liquids in landfills are prohibited.
Hazardous Waste Management: Interim Status Facilities and Ground water Monitoring requirements, Closure and	RCSA §22a-449(c)105	Relevant and Appropriate (Applicable to	This section establishes interim status standards for treatment, storage, and disposal of hazardous waste, and establishes standards for closure, post closure, and ground water monitoring. The standards of 40 CFR §265 are incorporated by reference. The

List of Typical State Applicable or Relevant and Appropriate Requirements For Superfund Remedial or Removal Actions November 8, 1999

Action Specific ARARs			
Requirement	Citation	Typical Status *	Synopsis of Requirement
Post Closure Requirements		Investigation Derived Waste)	Commissioner may require ground water monitoring based on site specific considerations.
Hazardous Waste Management: Management Standards for Specific Waste Types	RCSA §22a-449(c)106	Relevant and Appropriate (Applicable to Investigation Derived Waste)	This section establishes standards for specific types of wastes, including waste oil and spent lead acid batteries being reclaimed. The standards of 40 CFR §266 are incorporated by reference.
Hazardous Waste Management: Land Disposal Restrictions	RCSA §22a-449(c)108	Relevant and Appropriate (Applicable to Investigation Derived Waste)	This section incorporates by reference the Federal Land Disposal Restrictions given at 40 CFR §268.
Hazardous Waste Management: Permit Requirements	RCSA §22a-449(c)110	Relevant and Appropriate (Applicable to Investigation Derived Waste)	This section incorporates by reference the Federal hazardous waste permitting requirements given at 40 CFR §§270 & 124.
Solid Waste Management	RCSA §§22a-209-1 to 15	Relevant and Appropriate	These standards establish operating and closure standards for solid waste disposal areas including closure, post-closure, and groundwater monitoring requirements. Note that the definition of Solid Waste is given in CGS §22a-207.
Solid Waste Management	CGS 22a-208a through 208c	Relevant and Appropriate	A permit is required for construction, alteration or operation of a solid waste management facility, or to receive, dispose of , process or transport solid waste in a solid waste facility, volume reduction plant, solid waste disposal area, recycling facility, recycling center, transfer station or biomedical waste facility.
Disposition of PCBs	CGS §22a-467	Relevant and Appropriate	This section requires that PCBs be disposed under a permit issued by the Commissioner. PCBs may also be disposed of under a written approval of the Commissioner in a manner which results in the destruction of the PCB or in a manner not inconsistent with the Requirements of the Toxic Substances Control Act (TSCA), listed at 40CFR §761.
Transportation of Oils and Chemical	CGS §22a-454	Offsite requirement	These rules require permits for persons who transport oils and chemical liquids.

List of Typical State Applicable or Relevant and Appropriate Requirements For Superfund Remedial or Removal Actions
November 8, 1999

Action Specific ARARs			
Requirement	Citation	Typical Status *	Synopsis of Requirement
Liquids			
Control of Noise Regulations	RCSA §§22a-69-1 to 69-7.4	Applicable	These regulations establish allowable noise levels. They would apply to construction activities at a site.
Water Pollution Control	RCSA §§22a-430-1 to 8	Applicable	These rules establish permitting requirements and criteria for water discharge to surface water, ground water and POTWs.
Water Pollution Control	CGS §22a-430b	Applicable	This section establishes general permits for many categories of discharges including storm water, and discharges to a POTW by a ground water remediation system. General permits may require that the discharge be registered with the Commissioner prior to initiating the discharge.
Water Pollution Control	CGS §22a-430	Applicable	This section prohibits discharge to the waters of the State without a permit.
Water Quality Standards	CGS §22a-426	Applicable	Connecticut's Water Quality Standards were adopted under this statute. They establish specific numeric criteria, designated uses, and anti degradation policies for groundwater and surface water.
Connecticut Water Diversion Policy Act	CGS §§22a-365 to 378	Applicable	These rules regulate many diversions of the waters of the State. Several broad categories are exempt, including any diversion of less than 50,000 gallons per day and any discharge permitted under CGS §22a-430.
Air Pollution Control- Stationary Sources	RCSA §22a-174-3	Applicable	This section requires permits to construct and operate stationary sources of emissions, and requires those sources to meet specified standards. Pollution abatement controls may be required. Specific standards are listed for many pollutants. Any landfill with potential emissions of any particular air pollutant including methane exceeding 5 tons per year requires a permit under subsection 3(a)1(K). Active gas collection systems with emissions controls may be required.
Air Pollution Control- Control of Particulate Emissions	RCSA §22a-174-18	Applicable	This subsection sets specific standards for particulate emissions. Specific standards include Fugitive Dust (18b), and Incineration (18c). Gas flares are regulated as incinerators.

