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NSB NEW LONDON
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MARCH 1983

FINAL

INITIAL ASSESSMENT STUDY OF NAVAL SUBMARINE BASE NEW LONDON, CT

NEESA 13-025

NAVAL ENERGY AND ENVIRONMENTAL
SUPPORT ACTIVITY
Port Hueneme, California 93043

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INITIAL ASSESSMENT STUDY
NAVAL SUBMARINE BASE, NEW LONDON, CT
UIC: N00129

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NAVY ASSESSMENT AND CONTROL
OF INSTALLATION POLLUTANTS (NACIP) DEPARTMENT
Naval Energy and Environmental Support Activity (NEESA)
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March, 1983

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FOREWORD

The Navy initiated the Navy Assessment and Control of Installation Pollutants (NACIP) program in OPNAVNOTE 6240 ser 45/733503 of 11 September 1980, and Marine Corps Order 6380.1 of January 1981. The purpose of the program is to systematically identify, assess, and control contamination of the environment resulting from past hazardous materials management operations.

An Initial Assessment Study (IAS) was performed at the Naval Submarine Base, New London, Connecticut by a team of specialists from Envirodyne Engineers, Inc., St. Louis, Missouri. Further confirmation studies under the NACIP program were recommended at several areas at the activity. Sections dealing with significant findings, conclusions and recommendations are presented in the earlier section of the report. The later technical sections provide more in-depth discussion on important aspects of the study.

Questions regarding the NACIP program should be referred to the NACIP Program Director, NEESA 112N, Port Hueneme, CA 93043, AUTOVON 360-3351, FTS 799-3351, or commercial (805) 982-3351. Further information regarding this study may be obtained from NACIP Program Director at the above numbers.

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Environmental Officer
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ACKNOWLEDGEMENTS

The Initial Assessment Study Team expresses its thanks for the support, assistance, and cooperation provided by personnel at Northern Division, Naval Facilities Engineering Command; Naval Energy and Environmental Support Activity; and the Naval Submarine Base, New London, Groton. In particular, the team acknowledges the effort provided by the following people, who greatly assisted in the successful completion of this study:

William Mansfield, Environmental Coordinator, NSB

Jeff Heath, Project Coordinator, NEESA

Mel Leifer, Northern Division, NAVFAC

EXECUTIVE SUMMARY

An Initial Assessment Study (IAS) was performed at the Naval Submarine Base, New London, Connecticut to identify and evaluate past hazardous waste disposal practices and to assess the potential for environmental contamination. There is sufficient evidence existing at three Subase areas to recommend further confirmation studies. Sampling and analysis programs were recommended for Area A Landfill, Site No. 2; Over-bank Disposal Area Northwest, Site No. 3; and DPDO Area, Site No. 6, to determine whether contamination exists and, if so, the extent of this contamination.

None of the sites identified represented an immediate threat to human health or the environment. Except for oil contamination associated with groundwater at the lower Subase, there has been no documentation of any other contamination at the Subase. No drinking water supplies are threatened by contaminants that might be emanating from the Subase.

SECTION 1

INTRODUCTION

1.1 PURPOSE OF INITIAL ASSESSMENT STUDY

As directed by the Chief of Naval Operations (CNO), the Naval Energy and Environmental Support Activity (NEESA), in conjunction with the Ordnance Environmental Support Office (OESO), conducts Initial Assessment Studies (IASs) to collect and evaluate evidence which indicates the existence of pollutants which may have contaminated a site or pose a potential health hazard for people located on or off the installation. The IAS is the first phase of the Navy Assessment and Control of Installation Pollutants (NACIP) program, which has the objective of identifying, assessing, and controlling environmental contamination from past hazardous materials storage, transfer, processing, and disposal operations. The NACIP program was initiated by OPNAVNOTE 6240 ser 45/733503 of 11 September 1980 and Marine Corps Order 6280.1 of 30 January 1981.

1.2 SEQUENCE OF EVENTS

1. Naval Submarine Base (NSB), New London, Groton was designated for an IAS by CNO letter ser 451/397464 of 3 August 1981.

2. Contract to perform IAS was awarded to Envirodyne Engineers, Inc. (EEI), St. Louis on 26 April 1982.

3. The Commanding Officer of NSB was notified of the selection of EEI to perform the IAS. Activity support requirements for the IAS were forwarded to the installation to outline assessment scope, provide guidelines to personnel and request advance information for review by the IAS team.

4. NSB personnel were briefed by NEESA, Project Coordinator, Jeff Heath, and EEI's Don Monnot on 10-11 May 1982.

5. A records search at various government agencies was conducted 17-28 May 1982 for documents pertinent to the IAS effort. Agencies contacted include:

a. NEESA Library

b. NORTHDIV Facilities Planning and Real Estate Department, Environmental Branch, Utilities Division, Applied Biology and Natural Resources Branches

c. Federal Archives, Bayonne, New Jersey

d. Federal Archives, Boston, Massachusetts

e. Washington National Records Center, Suitland, Maryland

f. National Archives, Washington, D. C.

g. Naval History Office, Washington Navy Yard, Washington, D. C.

h. Department of Defense Explosives Safety Board, Alexandria, Virginia

i. U. S. Geological Survey, Reston, Virginia

j. Ordnance Environmental Support Office (OESO), Indian Head, Maryland

k. NAVFAC, Alexandria, Virginia

l. NAVSEA, Alexandria, Virginia

m. U. S. Coast Guard

n. Connecticut Department of Environmental Protection

o. USEPA

6. The on-site phase of the IAS was conducted from 21 to 25 June 1982. The EEI team consisted of six members: two engineers, and four environmental scientists. Installation records were reviewed, interviews were conducted with present long-term and former employees, ground and aerial tours of the installation were made, and photographs were taken.

1.3 SUBSEQUENT NACIP STUDIES

The recommendation for the next phase of the NACIP program, the Confirmation Study, is based on the findings of the Initial Assessment Study. A Confirmation Study consists of extensive monitoring and sampling to determine the quantity and extent of suspected contamination. It is conducted only if the IAS concludes that:

1. Sufficient evidence exists to suspect that an installation is contaminated, and

2. The contamination presents a danger to:

   a. The health of civilians in adjoining communities or personnel within the base fenceline, or

   b. The environment within or outside the installation.

If these criteria are not met, no further studies will be conducted under the NACIP program.

1.4 WASTE DOSPOSAL SITES

All known or suspected hazardous waste disposal sites identified by the IAS team were evaluated using a Confirmation Study Ranking System (CSRS) developed by NEESA for the NACIP program. The system is a two-step procedure for systematically evaluating a site's potential hazard to human health and the environment based on evidence collected during the IAS.

Step one of the system is a flow chart which eliminates innocuous sites from further consideration. Step two is a ranking model which assigns a numerical score, within a range of 0 to 100, to indicate the potential severity of a site. Scores are a reflection of the characteristics of the wastes disposed of at a site, contaminant migration pathways, and potential contaminant receptors on and off the installation. CSRS scores and engineering judgment are then used to evaluate the need for a confirmation study based on the criteria stipulated in Section 1.3. CSRS scores assigned to sites recommended for confirmation studies also assist Navy managers to establish priorities for accomplishing the recommended actions.

A more detailed description of the Confirmation Study Ranking System is contained in NEESA Report 20.2-042.

SECTION 2

SIGNIFICANT FINDINGS

An examination of past support operations and disposal practices at the NSB New London, revealed 16 potential sites which may contain hazardous materials. These sites are identified in Figure 2-1 as to their location on base. Sites 5, 7, 9, 12, and 16 were identified during the survey but were found to be outside the scope of the NACIP program and will not be discussed in this report. Discussion of the remaining sites follows.

Of the 11 potential sites identified, 6 were found to have a low or moderate potential for contributing contaminants to the surrounding environment. The remaining 5 sites were found to have a high potential for contributing contaminants as evidenced by the criteria mentioned above. A complete discussion of all 11 sites is included in Section 6.2 (Waste Disposal Sites).

The following discussion will address the significant findings at each site in the following sequence: those sites not requiring further action, those sites requiring further action, and general significant findings (interrelationships of site, drainage, and the surrounding environment).

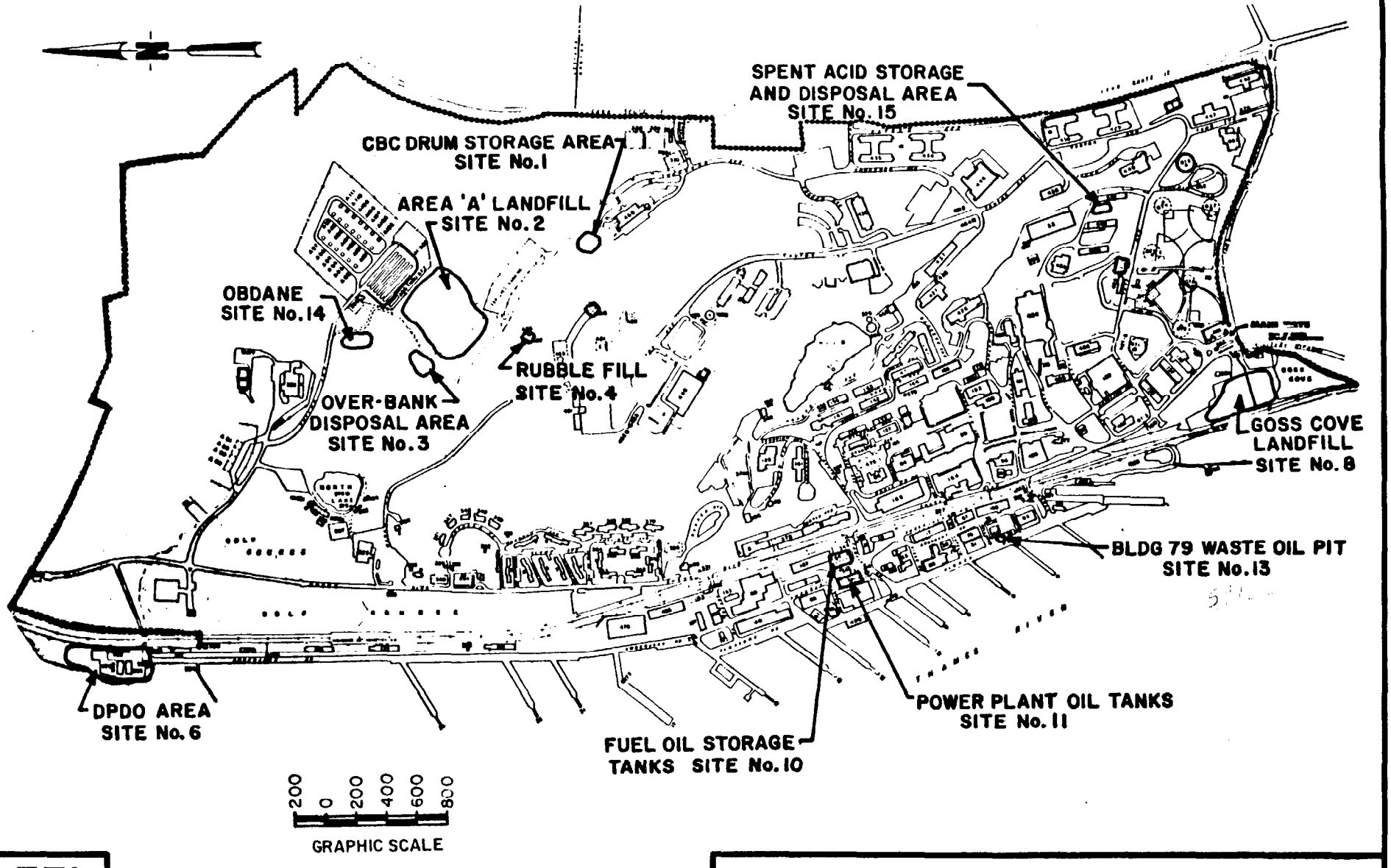
2.1 SITES NOT REQUIRING FURTHER ACTION

2.1.1 CBU Drum Area, Site No. 1

The contaminants at this site emanate from twenty-six 55 gallon drums of waste oil, lube oil, and paint materials, some of which are leaking onto the ground. The site apparently has not been used for more than two years. This is evidenced by the vegetative condition of the site and the amount of petroleum, etc. found on the ground. Drainage from this area enters the Area A marsh and drainage. Since the on-site survey, the drums have been removed and disposed of off-base. No significant contamination, therefore, remains at the site.

2.1.2 Goss Cove Landfill, Site No. 8

This area was used as a landfill from 1946 to 1957. Approximately 50 percent of the area is capped with asphalt and the remainder is covered with soil and heavy vegetation. The materials disposed of at this site



EEI

FIGURE 2-1

WASTE DISPOSAL SITES

consisted of only incinerator ash and inert rubble. The site was constructed on a backwater area of the Thames River.

2.1.3 Building 79 Waste Oil Pit, Site No. 13

This site is located on the lower base and has been in use since World War II. The pit contained oils and solvents used in cleaning diesel engines. The pit is no longer in use for that purpose. It has been filled with concrete and closed to all drainage.

2.1.4 Spent Acid Storage and Disposal Area, Site No. 15

This site was used prior to and several years after World War II. All acid contaminated material has been removed or washed from the site. This site has no contamination potential.

2.2 SITES REQUIRING FURTHER ACTION

2.2.1 Area A Landfill, Site No. 2

This site was identified by base personnel and designated as Area A. The area covers approximately 25 acres. Landfill operations have occurred from prior to 1957 until 1973. All non-salvageable materials (scrap wood, metal, waste chemicals, etc.) generated by the subs and base operations were landfilled in this area. During the IAS survey, there were 55 gallon drums containing PCBs, and electric switches and transformers present on an asphalt pad within the landfill area. Past leakage of PCB oil onto the pad was evident during the IAS survey. Two transformers were slowly leaking oil onto the pad during the June 1982 survey. It is not known whether the oil was PCB or mineral.

The asphalt pad and landfill are part of the Area A marsh system and drainage area. Drainage from the marsh ultimately discharges into the Thames River near DPDO. The marsh and the drainage from it appear to be groundwater discharge areas. Orange organic sediments in the marsh, and petroleum slicks on the surface waters of the marsh and drainage area indicate a contamination problem. Also, materials recently placed into the marsh from the edge of the landfill (i.e., oxygen candles, construction material, petroleum compounds) and an irridescent green color (fluorescent-like material) in the waters of the lower portion of the drainage further evidence a potential contamination problem. The potential for contamination of surrounding environments by the Area A landfill is high.

2.2.2 Over Bank Disposal Area Northwest, Site No. 3

This area was used as a disposal site after the earthen dam was constructed in 1957. The partially buried condition of the 30 visible steel fuel drums and other materials at the site indicates that it has not been used in the past 5 to 10 years.

Subsurface drainage from the area of the landfill surfaces at this site. The small impoundment within the site contains bright orange organic sediments.

The potential of contamination emanating from this site is high. Materials from the steel drums may have concentrated in the sediments of the impoundment. The color of the sediments of the impoundment indicates contamination, and movement of the contaminants within the drainage would discharge into the river.

2.2.3 Rubble Fill at Bunker A-86, Site No. 4

This site is located next to bunker A-86 on a hill with a 30 percent slope. At the base of the slope is the Area A landfill and wetland. This site has been receiving construction type waste materials which are inert. Use of this site does not appear to date beyond the last ten years. Disposal was taking place during the June 1982 survey.

2.2.4 DPDO Area, Site No. 6

This site is located directly on the shoreline of the Thames River. It was used for 19 years as a burning ground and major base landfill (from 1950 to 1969). Materials burned or filled were primarily inert construction or other non-salvageable, combustible materials. After burning, residues were pushed into the river or partially covered on the river bank. Presently, there is no burning or landfilling in this area, and surplus (non-salvageable) materials are disposed of by private contractors (off-base).

The potential for contaminants entering the surrounding environment from this site is high. The majority of the site over the landfill is prone to flooding. Unknown materials were landfilled at groundwater level. There were operations within the site that may have contributed petroleum and other waste chemicals to the surface soils through leaks and spills. The underground drainage crossing the site and that which drains Area A, have an outfall on the shoreline of this site. The discharge had an irridescent green color (fluorescent) indicating potential chemical contamination (observed during June 1982 on-site survey).

2.2.5 Fuel Oil Storage Tanks (South of 107), Site No. 10

These are five underground concrete storage tanks each having 125,000 gallon capacity. The tanks are located approximately 300 feet from the river shoreline and have been in use since World War II. A monitoring well in the vicinity of the tanks yielded only small amounts of petroleum compounds. This indicates that there has been only slight leakage. The location of the tanks on the lower base puts them in close proximity to groundwater and the Thames River. There has been no detailed monitoring of fluid levels in the tanks to detect leaks below ground.

2.2.6 Power Plant Oil Tanks, Site No. 11

These four tanks are located underground on the lower base, and each has a 170,000 gallon capacity. These have been in operation since World War II. The fuel is #6 grade and is pumped into the tanks from the north base tank farms.

The potential for contaminants entering the environment from this site is high. Monitoring wells installed in this vicinity of the lower base show high petroleum concentrations, with a three-inch layer of oil on the groundwater. The tanks are constructed of concrete and are relatively old. They are below ground and close to the water table. Groundwater flow from this site would discharge directly into the Thames River.

2.2.7 OBDANE (Over-bank Disposal Area Northeast), Site No. 14

The disposal site is located within the drainage of Area A which confluences with the Thames River. The disposal site is on a steep hillside, and there is no cover over the materials. The composition of the material is undeterminable due to the condition of exposed containers. The containers disposed of at this site may have been empty when placed. The vegetative condition of the site indicates no disposal has occurred for 5 to 10 years.

2.3 GENERAL SIGNIFICANT FINDINGS

2.3.1 Biology

There is visible evidence of chemical leaching from the landfill in Area A into the wetland and associated drainage system. At the confluence of this drainage with the Thames River, evidence of contaminants can be seen entering the river. However, there is no visible evidence or documentation of the impacts that this drainage may be having on Thames River biota.

Petroleum compounds are sometimes visible on the water surface along the shoreline of the lower base. These compounds affect the river biota by clogging filtering mechanisms, killing eggs and larvae, tainting flesh, etc. The degree to which these impacts occur and the extent to which the river is affected are not known. No current evidence of severe impacts was evident. No studies have been conducted in the vicinity of the Subase to determine impacts on river biota by petroleum compounds.

Tons of fish and shellfish are privately harvested annually from the Thames River for human consumption. The majority of species are taken from the river below the Subase. The most important and commonly caught species is the winter flounder which inhabits the river year-round. There is presently a commercial fishery for eels. American shad, Whiting and blueback herring may be present in numbers sufficient to allow commercial harvesting in the future. At the present time, there is no commercial harvesting of shellfish.

2.3.2 Surface Drainage

The Subase is situated along the eastern bank of the Thames River. All surface drainage from the Subase is into the river. Surface runoff from many areas is directly into the river. Those streams which receive drainage from areas of the Subase also discharge directly into the river.

2.3.3 Groundwater

Groundwater at the Subase is generally within a depth of 10 feet. In the lower base, the groundwater is often within just two or three feet of the surface. Groundwater from the Subase discharges into the Thames River.

The groundwater at the Subase is not presently being utilized, although a well in the vicinity of the golf course was considered for use in watering the golf course during the recent period of drought. The Subase receives its water supply from the city of Groton, which utilizes a series of reservoirs. These reservoirs all lie in watersheds separate from the Subase.

SECTION 3

CONCLUSIONS

3.1 SITES NOT REQUIRING FURTHER ACTION

3.1.1 CBU Drum Area, Site No. 1

At this site, there were twenty-six 55 gallon drums. Some of these drums were leaking petroleum compounds and paint materials. The hillside drainage carries these materials into Area A marsh and drainage system. (Monitoring of Area A would detect contaminants emanating from this site.) The removal of the barrels has eliminated the potential contamination problem at this site.

3.1.2 Goss Cove Landfill, Site No. 8

This area has not been used as a landfill since 1957. It is capped, and there is little potential for erosion of fill materials. The materials disposed of at the site included only incinerator ash and inert rubble. The non-permeable cap limits the potential for contaminants to emanate from this site. There also is no visible or documented evidence of contamination problems with this site. For these reasons, it was not recommended for confirmation study.

3.1.3 Building 79 Waste Oil Pit, Site No. 13

This 500 gallon pit contained waste oil and solvents used to clean diesel engines. The pit is no longer being used for this purpose and has been filled with concrete and closed to all drainage.

3.1.4 Spent Acid Storage and Disposal Area, Site No. 15

All equipment and acid contaminated materials have been removed from this site. Natural weathering has cleansed the area of acid contamination. There is no contamination potential from this site.

3.2 SITES REQUIRING FURTHER ACTION

3.2.1 Area A Landfill, Site No. 2

This area is the most likely one at Subase New London to contribute contaminants to the surrounding habitats and surface drainage. Materials disposed of at the site included all non-salvageable materials generated by the subs and support operations. The filling was conducted in the marsh, i.e., at or below the water table. Contamination of shallow groundwater is likely. Since this is a groundwater discharge area, the extent of the groundwater contamination would be limited. Drainage from the landfill is carried downstream to outfalls in the DPDO area. Evidence of contamination in the surrounding environment includes: petroleum spills at the edge of the landfill observed flowing into the marsh; oil slicks on surface waters of the marsh; bright orange organic sediments; low diversity of flora and fauna in the marsh; discolored sediment and oil slicks on surface waters of the marsh drainage; and an irridescent green color of the waters discharging into the Thames River. A confirmation study is recommended at this site. As previously mentioned (Section 2.3.1) and fully explained in Section 5, the Thames River is a very important resource for the harvesting of sea food for human consumption, for boating and for aesthetics.

3.2.2 Over-bank Disposal Area Northwest (North of Area A Dam), Site No. 3

This site was used as a disposal area sometime after 1957. The material placed in this site partially covered thirty 200 gallon steel fuel drums which are presently empty. It is not known whether the drums disposed of at this site contained hazardous materials. The area is presently overgrown. The condition of exposed materials indicates that no disposal operations have occurred for 5 to 10 years. However, the sediment of the pond where the barrels are exposed has a bright orange color. It is unlikely that contaminants are presently emanating from the refuse material, but the organic sediments of the pond may be a sink for contaminants which either previously leaked from the refuse materials or are contained in the subsurface drainage from Area A which surfaces at this site. The drainage from the site ultimately enters the Thames River west of the golf course. As previously mentioned (Section 2.3.1) and fully explained in Section 5, the Thames River is a very important resource for boating, aesthetics, and the harvesting of sea food for human consumption.

3.2.3 Rubble Fill at Bunker A-86, Site No. 4

This site is presently being used and receives construction type refuse materials. It is directly uphill from Area A. However, the composition of the materials poses no threat of contamination to the surrounding environment or the drainage system.

