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23 February 2001

Mr. Mark Lewis
Connecticut Department of Environmental Protection
Water Management Bureau
Permitting, Enforcement, and Remediation Division
79 Elm Street
Hartford, Connecticut 06106-5127

RE: Technical Rationale for Calculation of Alternative Surface Water Protection Criteria for Naval Submarine Base, Lower Subase, New London
Contract No. N62472-92-D-1296
EA Project No. 29600.90

Dear Mr. Lewis:

EA Engineering, Science, and Technology is pleased to submit this document that describes our proposed approach for estimation of dilution factors for calculation of Alternative Surface Water Protection Criteria (ASWPC) for determination of ground-water remediation requirements at Lower Subase, Naval Submarine Base, New London. The methodology described in the Regulations of Connecticut State Agencies, Section 22a-133k-3(b)(3)(A) is applicable to non-tidal waters, but does not account for the dilution capacity associated with tidal flushing. Consequently, we have proposed a method, described below, which incorporates dilution from both freshwater flow and tidal mixing. We are providing this information for your review and comment. If the Connecticut Department of Environmental Protection (CTDEP) and U.S. Environmental Protection Agency (EPA) Region I concur with the approach presented, we will submit a formal application to the Commissioner for approval of the proposed ASWPC. These ASWPC will then be used to identify constituents of concern for ground-water remediation in the Feasibility Study for the Lower Subase.

1. GROUND-WATER REMEDIATION STANDARDS

CTDEP regulations establish that a pollutant's concentration in a ground-water plume that discharges to surface water should be at or below surface water protection criteria (SWPC) (Section 22a-133k-3[b]). Comparison of concentrations of chemicals found in ground water in the seven zones at the U.S. Naval Reservation adjacent to the Thames River in Groton, Connecticut (Figure 1) revealed that, with the exception of some polycyclic aromatic hydrocarbons, all ground-water concentrations were below SWPC. Section 22a-133k-3(b)(3)(A) provides direction for calculation of ASWPC using a site-specific dilution factor ($0.25 \times 7Q10/Q_{plume}$). However, this calculation, while applicable for discharge to a freshwater river, does not take into account the dilution of tidal inflow (tidal prism) that occurs at the U.S. Naval Reservation.

Guidance provided by CTDEP refers to standard estuarine Waste Load Allocation guidance (U.S. EPA 1990[1]) for methods to develop site-specific dilution factors in an estuarine environment. Waste Load Allocation guidance is designed for the derivation and modeling of the dilution of point discharges into the estuarine environment, primarily through discharge pipes or diffusers. Again, this guidance is not directly applicable to the discharge of ground water into a river like the Thames at the U.S. Naval Reservation. This guidance does, however, provide a generic process to assess Waste Load Allocation that can be applicable to this task.

Modeling efforts under Waste Load Allocation are preceded by the performance of rapid, simple screening calculations (U.S. EPA 1990, Section 3.2). The purpose of these simple calculations is to determine the need to proceed to more complex types of models. If conservative simple calculations sufficiently answer the questions, there is no need to invest additional time or money in characterizing more site-specific data or running the more complicated models.

1.1 SCREENING MODELS

Simple screening procedures have been developed to facilitate preliminary assessments of toxic and conventional pollutants in estuaries. They can provide a valuable initial assessment when resources are insufficient to allow for more rigorous modeling. Field effects are tidally averaged, and thus predict variations in transport and concentrations over relatively large space and time scales (i.e., weeks or longer). An advantage to this approach is that intertidal transport filters out tidal fluctuations and focuses on long-term variations resulting from the mean or residual flow.

Analytical Equations

Simple analytical equations can be derived for estuarine dilution by making certain simplifying assumptions about the estuary and pollutant behavior. All screening models (e.g., freshwater fraction, modified tidal prism) assume a one-dimensional estuary (i.e., concentrations do not vary in the lateral or vertical directions), and that tidally averaged, steady-state conditions are being represented. By making additional assumptions, pollutant behavior can be described using simple analytical equations. These assumptions are that cross-sectional area, flow, and first-order reaction rates are constant over the length of estuary of interest. With these assumptions, the pollutant concentration at the point of discharge (C_0) is given by:

$$C_0 = \frac{C_i Q_i}{Q_A}$$

where

C_i = Concentration of pollutant in discharge (μg/L)
Q_i = Pollutant discharge (ft^3/day)
Q_A = Tidally averaged river flow (ft^3/day).