List of Typical State Applicable or Relevant and Appropriate Requirements For Superfund Remedial or Removal Actions November 8, 1999

Action Specific ARARs			
Requirement	Citation	Typical Status *	Synopsis of Requirement
Air Pollution Control-Control of Organic Compound Emissions	RCSA §22a-174-20	Applicable	Subsection (f) sets standards for emission of organic compounds. Incineration of organic halocarbons is prohibited under subsection (f)(6)(A).
Air Pollution Control-Control of Odors	RCSA §22a-174-23	Applicable	This section prohibits emission of any substance that constitutes a nuisance because of objectionable odor.
Air Pollution Control-Control of Hazardous Air Pollutants	RCSA §22a-174-29	Applicable	This section establishes testing requirements and allowable stack concentrations for many specific substances.
Regulations for the Well Drilling Industry	RCSA §25-128-33 through 64	Applicable	These rules apply mainly to any new water supply or withdrawal wells. The rules specify that non water supply wells must be constructed so that they are not a source or cause of groundwater contamination. Procedures for abandonment of wells apply to both water wells and other types of wells.
Registration and permitting of wells and well drillers	CGS § 25-126 thru 131	Applicable	Well drillers must be registered and permits and fees are required for each water supply well drilled. Separate registrations apply to water supply and non-water supply drillers. Permits are not required for non water supply wells. However, the driller must file a completion report for both water supply wells and non-water supply wells.
CT Guidelines for Soil and Sediment Control	adopted pursuant to CGS §22a-328	Applicable	The guidelines provide technical and administrative guidance for the development, adoption and implementation of erosion and sediment control program.

Location-Specific ARARs			
Requirement	Citation	Typical Status*	Synopsis of Requirement
Aquifer Protection Areas	CGS 22a-354 through 354aa	Applicable	These statutes provide for the municipal regulation of various activities in aquifer protection areas.
Stream Channel Encroachment	CGS 22a-342 through 350	Applicable	These statutes prohibit the establishment of any obstruction or encroachment, without a permit from DEP, within designated stream channel encroachment lines.
Regulation of Dredging and Erection of Structures and Placement of Fill in Tidal,	CGS 22a-359 through 363f	Applicable	These statutes regulate dredging, the erection of structures and placement of fill in tidal, coastal or navigable waters waterward of the high tide line.

List of Typical State Applicable or Relevant and Appropriate Requirements For Superfund Remedial or Removal Actions November 8, 1999

Location-Specific ARARs

Requirement	Citation	Typical Status*	Synopsis of Requirement
Coastal, or Navigable Waters			
Coastal Management Act	CGS 22a-90 through 112	Applicable	This statute establishes Connecticut's enforcable coastal zone policies in accordance with the federal Coastal Zone Management Act.
Tidal Wetlands Act	CGS 22a-28 through 35	Applicable	These statutes regulate activities within tidal wetlands.
Tidal Wetlands regulations	RCSA 22a-30-1 through 30-17	Applicable	These regulations apply to activities within tidal wetlands
Inland Wetland and Watercourses Act	CGS 22a-36 through 45	Applicable	These statutes regulate any operation in or affecting a wetland or watercourse involving removal or deposition of material or any obstruction, construction, alteration or pollution of such wetlands.
Surface Water and Wetlands- Inland Wetlands and Watercourses Regulations	RCSA §§22a-39-1 to 15	Applicable	These regulations apply to activities within or affecting inland wetlands.
Surface Water and Wetlands- Inland Wetlands and Watercourses Act- General Permit Requirements	CGS§ 22a-45a	Applicable	This section authorizes the Commissioner to adopt a general permit for various minor activities including installation of water quality monitoring equipment, excavation of test pits and core sampling.
Flood Management	CGS §25-68b through 25-68h	Applicable	Regulates state activities in flood plains to minimize flood risk and prevent flood hazards. The use of state funding constitutes a state activity for purposes of these sections.
Flood Management Regulations	RCSA 25-68h-1 through 25-68h-3	Applicable	These regulations were adopted to implement the Flood Management statutes.

Chemical Specific ARARs

Requirement	Citation	Typical Status*	Synopsis of Requirement
Standards for Public Drinking Water Quality	RCSA 19-13-B101 through B102	Relevant and Appropriate	MCLs established under these standards are health-based limits for certain chemical substances in drinking water. Action levels are also established under this act.

List of Typical State Applicable or Relevant and Appropriate Requirements
For Superfund Remedial or Removal Actions
November 8, 1999

Requirements To Be Considered (TBC)			
Requirement	Citation	Typical Status*	Synopsis of Requirement

*The Status of a particular requirement will depend on the remedial or removal action being considered for a particular site. The entries in this column are typical, but the decision on whether a requirement is applicable, relevant and appropriate, or to be considered (TBC) must be made on a case by case basis.

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RESPONSE TO COMMENTS ON
REVISED DRAFT
ENGINEERING EVALUATION/COST ANALYSIS FOR THE CAUSEWAY AND DIKE
(DATED JULY 31, 2000)
STRATFORD ARMY ENGINE PLANT
STRATFORD, CONNECTICUT

U.S. ARMY CORPS OF ENGINEERS
NEW ENGLAND DISTRICT
CONCORD, MASSACHUSETTS

by

FOSTER WHEELER ENVIRONMENTAL CORPORATION
and
HARDING LAWSON ASSOCIATES

SEPTEMBER 2000

RESPONSE TO COMMENTS ON
REVISED DRAFT
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STRATFORD, CONNECTICUT

Comment # **Comment/Response**

CTDEP Comments dated September 13, 2000 on Revised Draft EE/CA Report Causeway and Dike Area, SAEP, Stratford, CT July 2000

General Comments

1. **Comment:** Section 2.2 describes the RCRA closure as completed, including the drum storage area, however this has not yet been finalized.

   Response: Section 2.2 has been revised to indicate that RCRA closure activities for the drum storage area have been initiated, but not completed.