3.2.4 DPDO Area, Site No. 6

This site was used as a burning ground and landfill for 19 years (1950 to 1969). Materials disposed of were generally inert, including combustible and non-salvageable construction material, furniture, wood scrap, etc. It has not been documented that hazardous materials have been disposed of at this site. The burn and fill operations took place on the bank of the river. The area today is prone to flooding. This increases the potential that hazardous materials, if they actually occur in the fill area, could leach into the river. The river is an important resource for recreation, aesthetics, and the harvesting of sea food for human consumption, as explained in Section 5.

3.2.5 Fuel Oil Storage Tanks (South of Building 107), Site No. 10

These five tanks are underground on the lower base approximately 300 feet from the Thames River shoreline. These tanks are concrete and have been in use since prior to World War II. Materials leaking from the tanks would practically be at groundwater level and would migrate relatively quickly to the river. A monitoring well was installed at this site as part of a previous study, which concluded that there was some measurable leakage from these tanks.

3.2.6 Power Plant Oil Tanks, Site No. 11

These four tanks are located underground on the lower base where the water table is near the surface. They each have a 170,000 gallon capacity. Previous studies indicate that there was leakage from the tanks as evidenced by large quantities of petroleum compounds found in groundwater samples from the area. Leakage of petroleum into steam and pipe tunnels and underground vaults may also present a fire hazard.

Presently the petroleum compounds are entering the river via the groundwater and possibly impacting the resources of the river (sea food, boating, aesthetics) explained in Section 5.

3.2.7 OBDANE (Over-bank Disposal Area Northeast), Site No. 14

The condition of the refuse materials and vegetation indicates that this area has not been used in 5 to 10 years. The materials in the site are unknown. The fibre drums, which make up the visible evidence of disposal, have decayed, leaving no indications of their contents. This site is located within the Area A drainage system. Reasons for not recommending confirmation are: the age and decayed condition of materials in the site indicate that, if contaminants are present, they are not in high concentrations; there is no evidence or documentation that hazardous materials were disposed of at the site. This site would be included in the monitoring plan for Area A.

3.3 GENERAL CONCLUSIONS

3.3.1 Biology

There is no visible evidence or documentation of adverse impacts on Thames River biota as a result of Subase activities. However, adverse impacts are possible.

There may be chronic or acute toxicities to organisms in the river by chemicals emanating from the base via groundwater or surface runoff. The river ecosystem is complex and contains fish and shellfish which are heavily harvested and consumed by humans. The ecosystem of the Thames River has been thoroughly studied and shown to be very sensitive to industrial effluents and municipal sewage treatment discharges. However, no investigations have been conducted to determine what contaminants are entering the river from the base or what their impact may be on river biota.

3.3.2 Surface Drainage

Due to its proximity to the Thames River, surface runoff and drainage from the Subase is directly into the river. It is possible that contaminants from the Subase are migrating off-site and into the river.

3.3.3 Groundwater

Contamination of the shallow groundwater at the Subase is possible. The groundwater moves in a westward direction and discharges into the Thames River.

The groundwater in the area of the Subase is not used for drinking water supplies. It could be used during future dry periods for irrigation of the golf course on base. The Subase receives its drinking water from the town of Groton, which uses a series of reservoirs for potable water supplies.

SECTION 4

RECOMMENDATIONS

Based on the significant findings and conclusions, three areas at the Naval Submarine Base, New London have a significant contamination potential which could pose a threat to human health or the environment. The remainder of this chapter addresses the specific recommendations for each of these sites. A summary of the recommendations and CSRM scores for all of the sites recommended for confirmation study at NSB are shown in Table 4.1-1.

4.1 CONFIRMATION STUDY

The areas which warrant further investigation are listed below.

Area A Landfill, Site No. 2

Over-bank Disposal Area, Northwest, Site No. 3

DPDO Area, Site No. 6

The specific recommendations in regard to each site suggested for confirmation study and those for lesser remedial action will be discussed below.

4.1.1 Area A Landfill, Site No. 2

Due to the wide assortment of hazardous materials potentially disposed of in this landfill and the fact that surface drainage from the site is ultimately into the Thames River, EEI recommends that a sampling program be initiated to determine if there has been any contaminant migration, and if so, to what extent. A combination of 8 surface water samples and 10 sediment cores is recommended. Figure 4.1-1 shows the recommended locations of these sampling sites. The sampling program recommended for Site 2 will also pick up contaminants associated with Site 3. Each of the surface water samples and sediment cores should be put through a priority pollutant scan (Appendix A).

The sediment cores should be taken to a depth of two feet or through the entire thickness of marsh deposits, whichever is shallower. Each core should be vertically composited.

TABLE 4.1-1

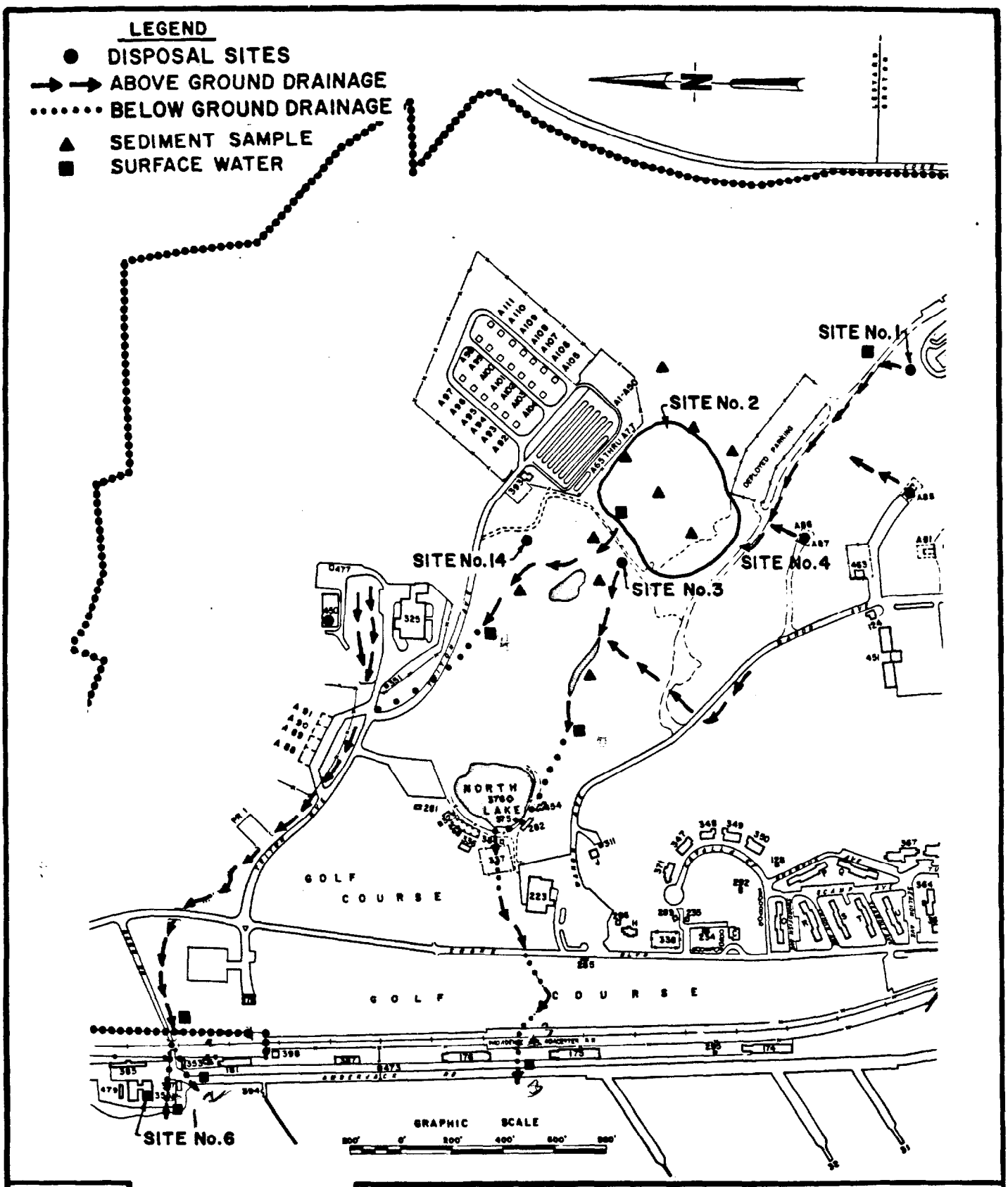
SUMMARY OF RECOMMENDATIONS
NAVAL SUBMARINE BASE, NEW LONDON, CONNECTICUT
SITES RECOMMENDED FOR CONFIRMATION STUDY

Site Number	Name	Score	Sampling	Frequency		Lab Testing Parameters	
2	Area A Landfill	25.4	8 surface water samples, 10 sediment cores.	Sediment cores one time only, surface water (six) times.	8 48 6 10	Priority Pollutants	5,000
3	Over Bank Disposal Area Northwest	18	Sampling recommended for Area A Landfill can be applied to this site.	See Area A Landfill.		See Area A Landfill	
6	DPDO Area	12.1	3 Soil Cores.	One time only.	3	Priority Pollutants	6,000
					61		

61 pp.

OTHER RECOMMENDED ACTIONS

Site Number	Name	Recommended Action
4	Rubble Dump at Bunker A-86	Post no dumping signs at fence site.
10	Fuel Oil Storage Tanks	Monitor level of tank to see if leaking.
11	Power Plant Oil Tank	Replace tanks, implement oil recovery.
14	Obdane	Post no dumping signs.



EEI

FIGURE 4.1-1

RECOMMENDED SAMPLING LOCATION FOR SUBASE

The various surface water samples are situated so as to trace the flow of contaminants from the landfill. The easternmost surface water sampling site can be used as an indication of the background surface water before it enters the landfill area. The two streams receiving drainage from this site ultimately discharge into the Thames River at three outfalls. These discharge pipes should be sampled in order to determine whether or not contaminants are presently entering the river.

The sediment cores need only be taken one time. However, it is recommended that the surface water sites be sampled twice in the spring and twice in the summer and once each in the fall and winter.

The marsh and the drainageways which flow out of Area A both appear to be groundwater discharge areas. Any contamination of the aquifer would, therefore, be of only limited vertical and areal extent, so no groundwater monitoring is warranted at the present time.

Types of Samples: Eight surface water samples and ten sediment samples

Sampling Frequency: Sediment cores should be sampled once; surface water sites twice in the spring and twice in the summer, and immediately following significant rainfall events

Testing: Priority pollutants

4.1.2 Over-bank Disposal Area, Northwest, Site No. 3

For purposes of the confirmation study, this site can be grouped together with the Area A landfill (Section 4.1.2). The sites are in such close proximity to each other, with surface drainage into the same streams, that it is not possible to separate the two sites. Therefore, the sampling program recommended for the Area A landfill will yield sufficient data to evaluate this site.

4.1.3 DPDO Area, Site No. 6

It is recommended that three soil borings be taken in the vicinity of the old burning area. (The location of the burning area can be obtained from photographs available in the DPDO office.) These cores should be taken down as deeply as possible but need not exceed 10 feet. Vertical composites of all three borings should be made and put through a priority pollutant scan (Appendix A).

If contamination is found, it is also recommended that a levee be constructed at this site. The site is currently subject to periodic flooding. Construction of a levee at this site would alleviate this problem and lessen the potential for contaminant migration.

The landfilling extended to the present shoreline. Therefore, no on-land downgradient areas exist, and so no groundwater monitoring is recommended.

Types of Samples: Three soil cores

Sampling Frequency: One time

Testing Parameters: Priority pollutants

4.1.4 General Recommendations

4.1.4.1 Sampling of Thames River - It is recommended that the shoreline of the Subase remain closed to all shellfishing. If, for any reason, these waters are opened to this activity, a detailed sampling and analysis plan should be initiated.

4.1.4.2 Mark Sites - Put all identified waste disposal sites on the installation maps.

4.2 SITES NOT SELECTED FOR CONFIRMATION

4.2.1 Rubble Dump at Bunker A-86, Site No. 4

This site represents no contamination threat but is visible from the road and has easy access. Therefore, it is recommended that "No Dumping" signs be posted at this site. Unauthorized access should be restricted by fencing the site.

4.2.2 Fuel Oil Storage Tanks, Site No. 10

It is recommended that the level of these tanks be closely monitored to determine if they are leaking. If leaking is discovered, these tanks should be repaired or replaced. Monitoring should be conducted directly from the tanks for greatest accuracy and because the test wells cannot be located.

4.2.3 Power Plant Oil Tanks, Site No. 11

These tanks are old and in a deteriorated and leaking condition. However, plans are already underway to replace these tanks in the near future. Recovery of oil which has leaked from the tanks will help alleviate the problem of oil with the groundwater in the lower portion of the base. The extent of the oil contamination in the lower portions of the Subase has already been documented in a report by NEESA ("Oil Contamination of the Groundwater at Subase, New London, Connecticut").

4.2.4 OBDANE, Site No. 14

It is recommended that "No Dumping" signs be posted at this site.

SECTION 5

BACKGROUND

5.1 GENERAL

5.1.1 Location

The Naval Submarine Base (Subase), New London is located in southeastern Connecticut approximately midway between the cities of Boston and New York. The Subase is situated along the east bank of the Thames River just north of the town of Groton. Long Island Sound and the Atlantic Ocean are six miles south of the Subase. The Subase lies within the Connecticut townships of Ledyard and Groton. A general location map of the area is shown in Figure 5.1-1, and a vicinities map is shown in Figure 5.1-2.

The Subase, including all the non-contiguous areas, encompasses 1,412 acres of land. The main base has 547 acres while the remaining areas are used for housing and community support. Figure 5.1-3 shows the main Subase, including all buildings and structures. The Subase has 1,383 structures and buildings with over 5.8 million square feet of floor space. The Subase is divided into an upper and lower base, with admittance to the lower base being restricted because of the berthing and support activities associated with the submarines. The lower base has pier space for 16 submarines.

5.1.2 Command and Tenant Command Relationships and Missions

The Naval Submarine Base (Subase) primarily serves as an operating and support base for naval submarine operations in the Atlantic Ocean. The afloat commands situated at the Subase include Submarine Group Two, Submarine Squadron Two, and Submarine Development Squadron Twelve. Submarine Squadron Ten is located at the Connecticut State Pier in New London. The chain of command at the Naval Submarine Base is listed below.

1. Chief of Naval Operations
2. Commander in Chief, U. S. Atlantic Fleet
3. Commander Submarine Force, U. S. Atlantic Fleet

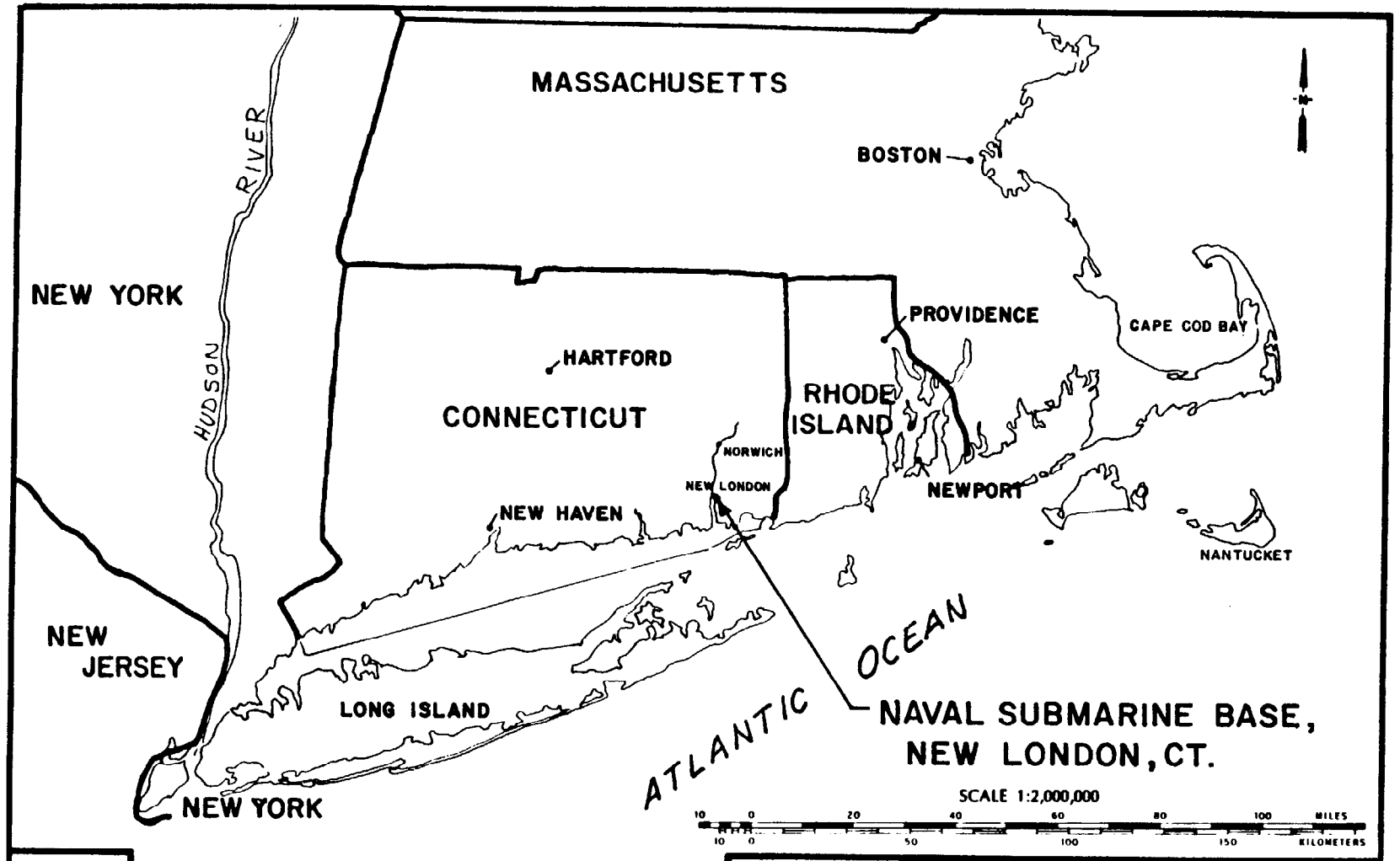


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FIGURE 5.1-1

LOCATION MAP

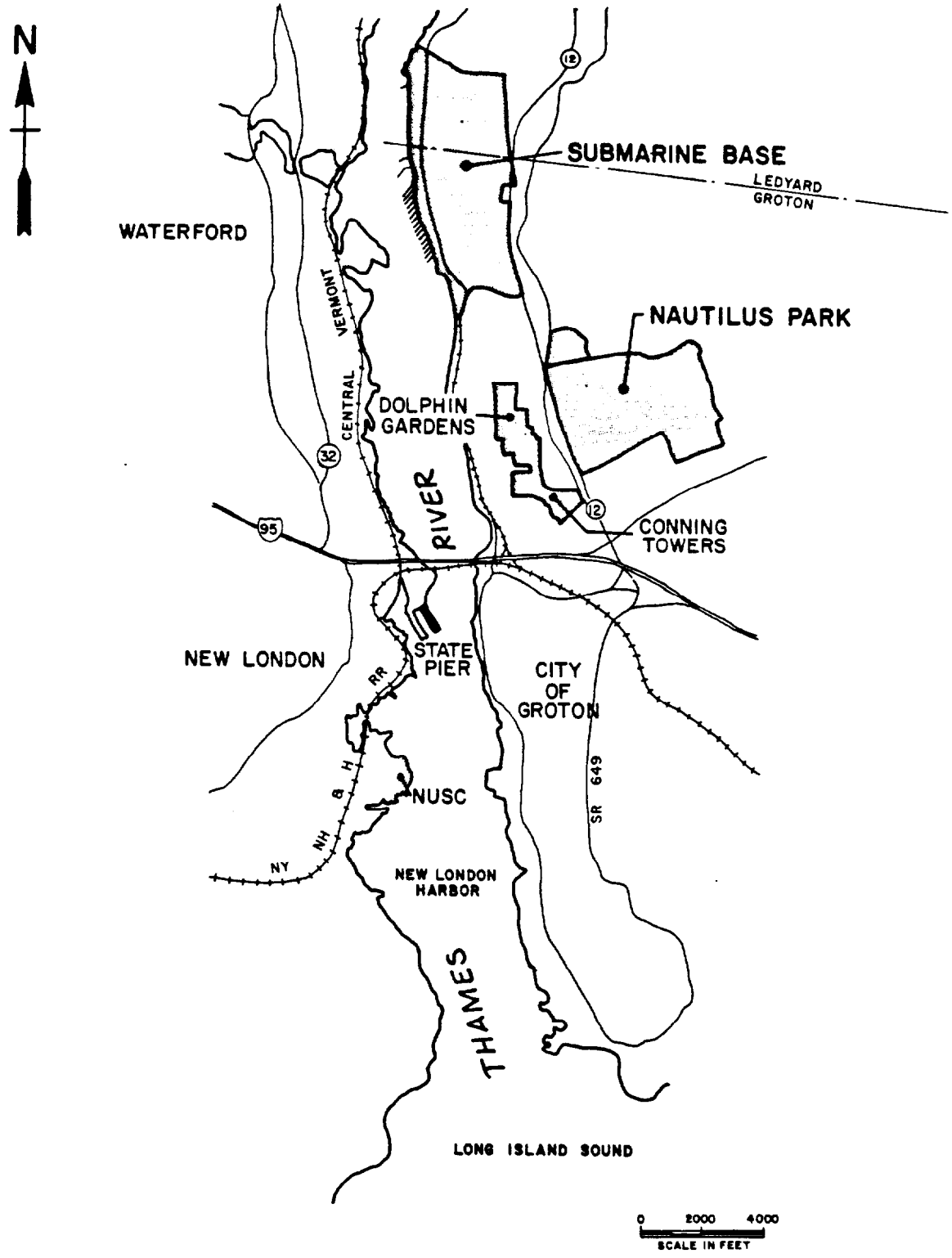

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FIGURE 5.1-2

VICINITIES MAP
NAVAL SUBMARINE BASE
NEW LONDON, CT.