1. U.S. Environmental Protection Agency (U.S. EPA). 1990. *Technical Guidance Manual for Performing Waste Load Allocations; Book III, Estuaries.* Office of Water. May.

Fraction of Freshwater

The fraction of freshwater method estimates the dilution from freshwater and tidal flow by comparing salinity in the estuary to the salinity of local seawater, (i.e., the fraction of freshwater). The method is useful for systems with irregular cross-sections or non-uniform flow. The fraction of freshwater in an estuarine segment (f_x) is calculated by examining the ratio of salinity comparing a freshwater reach (S_x) to seawater (S_s):

$$f_x = \frac{S_s - S_x}{S_s}$$

The concentration of a pollutant in the estuarine segment downstream of the pollutant discharge (C_x) is then calculated as:

$$C_x = f_x \frac{W}{Q_R}$$

where

W = Pollutant mass loading rate (µg/day)
Q_R = Freshwater discharge rate (ft^3/day).

Concentrations upstream of the discharge are estimated from the location of discharge, and the relative salinity of the upstream location. It is assumed that the initial mix concentrations are diluted by freshwater in the upstream direction to the same degree that salinity is diluted. The equation is:

$$C_x = f_0 \frac{W}{Q_R} \frac{S_x}{S_0}$$

where

f_0 = Fraction of freshwater (i.e., dilution) at discharge location
S_x = Salinity at location X (ppt)
S_0 = Salinity at discharge location (ppt).

The data requirements for the fraction of freshwater method are:

- River flow
- Estuarine salinity distribution
- Pollutant mass loading rate.

A more detailed description of the freshwater fraction method can be found in Martin and McCutcheon (1998[2]), Thomann and Mueller (1987[3]), and U.S. EPA (1990).

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2. Martin, J.L. and S.C. McCutcheon. 1998. *Hydrodynamics and Transport for Water Quality Modeling*. Lewis Publishers. Boca Raton, Florida.
3. Thomann, R.V. and J.A. Mueller. 1987. *Principles of Surface Water Quality Modeling and Control*. Harper and Row, New York, New York.

Modified Tidal Prism

The modified tidal prism method estimates tidal dilution from the total amount of water entering the estuary or a volume segment of the estuary from tidal inflow. The method allows consideration of dilution as well as reaction losses of water quality constituents. The method is applied by dividing the estuary into segments whose volumes are calculated considering low tide volumes and tidal inflow (i.e., the tidal prism). The tidal prism is compared for each segment with total segment volume to estimate the flushing potential in that segment over a tidal cycle assuming that complete mixing of tidal inflow occurs.

The data requirements for the modified tidal prism method are:

- Estuarine geometry
- River flow
- Tidal range
- Pollutant mass loading rate.

A more detailed description of the modified tidal prism method can be found in Martin and McCutcheon (1998), Thomann and Mueller (1987), and U.S. EPA (1990).

1.2 DETERMINISTIC MODELS

Deterministic models provide descriptions of both the hydrodynamics (i.e., current, tides, circulation, and mixing) and water quality processes (i.e., advection, dispersion, and kinetic transformations), and can predict variations that can occur within, as well as between, tidal cycles. In deterministic modeling, the estuary is divided into a series of reaches and the mass balance equations are then solved for each reach under steady state or time variant conditions. Deterministic modeling can be both labor and data intensive. The types of data required for detailed deterministic modeling include:

- **Morphometry Data**—Channel geometry and Manning's roughness coefficients

- **Hydrodynamic Data**—Water surface elevations, velocity and direction, incoming flow, and point and distributed waste loads

- **Meteorological Data**—Solar radiation; air temperature; precipitation; wind speed and direction; wave height, period, and direction; relative humidity; and cloud cover

- **Water Quality Data**—Salinity, water temperature, suspended sediments, and dye studies.

Examples of deterministic models that have been applied to estuarine systems include WASP, CE-QUAL-RIV1, CE-QUAL-ICM, The Dynamic Estuary Model, and CORMIX.