2. **Comment:** The citation of ARARs is incorrect in detail for the Remediation Standard Regulations. The Connecticut General Statutes (CGS) Section 22a-133k required adoption of remediation standard regulations, which were promulgated as Regulations of Connecticut State Agencies (RCSA) Sections 22a-133k 1 to 22a-133k 3. Environmental Land Use Restrictions are statutorily defined in CGS Sections 22a-133n through 22a-133r, and the format for filing is detailed in RCSA Section 22a-133q.

   Response: Table 3-1 has been revised to reference both the Connecticut General Statutes and the Regulations of Connecticut State Agencies associated with the Remediation Standard Regulation (RSR).

3. **Comment:** Alternative 4 is the installation of a cover/structure which renders underlying soil inaccessible as specified in the definition of inaccessible soil at RCSA Section 22a-133k 1(a)(28). This definition should be cited. As provided in RCSA Section 22a 133k 2 (b)(3), the Direct Exposure Criteria do not apply to inaccessible soil which is subject to an Environmental Land Use Restriction (ELUR). Because of this exemption, the proposed remedy in alternative 4 is not strictly considered an engineered control under the Remediation Standard Regulations, thus many of the specific provisions of RCSA 22a 133k 2(f)(2) do not apply. However, DEP recommends that appropriate engineering design and postclosure care be included in the remedy to ensure long-term continued inaccessibility. The timing of and procedure for the ELUR placement should be indicated.

Response: Table 3-1 has been revised to provide more detail regarding the "Requirement Synopsis" and "Action to be taken to attain ARAR" relative to the RSR and the use of engineered controls, a cover or structure to render contaminated soil inaccessible, and ELURs.

Text has been added to Section 4.0 regarding the timing and procedure for establishing the ELUR.

4. **Comment:** Note that the provisions for approval of an engineered control present at RCSA Section 22a 133k 2(f)(2) do apply to alternatives 1 and 2. DEP recommends that, to ensure implementation is not delayed in the event alternative 1 or 2 is selected as the remedy, the specified Section 22a 133k 2(f)(2)(A)(iv) public notification be concurrent with other public notifications for the project. Also, the detailed design and decision documents should address all the required elements at Section 22a 133k 2(f)(2)(B) if alternative 1 or 2 is selected.

   Response: The public notice to announce the availability of the EE/CA for public comment, will be prepared to address the requirements of CERCLA and the NCP, as well as the requirements of the CTDEP RSR. Additionally, if Alternative 1 or 2 is the selected remedy, the decision document and design will address the requirements of the CTDEP RSR Section 22a 133k 2(f)(2)(B).

5. **Comment:** DEP notes that the activity specific ARARs will be identified during the design phase, and reserves comment until these ARARs are identified in detail. The EE/CA should include any consideration of activity specific ARARs which may affect the selection of the preferred remedy.

   Response: Table 3-3 presents the potential action-specific ARARs that may apply to the removal action alternatives evaluated in the EE/CA. The action-specific ARARs associated with the selected removal action alternative will be presented in the Causeway Non-Time-Critical Removal Action Decision Document and the Causeway Removal Action Design. Both of these documents will be submitted to the regulatory agencies for review.

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Comment # **Comment/Response**

6. **Comment:** The 600 pound rip-rap proposed for the side slopes of the causeway can be viewed as "another existing permanent structure", rather than soil, under the provisions of RCSA Section 22a 133k 1(a)(28)(C)(ii), since it will be existing at the time the Environmental Land Use Restriction is established. DEP can accept a final designed rip-rap thickness of less than four feet, provided the design clearly is demonstrated to meet the objective of maintaining long-term inaccessibility. The conceptual diagrams and discussion should be modified accordingly. This may reduce the proposed widening of the causeway landform at the mean high water level.

   Response: The Army is pleased to hear that the CTDEP can accept a riprap layer that is less than four feet thick. Alternative 4 currently projects the overall "footprint" of the Causeway to increase by approximately 0.3 acres. Using a thinner layer of riprap could potentially reduce the final Causeway "footprint". However, the thickness of this layer is somewhat dependent upon the size of the rock used for the riprap (e.g., the thickness should be approximately two times the diameter of the minimum W_{50}, based on the gradation of the riprap). Several details must be evaluated and addressed during the detailed design of the selected removal action alternative, including the size and thickness of the riprap to provide the necessary protection from storm surge and wave action.

   The Army prefers not to revise the "conceptual" design presented in the EE/CA at this time. The detailed design of the selected remedy will provide the recommended size and thickness of the riprap layer, as well as better define the amount, if any, of expansion of the overall Causeway "footprint".

7. **Comment:** DEP understands that groundwater quality will be addressed in a separate operational unit. RCSA section 22a 133k 3(b)(2) mandates that groundwater discharging to the tidal flat conform with surface water quality criteria. Note that these values are lower than the Remediation Standard Regulation Appendix D Surface Water Protection Criteria, which incorporate a default attenuation factor. To ensure the interim remedy is consistent with the final remedy, DEP recommends that the proposed spot removal of soils with mobile pollutants also consider potential impacts of leachable pollutants on surface water. This would limit the risk for further action in a final remedy to address soil as a pollutant source if groundwater exceeds evaluation criteria. The degree of concern depends on the difference between a pollutant's GB Pollutant Mobility Criterion (the target interim removal criterion) and its Aquatic Water Quality Benchmark value, and also on the potential for attenuation

between the soil location and the receptor tidal flat. For example, DEP recommends a value of 280 ug/l for vanadium acute toxicity in water, as compared to a GB Pollutant Mobility Criterion of 500 ug/l. A removal criterion of 280 ug/l, as opposed to 500, would ensure that, even without any attenuation on the transport path from soil to surface water, there would be no possibility of acute toxicity. Suggested Aquatic Benchmark values for identified pollutants not listed in Connecticut's Water Quality Criteria and Standards can be obtained from Traci Iott (860-424-3082).