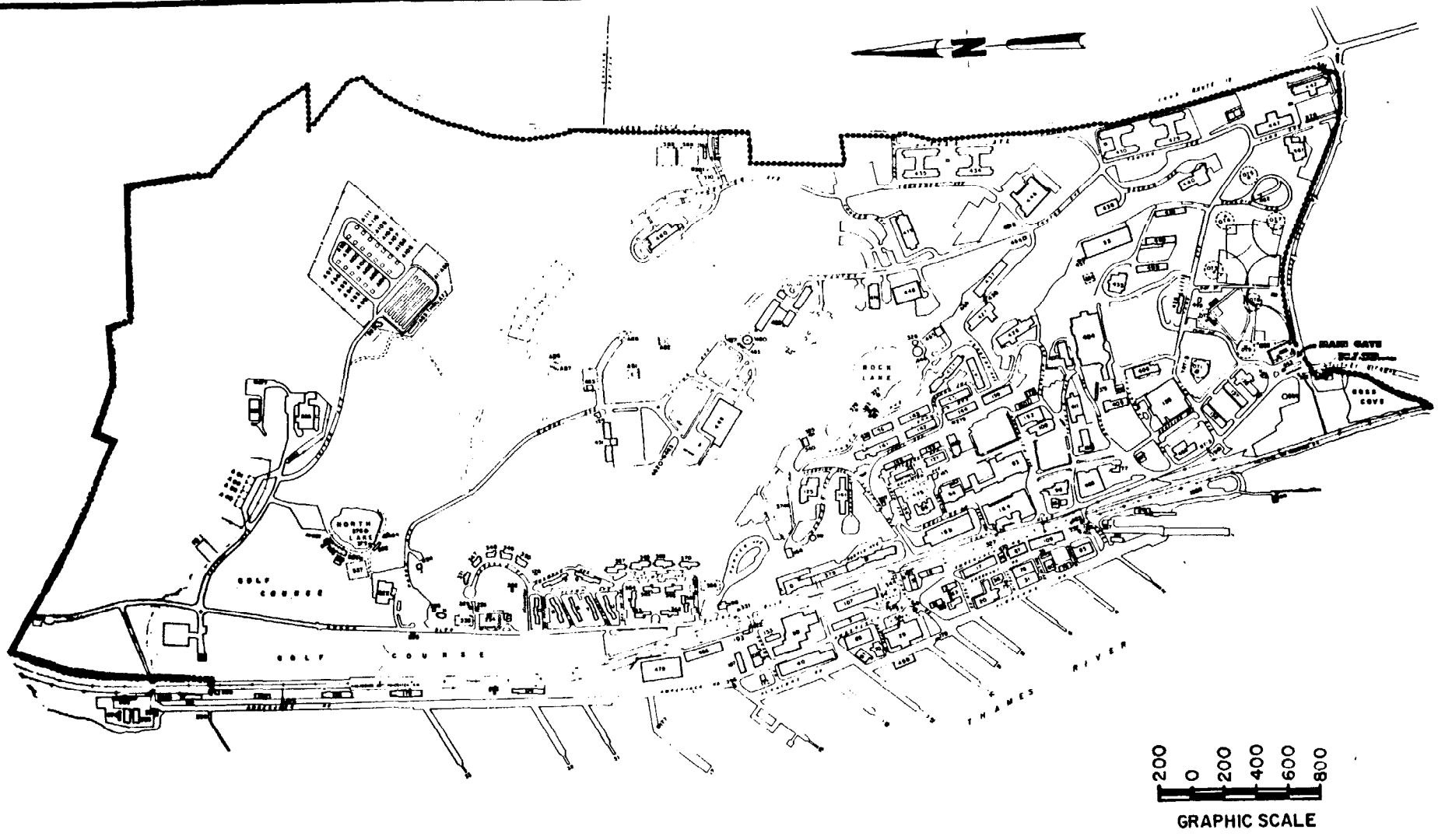

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FIGURE 5.1-3

INSTALLATION MAP

4. Commanding Officer, Naval Submarine Base New London, Groton, Connecticut

The Subase, along with its tenant activities, performs four major services to the operational fleet. First of all, the Subase provides homeporting for submarines and their crews. Secondly, the Subase provides maintenance and repairs (intermediate level) of submarines and other assigned craft. Thirdly, submarine basic, advanced, and refresher training classes are provided to Naval personnel. Lastly, medical care, research and training in the field of submarine medicine is provided. Major tenant commands at the Subase include the Naval Submarine Support Facility, Naval Submarine School, Naval Submarine Medical Center, Naval Submarine Medical Research Laboratory, and the Marine Barracks. These will be discussed below.

5.1.2.1 Naval Submarine Support Facility (NSSF) - NSSF is a separate command which is responsible to the Commander, Submarine Squadron Two. The NSSF has the responsibility of repair, maintenance and upkeep of submarines, assigned submarine rescue vehicles, and small service crafts. NSSF provides port services such as maintaining schedules for surface vessels, boards incoming vessels, assigns berthing under Naval control, arranges for control of port movements and craft, provides tugs and equipment for docking and undocking, provides towing services, and coordinates arrangements for logistics requirements. NSSF coordinates and assigns service crafts and small boats and maintains and operates service craft assigned it. Also, NSSF is responsible for receiving and issuing, overhaul, maintenance, and storage of submarine weapons.

5.1.2.2 Naval Submarine School - The mission of the Naval Submarine School is to provide officers and enlisted men with the basic submarine knowledge and skills needed to operate submarines competently and efficiently. This includes submarine weapon systems. The Naval Submarine School also provides functional, refresher, advanced, and team training in specific skill areas.

5.1.2.3 Naval Submarine Medical Center - The mission of the Medical Center is to provide general clinical and hospitalization services to active duty Navy and Marine Corps personnel. The Medical Center also cooperates with military and civil authorities in matters pertaining to public health, local disasters, and other emergencies.

5.1.2.4 Naval Submarine Medical Research Laboratory - The mission of the Medical Research Laboratory is to conduct medical research and development as it relates to submarine, shipboard, diving and amphibious environments and to perform such other functions and tasks as directed by higher authority.

5.1.2.5 Marine Barracks - The mission of the Marine Barracks is to provide such security as approved by the Chief of Naval Operations in cooperation with the Commanding Officer of the Subase. This includes providing perimeter security guards and any additional security as directed for other short term military and emergency operations.

A listing of the other tenant activities at the Subase is provided below.

Commander Submarine Group Two

Commander Submarine Squadron Two

Commander Submarine Development Squadron Twelve

Homeported and transient commands and units of the Operating Forces

SSBN Off Crews

Regional Accounting and Disbursing Center

Navy Branch Commissary Store NPT

Personnel Support Activity

Naval Investigative Service Office Resident Agency

Navy Consolidated Publications and Printing Service Facility, Brooklyn

Personnel Support Detachment

Naval Reserve Submarine Training Detachment

Naval Electronics Engineering Office, Portsmouth

Fleet Religious Support Activity Detachment

Naval Security Group Detachment, Groton

LANTFLT Supply Operations Assistance Program Team

Naval Construction Battalion Unit 414

Navy Counseling and Assistance Center

Defense Property Disposal Office

Mobile Ordnance Technical Unit - 4

Navy Alcohol Safety Action Program Detachment

Navy Legal Service Branch Office NPT

Branch Navy Dental Clinic

Naval Undersea Medical Institute

Officer in Charge of Construction

Consolidated Civilian Personnel Office

Education Training Support Center Atlantic Detachment

Sea Support Center Atlantic Field Office

Ship Engineering Center

Navy Campus for Achievement

Human Resources Management Detachment

PTEP Central Test Site Detachment

Regional Librarian

The information contained in this section was obtained from the most recent Master Plan for the Subase (NORTHDIV, 1980).

5.1.3 Adjacent Land Use

The Subase lies within the two townships of Ledyard and Groton, with the boundary line between them dividing the base into northern and southern sections. The northern portion of the base is in Ledyard township while the southern section is in Groton township.

The western boundary of the Subase adjoins the Thames River. Immediately adjacent to the northern boundary of the base is undeveloped land with scattered residential use. Further north the land use is predominantly medium and high density residential use. The rest of this northern area is a mixture of commercial, open space, institutional, wetlands, recreational, and residental land.

Almost the entire eastern boundary of the base is along Route 12 which is a major north/south arterial highway. East of Route 12 there is primarily undeveloped land with scattered residential use. To the northeast, there is also a mixture of commercial, medium and high density residential, wetlands, and industrial uses. The industrial area is very small. To the southwest are areas of natural resource use that encompass many acres of protected wetlands. Among the wetland areas are moderate density residential areas which include the Nautilus Park Navy housing.

Crystal Lake Road parallels the southern boundary of the Subase. There is a small commercial area at the intersection of Crystal Lake Road and Route 12 and another commercial strip further south along Route 12. The remainder of the land south of the base is primarily moderate density residential use with recreational and open space areas. The three Navy housing developments, Conning Towers, Polaris Park and Dolphin Gardens,

are located in this area. Further south, the area becomes more urban with moderate density residential and industrial uses dominating.

Located along the Thames River are also some industries which may have an adverse impact on the estuary. Included in this group of industries are General Dynamics' Electric Boat Division, Pfizer Chemical Company, and Dow Chemical Company. Electric Boat is located in Groton and is currently involved in the production of the Trident Submarines. Also located in Groton is Pfizer Chemical Company. Dow Chemical Company is located north of the Subase along the Thames River.

5.2 HISTORY

In 1867, the State of Connecticut donated to the Navy 112 acres on the east bank of the Thames River above the town of Groton. There was no Naval activity on this donated property until July of 1868 when the facility was officially designated a Navy Yard. The site was used to moor small craft and obsolete warships and as a coaling station for the Atlantic Fleet. At this time, two brick buildings, including Building One which remains standing today and a "T" shaped pier, were constructed. By 1881, the yard consisted of five or six structures but was little used and was reduced to a coaling station for the Atlantic Fleet's small craft.

The facility remained relatively inactive for the next few years and was listed to be disposed of in the Naval Appropriations Bill submitted to Congress in 1912. Only a last minute speech saved the site from being disposed of. In 1915, the Monitor Ozark, a floating raft with guns, acting as a tending vessel, arrived at the Navy Yard with four submarines which made up the then just beginning submarine service. Other tenders and submarines soon followed, and in 1916, permanent status came to the facility when the Navy Department designated it a submarine base. The Naval Submarine Base, New London became the nation's first continental submarine base.

During World War I, facilities at the base were greatly expanded. Between October 1917 and October 1918, eighty-one buildings were either completed or under construction, six piers were added, and the old "T" shaped pier was removed. In 1917, the Submarine School was established, and 10,000 officers and enlisted personnel were trained for submarine service. In 1918, the Submarine Medical Center was established as a dispensary. Following World War I, the Subase continued to service the submarines homeported there, and the Submarine School's curriculum was expanded.

During World War II, the Subase had to service a submarine fleet which was undergoing unprecedented growth. From 1935 to 1945, the Subase expanded from 112 acres to 497 acres and from 86 to 270 buildings. The Submarine Medical Research Laboratory was organized in 1942 as a Medical Research Department within the Subase Medical Department.

Following World War II, the Subase continued to expand. The Medical Research Department was established as a separate activity and designated the Medical Research Laboratory. Its mission was to select personnel for the Submarine School, instruct hospital corpsmen attending the Submarine School, and undertake research. In May of 1955, the dispensary was redesignated as a Station Hospital. The Medical Research Laboratory and the Station Hospital were disestablished in June of 1964 to form the Submarine Medical Center.

The status of the Submarine School was changed from an activity to a command in June of 1968, and it became the largest single tenant on the Subase. In February of 1974, the Naval Submarine Support Facility (NAVSUBSUPFAC) was established, encompassing the former departmental areas of submarine repair, operations and weapons. In February of 1975, the Naval Undersea Medical Institute (NUMI) was established as a separate command. The Subase now consists of over 300 buildings and more than 547 acres of land.

The above information on the history of the Subase was obtained from the most recent Master Plan (NORTHDIV, 1980) and from the Command Histories at the Naval History Office in Washington, DC.

5.3 PHYSICAL FEATURES

5.3.1 Climatology

Continental and maritime air masses define the climate of the region. The climate of the Subase is influenced by its proximity to the Atlantic Ocean. The ocean tends to modify temperatures, making winters somewhat warmer and summers cooler than areas more inland. Winters are moderately cold in the area, and summers are generally mild.

Temperatures for the entire year average around 50°F. January and February are the coldest months with mean temperatures of around 29°F. The average temperature range for these two months is 20.6 to 37.6°F. July is the warmest month with a mean temperature of 72.1°F. The temperature range for the month is 63 to 81.1°F. The average growing season is from about the middle of April through the middle of October. Subzero temperatures seldom occur and are confined to December, January and February. Temperatures in excess of 100°F seldom occur and are limited to June, July and August. Temperature extremes for the area are -13°F and 104°F.

Average annual precipitation for the area is around 43 inches, but this has varied from as little as 25 inches to as much as 65 inches. Southeastern Connecticut is characterized by frequent but short periods of precipitation. Measurable precipitation (0.01 inches or greater) occurs on about one day out of every three and is evenly distributed throughout the year. Thunderstorms are responsible for much of the rainfall from May through August. These thunderstorms can be very intense but are generally of short duration. Snowfall varies considerably from year to year, with most snowfall occurring in January, February and March.

The prevailing winds are southwesterly in the summer and northwesterly in the winter. The average wind speed is around 10 miles per hour.

Relative humidity in the area averages 55 percent in midafternoon and 75 percent at dawn. Lowest relative humidities occur in April and the highest in September.

The area is exposed to occasional coastal storms that travel up the Atlantic seaboard. Some of these storms are of tropical origin and occasionally are of hurricane intensity (winds in excess of 73 miles per hour). These storms are heavily laden with moisture and can result in substantial tidal damages.

Table 5.3-1 summarizes the climatological data for the Subase area.

5.3.2 Topography

Geographically, the Subase is located in the Northern Appalachian Mountain Belt of the New England Physiographic Province. The present topography of the Subase and surrounding areas is the result of glaciation which covered the area with ice up to 5,000 feet thick during Wisconsin time. Ice movement across New England was in a southeasterly direction. The southward movement of the ice caused many of the land forms to be oriented in a north to south direction, such as bedrock ridges.

The portion of southeastern Connecticut where the Subase is located is mostly upland area. The upland is an irregular, hilly area with many swamps, rock ledges, and poorly drained valleys. The topography of the upland reflects the lithology of the underlying bedrock. Resistant rocks tend to form ridges, hills, and knobs, whereas weak rocks form valleys. The upland is divided by the Thames River which is flanked by a discontinuous series of terraces that form the only appreciable areas of flat land.

The lower portions of the Subase are on a terrace of the Thames River, while the remaining areas are upland. Elevations at the Subase range from near sea level to around 234 feet. The 100 year flood inundation level for the Subase is 11.2 feet, making much of the area susceptible to flooding. Figure 5.3-1 shows the topography of the Subase.

5.3.3 Geology

5.3.3.1 Bedrock Geology - The bedrock in southeastern Connecticut is hard, dense, metamorphosed sedimentary and crystalline rock. The bedrock is divided into two age groups, Pre-Silurian and Pre-Pennsylvanian rocks. Structurally, the area contains a complex series of folds, faults, anticlines and synclines. The bedrock geology of the area is shown in Figure 5.3-2, and a geologic cross-section through the Subase is represented in Figure 5.3-3.

TABLE 5.3-1

SUMMARY OF CLIMATOLOGICAL DATA

Months	Normal				Extremes		Precipitation (inches)			Relative Humidity Hour		Wind		Mean Number of Days			
	Daily Max.	Daily Min.	Monthly	Highest	Record Lowest	Record Normal	Monthly	Monthly	24 hr.	07	13	Mean Speed (MPH)	Prevailing Direction	Precipitation 0.01 inches or more	Thunderstorms	90° F + Above	32°F + Below
(a)				27	27		27	27	27	17	17	27	10	27	27	17	17
Jan	36.2	20.6	28.4	66	-13	3.52	11.66	0.50	3.34	71	57	11.5	NW	11	0	0	12
Feb	37.6	21.2	29.4	69	-7	3.45	5.63	1.16	3.14	70	54	11.7	NNW	10	0	0	9
Mar	44.7	29.0	36.9	78	1	3.99	8.11	1.72	4.53	70	54	12.2	WNW	12	1	0	2
Apr	56.7	37.8	47.3	98	14	3.72	7.32	1.48	2.82	68	47	12.2	SW	11	1	0	0
May	66.8	46.9	56.9	94	29	3.49	7.62	0.71	3.78	72	52	10.9	S	11	3	1	0
June	76.3	56.5	66.4	96	41	2.65	6.83	0.39	2.09	76	56	10.0	SW	11	4	2	0
July	81.1	63.0	72.1	100	49	2.85	8.08	1.00	4.83	77	56	9.5	SW	9	5	3	0
Aug	79.8	61.0	70.4	104	40	3.90	11.12	0.91	6.71	80	56	9.3	SSW	10	4	2	0
Sep	73.1	53.6	63.4	97	33	3.26	7.92	0.77	4.89	82	56	9.5	SW	8	2	1	0
Oct	63.9	43.4	53.7	86	20	3.27	11.89	1.62	6.63	80	54	9.7	NW	8	1	0	4
Nov	52.0	34.6	43.3	78	14	4.52	8.45	0.81	3.13	77	58	10.5	SW	11	1	0	13
Dec	39.6	23.4	31.5	69	-10	4.13	10.75	0.58	3.85	75	59	11.0	WNW	12	0	0	25
Year	59.0	40.9	50.0	104	-13	42.75	11.89	0.39	6.71	75	55	10.7	SW	124	20	9	123

Notes: (a) Length of record (years)

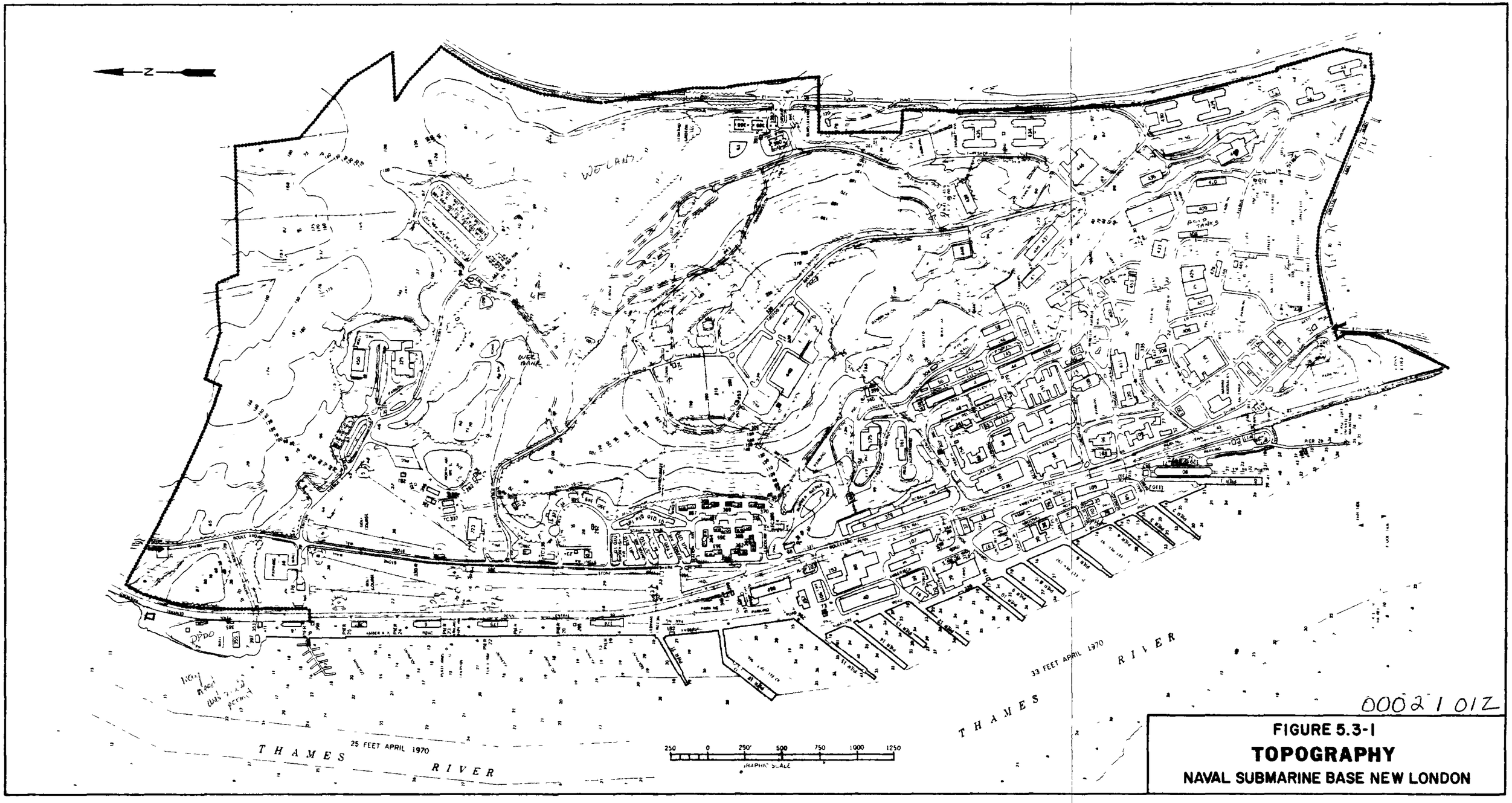
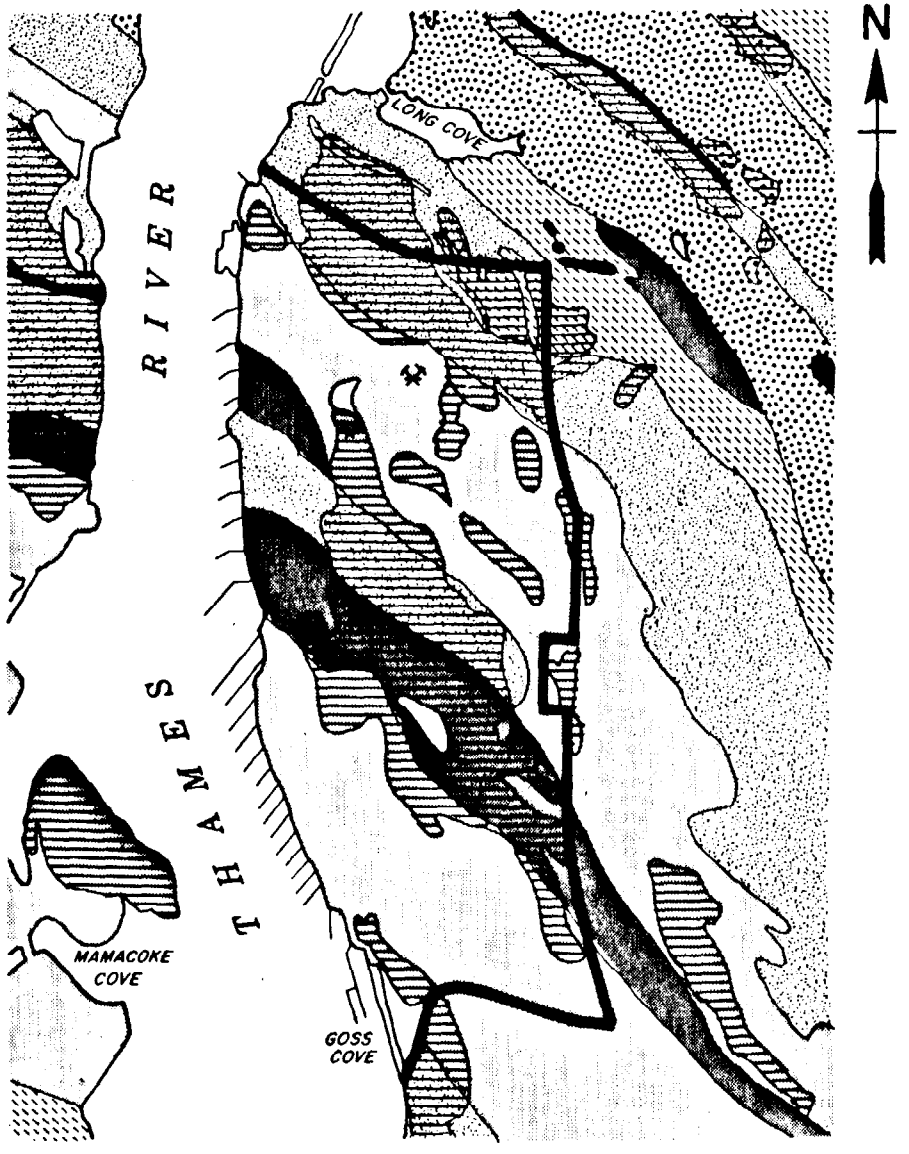


FIGURE 5.3-1
TOPOGRAPHY
NAVAL SUBMARINE BASE NEW LONDON



Pegmatite

pe - concordant to semi-concordant, indistinctly gneissic, orange-pink and minor white pegmatite composed of quartz, microcline, oligoclase or albite, and accessory biotite and magnetite. Locally contains garnet, muscovite, and sillimanite.