2. ESTUARINE DILUTION

The purpose of this report is to estimate the potential for dilution for ground-water plumes that discharge into the Thames River Estuary. Therefore, a screening model that uses tidally averaged flows under steady state conditions in an idealized estuary is appropriate. A simplified analytical

model was developed to estimate the potential for pollutant dilution. This section of the memo contains a description of the simplified analytical tidal prism dilution model for the discharge of ground water into the Thames River at the U.S. Naval Reservation.

River Freshwater Flow

The minimum daily average freshwater flow in the Thames River at Norwich (1.51×10^6 ft^3/day) (Tolderlund 1975[4]) was used to represent low flow conditions because sufficient data were not available to calculate the 7Q10 (Q_R). This same procedure was accepted by the Agency in the Defense Reutilization and Marketing Office Feasibility Study.

Tidal Prism Calculations

The U.S. Naval Reservation is located in an estuarine environment that is subject to a tidal range of 2.6 ft (Tolderlund 1975). Because of the diurnal tidal flux in the Thames River, dilution factors have been derived based on the tidal prism. A conservative estimate of the area for dilution was established, bounded by the beginning and end of the U.S. Naval Reservation, and extending to approximately the middle of the Thames River (yellow shaded area of Figure 1).

A planimeter was used to estimate the area within this dilution zone (1.92 in.^{2}) that, when using the scale of 1 in. = 2,000 ft, resulted in an area of 7.6×10^6 ft^2:

$$(2{,}000\, ft/in.)^2 \times 1.92\ in.^2 = 7.68 \times 10^6\ ft^2$$

Given a tidal range of 2.6 ft (Tolderlund 1975), the volume of one tidal excursion in this reach is calculated as:

$$7.68 \times 10^6\,\text{ft}^2 \times 2.6\text{ft} = 2.0 \times 10^7\,\text{ft}^3$$

For one tidal cycle, and given that the tide cycles approximately two times every day, the tidal prism (Q_{TV}) is calculated as:

$$Q_{TV} = \frac{2.0 \times 10^7\,\text{ft}^3}{\text{cycle}} \times \frac{2\text{ cycles}}{\text{day}} = 4.0 \times 10^7\,\text{ft}^3/\text{day}$$

As noted earlier, Section 22a-133k-3(b)(3)(A) states that 25 percent of freshwater flow is available for dilution. Connecticut regulations allow for mixing in the derivation of ASWPC, however, no specific guidance has been provided outside of the above noted freshwater flow dilution. For tidal flow, a typical mixing factor that has been used for comparison to chronic values is 10 percent of total tidal flux. The use of a 10 percent mixing factor is consistent with other States, for example, the State of Maryland allows a 10 percent dilution according to the Code of Maryland Regulations 26.08.02.05 C and D. Therefore, the total tidally averaged flow available for dilution (Q_A) is:

4. Tolderlund, D.S. 1975. Ecological Study in the Thames River Estuary (Conn.) in the Vicinity of the U.S. Coast Guard Academy. 3 February.

$$Q_A = 0.25Q_R + 0.10Q_{TV}$$

$$Q_A = (0.25 \times 1.51 \times 10^6) + (0.10 \times 4.0 \times 10^7) = 4.4 \times 10^6 \, ft^3/day$$

Ground-Water Waste Loadings

The second piece of information necessary for completion of these dilution factors is the estimation of the daily average discharge from the ground-water plume (Q_{plume}). This parameter was calculated consistent with Section 22a-133k-2(c)(2)(E)(ii) using estimates of the hydraulic gradient (i) and hydraulic conductivity (K) (Table 1) presented in the Phase II Remedial Investigation (Brown & Root 1997[5]). The hydraulic conductivity ranged from 1.7 to 576 ft/day among the seven zones. The hydraulic conductivity for Zone 3 (1.7 ft/day) results in an unrealistically low estimate of ground-water discharge (32.3 ft^3/day), therefore, the flow from Zone 4 (Q_4 = 5,391 ft^3/day, the maximum Q_{plume} among all zones) was substituted.