Response: The Army has compared the existing (through 09/01/2000) SPLP organic and inorganic Causeway soils data to the Aquatic Water Quality Criteria (AWQC) benchmark values provided by the CTDEP. The following table provides information on the concentrations of analytes (from SPLP analyses) which exceed AWQC in Causeway soils:

Analyte	Location ID	Result (µg/L)	AWQC (µg/L)	GB-PMC(µg/L)
Vanadium	CB-99-03	5920	280	500
Vanadium	TP-DEP-11	807	280	500
Vanadium	TP-DEP-12	1070	280	500
Zinc	CB-99-01	293	120	50000

Of the locations listed above, CB-99-03, TP-DEP-11, and TP-DEP-12 were previously identified as areas where soil concentrations exceed the CTDEP GB PMC. At location CB-99-01, zinc does not exceed the GB PMC, but does exceed the AWQC.

The Army will consider use of the AWQC for definition of soils requiring excavation (during the Design phase of the project) to consider potential impacts of leachable pollutants on surface water.

8. **Comment:** DEP also reiterates earlier comment that polluted soils within the zone of diurnal tidally influenced groundwater fluctuation may require additional mitigation in the final remedy if they are found to be unacceptably affecting the environment.

   Response: Comment noted.

Comment # **Comment/Response**

CTDEP (Office of Long Island Sound Programs) Comments dated September 7, 2000 on Revised Draft EE/CA Report
Causeway and Dike Area, SAEP, Stratford, CT
July 2000

In general, we are disappointed that our prior comments have not been adequately addressed in this revision (see discussion below). We must continue to stress that it is the responsibility of the Army to minimize any structural solution at this site in order to proceed with a project that is consistent to the maximum extent practicable with the enforceable policies of Connecticut's federally approved coastal management program. Encroachment into or over the intertidal flat must avoided if possible. If avoidance is not possible, any encroachment must be minimized to the maximum extent practicable and clearly and adequately justified. Significant changes from current conditions (e.g., changes in the size and location of the footprint of the causeway and dike, the character of the face of the causeway and dike including its slope and relative make-up) must be avoided if possible and, if not possible, must be well justified. Based on the information provided to date, there is no clear justification provided for enlarging the footprint of the dike and/or causeway nor is there adequate justification for altering the angle and general makeup of the side slopes.

As stated in our previous comments, it appears that the remedial solutions under consideration essentially consist of an "under barrier" and an "over cap" and that these components may, to some extent, be interchanged from one alternative to the other. The selection of the appropriate under barrier to prevent contact with the contamination is not within OLISP's area of expertise and we defer to others to determine which under barrier is most appropriate. We are, however, concerned about the type of material used for the outermost layer(s) of the over cap, its placement on the causeway and/or dike and the final overall configurations of these project components.

While one type of under barrier may be most appropriate, the associated over cap depicted in the series of alternatives presented here may not be the most appropriate from a coastal management perspective. The apparent ability to "mix and match" under barrier and over cap may prove especially useful in designing a project that achieves all ARARs to the maximum extent practicable.

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STRATFORD, CONNECTICUT

Comment # **Comment/Response**

ALTERNATIVES

The current draft EE/CA contains four alternatives, three of which are illustrated by Figures 4-1, 4-2 and 4-3. Alternative 4 has been added since the last draft EE/CA, dated February 23, 2000, and is identified as the current preferred alternative. All three of the illustrated alternatives raise concerns from a coastal management perspective and, as discussed below, it is not clear from the information provided that the preferred alternative actually meets the applicable design criteria.

<u>General Comments</u> – Unfortunately, the plans provided appear to be diagrammatic only and are lacking sufficient detail to enable us to make reasonable evaluation of the alternatives for consistency with the policies and standards of Connecticut's coastal management program. While cross-sections are provided for three of the four alternatives, there are no plan views provided. Plan views showing both existing and proposed conditions are necessary to evaluate the alternatives for consistency with the enforceable policies of the Connecticut Coastal Management Program.

Additionally, there are several specific and critical elevations that must be shown on all plans and cross-sections to allow for a coastal consistency determination. These elevations are the high tide line, mean high water and mean low water. The figures provided in the revised draft EE/CA depict mean high water at elevation 4.1 and "low tide" at elevation 0.8. The high tide line is not provided nor is the reference datum indicated. If the reference datum is National Geodetic Vertical Datum (NGVD), the elevation of mean high water is correct at 4.1 feet; however, the corresponding elevation of mean low water is not elevation 0.8 as shown in the figures, but rather, it is -2.7 feet NGVD.

The location of the high tide line should also be shown on all plans and cross sections. Without a careful on-site investigation, its exact elevation cannot be determined. However, based on our experience its location will be somewhat higher than elevation 5.7 feet NGVD (the one-year frequency tidal flood elevation as calculated by the Army Corps of Engineers) and may in fact, be close to elevation 7 feet NGVD. For the purposes of this project, the depiction of elevation 7 feet NGVD on all the plans will suffice to approximate the high tide line.