Alaskite gneiss

sa - orange-pink to light-grey, fine- to medium-grained, equigranular gneissic granite composed of about equal amounts of quartz, microcline, and albite to sodic aligoclase, and about 1 percent magnetite or as much as 2 percent magnetite and biotite.

Granite gneiss

sg - orange-pink to light-grey, mdeium-grained, gneissic biotite granite, main constituents quarts = microcline ≥oligoclase with 2-7 percent biotite and iron oxides. Locally contains muscovite and garnet; somewhat uneven in mineral distribution. Foliation typically marked by parallelism of alternate flat lenses of quarts and feldspars, and parallelism of biotite flakes. Biotite tends to be concentrated on surfaces between lenses. Some masses have slightly coarser grained streaks rich in orange-pink microcline in finer grained gray quartz-microcline-plagioclase rock. Locally mafic-poor similar to biotitic phases of the alaskite gneiss (sab).

Mamacoke Formation

mm - Indistinctly layered light- to dark-gray, biotite-, quartz-feldspar gneiss, and minor hornblende-biotite-quartz-feldspar gneiss; locally granitoid and migmatic. Thin layers of amphibolite and quartzite. Biotite flakes typically small and mostly evenly distributed.

Plainfield Formation

p - dark-green hornblende-biotite-quartz-plagioclase gneiss, in part diopsidic; dark biotite-quartz-plagioclase gneiss with variable amounts of microcline; garnet-biotite-quartz-feldspar schist and gneiss; amphibolite; light-gray sugary textured biotite-feldspar-quartz gneiss; thin gray quartzite, rare thick white quartzite.

pc - calc-silicate quartzite and gneiss.

ps - garnet-sillimanite-biotite-quartz-feldspar schist and gneiss; garnet-biotite-quartz-feldspar gneiss; biotite-quartz-feldspar gneiss; minor biotite-quartz-andesine gneiss with diopside and colorless amphibole; thin-bedded quartzite, locally pyritic.

psq - thick- to thin-bedded, white or tan, to light-gray, rarely greenish quartzite; thin-bedded micaceous quartzite, locally graphitic; thin interlayers of garnet and sillimanite-bearing schist and gneiss.

Bedrock Exposures - Individual outcrops and areas of abundant outcrops.

Inactive quarry.

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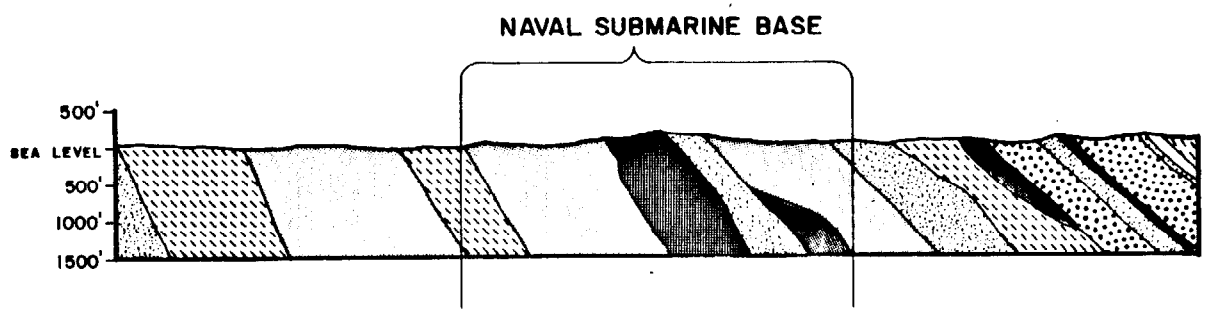
FIGURE 5.3-2

BEDROCK GEOLOGY

Source: Bedrock Geologic Map of Uncasville Quadrangle, USGS



Alaskite gneiss

sa - orange-pink to light-grey, fine- to medium-grained, equigranular gneissic granite composed of about equal amounts of quartz, microcline, and albite to sodic aligoclase, and about 1 percent magnetite or as much as 2 percent magnetite and biotite.

Granite gneiss

sg - orange-pink to light-grey, mdeium-grained, gneissic biotite granite, main constituents quarts = microcline ≥oligoclase with 2-7 percent biotite and iron oxides. Locally contains muscovite and garnet; somewhat uneven in mineral distribution. Foliation typically marked by parallelism of alternate flat lenses of quarts and feldspars, and parallelism of biotite flakes. Biotite tends to be concentrated on surfaces between lenses. Some masses have slightly coarser grained streaks rich in orange-pink microcline in finer grained gray quartz-microcline-plagioclase rock. Locally mafic-poor similar to biotitic phases of the alaskite gneiss (sab).

Mamacoke Formation

mm - Indistinctly layered light- to dark-gray, biotite-, quartz-feldspar gneiss, and minor hornblende-biotite-quartz-feldspar gneiss; locally granitoid and migmatic. Thin layers of amphibolite and quartzite. Biotite flakes typically small and mostly evenly distributed.

Plainfield Formation

p - dark-green hornblende-biotite-quartz-plagioclase gneiss, in part diopsidic; dark biotite-quartz-plagioclase gneiss with variable amounts of microcline; garnet-biotite-quartz-feldspar schist and gneiss; amphibolite; light-gray sugary textured biotite-feldspar-quartz gneiss; thin gray quartzite, rare thick white quartzite.

pc - calc-silicate quartzite and gneiss.

ps - garnet-sillimanite-biotite-quartz-feldspar schist and gneiss; garnet-biotite-quartz-feldspar gneiss; biotite-quartz-feldspar gneiss; minor biotite-quartz-andesine gneiss with diopside and colorless amphibole; thin-bedded quartzite, locally pyritic.

psq - thick- to thin-bedded, white or tan, to light-gray, rarely greenish quartzite; thin-bedded micaceous quartzite, locally graphitic; thin interlayers of garnet and sillimanite-bearing schist and gneiss.

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FIGURE 5.3-3

GEOLOGIC SECTION

Source: Bedrock Geologic Map of Uncasville Quadrangle, USGS

During Pre-Silurian times, this portion of southeastern Connecticut was inundated by the ocean. Sand, silt, and clay sediments were deposited in this marine environment. Subsequent uplifting forces metamorphosed these sediment layers, vastly changing their characteristics. These metamorphic rocks are the base of the eroded Appalachian Mountains of southern New England.

The Pre-Pennsylvanian bedrock in the area owes its origin to increased tectonic activity some 310 to 350 million years ago. This tectonic activity produced magmatic plutons which intruded between the older sedimentary layers. These intrusive layers are parallel to the older sedimentary beds. Slow cooling rates allowed metasomatism to proceed, which segregated mineral species within the rock mass. Subsequently, the area was subjected to intense deformation forces which produced granitic gneisses and schistose quartzites.

The Pre-Pennsylvanian rocks occurring at the Subase are members of the Sterling Plutonic Group, which is composed of igneous intrusives which have been transformed to granite gneisses. The Sterling Plutonic Group is further divided into the Alaskite gneiss and the Granite gneiss, both of which occur at the Subase.

The Alaskite gneiss is an orange-pink to light gray, fine to medium grained, equigranular gneissic granite composed of about equal amounts of quartz, microcline, and albite to sodic oligoclase. Also present in lesser amounts is magnetite and biotite.

The Granite gneiss is orange-pink to light gray, medium grained, gneissic biotite granite. The main constituents are quartz and microcline in equal amounts, oligoclase, and 2 to 7 percent biotite and iron oxides. Some areas contain muscovite and garnet and lenses of quartz and feldspar also occur.

Most of the Pre-Silurian rocks occurring in the area of the Subase are of the Mamecoke Formation. This is an indistinctly layered, light to dark gray biotite-quartz-feldspar gneiss. Minor layers of hornblende-biotite-quartz-feldspar gneiss occur, with localized areas which are granitoid and migmatic. Thin layers of amphibolite and quartzite occur.

Also of Pre-Silurian age are rocks of the Plainfield Formation. There are seven distinct units within the Plainfield Formation; however, only one of these units occurs within the boundaries of the Subase. This unit is a dark green hornblende-biotite-quartz plagioclase gneiss. There are also various layers occurring throughout this unit. Listed in order of decreasing abundance, these layers include dark biotite-quartz-plagioclase gneiss with variable amounts of microcline; garnet-biotite-quartz-feldspar schist and gneiss; amphibolite; light gray, sugary-textured biotite-feldspar quartz gneiss; thin, gray quartzite; and white quartzite.

5.3.3.2 Surficial Geology - Overlying the bedrock are surficial glacial deposits of Pleistecene age. These glacial deposits can be divided into two types: nonstratified drift or till, and stratified drift or outwash. The nonstratified till was laid down directly by the glaciers, and the

stratified drift was deposited by meltwater streams that sorted the material.

The till overlying the bedrock consists of a heteorgeneous mixture of rock fragments ranging from clay size particles to boulders many feet in diameter. This material is mostly unstratified, but local pockets or lenses of sand and gravel occur. The till is further classified as to ground moraine or end moraine deposits. In the vicinity of the Subase, only ground moraine deposits occur.

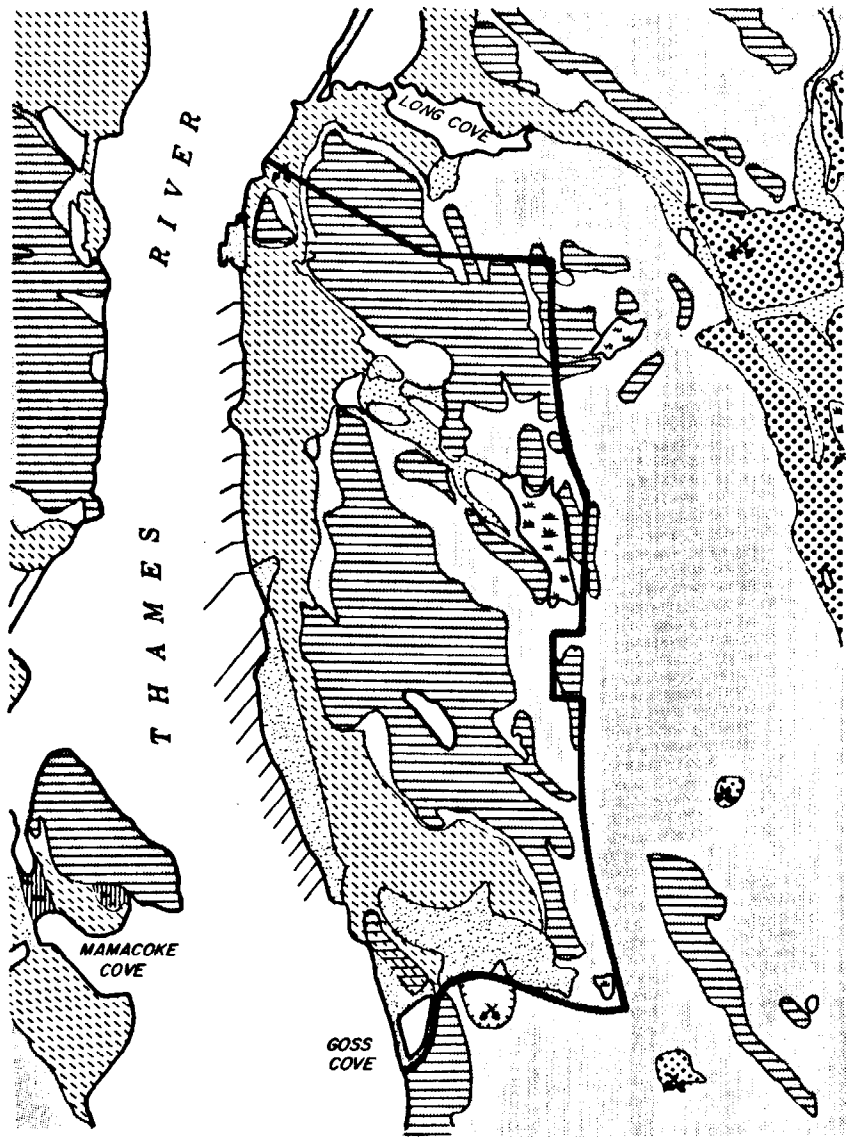
Ground moraine is exposed on most of the upland areas and probably underlies outwash material in the valleys. The moraine varies considerably in thickness but averages less than about 10 feet in the area of the Subase. The moraine is thickest on the north slopes of hills and thin to absent on the summits and south sides. The ground moraine consists of compact till that varies in composition from a nonfissile sandy, gravelly, bouldery till in which sand and gravel sizes are abundant, to a fissile bouldery till in which clay and silt sized particles are abundant. The type of till in an area depends upon the bedrock source. Areas of granite and mafic-poor quartz-feldspar gneiss generally produce a sandy, gravelly till, whereas areas of micaceous or hornblende schist and gneiss produce a clayey till. Much of the Subase is covered by ground moraine till.

Stratified drift deposits also occur throughout the area. These glacial deposits are primarily silt, sand and gravel that were sorted by glacial meltwater streams. These stratified drift deposits occur along streams and their terraces. These stratified deposits are a regionally important source of sand and gravel, as evidenced by the numerous gravel pits in the area.

The stratified deposits which occur at the Subase are on a terrace of the Thames River. As the glaciers melted, the Thames River rose to levels much higher than they are presently. The glacial material carried in these meltwaters was sorted and deposited by the river. As the glacier retreated, the Thames River adjusted downward to its present position, leaving flat terraces of stratified drift in the areas it once occupied.

Some surficial deposits in the vicinity of the Subase are more recent than Pleistocene age. These include swamp deposits, alluvial and alluvial-colluvial fan deposits, and artificial fill. The swamp deposits are composed of partly decomposed organic material which is mixed or interbedded with silt and sand. The alluvial and alluvial-colluvial fan deposits are silty sand and gravel. There are also areas with artificial fill. This artificial fill consists of till, sand, gravel, ash, crushed rock, rubble, and dredge material from the Thames River. Figure 5.3-4 shows the surficial geology of the Subase.

The geologic information for the Subase was obtained from two sources: The Bedrock Geology of the Uncasville Quadrangle (Goldsmith, 1967) and The Surface Geology of the Uncasville Quadrangle (Goldsmith, 1960).



Marsh Deposits

Qm - Partly decomposed organic material, primarily salt marsh grass, mixed with sand, silt and clay.

Swamp Deposits

Qs - Partly decomposed organic material mixed or interbedded with silt and sand.

Alluvium and Alluvial-Colluvial Fan Deposits

Qal/Qalf - Silt, sand and gravel in flood plains, Qal; and fans, Qalf. Some fans are of poorly sorted material deposited all or in part by solifluction process.

Silt, Sand and Gravel, Undifferentiated

Qsu - Deposited in temporary drainage courses or on the floors of ice-blocked basins.

Valley Train Deposits

Qvg - In some areas the valley train deposits, Qvg, are differentiated into older, Qvgo, and younger, Qvgy.

Ground Moraine Deposits

Qgm - Till varying from light-gray sandy-gravelly till to a compact, gray, fissile till containing more silt- and clay-size particles. Forms smooth-surfaced deposit of variable thickness over bedrock.

Bedrock Exposures

Bedrock outcrops and areas of abundant outcrops with thin surficial deposits.

Artificial Fill

af, afs - Fill composed of varied materials, af; fill composed of sand or sand containing mollusk shells, afs.

Pit

Mostly in sand and gravel, a few are in till; larger pits are hachured to show approximate boundaries.

Terrace Deposits

Qvt - Thames River terrace deposits.

0 1/2 1 mile

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FIGURE 5.3-4

SURFICIAL GEOLOGY

Source: Surficial Geology of the Uncasville Quadrangle, USGS

5.3.4 Soils

The soils in the area of the Subase formed in glacial deposits of till and outwash. The glacial till consists of unsorted boulders, gravel, sand, silt, and clay, whereas the glacial outwash is stratified deposits of gravel, sand, silt and clay. These glacial deposits were derived from the drystalline rocks, including a variety of igneous and metamorphic types which underlie the area.

Figure 5.3-5 represents a detailed soils map of the Subase area. A description of each of the soils occurring at the Subase, provided by the Soil Conservation Service, follows.

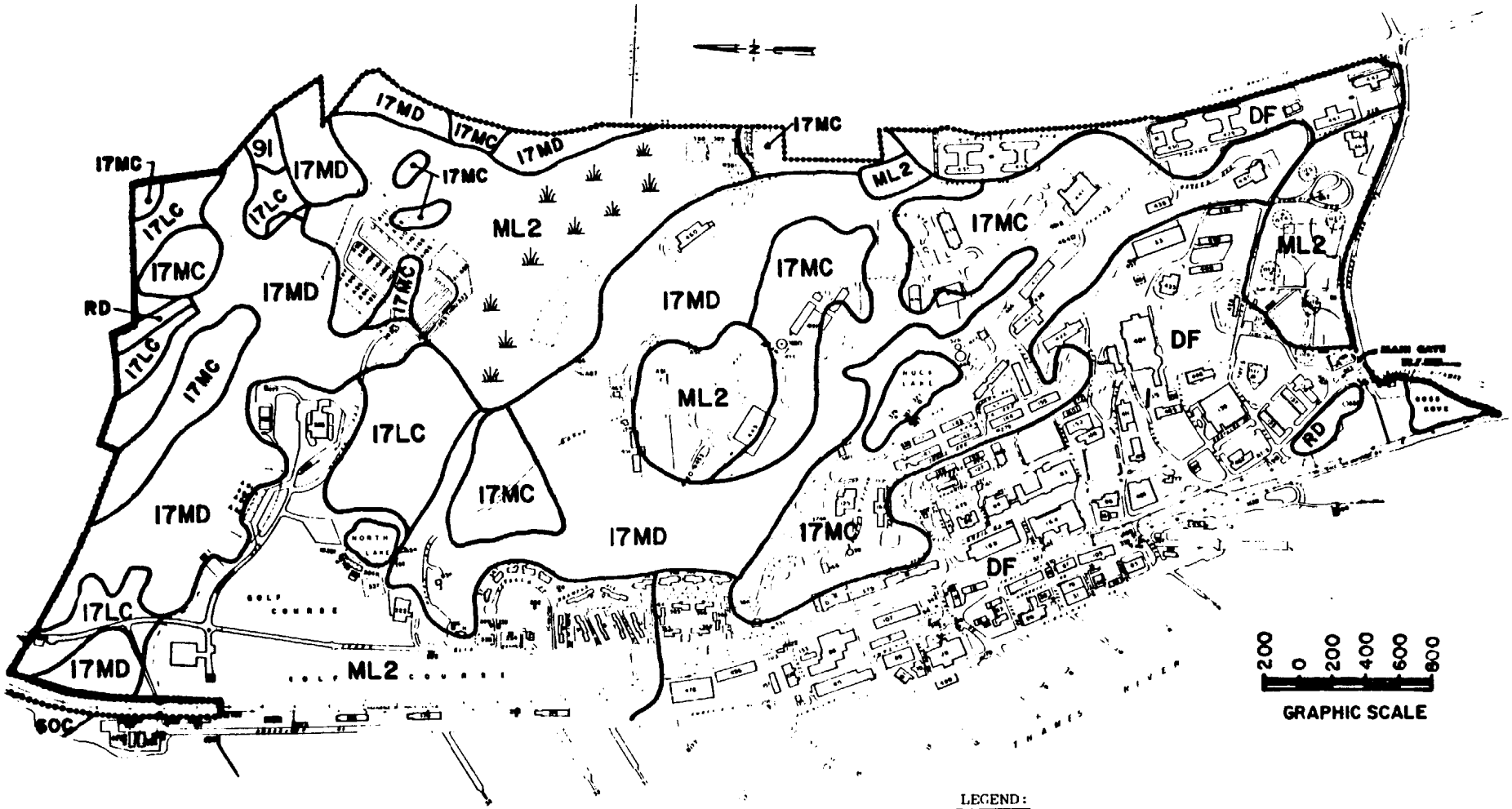
5.3.4.1 Charlton-Hollis Complex - The Charlton-Hollis complex is found on slopes of 3 to 15 percent and consists of somewhat excessively drained and well drained soils on glacial till uplands. Rock outcrops cover up to 10 percent of the surface, while stones and boulders cover 1 to 8 percent of the surface. The soils of this complex are so intermingled that it is not possible to separate them. This complex is about 55 percent Charlton soil, 20 percent Hollis soil, and 25 percent other soils and rock outcrops.

The Charlton soil has a very dark grayish-brown, fine sandy loam surface layer 3 inches thick. The subsoil is dark yellowish-brown, yellowish-brown, and light olive brown fine sandy loam 26 inches thick. The substratum is grayish brown fine sandy loam to a depth of 60 inches or more. Permeability of the Charlton soil is moderate or moderately rapid. The available water capacity is moderate, while runoff is medium or rapid. The Charlton warms up and dries out rapidly in the spring. It is strongly acid or medium acid.