2.1 SIMPLE STEADY STATE MASS BALANCE MODEL FOR ESTUARINE DILUTION

Following a control volume approach, a control volume was defined encompassing the area of dilution as shown on Figure 1. Assuming complete mixing, the tidally averaged mass balance equation for a conservative material given a single point source within the control volume is given as:

$$\frac{1}{V}\frac{dC}{dt} = \dot{m}_{in} - \dot{m}_{out} = Q_R C_R + Q_{TV} C_{TV} + Q_{plume} C_{plume} - (Q_R + Q_{TV} + Q_{plume})C$$

where

C	=	Concentration of pollutant in estuary segment (µg/L)
t	=	Time (days)
V	=	Control volume (ft^3)
$\dot{m}_{in}$	=	Pollutant mass flux into the control volume (µg/day)
$\dot{m}_{out}$	=	Pollutant mass flux out of the control volume (µg/day)
C_R	=	Concentration of pollutant in river freshwater (µg/L)
C_{TV}	=	Concentration of pollutant in the tidal inflow (µg/L)
C_{plume}	=	Concentration of pollutant in ground-water plume (µg/L)
Q_R	=	Average river freshwater flow (ft^3/day)
Q_{TV}	=	Tidal prism (ft^3/day)
Q_{plume}	=	Discharge in ground-water plume (ft^3/day).

The steady-state solution ($dC/dt = 0$) to the above mass balance equation is

$$(Q_R + Q_{TV} + Q_{plume})C = Q_R C_R + Q_{TV} C_{TV} + Q_{plume} C_{plume}$$

5. Brown & Root. 1997. Phase II Remedial Investigation Report for Naval Submarine Base, New London, Groton, Connecticut. Wayne, Pennsylvania. March.

Assuming that $C_R = 0$, $C_{TV} = 0$, and $Q_{plume} << (Q_R + Q_{TV})$, the model reduces to the following approximation:

$$(Q_R + Q_{TV})C = Q_{plume}C_{plume}$$

The principal of superposition can be used to extend the model to multiple point sources which, when solved for the pollutant concentration in the estuary, yields:

$$C = C_{plume}\frac{\sum Q_i}{Q_A} = C_{plume} \times DF$$

where

$\sum Q_i$	=	Sum of the individual plume discharges (ft^3/day)
DF	=	Dilution factor
Q_A	=	Total tidally averaged flow, $(Q_R + Q_{TV})$

In this equation, it is assumed that the pollutant concentration (C_{plume}) is the same in all sources, and that the sources are close enough together that they are well mixed within the control volume.

3. CALCULATION OF ALTERNATE SURFACE WATER PROTECTION CRITERIA

ASWPC can now be calculated as follows:

$$ASWPC\,(\mu g / L) = CTWQC x DF$$

where

CTWQC	=	Connecticut Water Quality Criterion (µg/L)
DF	=	Zone-specific dilution factor.

The CTWQC for all the polycyclic aromatic hydrocarbon constituents of concern are the same, 0.031 µg/L which is the concentration in water that could result in a 1×10^{-6} cancer risk to humans consuming organisms living in that water.

To be conservative, the maximum concentration among the seven ground-water plumes was used for C_{plume}. Only those zones where the pollutant was identified as exceeding CTWQC in the ground water without dilution were used in the calculation. For example, acenaphthylene was found to be above CTWQC in ground water from Zones 1, 5, 6, and 7. The maximum average acenaphthylene concentration was 5.45 µg/L in Zone 6. Therefore, for acenaphthylene, C_{plume} = 5.45 µg/L, $\Sigma Q_i = Q_1 + Q_5 + Q_6 + Q_7$ = 14,608 ft^3/day, $DF = Q_A/Q_{plume}$ = 300, $C = C_{plume}/DF$ = 0.02 µg/L, and $ASWPC = CTWQC \times DF$ = 9.29 µg/L. Table 2 lists C_{plume}, ΣQ_i, DF, C, and $ASWPC$ for all of the identified constituents of concern in the ground-water plumes.

4. IDENTIFICATION OF GROUND-WATER CONSTITUENTS OF CONCERN FOR SURFACE WATER PROTECTION

As discussed earlier, ASWPC have been calculated only for those zone/analyte combinations that exceeded standard SWPC. For the U.S. Naval Reservation these were:

- **Zone 1**: Acenaphthylene, phenanthrene
- **Zone 2**: None
- **Zone 3**: None
- **Zone 4**: Benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, indeno(1,2,3-c,d)pyrene, and phenanthrene
- **Zone 5**: Acenaphthylene, phenanthrene
- **Zone 6**: Acenaphthylene
- **Zone 7**: Acenaphthylene, chrysene, phenanthrene.