Please be aware that because of the diagrammatic nature of the plans, these critical elevations cannot be shown with any degree of confidence. Without a reasonable representation of the existing and proposed conditions in relation to these critical elevations, a formal coastal consistency determination will not be possible.

Comment #	**Comment/Response**

We have previously expressed our concern that the alternatives be designed to avoid any encroachment into the intertidal flat. Alternative 1 is described as maintaining the location of the existing toe of slope through the excavation of the side slope and toe materials with their consolidation on top of the causeway prior to construction of the under barrier and cap. The corresponding figure also includes a note that existing material will be excavated to maintain the existing toe of slope. However, since the existing condition is not shown on this figure, it cannot be verified that this approach will also maintain the existing locations of the high tide line and mean high water. Neither of the other figures appears to clearly depict the necessary excavation to ensure that the proposed alternatives will not ultimately alter the present locations of mean high water, mean low water and the high tide line. Accordingly, none of these alternatives is acceptable from a coastal management perspective without some additional refinement of the plans.

If there is confusion regarding this essential matter, I strongly recommend that we discuss it either over the phone or in person, or both. I understand that there are currently meetings of the RAB and BCT scheduled for September 28, 2000. Discussion of these issues should occur prior to those meetings. If necessary, and depending upon my schedule, I may be available to meet in Stratford when your consultant is due to be there, if it would be helpful.

<u>Alternative 1 - Figures 4-1</u> - The plans do not show the existing profile(s) for this alternative. Lacking this information, it is not possible to determine either the degree, if any, of encroachment into public trust and intertidal flats that this alternative represents or whether this alternative represents an ultimate change in the type and/or angle of side slope currently present on the causeway. It is our understanding that the causeway is already armored. If this is the case, replacement in place and in kind is acceptable and consistent with our enforceable policies regarding shoreline flood and erosion control structures. Additional information regarding the existing contours and make-up of the causeway side slopes in comparison to the proposed condition is necessary to determine the acceptability of this alternative.

<u>Alternative 2 - Figure 4-3</u> – Although the Army has indicated that this alternative is not the preferred project, we are compelled to reiterate our previous comments in the event that it comes under further consideration. Alternative 2 includes a vertical faced bulkhead. In prior discussion, we have discouraged the Army from considering such a structure as it constitutes a significant change from the existing condition. It also carries with it the potential to alter the localized wave energy patterns and we expect it would result in erosion of the intertidal flat.

Such erosion would be unacceptable as intertidal flats are a protected resource in Connecticut and we strongly advise against any further pursuit of this alternative.

Alternative 4 - Figure 4-3 – The current draft EE/CA contains a new alternative, number 4, which is identified as the preferred alternative and is allegedly based, in part, on our prior comments. Unfortunately, the information provided regarding this alternative describes a design that is actually less consistent with Connecticut's coastal management program than some of the alternatives considered for this project.

The description of this alternative includes removal of contaminated soil "hot spot areas" and containment of the remaining contaminated fill material within the causeway by constructing an erosion control cover system. Although the text indicated that following removal of the contaminated soil hot spot areas, the causeway would be regraded by cutting and filing existing material to establish base grades, these grading activities are not evident in Figure 4-3. Unlike Alternative 1, where the plans specifically note that the existing toe will be maintained by excavating existing material, Alternative 4 appears to include simply placing riprap over the existing side slopes. This method of armoring will result in significant and unacceptable encroachment beyond the high tide line and mean high water and into intertidal flats.

Additionally, Figure 4-3 is very confusing. It shows two existing slopes and only one proposed slope. There is no clear indication of where along the length of the causeway these apparently separate profiles are found. Nor is it clear why the proposed slope would not follow and reflect the existing condition. Regardless of the original profile, as discussed above, this alternative represents significant fill and encroachment beyond both the existing mean high water and mean low water lines. Although the high tide line is not shown on the plans, presumably fill is also proposed waterward of this critical elevation. It is not likely that a convincing demonstration can be made that this alternative, as currently proposed, is consistent with applicable enforceable policies and standards regarding shoreline flood and erosion control structures, filling in coastal waters and intertidal flats.

Based on both the tentative selection of Alternative 4 as the preferred alternative and its depiction provided in Figure 4-3, it does not appear that the Army fully understands the need to design a project that: 1) will not result in degradation of sensitive coastal resources, including the intertidal flats present at this site; 2) is consistent with the enforceable policies and standards regarding the construction of shoreline flood and erosion control structures; and 3) minimizes horizontal encroachment into coastal waters (i.e., encroachment beyond the high tide line, mean high water and/or mean low water).

If Alternative 4 is to remain the preferred alternative, it must be modified to eliminate, if possible, any encroachment beyond the existing location of the high tide line, mean high water, and mean low water. We strongly encourage the Army to investigate the potential to relocate existing material to the extent necessary to maintain the current causeway footprint. If elimination of all encroachments is not possible, adequate justification must be given as to why any encroachment should be found acceptable to the State of Connecticut.

Responses to Prior DEP-OLISP Comments

Unfortunately, several of the Army's responses, provided in Appendix A, do not adequately address the issues that we raised in our previous comments. Specifically, we note the following outstanding issues presented in the order that they appear in Appendix A.