The Hollis soil has a very dark brown, fine sandy loam surface layer 2 inches thick. The subsoil is dark brown and dark yellowish brown fine sandy loam 15 inches thick. Hard, unweathered bedrock is at a depth of 17 inches. Permeability of the Hollis soil is moderate or moderately rapid. The available water capacity is low, with runoff being medium or rapid. The Hollis soil warms up and dries out rapidly in the spring. It is strongly acid or medium acid.

5.3.4.2 Hollis-Charlton-Rock Outcrop Complex - The Hollis-Charlton-Rock Outcrop Complex is found on slopes of 3 to 45 percent and consists of somewhat excessively drained and well drained soils and rock outcrop on glacial till uplands. Stones and boulders cover 1 to 8 percent of the surface. The soils and rocks of this complex are so intermingled that they cannot be separated. This complex is about 40 percent Hollis soil, 25 percent Charlton soil, 20 percent rock outcrop and 15 percent other soils. A discussion of the Hollis and Charlton soils is found above.

5.3.4.3 Hinkley Soil - This soil is found on stream terraces, outwash plains, kames and eskers. It is on slopes of from 3 to 15 percent and is excessively drained. The Hinkley soil has a dark brown, gravelly sand loam surface layer 7 inches thick. The subsoil is yellowish brown gravelly loamy sand 15 inches thick. The substratum is brownish yellow,



LEGEND:

Naval Submarine Base Property Boundary

Soil Delineation and Symbols (17MC 17MD)

Swamp

Symbol	Name
17LC	Charlton-Hollis fine sandy loam, very rocky, 3-15% slopes
17MC	Hollis-Charlton-Rock outcrop complex, 3-15% slopes
17MD	Hollis-Charlton-Rock outcrop complex, 15-45% slopes
60C	Hinkley gravelly sandy loam, 3-15% slopes
91	Adrian and Palms mucks
DF	Urban land
ML2	Udorthents-Urban land complex
RD	Rock outcrop - Hollis complex

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FIGURE 5.3-5

DETAILED SOILS MAP

Source: Soil Conservation Service (unpublished)

very gravelly, coarse sand to a depth of 60 inches or more.

Permeability of the Hinkley soil is rapid in the surface layer and subsoil and very rapid in the substratum. The hazard of erosion is moderate or severe. The available water capacity is low and runoff is medium or rapid. Hinkley soil warms up and dries out rapidly in the spring. It is strongly acid or medium acid.

5.3.4.4 Adrian and Palms Muck - These nearly level, very poorly drained soils are in pockets and depressions of stream terraces, outwash plains, and glacial till uplands. This complex is about 55 percent Adrian soils, 30 percent Palms soils, and 15 percent other soils.

The Adrian soils have black and very dark grayish brown layers of muck 42 inches thick. The substratum is gray, light yellowish brown, and strong brown gravelly sand to a depth of 60 inches or more. Adrian soils have a high water table which is at or near the surface for most of the year. Permeability is moderately rapid in the organic layers and rapid in the substratum. The available water capacity is high, and runoff is very slow or ponded. These soils are strongly acid through slightly acid.

The Palms soils have black and very dark brown layers of muck 22 inches thick. The substratum is dark yellowish brown and olive, very fine, sandy loam and loamy, very fine sand to a depth of 60 inches or more. The water table is at or near the surface for most of the year. Permeability is moderately rpaid in the organic layers and moderately slow in the substratum. The available water capacity is high, and runoff is very slow or ponded. Palms soils are strongly acid through slightly acid.

5.3.4.5 Rock Outcrop-Hollis Complex - This gently sloping to very steep complex consists of rock outcrops and excessively drained soil on glacial till uplands. Stones and boulders cover 1 to 8 percent of the surface. This complex is about 50 percent rock outcrop, 30 percent Hollis soil, and 20 percent other soils. The rock outcrop is hard, unweathered, exposed bedrock of mainly gneiss and schist.

The Hollis soil has a very dark brown, fine, sandy loam surface layer 2 inches thick. The subsoil is dark brown and dark yellowish brown, fine, sandy loam 15 inches thick. Hard, unweathered bedrock is at a depth of 17 inches. Permeability is moderately rapid above the bedrock. The available water capacity is low, and runoff is medium to very rapid. These soils are strongly or medium acid.

5.3.4.6 Udorthents-Urban Land Complex - This complex consists of excessively drained to moderately well drained soils that have been disturbed by cutting or filling and areas that are covered by buildings or pavement. Slopes range from 0 to 15 percent. About 60 percent of this complex is Udorthents, 25 percent is urban land, and 15 percent is other soils. Some areas of Udorthents have been cut to a depth of 2 feet or more, and some have been covered with more than 2 feet of fill. Permeability of the Udorthents is slow to very rapid. The available water capacity and runoff are variable.

5.3.4.7 Urban Land - Land where more than 85 percent of the surface is covered by streets, parking lots, buildings and other structures. Most of the original soils have been altered by excavating or have been covered with fill material.

5.3.5 Hydrology

5.3.5.1 Surface Water - The Subase lies within the Thames River Drainage Basin which drains some 1,473 square miles of eastern Connecticut, south central Massachusetts, and western Rhode Island. The Subase is located along the eastern bank of the Thames River just north of Groton, Connecticut. The Thames originates in Norwich and is formed by the confluence of the Shetucket and Quinebaug Rivers. Another major tributary to the Thames is the Yantic River which enters the Thames at Norwich. Discharge from the Thames is into Long Island Sound which is about six miles downstream of the Subase.

All surface drainage from the Subase is westward into the Thames River. Surface drainage for the northern portions of the Subase are shown in Figure 5.3-6. Drainage from areas in the southern and lower portions of the Subase is either directly into the Thames River or into storm drainage sewers which discharge into the river.

5.3.5.1.1 Thames River Estuary: The Thames River is a tidal estuary extending from the mouth of the river northward some 16 miles to Norwich. The drainage area of the Thames covers 1,473 square miles of eastern Connecticut, south central Massachusetts, and western Rhode Island. The volume of fresh water entering the estuary is very small compared to the volume of sea water within the estuary. Widths of the river vary from 1.5 miles at New London harbor to about 400 to 500 feet wide at Norwich. The average discharge into Long Island Sound is about 2,470 cubic feet per second (EIS, 1973).

The Thames River estuary seems to exhibit a two-layered flow, with a net inward bottom current and a net outward surface current. The rivers flowing into the Thames provide a continual input of water which determines the downstream flow rate. This downstream flow rate is important in the exchange of water out of the river and into Long Island Sound. The average non-tidal downstream flow rate for the Thames from the Subase seaward is about 0.43 feet per second (EIS, 1973).

Tides are semi-diurnal in the Thames River with a mean range of 2.6 feet at New London and 3.1 feet at Norwich. The average tidal current is about 0.31 meters per second in the area of the Subase (EIS, 1973).

A wide range of salinity values occur in the Thames from the mouth of the river up to Norwich. Moving up the river, salinity values become lower as freshwater is more prevalent. At any given location, salinity values also vary between surface waters and bottom waters, with more freshwater in the surface layers and more salt water in the lower layers. This stratification indicates the presence of a saltwedge. During periods of low freshwater inflow, the upper limit of the Thames saltwedge extends

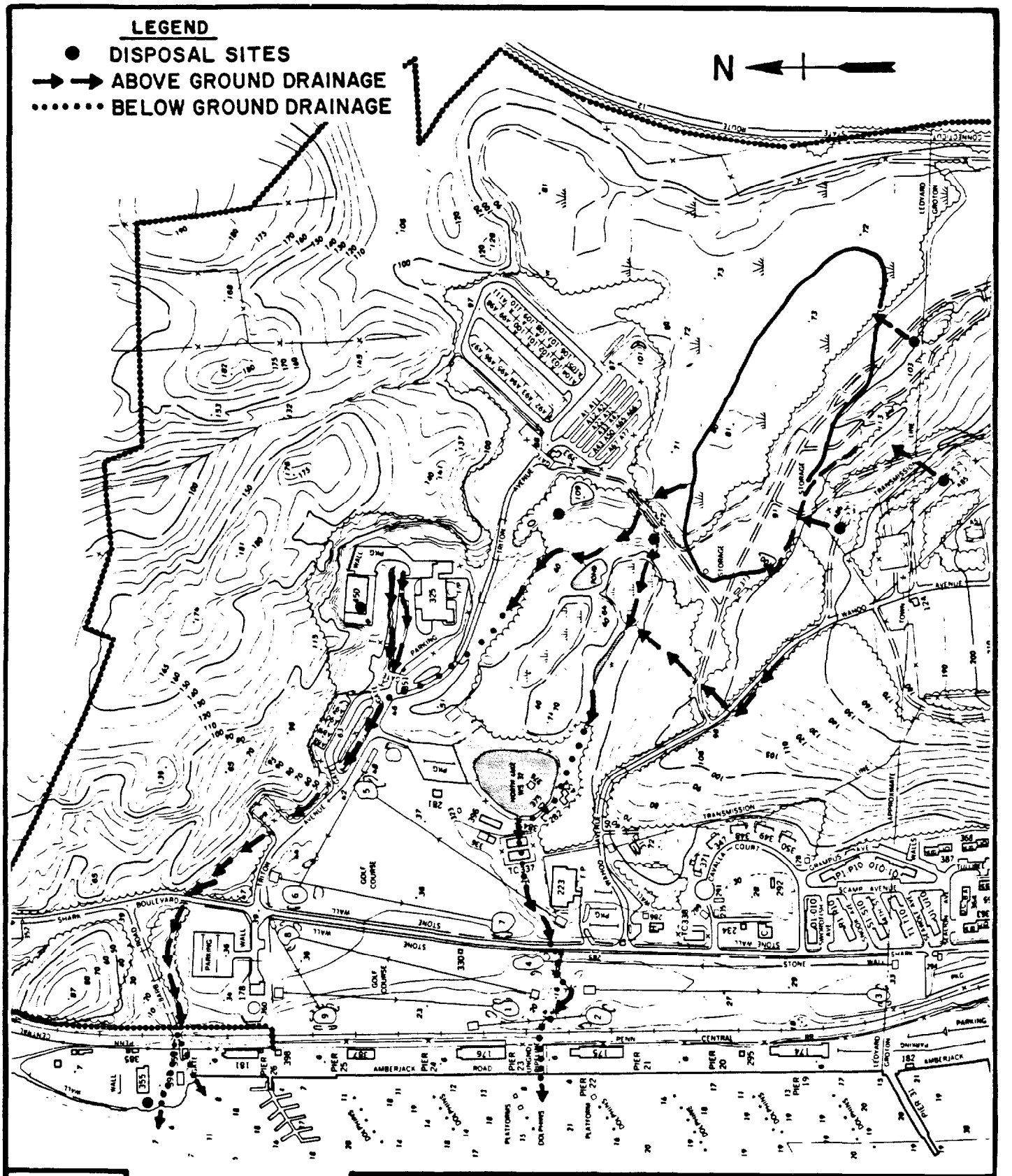

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FIGURE 5.3-6

SURFACE DRAINAGE
NORTHERN PORTION OF SUB-BASE

some two miles up along the bottom of the Yantic River. When high freshwater inflow volumes occur, the effects of stream discharge become significant, and at low tide, the head of the saltwedge is pushed several kilometers downstream of Norwich.

The State of Connecticut's Department of Environmental Protection has classified the Thames River as being suitable for fish, shellfish, and wildlife habitat; good aesthetic value; suitable for industrial cooling; and suitable for recreational boating and in some places bathing. Shellfish harvesting for direct human consumption is not permitted in the river.

5.3.5.2 Groundwater - Groundwater is readily available in the southeastern portion of Connecticut where the Subase is located. While the Subase and most of the areas within the township of Groton receive their potable water from surface water supplies, areas north and northeast of the Subase, in the township of Ledyard (Figure 5.1-2), are dependent upon groundwater for their potable water. Groundwater in the area can be obtained from three sources: the stratified glacial outwash deposits, glacial till, and the bedrock. Each of these aquifers will be described below.

5.3.5.2.1 Outwash Deposits: The outwash deposits consist of gravel, sand, silt and clay which have been sorted by glacial meltwater streams. These outwash deposits can be divided on a hydrologic basis into two water bearing units. There is a coarse grained unit which is capable of yielding large quantities of water (up to several hundred gallons per minute) and a fine grained unit which generally yields less than 20 gallons per minute. The coarse grained unit consists predominantly of medium sand or coarser material, whereas the fine grained unit consists predominantly of fine sand, silt, and clay.

These outwash deposits are the most productive groundwater sources in the area. In most areas, the glacial outwash material is underlain by till, but in some instances, it is underlain by bedrock. In isolated areas, till may be underlain by outwash deposits. Glacial outwash areas are common in valley and lowland areas, but they are scarce or absent on hillsides and upland areas.

Wells completed in the coarse grained glacial outwash material have yields which average 85 gallons per minute, with yields in excess of 880 gallons per minute reported. Permeability ranges from 250 to 4,000 gallons per day per square foot, with averages of 1,500 gallons per day per square foot. Thicknesses range from 1 to 120 feet throughout the area.

The lower portions of the Subase, which are on a terrace of the Thames River, have fine grained glacial outwash deposits. Yields of wells in this material average about 11 gallons per minute, with maximum recorded yields of around 20 gallons per minute. The permeability of these fine grained outwash deposits is about 300 gallons per day per square foot.

In the coarse grained glacial outwash, drilled wells which are properly screened provide the best yields. However, dug wells are the most practical in the fine grained outwash material such as that which occurs in the lower portions of the Subase. These wells are shallower than drilled wells, but the large diameter of dug wells enables them to serve as storage tanks. A four-foot diameter dug well holds about 94 gallons per foot of depth. These dug wells can supply sufficient quantities for domestic uses if periods of pumping do not exceed the quantity of water in storage.

5.3.5.2.2 Till: The till is a poorly sorted, non-stratified, unconsolidated deposit of boulders, cobbles, gravel, sand, silt and clay laid down directly by the glaciers. Till covers the bedrock almost everywhere in the area, and it occurs just below the soil on most hillsides, hilltops, and upland areas except where the bedrock is exposed.

Permeability measurements of the till range from 0.2 gallons per day per square foot for compact silty till to about 120 gallons per day per square foot for loose sandy till. Wells completed in till rarely yield more than a few hundred gallons per day, even to wells of large diameter. During periods of drought, wells completed in till are likely to be inadequate even for small domestic use. Till ranges in thickness from less than a foot near bedrock outcrops to some 110 feet but is usually less than 40 feet.

5.3.5.2.3 Bedrock: The bedrock underlying the area is a hard, dense, crystalline rock, including a variety of igneous and metamorphic types. The bedrock is fractured to a depth of several hundred feet, and it is along these cracks that most groundwater moves. Vertical joints, which are common in the area, may be connected by horizontal tension joints which are roughly parallel to the configuration of the bedrock surface. These horizontal joints are more common in granite and related igneous rocks. The abundance, width, and continuity of the joints vary widely from place to place. The joints become narrower and scarcer with depth so that the probability of encountering significant quantities of water at depths greater than 200 to 300 feet from the top of the bedrock is slight.

Even with fracturing, the permeability of the bedrock is very low, with an average of about 2 gallons per day per square foot. Despite its low permeability, bedrock wells yield small but dependable supplies of water. Bedrock wells yield, on the average, 14 gallons per minute. The yield from bedrock wells varies depending upon the thickness of the saturated bedrock penetrated, the surface topography, the size and distribution of water-bearing fractures, and the type of overburden. Drilling to greater depths than around 300 feet seldom increases the yields but does increase the well's storage capacity. Table 5.3-2 summarizes factors affecting the yield of bedrock wells.

Groundwater throughout the Subase is relatively shallow, generally being less than 10 feet below the surface. In the lower portions of the Subase, which are on the Thames River terrrace, groundwater is often less

TABLE 5.3-2

SUMMARY OF FACTORS AFFECTING THE YIELD OF BEDROCK WELLS

Geologic Setting	Above-Average Yields	Average Yields	Below-Average Yields
Topographic situation	Valley or lowland	Hillside	Hilltop or upland
Type of overburden	Stratified drift (sand and gravel)	Stratified drift or till	Till
Thickness of overburden	50 to 75 feet	0 to 50 feet	75 to 150 feet
Rock type	Gabbro, diorite and monzonite gneiss, schist and gneiss	Granite and gneiss, quartz, schist	Quartzite

than 5 feet below the surface. The groundwater is deepest on the hills which occur in the upper portions of the Subase.

The chemical quality of the groundwater is generally good for most uses. The crystalline bedrock and glacial material are composed of minerals which are only slightly soluble in water, and the dissolved solids are correspondingly low. Most groundwater has a dissolved solids concentration of less than 200 parts per million and a hardness of less than 120 parts per million, making the groundwater soft or moderately hard. Iron and manganese cause taste and odor and discoloration problems throughout this area of southeastern Connecticut.

Salt water intrusion can be a problem in wells completed close to the Thames river and where overpumping has occurred. Each of the three types of aquifers is vulnerable to salt water intrusion, but wells in the stratified drift most commonly have this problem (see Section 5.3.5.2.1). The high permeability of the stratified drift results in a relatively shallow but wide cone of depression, and during prolonged pumping, this cone may intersect with estuary waters. Dug wells close to the estuary also may be subjected to salt water contamination resulting from flooding during hurricanes.

The groundwater at the Subase is not presently being utilized. There is only one well located within the boundaries of the base (Figure 5.3-7). This well is not presently being used but may be utilized in the future to water the golf course during times of draught. Ledyard township, which encompasses those areas north of the Subase (Figure 5.1-2) does depend on groundwater for its potable water.

Much of the above information concerning the groundwater and surface water was obtained from the Water Resources Inventory of Connecticut, Part 3, Lower Thames and Southeastern Coastal River Basins (Thomas, et al., 1968).

5.3.6 Migration Potential

5.3.6.1 Surface Water - Drainage from many areas in the lower portions of the Subase is either directly into the Thames River or into storm drainage sewers which then discharge into the Thames River. The streams which drain the Subase also discharge directly into the Thames River. Therefore, the pollutants from those areas of the base which drain into these streams could migrate into the Thames River. The Thames River then discharges into Long Island Sound which is six miles downstream from the Subase.

5.3.6.2 Groundwater - Groundwater throughout the Subase is very shallow, generally being less than 10 feet below the surface. This shallow depth makes groundwater pollution very possible at the Subase. In fact, oil contamination of the groundwater in the lower portion of the Subase has already been documented in a study done by NESO in 1979. Pollutants which do get into the groundwater would generally tend to migrate to the west

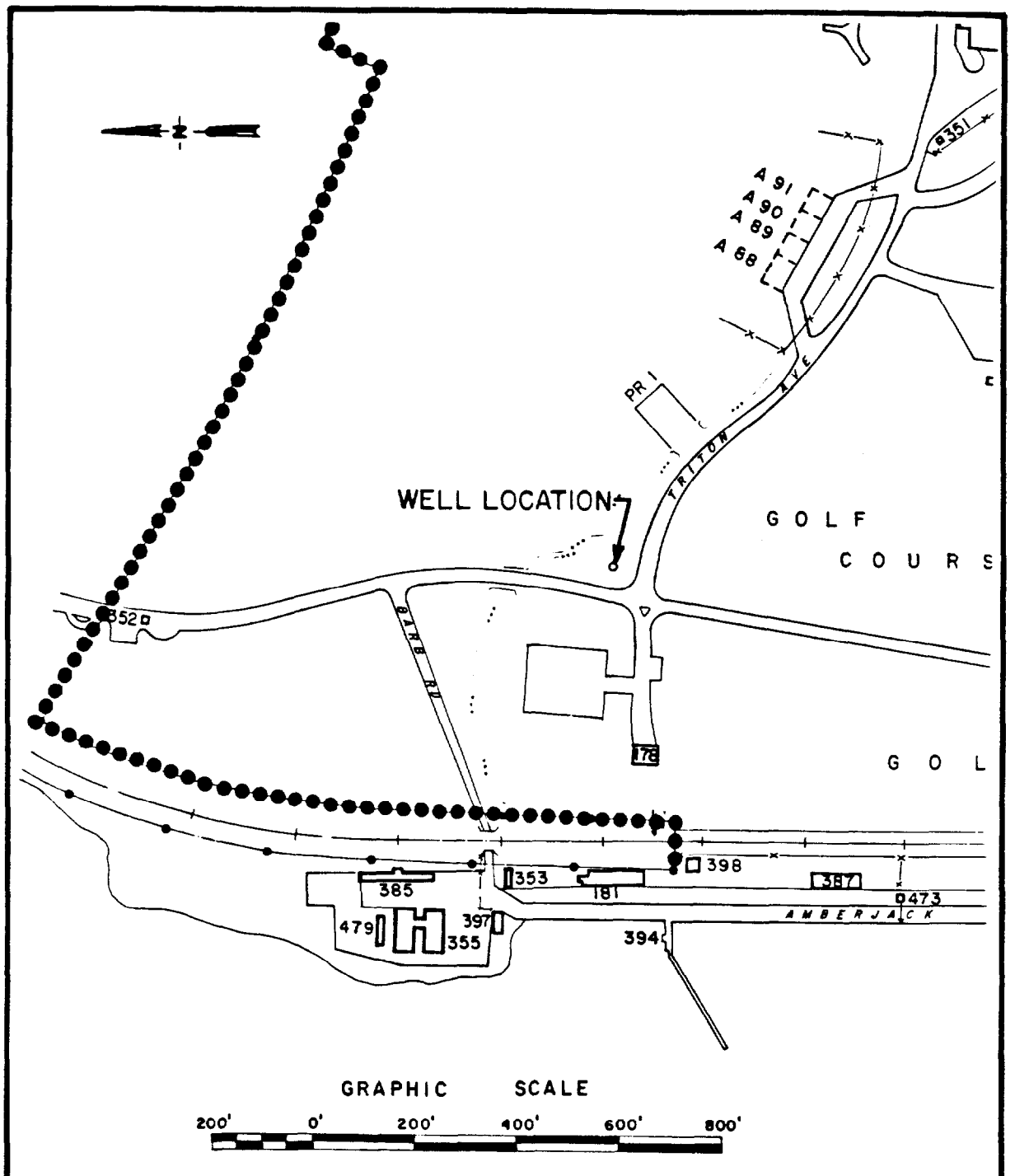

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FIGURE 5.3-7

SUBASE WELL LOCATION MAP

and discharge into the Thames River. The marsh in Area A and the drainage from it appear to act as a localized groundwater discharge area. With the western portion of the Subase bordering the Thames River, the groundwater does not have to migrate far to be off-site. The farthest any groundwater would have to migrate to get off-site is less than one mile.