Table 3 shows a summary of analytical data for these zone/analyte combinations. It is noteworthy that in all but two cases (Zone 1/phenanthrene and Zone 7/phenanthrene), the calculated mean concentrations are greater than the maximum detected concentration. This is a result of the standard detection limit for the majority of samples ranging from 10 to 12 µg/L (1/2 the detection limit was used to calculate the mean), while the occasionally reported estimated constituent concentrations were much lower than the standard detection limit. For example, the majority of identified constituents of concern in Zone 4 were based on a single detected concentration; often close to an order of magnitude lower than the standard detection limit (i.e., benzo[b]fluoranthene in Zone 4 mean is 5.1 µg/L, while the single detection was measured at 0.6 µg/L). Consequently, mean concentrations used to determine exceedance are driven by artificially high detection limits, and consequently overestimate exposure.

CTDEP regulations note "Compliance with a surface water protection criterion for a substance in ground water is achieved when the sampling locations are representative of the subject ground-water plume and (A) the average concentration of such substance in each plume is equal to or less than the applicable surface water protection criterion..." (Section 22a-133K-3[f]). Average concentrations for each zone of analytes exceeding standard SWPC are shown in Table 4, as well as a screening quotient. The screening quotient represents the ratio of the average ground-water concentration for a chemical divided by the ASWPC. By the above compliance definition, if the screening quotient is less than 1.0, compliance with SWPC for a substance in ground water has been achieved. As Table 4 shows, all zone-specific screening quotients are less than 1.0, indicating compliance with the applicable state standards. Consequently, no remedial activity of ground water is necessary to achieve SWPC.

5. SUMMARY OF SURFACE WATER PROTECTION AT U.S. NAVAL RESERVATION

Based on a simple, conservatively defined tidal prism dilution model, ground water at the U.S. Naval Reservation has been found to be in compliance with ASWPC. There are a number of factors that provide justification for use of the simple dilution model, as well as show that there are many other factors that add more conservatism to this assessment:

- Use of a simple, conservative dilution model is consistent with guidance recommended by EPA (1990). Only after the simple, conservative model continues to show problems does it become necessary to employ more rigorous models.

- Use of this simple dilution model revealed that all constituents in ground water in the seven zones of the U.S. Naval Reservation are in compliance with ASWPC.

The majority of calculated mean concentrations for each zone/analyte pair are driven by high detection limits. If the maximum detected values were used in lieu of the calculated mean, zone-specific screening quotients shown in Table 4 would be even smaller than the values presently shown.