Comment #4, pages 10 & 11 - The DEP-OLISP's comment was, in part, "it is important to maintain, to the extent practicable, the horizontal location of mean high water (4.1' NGVD), which is the landward extent of the public trust area." The response was to indicate on the plans the location of mean high water; however, no apparent effort was made to modify the plans to eliminate or reduce the indicated encroachment waterward of this critical line. Nor was an explanation offered as to why the project could not be designed to maintain the horizontal location of mean high water. This is a critically important issue to the State of Connecticut as we are the steward for the public trust land waterward of mean high water and, as such, must protect and preserve this area for the general public both for now and for the future. Any additional encroachment beyond the current location of mean high water must be avoided if at all possible, and if avoidance is not possible it must be both minimized to the maximum extent practicable and justified to our satisfaction.

It has recently been brought to our attention that there is concern that the proposed cap might, in fact, have to be designed with a larger footprint to spread the weight of the causeway and cap over a larger area. Apparently the issue is the potential for the extra weight of the causeway to produce an upward "bulging" of the adjacent intertidal flat. In our experience, increasing the weight on filled land has not lead to such bulging, but rather, has lead to the reverse. Increased loading, as has been seen with road construction on filled land, has more typically resulted in depressed areas alongside the filled area. In the case of the subject causeway, if depressions in the intertidal flat result from the proposed work, we expect increased sedimentation into the depressed areas until equilibrium has been reached and the surface is restored to its present state.

Comment #5, page 11 - The DEP-OLISP's comment was that the list of ARARs provided in the previous draft was incomplete. Of specific concern, in part, was that the list did not include Connecticut's Tidal Wetlands Act (Connecticut General Statutes 22a-28 through 22a-35). The response was that "the Inland Wetlands and Watercourses Act, also known as the Tidal Wetlands Act, was included" in the original list of ARARs. The Inland Wetlands Act and the Tidal Wetlands Act are separate and distinct statutes. They have never been interchangeable nor have they shared a title. To merge these two independent regulatory programs is incorrect and unacceptable. Although the current ARARs list (see Table 3-2) includes the *Tidal Wetlands Regulations*, it still fails to include the underlying statute. The Tidal Wetlands Act must be listed as an ARAR separate from both the Inland Wetlands and Watercourses Act and the Tidal Wetlands Regulations and it must be fully considered in the final development and consideration of alternatives for this action.

Additional Comments

We note that the description of the property on page ES-1 is incorrect. It is apparently carried forward from earlier property descriptions that we have continually attempted to have the Army correct. The Army does not own "48 acres of riparian rights." Riparian rights are not measured in acres or any other form of area measurement. Riparian rights are simply the rights of waterfront property owners to access navigable waters. This should be corrected in the final document.

We appreciate this opportunity to review and comment on the progress made to date on this project. We strongly encourage you to continue close coordination with this Office during the refinement of the final alternative(s) for this project. Please be aware that the formal federal consistency review will require additional detailed information including: 1) drawings that depict the existing and proposed footprint of the causeway; 2) existing and proposed locations of the high tide line, mean high water and mean low water on all plans and cross sections; 3) calculations of the total volume of fill to be placed waterward of the high tide line, mean high water and mean low water; and 4) adequate justification for such fill.

Response: The Army understands the issues and concerns raised by the CTDEP OLISP, which are primarily related to avoiding encroachment into the intertidal flats of the Housatonic River and waterward of the high tide line. However, much of these concerns cannot be adequately addressed at this time due to the limited amount of data available. However, the Army will conduct additional on-site investigation activities to collect the necessary data that will allow the Army to address the CTDEP OLISP issues and concerns during the detailed design of the selected removal action alternative. Harding Lawson Associates initiated on-site investigation activities at the Causeway September 14, 2000. These activities include a geotechnical investigation and topographic survey of the Causeway and adjacent area. The information obtained from these activities will be used to evaluate settlement and stability of the Causeway and proposed cover system, determine the size and thickness of the riprap/stone armor for the cover system, prepare existing and final grading plans, and prepare material specifications and quantity estimates. The removal action design will be prepared with consideration given to the issues and concerns raised in these, and previous, comments provided by the CTDEP OLISP. The 30-percent design will be submitted to the regulatory agencies (i.e., USEPA, CTDEP, and OLISP) for review.

The Army will design the selected remedy to minimize encroachment into the intertidal flats of the Housatonic River and waterward of the high tide line to the extent practicable. After the additional field investigations are completed and the data evaluated, the Army suggests a working meeting with the USEPA and CTDEP, including OLISP, to review the data evaluation and design criteria in an attempt to address the concerns raised by the CTDEP OLISP. The Army looks forward to working with the USEPA, CTDEP, and OLISP to resolve these outstanding issues and arrive at a mutually agreeable solution for the Causeway non-time-critical removal action.

RESPONSE TO COMMENTS ON
REVISED DRAFT
ENGINEERING EVALUATION/COST ANALYSIS FOR THE CAUSEWAY AND DIKE
(DATED JULY 31, 2000)
STRATFORD ARMY ENGINE PLANT
STRATFORD, CONNECTICUT

Comment # **Comment/Response**

USEPA Comments dated August 31, 2000 on Revised Draft EE/CA Report
Causeway and Dike Area, SAEP, Stratford, CT
July 2000

ARARs Tables 3-1 through 3-3

1. **Table 3-1**

- There should be an indication that there are no Federal chemical-specific ARARs.

- There should be some description of how contaminated soil will be remediated in accordance with CGS §§ 22a-133k and 22a-133q.

Response: Table 3-1 has been revised as requested.