The soils at the Subase, and the glacial till and outwash from which they were derived, do not, for the most part, restrict the vertical movement of water downward into the groundwater. Therefore, it is possible that contaminants transported in this water could contaminate the groundwater. The glacial till is compacted in some areas, and this would reduce the vertical movement of water thereby lessening the contamination potential. There are also many areas throughout the Subase where the bedrock is exposed at the surface. It is possible for contaminated water to reach the groundwater through the cracks and fissures which commonly occur in the bedrock.

5.3.6.3 On-Base Migration - The possibility of on-base contaminant migration from off-base sources is extremely unlikely at the Subase. The northeastern portion of the base does receive surface drainage from areas off-base, but these are mostly undeveloped and low density residential areas and present no contamination threat. Likewise, the groundwater migrating on-site is from undeveloped and low density residential areas which represent no contamination threat.

5.4 BIOLOGICAL FEATURES

5.4.1 Background

The New London/Groton area lies in the Central Hardwoods zone that covers a great portion of the northeastern United States. Due to settlement, agriculture, lumbering and coal production, the virgin forests have been replaced by second or third growth stands. Many of the wetlands have been filled and are presently in commercial and residential use.

The Thames River has been altered to accomodate large marine vessels through dredging and bank stabilization. However, the original course of the river is the same, and many indigenous species of flora and fauna remain the same as those present prior to manipulation.

The New London Subase encompasses 1,412 acres of land, of which 547 acres are used as operational and support facilities with the remaining acreage being used for housing and community support. Within this total acreage are areas used for drainage, disposal, buffer, recreational activities and areas set aside for potential expansion. These presently contain a variety of upland, wetland and aquatic habitats directly connected to similar habitats off-base. There are also approximately 1.7 miles of Thames River shoreline incorporated into the Subase.

Environmental concern for the river and surrounding natural habitats is strong among the local populace. The Connecticut Department of Environmental Protection (Conn. DEP) in cooperation with sportsmen's groups and citizens has developed programs to enhance and protect the aquatic and upland habitats and their wildlife components in the New London/Groton area.

5.4.2 Upland Vegetation

The southern New England climate supports a mixed deciduous-coniferous forest comprised of such common tree species as oak, hickory, chestnut, beech, birch, maple, white pine, and hemlock.

Forest cover varies from place to place, depending on soil moisture, soil fertility and temperature. The climate favors hardwoods over softwoods yet the latter can be found on poorer sites where competition from hardwood species is less intense.

Typical of most municipal areas in Connecticut, oak/beech/red maple forests dominate among the upland vegetational types. These hardwoods, or deciduous trees, comprise most of the total vegetative cover, with oak the dominant species. The softwoods, or evergreens, account for less than 10 percent of the forest types, with white pine, cedar and hemlock as the major trees in this category. Excluding ornamental plantings, the evergreens usually occur naturally in concentrated clusters or stands. Both the Pine Swamp and the Great Cedar Swamp in Ledyard are excellent examples of this condition. Though a deciduous tree, red maple usually dominates along with the evergreens in wet areas.

Although mature hardwoods and softwoods exist in the area, nearly 70 percent of the total woodland is occupied by immature trees as a result of the extensive logging and clearing for agricultural purposes that occurred in the last century and into the present one. Careful management of the State Forests, municipal and private land trust preserves can serve to protect many developing forests, as well as mature trees, from further logging activity or clearing for indiscriminate development.

Some common understory plants of wooded areas are dogwood, cherry, tupelo, sassafras and other tree saplings, catbriar and grape vine. Poison ivy is common. In open areas and old pasture land, bittersweet, barberry, goldenrod, poison ivy, green briar, catbriar, sumac, hawthorne, grasses and wildflowers flourish.

5.4.3 Wetland Vegetation

The freshwater wetlands of southeastern Connecticut include swamps, bogs and marshes. The New London Subase contains a large tract (approximately 80 acres) of wetland in the northeast section of the base, which can be characterized as a marsh. The area was artificially created by dumping dredge spoils into a lowland containing a small stream. The soft organic sediments throughout the majority of the marsh support a

monoculture of the reed Phragmites commonis which dominates all other vegetative forms. There are scattered patches of open water between the stands of reeds containing scattered duckweed (Lemna spp.) and filamentous algae. The firmer ground with no standing water quickly forms the transition to old field and upland species. Those found in the zone of transition include viburnum (Viburnum recognitum), spicebush (Lindera benzoin), and black alder (Ilex verticillata).

The State of Connecticut defines marshes as those areas where a vegetational community shall exist in standing or running water, and where that community shall include, but not be limited to, some, but not necessarily all, of the following: horsetails (Equisetaceae); bur-reeds (Sparganiaceae); cattails (Typhaceae); pondweeds (Zostereraceae); water plantains (Alismaceae); frog's bits (Hydrocharitaceae); hydrophytic grasses (Gramineae); sedges (Cyperaceae); arums (Araceae); duckweeds (Lemnaceae); rushes (Juncaceae); pickerelweed (Pontederiaceae); pipeworts (Eriocaulonaceae) ; sweet gale (Myrica gale); tear-thumbs (Polygonaceae); water lilies (Nymphaeaceae); water milfoils (Halorrhagidaceae); dogwoods (Cornus spp.); buttonbush (Cephalanthus occidentalis); and arrowwood (Viburnum spp.).

The subject marsh and its drainage on the Subase contain several of the above mentioned species; however, diversity appears to be limited.

5.4.4 Terrestrial Fauna

The land within and surrounding the Subase provides a variety of habitats for terrestrial fauna. These include hardwood forests, old fields, wetlands and residential areas.

Mammals common to the area are eastern gray squirrel (Sciurus carolinensis), raccoon (Procyon loto), white-tailed deer (Odocorleus virginianus), oppossum (Didelphis marsupialis), eastern cottontail (Sylvilogus floridanus), and the woodchuck (Marmota monax). These forms are common to the hardwood forest and old field habitats but do overlap into the other areas. A complete list of mammalian forms known or expected to be found in the area is included in Table 5.4-1 (Burt and Grossenheider).

Amphibians common to the area include the American toad (Bufo americanus), bullfrog (Rana catesbiana), leopard frog (Rona pipiens), dusky salamander (Desmognathus fuscus), and the red-backed salamander (Plethodon cinerius).

The common reptiles to be found in the Subase area are the water snake (Natrix sipedon), garter snake (Thamnophis sirtalis), hognose snake (Heterodon platychinos), painted turtle (Chrysemys picta), and spotted turtle (Clemmys guttata). A list of reptiles and amphibians known or expected to be found in the Subase area is included in Table 5.4-2 (Conant, 1974).

TABLE 5.4-1

MAMMALS KNOWN OR EXPECTED TO INHABIT THE AREA*

Common Name and Scientific Name

Opossum, *Didelphis marsupialis*
Masked shrew, *Sorex cinereus*
Shorttail shrew, *Blarina brevicauda*
Eastern mole, *Scalopus aquaticus*
Hairytale mole, *Parascalops breweri*
Little brown myotis, *Myotis lucifugus*
Keen myotis, *Myotis keeni*
Eastern pipistreal, *Pipistrellus subflavus*
Silver-haired bat, *Lasionyctris noctivagans*
Big brown bat, *Eptesicus fucus*
Red bat, *Lasiurus borealis*
Hoary bat, *Lasiurus cinereus*
Raccoon, *Procyon loto*
Shorttail weasel, *Mustela erminea*
Longtail weasel, *Mustela frenata*
Striped skunk, *Mephitis mephitis*
Red fox, *Vulpes fulva*
Gray fox, *Urocyon cinereoargenteus*
Woodchuck, *Marmota monax*
Eastern chipmunk, *Tamias striatus*
Eastern fox squirrel, *Sciurus niger*
Eastern gray squirrel, *Sciurus carolinensis*
Red squirrel, *Tamiasciurus hudsonicus*
Southern flying squirrel, *Glaucomys volans*
White-footed mouse, *Peromyscus leucopus*
Boreal redback vole, *Clethrionomys gapperi*
Meadow vole, *Microtus pennsylvanicus*
Pine vole, *Pitymys pinetorum*
Muskrat, *Ondatra sibenthica*
Meadow jumping mouse, *Zapus hudsonius*
Woodland jumping mouse, *Napaeozapus insignis*
Eastern cottontail, *Sylvilagus floridanus*
New England cottontail, *Sylvilagus transitionalis*
Whitetail deer, *Odocoileus virginianius*

*Based on Burt and Grossenheider

TABLE 5.4-2

AMPHIBIANS AND REPTILES KNOWN OR EXPECTED TO INHABIT THE AREA*

Scientific and Common Name

AMPHIBIANS

Dusky salamander, *Desmognathus fuscus*
Red-backed salamander, *Plethodon cinereus*
Spotted salamander, *Ambystoma maculatum*
Red-spotted newt, *Notophthalmus viridescens*
American toad, *Bufo americanus*
Fowler's toad, *B. woodhousei*
Spring pepper, *Hyla crucifer*
Leopard frog, *Rana pipiens*
Pickeral frog, *R. palustris*
Wood frog, *R. sylvatica*
Green frog, *R. clamitans*
Bullfrog, *R. catesbeiana*

REPTILES

Five-linked skink, *Cumeces fasciatus*
Snapping turtle, *Chelydra serpentina*
Stinkpot, *Sternotherus odoratus*
Mud turtle, *Kinosternon subrubrum*
Spotted turtle, *Clemmys guttata*
Wood turtle, *C. insculpta*
Box turtle, *Terrapene carolina*
Painted turtle, *Chrysemys picta*
Water snake, *Natrix sipedon*
DeKay's snake, *Storeria deKayi*
Red bellied snake, *S. occipitomaculata*
Garter snake, *Thamnophis sirtalis*
Ribbon snake, *I. sauritus*
Hognose snake, *Heterodon platyrhinos*
Ringneck snake, *Diadophis punctatus*
Worm snake, *Carphophis amoenus*
Black racer, *Coluber constrictor*
Smooth green snake, *Opheodrys vernalis*
Black rate snake, *Elaphe obsoleta*
Milk snake, *Lampropeltis triangulum*
Copperhead, *Agkistrodon contortrix*

*Based on Babbit (1937), Petersen (1970) and Conant (1974)

The avian fauna of the Subase consists of a variety of species which may be permanently residential, migratory or seasonal. Winter birds often found around feeders include the tufted titmouse (Parus bicolor), nuthatch (Sitta canadensis), and cardinal (Cardinalis cardinalis). Summer birds of residential areas are blue jay (Cyanocitta cristata), robin (Turdus migratorias), chickadee (Parus atricapillus), and house sparrow (Passer domesticus). Summer birds common to more natural and open areas are mourning dove (Zenaida macroura), common crow (Corvus brachyrhynchos), eastern kingbird (Tyrannus tyrannus), and the sparrow hawk (Falco sparvarius). Over 20 species of birds can be found breeding in the upland forests and fields. The most commonly found breeding species are the bobwhite quail (Colinus virginianus), yellow shafted flicker (Colaptes auratus), towhee (Pepelo erythropthalmus), brown thrasher (Toxostoma rufum), and great horned owl (Bubo virginianus). The species known or expected to be found in the vicinity of the Subase are included in Table 5.4-3 (Dowhan and Craig, 1976). The list includes species, seasonal status, nesting potential, and status as state or federal threatened or endangered.

5.4.5 Aquatic Ecosystems

The freshwater aquatic ecosystems naturally occurring within the Subase are restricted to shallow waters of wetland pools and the ephemeral streams draining the wetlands. The water sources for these emanate from drainage of operations areas and natural areas in the north portion of the base. The ephemeral nature of the streams and the shallowness of the wetland surface waters restrict the diversity of aquatic fauna within the systems. The chemical constituents of the organic substrates in the wetlands, especially in Area A, appear to restrict the diversity of aquatic flora. There are two artificial lakes maintained on the Subase, North Lake and Rock Lake, both of which are for recreational and aesthetic purposes. The watersheds for both impoundments receive no drainage from contaminated areas.

The marine ecosystem which forms the entire 1.7 mile western border of the Subase is the Thames River.

5.4.5.1 Marine Algae - There were thirteen species of algae collected from the Thames River during the 1973 studies (FEIS Subase New London, Connecticut, 1973). These included 7 Rhodophyta, 2 Phaeophyta and 4 Chlorophyta. The Rhodophyta included: Chondrus crispus, Dosya pedicellata, Grinnellia americana, Agardhiella tenera, Chondria tenuissima, Rhodymenis palmata, and Gracilaria foliifera. Phaeophyta were: Laminaria sp. and Fucus vesiculosus var. sphaerocarpus. Chlorophyta consisted of: Codium fragile ssp. tomentosoides, Ulva lactuca, Protoderma marinum and Ulthrix flacca. The majority of the species were collected by dragging and Eckman sampler in the sublittoral zone, while one Scuba dive was made for collecting purposes. The eulittoral zone is narrow with little substrate for the attachment of algae. Only two species were collected in the eulittoral zone.

TABLE 5.4-3

BIRDS EXPECTED TO UTILIZE THE AREA

Birds	Seasonal Status(1)	Nest Potential	Rare/ Endangered (3)
Green heron	P.M. (summer only)	Yes	--
Mallard	P.M.	Yes	--
Wood duck	P.M.	Yes	--
Sharp-skinned hawk	hunt bird (2)	--	Declining
Cooper's hawk	hunt bird (2)	--	State endangered
Red-tailed hawk	P.M.	Yes	--
Red-shouldered hawk	P.M.	Yes	--
Broad-winged hawk	M.	Yes	--
Rough-legged hawk	winter only	--	--
Marsh hawk	migrant only	--	--
Merlin	migrant only	--	Declining
American kestrel	P.M.	Yes	--
Bobwhite	R.	Yes	--
Ring-neck pheasant	R.	Yes	--
American woodcock	P.M.	Yes	--
Common snipe	P.M.	--	--
Mourning dove	P.M.	Yes	--
Yellow-billed cuckoo	M.	Yes	--
Black-billed cuckoo	M.	Yes	--
Barn owl	winter only	--	--
Long-eared owl	winter only	--	Indeterminate
Short-eared owl	winter only	--	Indeterminate
Saw-whet owl	winter only	--	--
Whip-poor-will	M.	Yes	--
Common nighthawk	M.	--	--
Ruby-throated hummingbird	M.	Yes	--
Belted kingfisher	P.M.	Yes	--
Common flicker	P.M.	Yes	--
Red-headed woodpecker	migrant only	--	Rare
Yellow-bellied sapsucker	migrant only	--	Rare
Hairy woodpecker	R.	Yes	--
Downy woodpecker	R.	Yes	--
Eastern kingbird	M.	Yes	--
Crested flycatcher	M.	Yes	--
Eastern phoebe	M.	Yes	--
Least flycatcher	M.	Yes	--
Eastern pewee	M.	Yes	--
Tree swallow	M.	Yes	--
Bank swallow	M.	Yes	--
Rough-winged swallow	P.M.	Yes	--
Blue jay	P.M.	Yes	--
Common crow	P.M.	Yes	--
Fish crow	P.M.	--	--
Black-capped chickadee	P.M.	Yes	--
White-breasted nuthatch	migrant only	--	--
Brown creeper	migrant only	--	--
House wren	M.	Yes	--
Mockingbird	R.	Yes	--
Catbird	M.	Yes	--
Brown thrasher	P.M.	Yes	--
Robin	P.M.	Yes	--
Wood thrush	M.	Yes	--
Hermit thrush	migrant only	--	--
Verry	M.	Yes	--
Eastern bluebird	P.M.	-	Declining
Cedar waxwing	P.M.	Yes	--
Loggerhead shrike	migrant only	--	--
Starling	P.M.	Yes	--
White-eyed vireo	P.M.	Yes	--
Yellow-throated vireo	migrant only	--	--
Red-eyed vireo	M.	Yes	--
Warbling vireo	M.	Yes	--
Black and white warbler	M.	Yes	--
Worm-eating warbler	M.	Yes	--
Golden-winged warbler	migrant only	--	--
Blue-winged warbler	M.	Yes	--
Nashville warbler	migrant only	--	--
Parula warbler	migrant only	--	Rare
Yellow warbler	P.M.	Yes	--
Black-throated blue warbler	migrant only	--	--
Black-throated green warbler	M.	Yes	--
Chestnut-sided warbler	M.	Yes	--

TABLE 5.4-3

BIRDS EXPECTED TO UTILIZE THE AREA
(Continued)

Birds	Seasonal Status (1)	Nest Potential	Rare Endangered (3)
Bay-breasted warbler	migrant only	Yes	--
Prairie warbler	P.M.	Yes	--
Ovenbird	M.	Yes	--
Yellow throat	P.M.	Yes	--
Yellow-breasted chat	P.M.	yes	--
Hoodde warbler	migrant only	--	--
Canada warbler	migrant only	--	--
English sparrow	R.	Yes	--
Eastern meadowlark	P.M.	Yes	--
Red-winged blackbird	P.M.	Yes	--
Orchard oriole	migrant only	--	--
Northern Oriole	M.	Yes	--
Common grackle	P.M.	Yes	--
Brown-headed cowbird	P.M.	--	--
Scarlet tanager	M.	Yes	--
Cardinal	R.	Yes	--
Rose-breasted grosbeak	M.	Yes	--
Common goldfinch	P.M.	Yes	--
Eastern towhee	P.M.	Yes	--
Savannah sparrow	migrant only	--	--
Tree sparrow	winter only	--	--
Chipping sparrow	P.M.	Yes	--
Field sparrow	P.M.	Yes	--
White-throated sparrow	migrant only	--	--
Song sparrow	P.M.	Yes	--
Swamp sparrow	P.M.	Yes	--

(1) R-Residents, M-Migrants, P.M.-Partially Migratory
(2) Hunt bird in migration
(3) Dowhan and Craig (1976)

The forms collected were sporadic in distribution, being present in few locations. The greatest number of species were collected near the mouth of the river where a total of seven different species were found. Fucus sp. and Ulothrix lacea were collected at a few locations in the eulittoral zone in addition to the pier pilings at the Naval Base marina. At no station was the density of algae very great.

The lack of species diversity and density of algae in the Thames River is probably due to the extreme lack of suitable substrate. When collected, it was found growing on large Venus mercenarca shells and submerged objects such as lobster traps and other debris. Few rocks were present. Small rocks and larger outcroppings were present along one area of the shore where Fucus and Ulothrix were found.

Marine algae is important in the food chain of Thames River marine organisms. Laminaria, Chondrus, Ulva, and Rhodymenia are utilized by such forms as herbivorous gastropods, crustaceans and fishes. These organisms are then eaten by carnivorous forms and so on up the food chain. In addition to being important as a food source, attached marine algae also provide a substrate for the attachment of such invertebrates as hydrozoans, bryozoans and the polychaete, Spirorbis. Starfish, polychaetes and molluscs are also found entangled in the holdfasts of Laminaria. Despite low numbers and diversity, the importance of the algae in the river should not be minimized.

Species of benthic algae found in this area, of which Ulva was the most prevalent, are:

Agardhiella tenera

Chondria tenuissima

Chondrus crispus

Gracilaria folifera

Grinnellia americana

Protoderma marimum

Ulothrix flacca

Ulva lactuca

Fucus vesiculosus var. sphaerocarpus

One species of vascular plant was found in the area; Potamogeton pectinatus was found floating throughout the region. No rooted plants of this species were located, however.

5.4.5.2 Phytoplankton - Zooplankton - Plankton tows were conducted in September, 1972, to determine the density and diversity of phytoplankton in the Thames River. Collection was done with a #25 Standard Mesh

Plankton net. Although exact density is not known at this time, the total number of cells was low. Zooplankton were almost completely absent. The few phytoplankters present were members of the Bacillariophyceae and included Ditylum brightwelli, Coscinodiscus spp., Gyrosigma spp., and Glenodinium spp. Ditylum brightwelli was the only species which was uniform in the samples, although density was very low.

A low diatom population was also found in the Thames River. This was probably due to the time of collecting. Nutrient levels were not excessively high, as thorough mixing had not released nutrients from the bottom sediments. Thus, a dense population was not possible. Low temperatures along with winds and wave action in the fall will result in a mixing and release of bottom nutrients and subsequent diatom "bloom."

5.4.5.3 Aquatic Inverertebrates - The invertebrate fauna of the Thames River constitutes a large portion of the protein harvested for human consumption from the river each year. The most sought after invertebrate species for human consumption are lobsters, crabs, clams, and oysters.

The harvesting of lobsters (Homorus americanus) occurs primarily through the spring and summer months. The lobsters move inshore during the warm months to feed and molt near bottom structures. Trapping occurs in the river from the mouth to just upstream of the I-95 bridge (interview, biologist, Conn. DEP). Lobsters are scavengers and feed on almost anything they can find. Molluscs, crustaceans (ranging from crabs to amphipods), and dead fish are included in this diet. These characteristics delineate their level in the food chain of the Thames River estuary.

The harvesting of blue crabs (Callinectes sapidus) from the Thames River occurs primarily during the months of July, August and September. This species cannot be harvested commercially in the river and must be taken with folding traps or dip nets. Its distribution in the river is considered cosmopolitan, being harvested from the mouth of the river upstream to Norwich. This species is highly intolerant of low temperatures and salinity fluctuations. Correspondingly, there are massive die-offs during extremely cold winters or after severely heavy or prolonged rains which reduce the salinity in the river. The blue crab is an important member of the food chain. Injured specimens are preyed upon by lobsters and fish, while healthy forms feed on molluscs, crustaceans, dead fish, and so forth.

There is no commercial harvesting of clams or oysters in the Thames River.

Non-commercial harvesting is allowed but is strictly regulated (concerning areas open to harvesting and seasons) by the Connecticut DEP. Coliform counts are used as indicators of pollution (especially hepatitis) and water samples are analyzed from several locations weekly or after rainfall events. The results of the analyses determine the potential for pollution of the shellfish. As filter feeders, the shellfish ingest large quantities of water and filter out the organic material as food. This leaves them very susceptible to pollutants, especially bacterial and

viral. A large portion of the river is permanently closed to shellfishing and this includes the waterfront of the Subase.

Dredging for shellfish during the 1973 EIS studies has revealed large beds and much preferred substrates near the mouth of the river and extending up to the I-95 bridge.

The quahog (Mercenaria mercenaria) is the most common clam species in the river. It is found in large numbers in shoals and channel banks below the I-95 bridge (biologist, Conn. DEP). The vast beds of quahogs would be an accessible and valuable resource for the area if upstream pollutants could be controlled.

There are no large soft shell clam (Mya orenaria) beds in the river system. Studies conducted by the U. S. Coast Guard (USCG) in 1973 revealed few soft shell clams, and these were restricted to small, isolated groups between the I-95 bridge and the Subase. This area does have substrates preferred by this species, and with improved water quality conditions, a viable population would develop.