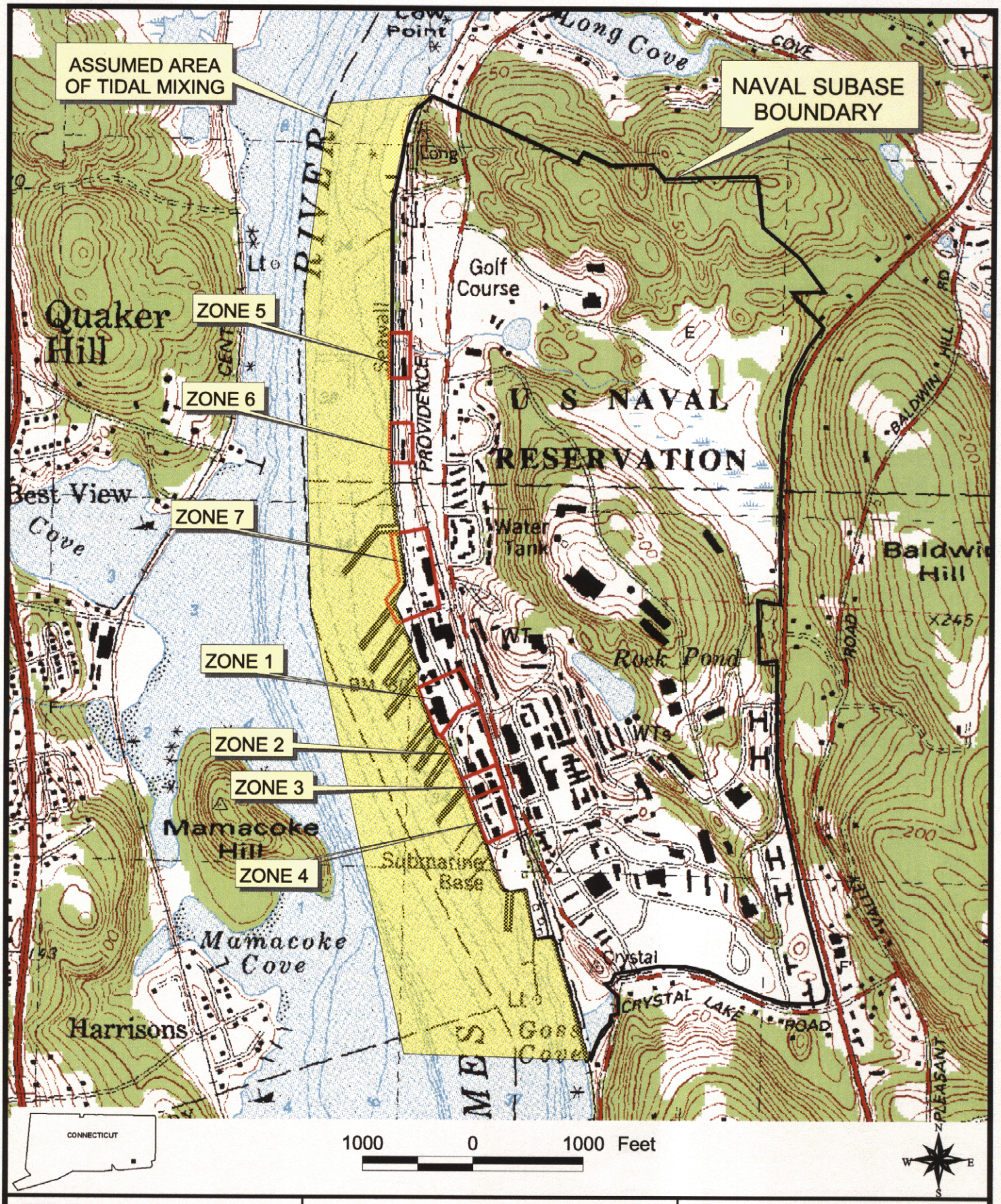
If you have any questions or comments, please do not hesitate to contact me.

Sincerely yours,

Charles E. McLeod, Jr., P.E.
Project Manager

CEM/caw
Attachments

cc: M. Evans (Northern Division)
M. Fohner (Northern Division)
A. Bush (Northern Division)
J. Speicher (Northern Division)
D. Conant (Subase)
D. Ward (Subase)
K. Keckler (EPA)
E. Mahoney (EA)
J. Tizard (EA)
K. Kilmer (EA)



EA ENGINEERING, SCIENCE, AND TECHNOLOGY	LOWER SUBASE NAVAL SUBMARINE BASE NEW LONDON, CONNECTICUT	FIGURE 1 SITE LOCATION MAP WITH TIDAL MIXING ZONE					
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TABLE 1 GROUND-WATER FLOW RATES FOR EACH IDENTIFIED REMEDIATION ZONE AT LOWER SUBASE

Zone	Hydraulic Gradient (ft/ft)	Hydraulic Conductivity (ft/day)	Ground-Water Discharge (Q_i) (cfd)
1	0.00476	158	4,242
2	0.00318	74	1,398
3	0.00792	1.7	32.3 (5,391)[a]
4	0.0039	576	5,391
5	0.0092	74	3,366
6	0.0092	74	2,957
7	0.00527	74	4,043
Total Q_{plume}			26,788

(a) The maximum Q_{plume} = 5,391 ft^3/day was substituted as the ground-water discharge for Zone 3.