2. **Table 3-2**

- There should be some description of how remedial activities that involve dredged or fill material will comply with 40 CFR § 230 and 33 CFR Parts 320-330.

- There should be some description of how remedial activities affecting the coastal zone of the site will be conducted in accordance with 16 USC §1451, et seq.

- There should be some description of how remedial activities will be conducted in accordance with CGS §§ 22a-28 through 22a-35 and RCSA §§ 22a-30-1 through
- 22a-30-17.

- There should be some description of how remedial activities will be conducted in accordance with CGS §§ 25-68b through 25-68h and RCSA §§ 25-68h-1 through
- 25-68h-3.

- There should be some description of how remedial activities will be concluded in accordance with CGS §§ 22a-359 through 22a-363(f).

Response: Table 3-2 has been revised as requested.

Comment # **Comment/Response**

3. **Table 3-3**

- There should be some description of how remedial activities associated with design, monitoring and maintenance will comply with 40 CFR § 264.110 - 264.120.

Response: Table 3-3 has been revised as requested.

PRELIMINARY CALCULATIONS

PROJECT Stratford Army Engine Plant
SUBJECT EE/CA for the Causeway

Preliminary Armor Sizing

Mean High Tide = ± 4.1

Low Tide = ± 0.8

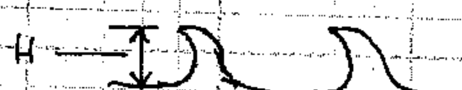
Ref. : "Design of Coastal Revetments, Seawalls, and Bulkheads"
EM 1110-2-1614, USACOE

Use
$$W = \frac{\gamma_R H^3}{K_D \left[\gamma_R / \gamma_w - 1 \right]^3 \cot\theta}$$
for preliminary stone sizing

Where:

W = individual armor unit weight in lbs (or W_{50} for graded rip rap)

H = monochromatic wave height, ft



K_D = stability coefficient (Table 2-3 in above reference)

γ_R = specific unit weight of the rock armor, lb/ft^3

γ_w = specific unit weight of water = 64.0 lb/ft^3 (salt water)

θ = structure slope = 18.435° (3H : 1V)

PROJECT: STRATFORD ARMY ENGINE PLANT

SUBJECT: EE/CA FOR CAUSEWAY

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FOR PRELIMINARY ARMOR SIZING, USE THE FOLLOWING ASSUMPTIONS:

USE $H = 4'$ – SITE CONDITIONS ARE SHALLOW WATER (MEAN HIGH TIDE ± 4.1') AND LOCATED WITHIN THE MOUTH OF THE RIVER

USE $\gamma_R = 170 \text{ lbs/FT}^3$ (SHALE/SLATE ≈ 175 lbs/FT³, GRANITE ≈ 175 lb/FT³, LIMESTONE ≈ 165 lbs/FT³)

$K_D = 2.0$ FROM TABLE 2-3 FOR ROUGH ANGULAR ARMOR

$$\therefore \quad W = \frac{170\,(4)^3}{2 \times \left[\frac{170}{64} - 1\right]^3 \cot(18.435°)}$$

$$W = 399 \text{ lbs}$$

USE $W \times SF = 399 \times 1.5 = 599$ lbs ⇒ <u>600 lbs</u>

FOR FINAL DESIGN, WILL NEED TO VERIFY / REFINE ASSUMPTIONS

For other configurations of seawalls, Ward and Ahrens (1992) should be consulted, or physical model tests should be performed.

2-15. Stability and Flexibility

Structures can be built by using large monolithic masses that resist wave forces or by using aggregations of smaller units that are placed either in a random or in a well-ordered array. Examples of these are large reinforced concrete seawalls, quarrystone or riprap revetments, and geometric concrete block revetments. The massive monoliths and interlocking blocks often exhibit superior initial strength but, lacking flexibility, may not accommodate small amounts of differential settlement or toe scour that may lead to premature failure. Randomly placed rock or concrete armor units, on the other hand, experience settlement and readjustment under wave attack, and, up to a point, have reserve strength over design conditions. They typically do not fail catastrophically if minor damages are inflicted. The equations in this chapter are suitable for preliminary design for major structures. However, final design will usually require verification of stability and performance by hydraulic model studies. The design guidance herein may be used for final design for small structures where the consequences of failure are minor. For those cases, project funds are usually too limited to permit model studies.

2-16. Armor Unit Stability

a. The most widely used measure of armor unit stability is that developed by Hudson (1961) which is given in Equation 2-15:

$$W = \frac{\gamma_r H^3}{K_D \left(\frac{\gamma_r}{\gamma_w} - 1 \right)^3 \cot\theta} \qquad (2\text{-}15)$$

where

W = required individual armor unit weight, lb (or W_{50} for graded riprap)

γ_r = specific weight of the armor unit, lb/ft^3

H = monochromatic wave height

K_D = stability coefficient given in Table 2-3

γ_w = specific weight of water at the site (salt or fresh)

θ = is structure slope (from the horizontal)

Stones within the cover layer can range from 0.75 to 1.25 W as long as 50 percent weigh at least W and the gradation is uniform across the structure's surface. Equation 2-15 can be used for preliminary and final design when H is less than 5 ft and there is no major overtopping of the structure. For larger wave heights, model tests are preferable to develop the optimum design. Armor weights determined with Equation 2-15 for monochromatic waves should be verified during model tests using spectral wave conditions.