The 1973 USCG study revealed approximately 174 acres of oyster beds on the west side of the river. They are located on the west channel bank and extend into the shallows from the Tydol Fuel Dock upstream to approximately one-quarter mile north of the Subase. There is a winter season for harvesting oysters on a non-commercial basis, and no commercial harvesting of oysters has been allowed in the river for many years. However, upstream from the Subase, there are coves being leased and artificially seeded with oysters for potential commercial harvesting in the future.

A list of invertebrates known or expected to be found in the Thames River is included in Table 5.4-4. This list also includes those species of invertebrates common to the river but not regularly consumed by humans. These are important to the river system as they play an integral role in the food chain of the ecosystem.

5.4.5.4 Finfish - The only water supply affected by the Subase and supporting a fishery is the Thames River. Fish were sampled in the river from the mouth to one-quarter mile north of the Subase during the EIS study by the USCG in 1973. Also, frequent river fish collections are made from March to November by the University of Connecticut, Project Oceanology, Avery Point.

There is presently no commercial fishing allowed in the Thames River for any fish species above the I-95 bridge (biologist, Conn. DEP). There is, however, a commercial fishery for eels, and some sport fish are caught from the river and sold. The results of collections indicate that the most common species of fish in the river between the mouth and the Subase are winter flounder (Pseudopleuronectes americanus), porgy (Stenotomus versicolor), weakfish (Cynoscion regalis), and tautog (Tautoga onitis). The adult weakfish and porgy are sometimes brackish and primarily marine species substantiating the belief that the fish collected in the trawls were juvenile, temporarily inhabiting the river. The winter flounder

TABLE 5.4-4

INVERTEBRATES KNOWN OR EXPECTED TO BE FOUND IN THE THAMES RIVER

Genus Species, Common Name	Location
M. mercenaria (quahog)	TH
Crassostrea virginica (oyster)	TH
Spisula solidissma (surf clam)	LR
Nassarius obsoletus (mud snail)	TH
Cripidula fornicata (slipper shell)	LR
Pagursus longicarpus (hermit crab)	LR
Cripidula plana (deck shell)	LR
Cancer irrortatus (rock crab)	TH
Balanus drentatus (barnacle)	TH
Balanus balanoidies (barnacles)	TH
Pagursus pollicaris (hermit crab)	LR
Busycon canaliculatum (c. whelk)	LR
Lunatia heros (moon snail)	TH
Eupleura caudata (drill)	LR
Yoldia limulata (bivalve)	LR
Pandora gouldiania (bivalve)	LR
Crangon septemspinosus (prawn)	TH
Rhithropanopeus harrisi (mud crab)	TH
Koldia limulata (bivalve)	LR
Lyonsia hyalina (bivavle)	LR
Ensis directus (razor clam)	TH
Callinectes sapidus (blue crab)	TH
Carinides maenas (green crab)	TH
Crangon septemspinosis (sand shrimp)	LR
Limulus polyphemus (horseshoe crab)	LR
Libinia emarginata (spider crab)	LR
Scoloplos robustus (annelid)	LR
Nephyts caece (Polycheare annelid)	TH
Sabella micropthalma (feather worm)	LR
Sabellaria vulgaris (polychaeta)	LR
Terebellid polychaeta	LR
Diopatra cuprea (ornate worm)	LR
Nereis virens (sand worm)	LR
Polydora ligni (polychaeta)	LR
Cliona 2 spp. (sulfer boring sponge)	LR
Asterias forbesi (common starfish)	LR
Gammarus marinus (gammarid amphipod)	LR
Tubularia spp.	TH
Hydroid spps.	LR
Hydractinia spp.	LR
Cryptosula spp.	LR
Alyconidin spp.	LR
erect bryozoan	LR
Polynoidae and Sigalionidae (scale worms)	TH
Cirrebled polychaeta (worm)	LR
Clymenalla torquata (bamboo worm)	LR
Ninoe nigripes (Polychaeta)	TH
Haliclona 2 spp. (sponge)	LR
Metridium semile (anenomae)	LR
Toredo navis (shipworm)	TH
Cerabratulus sp. (nemertean)	TH
Haliplanella luciae (anemonae)	LR
Pectenaria gouldi (cone worm)	LR

UR - From I-95 bridge to Norwich (Upper river)
LR - From I-95 bridge to Mouth (Lower River)
TH - From Mouth of River to Norwich (Throughout)

appears to inhabit the Thames permanently, and several reliable sources indicate successful spawning does take place. Being the most dominant, these four species would be the most likely to be harvested by sportsmen for human consumption.

Research of existing data indicates that the Thames estuary is also an important spawning and nursery area for anadromous runs of alewives (Alosa aestivalis) and Menhaden (Brenooria tyrannus) which are found in the area from July through October utilizing the river as a nursery area.

Extensive recreational fishing exists for white perch (Roccus americanus), American smelt (Osmerus mordox), tomcod (Microgadus tomcod), bluefish (Pomatomus saltatrix), and striped bass (Morone saxatilis). The striped bass is one of the most sought after game species on the east coast. A large population of this species winters in the channel of the Thames River in the area of Stodard State Park (Conn. DEP).

There is the potential for a commercial market for American smelt, American shad (Alosa sapidissima), whiting (Merluccius bilinearis), and blueback herring (Alosa aestivalis). The populations of these species in the river are on the rise, and habitat and water quality improvements have increased the potential for an increase in numbers allowing for commercial harvesting.

Efforts are also being made to re-establish anadromous fish runs of Atlantic salmon (Salmo salor), alewife, and brown trout (Salmo trutta). The browns have escaped from stocked impoundments and streams in the headwaters and developed a considerable population of large fish in the river, and these are sought after by sportsmen. The major problem with re-establishing an anadromous fish run and breeding population in the river is the dams. These impede upstream migration to necessary spawning substrates.

A list of finfish known or expected to be found within the Thames River and the seasons in which they inhabit the river is included in Table 5.4-5.

5.4.5.5 Threatened and Endangered Species - The ecological habitats within or immediately surrounding the Subase may potentially harbor floral or faunal species of threatened or endangered status as classified by the State of Connecticut or the USDA Fish and Wildlife Service. The habitat which has the greatest potential for harboring these species is the wetland and its associated drainages emanating from Area A. The subject species are limited primarily to plants due to the urbanized nature of the entire area and the constant disturbance by heavy equipment and normal base operations. There have been no confirmed sightings of threatened and endangered species. A list of threatened and endangered species as classified by state and federal governments is included in Table 5.4-6.

TABLE 5.4-5

FISHES KNOWN OR EXPECTED TO INHABIT THE THAMES RIVER

Common Name, Genus species	Season Within River
Blue back herring, Alosa aestivalis	Sp, S
Alewife, Alosa pseudoharengus	Sp, S
Anchovy, Anchoa mitchilli	Y
American eel, Anguilla rostata	Y
Fourspine stickleback, Apeltes quandracus	Y
Menhaden, Breuooria tyrannus	S
Herring, Clupea harengus harengus	Y
Weakfish, Cynoscion regalis	Sp, S
Sheephead, Cyprinodon variegatus	Y
Common mummichog, Fundulus heteroclitus	Y
Threespine stickleback, Gastrosteus aculeatus	Y
Sea raven, Hemitripterus americanus	Y
Silverside, Menidia menidia	Y
Kingfish, Mentricirrhus saxatilis	Sp, S, F
Whiting, Merluccius bilinearis	Sp, S
Tomcod, Microgadus tomcod	Y
Common file fish, Monacanthus hispidus	S
Striped bass, Morone saxatilis	Y
Longhorn sculpin, Myoxocephalus octodecimspinosus	W, Sp, F
Toadfish, Opsanus tau	Y
American smelt, Osmerus mordax	Y
Fluke, Paralichthys dentatus	Sp, S, F
Striped killfish - Fundulus Majalis	Y
Tidewater silverside - Menidia beryllina	Y
Sand eel - Ammodytes americanus	Y
Four spot flounder, Paralichthys oblongus	Sp, S
Bluefish, Pomatomus saltatrix	Y
Butterfish, Poronotus triacanthus	S, F
Common searobin, Prionotus carolinus	Y
Striped searobin, Prionotus martis	F, W
Winter flounder, Pseudopleuronectes americanus	Y
Ninespine stickleback, Pungitus pungitius	Y
Little skate, Raja Binerinacea	Y
White perch, Morone americanus	Y
Atlantic mackerel, Scomber scrombrus	Y
Sand dab, Scophthalmus aquosus	Y
Dog fish, Squalus acanthias	S
Porgy, Stenotomus chrysops	Sp, S, F
Pipefish, Synagnatus fuscus	Y
Tautog, Tautoga onitis	Y
Cunner, Tautogolabrus adspersus	Y
Hog choker, Trinectes maculatus	Sp, S, F
Red hake, Urophyeis chuss	Sp, S
White hake, Urophyeis tenuis	Sp, S, F
Windowpane flounder, Scophthalmus aquosus	Y
Goosefish, Lophis americanus	Sp, S, F
Squirrel Hake, Urophycis chuss	S, F
Needlefish, Strongylura marinus	Y

*SP - Spring
S - Summer
F - Fall
W - Winter
Y - Yearround

TABLE 5.4-6

STATE AND FEDERALLY LISTED ENDANGERED AND THREATENED SPECIES IN CONNECTICUT

Common and Scientific Name	Status	Distribution
Fishes:		
Sturgeon, shortnose*, Acipenser brevirostrum	E	Connecticut River and Atlantic Coastal Waters
Reptiles:		
Turtle, green*, Chelonia mydas	T	Oceanic straggler in Southern New England
Turtle, hawksbill*, Eretmochelys imbricata	E	Oceanic straggler in Southern New England
Turtle, leatherback*, Dermochelys coriacea	E	Oceanic summer resident
Turtle, loggerhead*, Caretta caretta	T	Oceanic summer resident
Turtle, Atlantic ridley*, lepidochelys kempii	E	Oceanic summer resident
Birds:		
Eagle, bald, Haliaeetus leucocephalus	E	Entire state
Falcon, American peregrine, Falco peregrinus anatum	E	Entire state - re-establishing to former breeding range in progress
Falcon, Arctic peregrine, Falco peregrinus tundrius	E	Entire state Migratory - no nesting
Eastern bluebird, Sialia sialis	D	Entire state
Parula warbler, Parula americana	R	Entire state
Sharp-shinned hawk, Accipiter striatus	D	Entire state
Coopers hawk, Accipiter cooperii	E	Entire state
Red shouldered hawk, Buteo lineatus	R	Entire state
March hawk, Circus cyaneus	D	Entire state
Long-eared owl, Asio otus	I	Entire state
Short-eared owl, Asio flammeus	I	Entire state
Red-headed woodpecker, Melanerpes erythrocephalus	R	Entire state
Yellow-bellied sapsucker, sphyrapicus varius	R	Entire state
Mammals:		
Wolf, Gray, Canis lupus	E	Entire state
Cougar, eastern, Felis concolor cougar	E	Entire state - may be extinct
Whale, blue*, Balaenoptera musculus	E	Oceanic
Whale, finback*, Balaenoptera physalus	E	Oceanic
Whale, humpback*, Megaptera novaeangliae	E	Oceanic
Whale, right*, Eubalaena spp. (all species)	E	Oceanic
Whale, sei*, Balaenoptera borealis	E	Oceanic
Whale, sperm*, Physeter catodon	E	Oceanic
Mollusks:		
None		
Plants:		
Small Whorled Pogonia Isotria meleoloides	E (proposed)	Hartford, Litchfield, New Haven, Fairchild, New London, Windham Counties
Ames' Quillwort, Isoetes saccharata	E	Entire state
Tuckerman's pondweed, Potamogeton confervoides	R	Entire state
Small drop-seed, Sporobolus neglectus	R	Entire state
Sedge, Carex aquiatilis	R	Entire state
Sedge, Carex polymorpha	E	Entire state
Sedge, Carex tetanica	R	Entire state
Spike-rush, Elecocharis microcarpa	I	Entire state
Hemicarpha micrantha	R	Entire state
Papillose nut-rush, Scleria pauciflora	R	Entire state
Small's yellow-eyed grass, Xyris smalliana	R	Entire state
Putty-root, Aplectrum hyemale	E	Entire state
Early coralroot, Corallorhiza trifda	R	Entire state
Yellow-fringed orchis, Habenaria ciliaris	D	Entire state
Green Adder's mouth, Malaxis unifolia	D	Entire state
Nodding Pogonia, Threebirds, Triphora trianthophora	E	Entire state
Swamp Cottonwood, Populus heterophylla	R	Entire state
Virginia snakeroot, Airstolochia serpentaria	R	Entire state
Barren strawberry, Waldsteinia fragarioides	R	Entire state
Tick-trefoil, Desmodium humifusum	R	Entire state

TABLE 5.4-6

STATE AND FEDERALLY LISTED ENDANGERED AND THREATENED SPECIES IN CONNECTICUT (Continued)

Common and Scientific Name	Status	Distribution
Plants:		
Creeping bush-clorer, *Lespedeza repens*	R	Entire state
Northern Wild bean, *Phaseolus polystachios*	R	Entire state
Three-seeded mercury, *Acalypha virginica*	R	Entire state
False mermaid, *Floerkea proserpinacoides*	R	Entire state
Fragrant sumac, *Rhus aromatica*	R	Entire state
Inkberry, *Ilex glabra*	R	Entire state
American holly, *Ilex opaca*	D	Entire state
Creeping St. John's-wort, *Bypericum adpressum*	R	Entire state
Low rockrose, *Helianthemum propinaquum*	E	Entire state
Tooth-cup, *Rotala ramosior*	R	Entire state
Ginseng, *Panax quinoquefolius*	E	Entire state
Golden Alexanders, *Zizia aptera*	R	Entire state
Great Rhododendron, *Rhododendron maximum*	R	Entire state
Persimmon, *Diospyros virginianae*	D	Entire state
White milkweed, *Asclepias variegata*	R	Entire state
Green milkweed, *Asclepias viridiflora*	R	Entire state
Chaffseed, *Schwalbea americana*	E	Entire state
Long-leaved Bleuts, *Houstonia longifolia*	R	Entire state
Possum-haw, *Viburnum nudum*	R	Entire state
Field Pussy's-toes, *Antennarai petaloidea*	R	Entire state
Crooked-stemmed aster, *Aster prenanthoides*	R	Entire state
Showy aster, *Aster spectabilis*		
Small white snakeroot, *Eupatorium aromaticum*	R	Entire state

*Except for sea turtle nesting habitat, principal responsibility for these species is vested with the National Marine Fisheries Service

E - Endangered
T - Threatened
D - Declining
I - Intermediate
R - Rare

SECTION 6

ACTIVITY FINDINGS

6.1 GENERAL

The Naval Submarine Base (NSB), including all activities under its cognizance, encompasses a total of 1,412 acres of land, primarily in the town of Groton and partially in the town of Ledyard, Connecticut. The base and the tenant activities perform four main services to the fleet which include:

1. Homeporting of the submarines

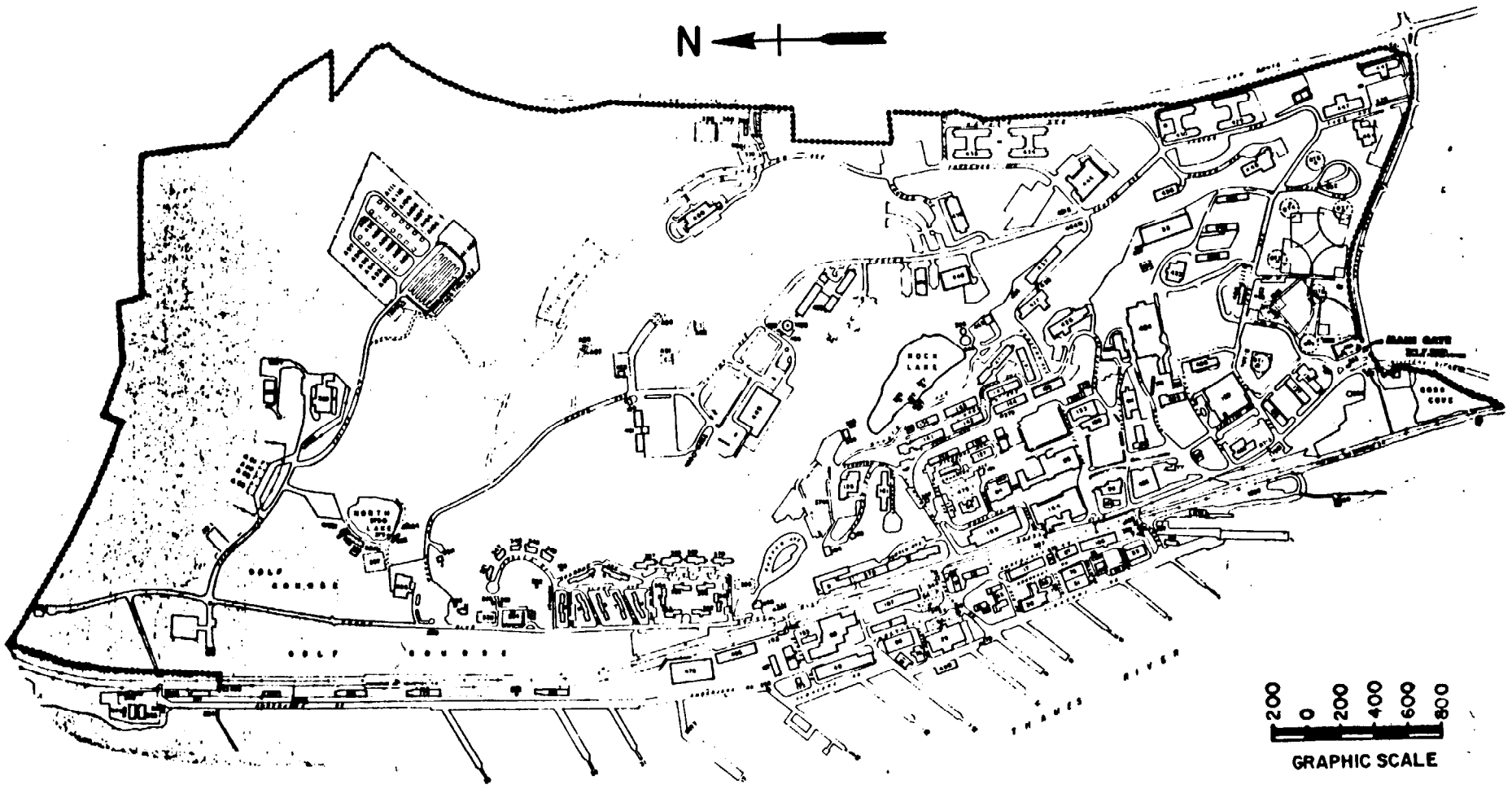
2. Intermediate level maintenance and repairs for submarines

3. Submarine training

4. Medical care and research in the field of submarine medicine

The main base area, shown in Figure 6.1-1, containing 547 acres, is used principally for operational and direct support facilities, while the remaining areas are used for housing and community support. The base has almost 1,400 structures and buildings with over 5.8 million square feet of floor space in use. Included are several piers with a capability of providing adequate berthing and support for 16 SSN submarines plus numerous other assigned craft. The leased facilities at the Connecticut State Pier provide berthing for Submarine Squadron Ten whose craft include one AS, one TWR, one YD, seven SSN, and several other small craft. Five Navy housing developments also lie within one and one-half miles of the Subase.

The Subase is physically divided into what are termed the upper and lower base areas. The Providence and Worcester Railroad operates a branch line that runs completely through the main part of the base parallel to Shark Boulevard. The land east of the right-of-way is the lower base, and land to the west of the right-of-way is called the upper base. The lower base primarily contains facilities that provide support in the areas of operations and maintenance/production for the sub fleets. Operations utilize 13 of the 14 piers along the waterfront and the narrow strip of land immediately adjacent to the quay wall that runs almost the entire length of the base. Maintenance/production functions use the remaining pier and a number of buildings which, when combined, use a larger part of the lower base than any other function.



EEI

FIGURE 6.1-1

SUBMARINE BASE LAYOUT

Two other functions which occupy significant portions of the lower base are the administrative facilities for Submarine Group Two, Sub Squadron Two, Submarine Development Squadron Twelve, and the Supply Department's warehouse, shipping and receiving facilities. Other activities which occupy lower base space include Submarine Training, Utilities Departments, including the main power plant, community facilities and research departments. The north end of the lower base is narrow and contains less land than the southern end. The northern end is used for supply/storage by DPDO, Community Facilities, Maintenance/Production, and Administration.

The upper base can be viewed as being divided into three general sections. The northern section, predominantly undeveloped and natural land, contains the Weapons Department, torpedo shops, and ammunition storage bunkers. The middle section contains both developed and undisturbed land. The Naval Submarine Medical Center and the Base Hospital, Building 449, are located here. Community facilities, which include the Rock Lake recreation area, golf course, and all tennis courts, use a few acres of land in this area. The area also contains troop housing, indoor community facilities, training, and family housing.

The southern portion of the upper base has three land uses that dominate the area in land utilization. Each use, troop housing, training, and community facilities, involves many structures. Collectively, these three activities occupy half of the southern section of the upper base. Other functions conducted in this area include: Administration for the Subase and forces afloat; supply/storage warehouses; maintenance/production facilities for the Public Works Department; and Exterior Community Facilities, in the form of baseball fields. The underground fuel farm is also located in this section. Also located here are Interior Community Facilities which include the gymnasium, theater, bowling alley, Navy Exchange and Commissary. The land adjacent to Goss Cove is used for parking and will be the future site of the Nautilus Memorial.

The sections which follow provide more specific descriptions of the operations at NSB New London, that utilize hazardous materials or generate hazardous waste. This discussion covers Ordnance Operations, Industrial Operations including Public Works - Utilities, Materials Storage, and the Waste Disposal Sites identified during this study.

In addition to describing the specific operations, types of wastes generated by the activity are identified. Periods of operations and quantities of materials disposed of are given in as great a detail as was possible. In instances where a lack of historical information existed, an estimate was provided to assist in the evaluation. This was done only after careful review of the related operation was conducted. Generally, it was inferred that the order of magnitude of past generation rates compares closely to those of current operation.

6.2 WASTE DISPOSAL OPERATIONS

The disposal of all types of waste materials at the New London Subase was investigated by EEI during the June, 1982 survey. There were 16 areas identified by EEI as potential sites containing contaminated materials. Figure 6.2-1 shows the location of these sites on the Subase. Each potential site was put through the confirmation study flow chart. Depending on those results, selected sites were put through the confirmation study rating model.

Sites 1 through 5 and 7 are directly associated with Area A wetland and its drainage, confluencing with the Thames River. A detailed diagram of this drainage system is included in Figure 6.2-2. All of the disposal sites will be discussed in the following text according to available information pertaining to each site's history, contents, operation, drainage, present land use, and potential to contribute to contaminants.