TABLE 2 ALTERNATE SURFACE WATER PROTECTION CRITERIA FOR LOWER SUBASE

Chemical	CTWQC[a] (µg/L)	Q_A (cfd)	C_{plume} (µg/L)	ΣQ_i (cfd)	DF	C (µg/L)[b]	ASWPC (µg/L)
Acenaphthylene	0.031	4.38E+06	5.29	14,608	300	0.018	9.29
Benz(a)anthracene	0.031	4.38E+06	5.12	5,391	812	0.006	25.17
Benzo(a)pyrene	0.031	4.38E+06	5.11	5,391	812	0.006	25.17
Benzo(b)fluoranthene	0.031	4.38E+06	5.1	5,391	812	0.006	25.17
Benzo(k)fluoranthene	0.031	4.38E+06	5.12	5,391	812	0.006	25.17
Benzo(g,h,i)perylene	0.031	4.38E+06	5.12	5,391	812	0.006	25.17
Chrysene	0.031	4.38E+06	5.49	9,434	464	0.012	14.38
Indeno(1,2,3-c,d)pyrene	0.031	4.38E+06	5.1	5,391	812	0.006	25.17
Phenanthrene	0.031	4.38E+06	5.71	17,042	257	0.022	7.96

(a) CTWQC for the protection of humans consuming organisms (CTWQC = 0.031 µg/L).
(b) Expected concentration of chemical after dilution in Thames River.

NOTE: CTWQC = Connecticut Water Quality Criterion.
ASWPC = Ambient Surface Water Protection Criteria.

TABLE 3 SUMMARY OF APPROPRIATE GROUND-WATER ANALYTICAL DATA FROM LOWER SUBASE

Zone	Analyte	Total Samples	Number of Detects	Mean Concentration	Maximum Hit Concentration	Units
1	Acenaphthylene	33	1	5.2	1	µg/L
1	Phenanthrene	33	6	5.3	9	µg/L
4	Benz(a)anthracene	26	1	5.1	1	µg/L
4	Benzo(a)pyrene	26	1	5.1	0.8	µg/L
4	Benzo(b)fluoranthene	26	1	5.1	0.6	µg/L
4	Benzo(g,h,i)perylene	26	1	5.1	1	µg/L
4	Benzo(k)fluoranthene	26	1	5.1	1	µg/L
4	Chrysene	26	1	5.1	0.9	µg/L
4	Indeno(1,2,3-cd)pyrene	26	1	5.1	0.7	µg/L
4	Phenanthrene	26	2	4.9	1	µg/L
5	Acenaphthylene	5	1	4.7	2	µg/L
5	Phenanthrene	5	2	3.9	2	µg/L
6	Acenaphthylene	5	2	4.5	0.8	µg/L
7	Acenaphthylene	17	2	5.3	1	µg/L
7	Chrysene	17	1	5.5	0.9	µg/L
7	Phenanthrene	17	2	5.7	9	µg/L

TABLE 4 ZONE-SPECIFIC SCREENING QUOTIENTS FOR EVALUATION OF GROUND-WATER CONCENTRATIONS RELATIVE TO ALTERNATIVE SURFACE WATER PROTECTION CRITERIA

Chemical	Zone													
	1		2		3		4		5		6		7	
	Conc.	SQ	Conc.	SQ	Conc.	SQ	Conc.	SQ	Conc.	SQ	Conc.	SQ	Conc.	SQ
Acenaphthylene	5.16	0.56	None	NC	None	NC	None	NC	4.7	0.51	4.54	0.49	5.29	0.57
Benz(a)anthracene	None	NC	None	NC	None	NC	5.12	0.20	None	NC	None	NC	None	NC
Benzo(a)pyrene	None	NC	None	NC	None	NC	5.11	0.20	None	NC	None	NC	None	NC
Benzo(b)fluoranthene	None	NC	None	NC	None	NC	5.1	0.20	None	NC	None	NC	None	NC
Benzo(k)fluoranthene	None	NC	None	NC	None	NC	5.12	0.20	None	NC	None	NC	None	NC
Benzo(g,h,i)perylene	None	NC	None	NC	None	NC	5.12	0.20	None	NC	None	NC	None	NC
Chrysene	None	NC	None	NC	None	NC	5.11	0.36	None	NC	None	NC	5.49	0.38
Indeno(1,2,3-c,d)pyrene	None	NC	None	NC	None	NC	5.1	0.20	None	NC	None	NC	None	NC
Phenanthrene	5.25	0.66	None	NC	None	NC	4.93	0.62	3.9	0.49	None	NC	5.71	0.72

NOTE: Screening Quotient = Average Zone Concentration/Alternate Surface Water Protection Criteria.
NC = Not calculated because not identified as a constituent of concern in ground water.