b. Equation 2-15 is frequently presented as a stability formula with N_s as a stability number. Rewriting Equation 2-15 as

$$N_s = \frac{H}{\left(\frac{W}{\gamma_r} \right)^{1/3} \left(\frac{\gamma_r}{\gamma_w} - 1 \right)} \qquad (2\text{-}16)$$

it is readily seen that

$$N_s = (K_D \cot\theta)^{1/3} \qquad (2\text{-}17)$$

By equating Equations 2-16 and 2-17, W is readily obtained.

c. For irregular wave conditions on revetments of dumped riprap, the recommended stability number is

$$N_{sz} = 1.14 \cot^{1/6}\theta \qquad (2\text{-}18)$$

where N_{sz} is the zero-damage stability number, and the value 1.14 is obtained from Ahrens (1981b), which recommended a value of 1.45 and using H_s with Equation 2-16, then modified based on Broderick (1983), which found using H_{10} (10 percent wave height, or average of highest 10-percent of the waves) in Equation 2-16 provided a better fit to the data. Assuming a Rayleigh wave height distribution, H_{10} = 1.27 H_s. Because H_s is more readily available than H_{10}, the stability number in Equation 2-17 was adjusted (1.45/1.27 = 1.14) to allow H_s to be used in the stability equation while providing the more conservative effect of using H_{10} for the design.

d. Stability equations derived from an extensive series of laboratory tests in The Netherlands were presented in van der Meer and Pilarczyk (1987) and van der

Table 2-3
Suggested Values for Use in Determining Armor Weight (Breaking Wave Conditions)

Armor Unit	n[1]	Placement	Slope (cot θ)	K_D
Quarrystone				
Smooth rounded	2	Random	1.5 to 3.0	1.2
Smooth rounded	>3	Random	1.5 to 3.0	1.6
Rough angular	1	Random	1.5 to 3.0	Do Not Use
Rough angular	2	Random	1.5 to 3.0	2.0
Rough angular	>3	Random	1.5 to 3.0	2.2
Rough angular	2	Special[2]	1.5 to 3.0	7.0 to 20.0
Graded riprap[3]	2[4]	Random	2.0 to 6.0	2.2
Concrete Armor Units				
Tetrapod	2	Random	1.5 to 3.0	7.0
Tripod	2	Random	1.5 to 3.0	9.0
Tripod	1	Uniform	1.5 to 3.0	12.0
Dolos	2	Random	2.0 to 3.0[5]	15.0[6]

[1] *n* equals the number of equivalent spherical diameters corresponding to the median stone weight that would fit within the layer thickness.

[2] Special placement with long axes of stone placed perpendicular to the slope face. Model tests are described in Markle and Davidson (1979).

[3] Graded riprap is not recommended where wave heights exceed 5 ft.

[4] By definition, graded riprap thickness is two times the diameter of the minimum W_{50} size.

[5] Stability of dolosse on slope steeper than 1 on 2 should be verified by model tests.

[6] No damage design (3 to 5 percent of units move). If no rocking of armor (less than 2 percent) is desired, reduce K_D by approximately 50 percent.

Meer (1988a, 1988b). Two stability equations were presented. For plunging waves,

$$N_s = 6.2\,P^{0.18}\left(\frac{S}{\sqrt{N}}\right)^{0.2}\xi_z^{0.5} \tag{2-19}$$

and for surging or nonbreaking waves,

$$N_s = 1.0\,P^{-0.13}\left(\frac{S}{\sqrt{N}}\right)^{0.2}\sqrt{\cot\theta}\;\xi_z^{P} \tag{2-20}$$

where

P = permeability coefficient

S = damage level

N = number of waves

P varies from P = 0.1 for a riprap revetment over an impermeable slope to P = 0.6 for a mound of armor stone with no core. For the start of damage S = 2 for revetment slopes of 1:2 or 1:3, or S = 3 for revetment slopes of 1:4 to 1:6. The number of waves is difficult to estimate, but Equations 2-19 and 2-20 are valid for N = 1,000 to N = 7,000, so selecting 7,000 waves should provide a conservative estimate for stability. For structures other than riprap revetments, additional values of P and S are presented in van der Meer (1988a, 1988b).

e. Equations 2-19 and 2-20 were developed for deepwater wave conditions and do not include a wave-height truncation due to wave breaking. van der Meer therefore recommends a shallow water correction given as

$$\frac{N_{s\,(shallow\ water)}}{N_{s\,(deep\ water)}} = \frac{1.40\,H_s}{H_2} \tag{2-21}$$

where H_2 is the wave height exceeded by 2 percent of the waves. In deep water, $H_2 \approx 1.40\ H_s$, and there is no correction in Equation 2-21.

Harding Lawson Associates
Engineering
and
Environmental Services

SHEET 1 OF 1
JOB NO
DATE 1/18/00
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PROJECT STRATFORD CAUSEWAY
SUBJECT PRELIM. GRADATION OF ARMOR

FOR: γ_s = 165 pcf & T = 3.0'
T_{FILTER} = 1.0'

% PASSING BY WT.	DIAM. (FT) / MIN. WT. POUNDS
100	2.5 / 540
90	1.77 / n.a.
85	1.9 / n.a
50	1.5 / 270
30	1.22 / n.a.
15	1.10 / 84
Ø	

COMPOSITE TABLE OF PUBLISHED GRADATION AND PARAMETRIC RUN OF ACES - RUBBLE-MOUND REVETMENT DESIGN