6.2.1 CBU Drum Area, Site No. 1

The physical appearance of this site indicates that drums have not been stored here longer than two years. The site contained twenty-six 55-gallon drums of waste oil, lube oil, and paint materials. Leaks were evident. The area appeared to be used for storage of construction materials, including large treated timbers, concrete blocks and steel sheds. All construction materials and waste oil drums are exposed directly to surface soils. There is no covering on any of the material, and all are exposed to weathering.

Drainage from the hillside behind Site #1 flows directly between the stored 55-gallon drums. This runoff flows over the spilled wastes and then down the hillside, across the road to deployed parking and into the wetland of Area A. The wetland is the headwaters for the drainage which confluences with the Thames River (Figure 6.2-2). The potential for contribution of contaminants from the drums to the surrounding ecosystem and the Thames River has been reduced by their removal from the site.

6.2.2 Area A Landfill, Site No. 2

This area was used as a landfill for an undetermined number of years prior to 1957. The site was officially closed in 1973. Previously the area was low-lying with a stream traversing it and draining 148 acres to the north and west. The Thames River was dredged in 1957, and the spoils were deposited in this area. An earthen dam was constructed to retain the spoil which is 600 to 800 feet wide and covers 25 acres. All other materials generated by base operations that were not salvageable were incinerated, and the residues were disposed of in Area A.

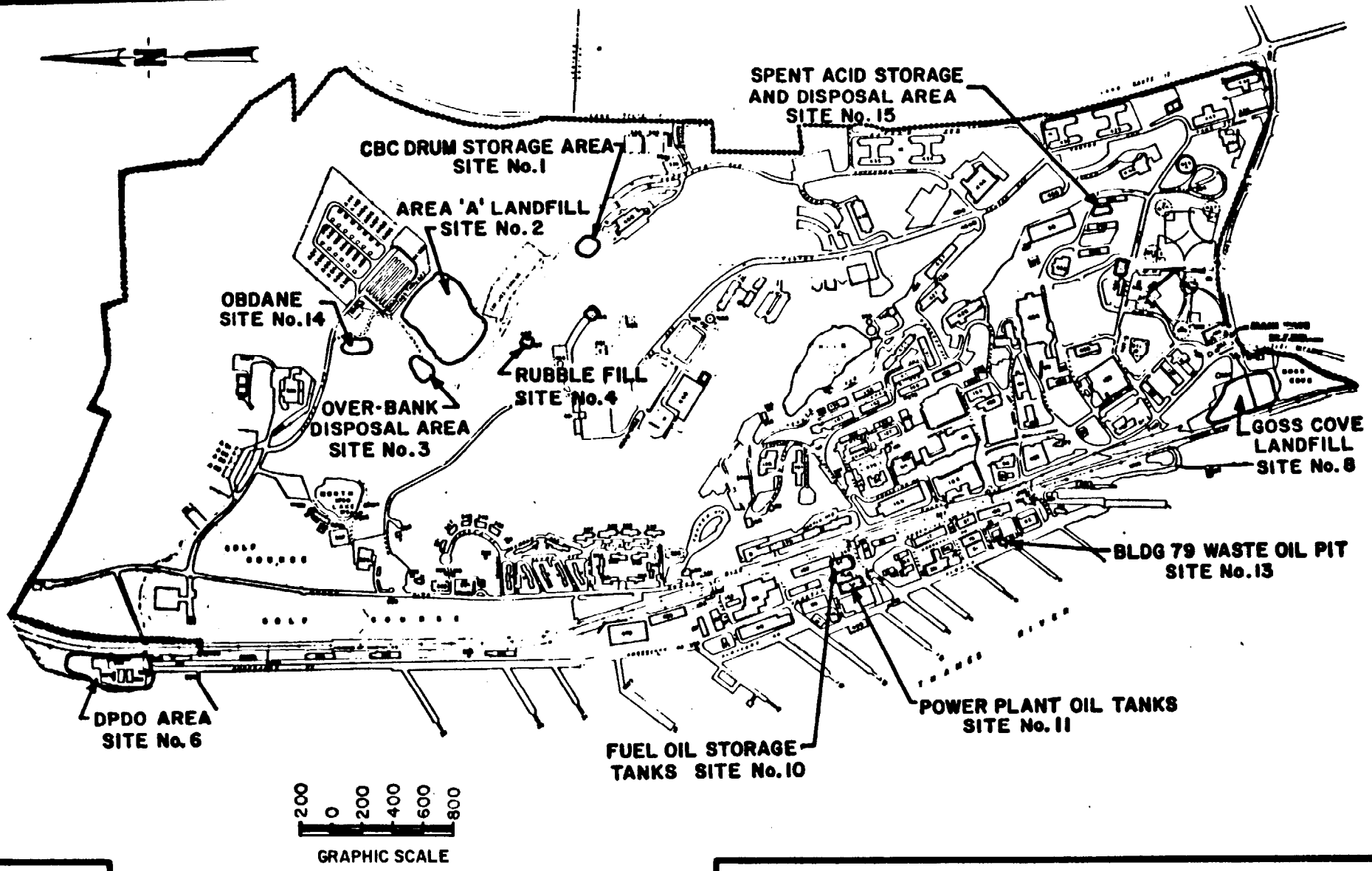


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FIGURE 6.2-1

WASTE DISPOSAL SITES

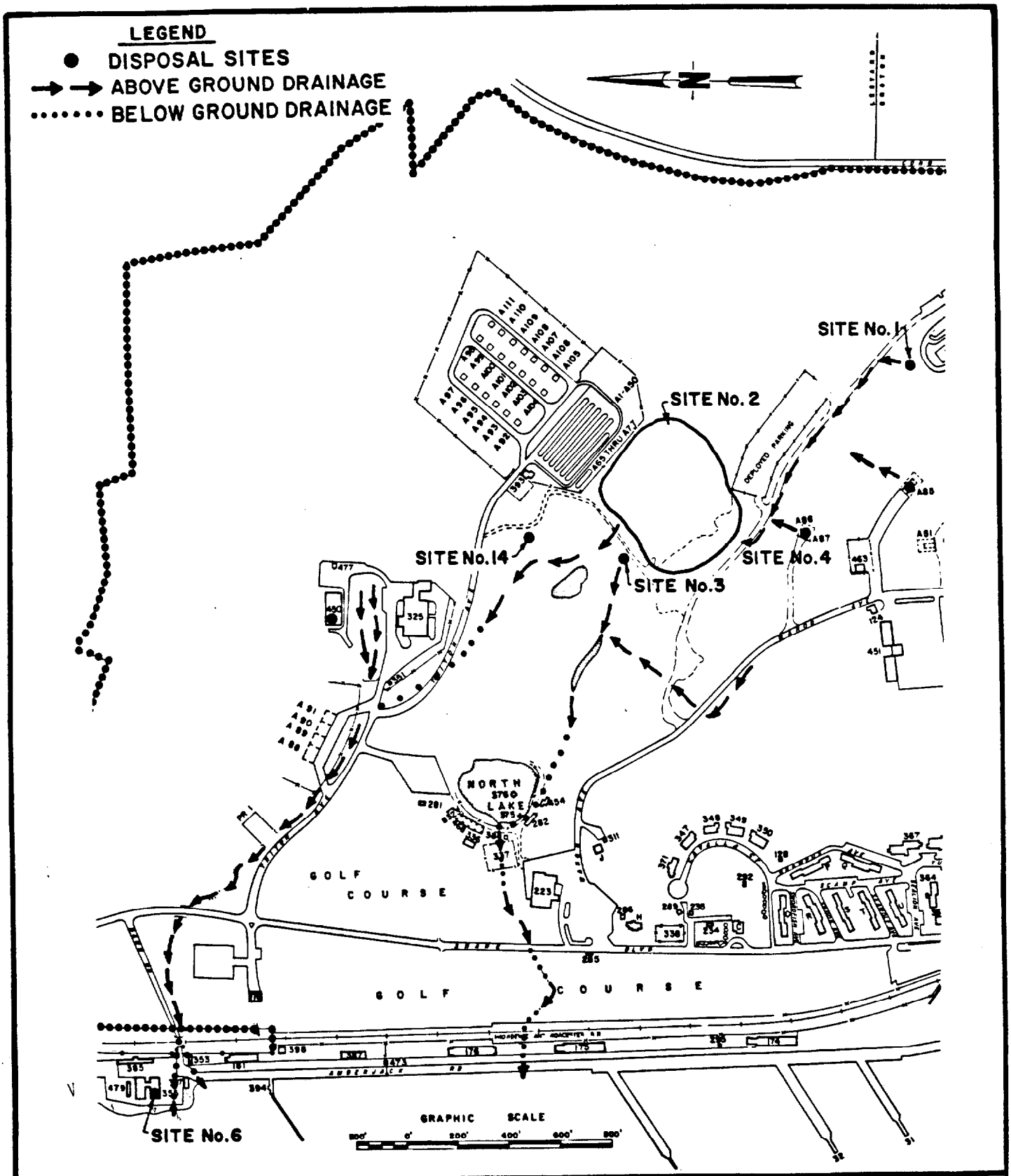

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FIGURE 6.2-2

SUBASE DRAINAGE AND ASSOC. WASTE DISPOSAL SITES

The incinerator broke down in 1963, and all wastes were then being disposed of in Area A unburned. This practice continued until 1973. At that time, an asphalt pad was created for above ground storage of "hazardous" industrial wastes (Table 6.3-2). There were 42 steel drums, 87 transformers (mineral and PCB), and 60 to 80 electric switches located on the pad. Leaks were evident coming from two transformers and several electric switches. It is not known whether the oil leaks were mineral or PCB. Most drums were stacked on wooden pallets, and those having PCB labels were covered and bound with plastic sheeting.

At the edge of the landfill, which borders the marsh, steel drums, oxygen candles, wood scrap, metal scrap, concrete, and tires were exposed by either erosion of the fill material or recent dumping. In two locations along this edge, it was evident that petroleum compounds had been recently poured from containers and had flowed down the edge of the landfill into the marsh.

The Area Fill Method was used in landfill operations. The refuse was dumped from the face of the deposited refuse and covered with earth.

The cover material used on the landfill was run-of-bank gravel obtained from the Groton water supply reservoir. The material is very permeable and allows quick percolation of surface water. The water table, based on the presence of the marsh, is probably within the landfilled refuse. Drainage from the marsh enters two intermittant streams (Plate 6-1) that confluence with the Thames River 2,000 feet to the west at DPDO (Plate 6-2).

Filling operations in Area A have stopped. The old landfill is covered by gravel and the asphalt pad. Many sandbags are stored on pallets on the western edge of the gravel area. There are 8 to 10 trailers next to the asphalt pad which are used to store construction equipment and salvage materials. There is moderate activity around the trailers and on the road crossing between the asphalt pad and the gravel area.

The greatest potential for contaminants to enter the surrounding ecosystems occurs at Site #2. The permeable material used to cover the fill allows rainwater to percolate through and enter groundwater. Most of this groundwater then discharges into the bordering marsh. Contaminants were evident in the marsh as orange organic sediment and petroleum slicks on the surface water (Plate 6-3). The Area A marsh and surrounding terrain are shown in Plate 6-4.

6.2.3 Over-Bank Disposal Area Northwest, Site No. 3

This area (north of Area A and west of the stream) served as a disposal site after the earthen dam was constructed in 1957. The condition of the materials and vegetation in the site indicates that the material has been there for many years. There appeared to have been no effort to cover the waste materials. These included 30 partially covered 200-gallon metal fuel tanks and much scrap lumber. The material was

Plate 6-1

The above photograph depicts the Area A marsh (No. 1), the Area A Transformer Storage Area (No. 4) and the Over-Bank Disposal Area (No. 3). The two streams which receive drainage from these areas are also shown (No. 2).

0002 101Y

Plate 6-2

The arrows in the above photograph depict where the streams from the northern portion of the Subase discharge into the Thames River at DPDO.

00021024

Plate 6-3

The arrows in the photograph above point out the orange organic sediments which occur in the ponds just west of the Area A marsh. These ponds receive drainage from sites No. 1, 2, 3, 4, 5 and 14.

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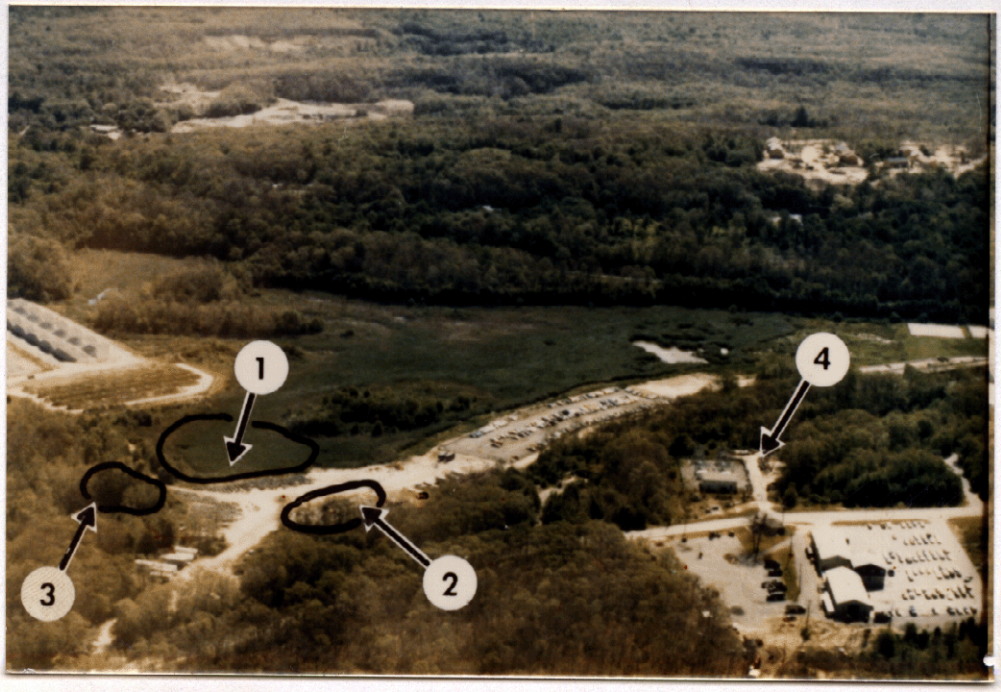

Plate 6-4

The photograph above depicts the Area A Marsh (No. 1) and surrounding sites. The other areas shown are the Transformer Storage Area (No. 2), the Over-Bank Disposal Area (No. 3), and the Rubble Fill at Bunker A-86 (No. 4).

00021044

simply dumped down the dike opposite the marsh.

The pond at this site receives subsurface drainage from the area of the landfill. During the June, 1982 survey, a stream with a flow of less than one cubic foot per second was seen discharging from the bank of the southwest side. The drainage from this site also flows to the river.

The area is presently overgrown with herbaceous and woody vegetation. This covers much of the material dumped at this site.

The 55-gallon steel drums and 200-gallon fuel tanks have been rusted through and are empty. Contaminants from this site and/or the Area A landfill may have been trapped in the sediments of the pond. If the sediments of the pond are disturbed or scoured by high water, contaminants may be resuspended back into the water column and flushed toward the river.

6.2.4 Rubble Fill at Bunker A-86, Site No. 4

This area has been receiving construction waste materials for an undetermined amount of time. The materials are being dumped along the roadside and down the hill in front of the bunker. The hill has an approximate 30 percent slope which is directly above the asphalt pad of Site #2. The site contained concrete and asphalt chunks, an electric motor, tar buckets, paper and wood scrap, gravel, and leaf litter. The condition of the materials indicates that the dumping is recent.

Runoff from this site flows down the hillside into Area A's drainage system. The potential for contribution of chemicals into the drainage system is low due to the composition of materials being disposed of.

6.2.5 DPDO Area, Site No. 6

The area is located on the shoreline of the Thames River at the northernmost point of the base. The site opened in 1950 and was used as a landfill and burning ground until 1969.

The materials which were burned and landfilled were primarily inert and consisted of construction materials and combustible scrap (i.e., wood pallets, tires, old furniture) and other non-salvageable waste items. These materials were piled together at the north shoreline of what is now DPDO and burned. The residue was pushed to the shoreline and partially covered.

At the present time, there is no burning or landfilling occurring in the area. All materials are salvaged or trucked off base to be disposed of elsewhere.

Drainage from the area is directly into the Thames River. The majority of materials presently accumulated at DPDO are stored outside in the weather (i.e., old vehicles, metal scrap piles, empty drums, furniture, etc.). The runoff from these goes directly to the river. The entire area is low lying and is very prone to flooding. The water table, during years of normal precipitation, is less than one foot below the surface. Approximately 50 percent of the area has been asphalted; however, periodic inundation and freeze-thaw have broken most of it apart.

The potential of contaminants emanating from the DPDO area and contaminating the surrounding ecosystem is moderate. The types of materials landfilled are not extremely hazardous. Groundwater leaching through the landfill and discharging into the river probably has little impact. However, there is some spillage of petroleum compounds that may enter the marine ecosystem through runoff and flooding.

6.2.6 Goss Cove Landfill, Site No. 8

This area was actively used as a landfill from 1946 until 1957 when the site at Area A was opened. The materials disposed of in this site consisted primarily of inert rubble and some ash. The drainage from this site would have gone directly into the river. The relief of the area also suggests that it was once prone to flooding.

At present, there are no signs of rubble or waste materials at the site. It is approximately 80 percent covered with concrete and asphalt parking lot. The Municipal Sewage Treatment Plant has a pumping station on the east side of the landfill. A large (approximately 3-foot diameter) storm sewer crosses the site underground and terminates in the river.

The potential for contamination from this area to the surrounding environment is low. The materials within the site are basically inert, and there is a paved cap, preventing percolation and erosion, on the entire area.

6.2.7 Fuel Oil Storage Tanks, Site No. 10

This site (east of Amberjack Avenue, south of Building 107) is located in the lower base approximately 300 feet from the river shoreline. The five storage tanks are underground and next to a paved parking area. The tanks are concrete and have been in use since prior to World War II. Three of the tanks (E, F, and G) each have a 125,000 gallon capacity and are used to store diesel fuel. Tanks K and L have a 25,000 gallon capacity and are used to store lube oil. Monitoring wells installed in the area of the tanks yielded only small amounts of petroleum products.

The potential for contamination of the surrounding environment by leakage from the tanks is moderate. The tanks are just above the water table and in close proximity to the river. Groundwater flow would transport the petroleum compounds in the direction of the river.

6.2.8 Power Plant Oil Tanks, Site No. 11

These tanks are also located underground on the lower base and have been in operation since World War II. There are four tanks, and each has a 170,000 gallon capacity. Tanks A and B contain #6 grade fuel oil which is pumped to them from the tank farms on the north end of the base. Tank C contains diesel oil, and tank D contains waste oil from the power plant bilge water oil recovery system. The fuel and waste oil is used in the power plant boilers to generate steam and electricity for support operations on the lower base. Groundwater samples from the area indicated petroleum compounds are three inches thick on the groundwater.

The potential for contaminants entering the surrounding environment from the tanks is high. They are located below ground and close to the water table. Fuels that leak from the tank aredirected toward the Thames River by groundwater flow. Oil slicks have been reported in the river, at low tide, in this area of the lower base including the area of Pier 4 and Building 79.

6.2.9 Building 79 Waste Oil Pit, Site No. 13

This was an open sump pit covered by a floor grate which received waste oil and solvents from the cleaning of diesel engines during and after World War II. The pit was constructed of concrete and had a 500 gallon capacity. It has been filled with concrete and eliminated from the drainage system.

6.2.10 OBDANE (Over-bank Disposal Area-Northeast), Site No. 14

This site is located within the drainage of Area A. The disposal took place on a steep hillside having mature trees and thick understory. The road leading to the site is heavily overgrown with trees and brush. This indicates that the site has not been used in the last 5 to 10 years. The contents of the site include many fibre drums covered by scrap lumber. The fibre portions of the drums are mostly decayed leaving only upper and lower hoops. Also, remnant piles of brush, leaves and grass clippings were evident at the edge of the site. The location of the materials at the site indicates that dumping off the road edge, down the hillside was the only means of disposal. There was no effort made to cover the material.

The drainage from the site flows downhill into the system which eventually confluences with the Thames River. The entire area is overgrown with vegetation and is no longer accessible by road.

The potential for contaminants entering the surrounding environment from this site is low. The contents of the fibre drums, if any, have long been eroded away. The vegetation growing within the site is contiguous with surrounding vegetation in species composition and diversity, and

there appears to be no deleterious effects to the flora.

6.2.11 Spent Acid Storage and Disposal Area, Site No. 15

This site was used prior to and several years after World War II for disposal of waste battery acid. There was an underground tank between Buildings 409 and 410. It was rubber coated and was approximately 12 feet long by 4 feet wide by 4 feet high. The batteries were placed on a concrete pad next to the tank where some acids occasionally leaked onto the pad. No major spills were recorded. The acid from the batteries was placed in the tank, and when full, it was pumped into a tank truck and placed in the landfill in Area A. The runoff from this site ultimately enters the Thames River.

The potential of contaminants affecting the surrounding environment from this site today is low. The spilled acids have probably long been diluted and washed away.

6.3 INDUSTRIAL OPERATIONS

6.3.1 Public Works Department

The Public Works Department (PWD) is responsible for the design, acquisition, construction, maintenance, repair, and operation of the base utilities, test facilities, production and support equipment. The department also operates, assigns, maintains and repairs the construction, transportation and material handling equipment. They administer the family housing areas and pest control programs.

6.3.1.1 Steam Production and Distribution - The Power Plant, Building 29, is the producer of steam on the base. The activity uses five boilers to generate the steam. Three of the boilers (Numbers 1, 2, and 3) are Babcock and Wilcox boilers with a 76,500 pound per hour capacity. Another boiler (Number 4) is a 65,000 pound per hour Babcock and Wilcox unit. The final boiler (Number 1-S) is a 76,500 pound per hour Keller unit. All boilers produce steam at 625 psig except Number 4, which produces steam at 200 psig. Boiler Number 4 is reported to be in poor condition and will be demolished when Boiler Number 1-S upgrading is completed. The combined output capacity will be 306,000 pounds per hour when all the work is completed. Generally, the steam is used for building space heating and for domestic hot water supply. Steam supplied to the piers is used for the various valve stations and for protecting pier water lines against freezing.

The base steam supply system consists of three distribution systems (Figure 6.3-1). The north steam distribution system consists of one 8-inch steam main from the power plant and serves the buildings located on the lower base north of the power plant. The steam main, reduced to a 6-inch size 200 feet east of Building 98, runs east to serve the Hospital,

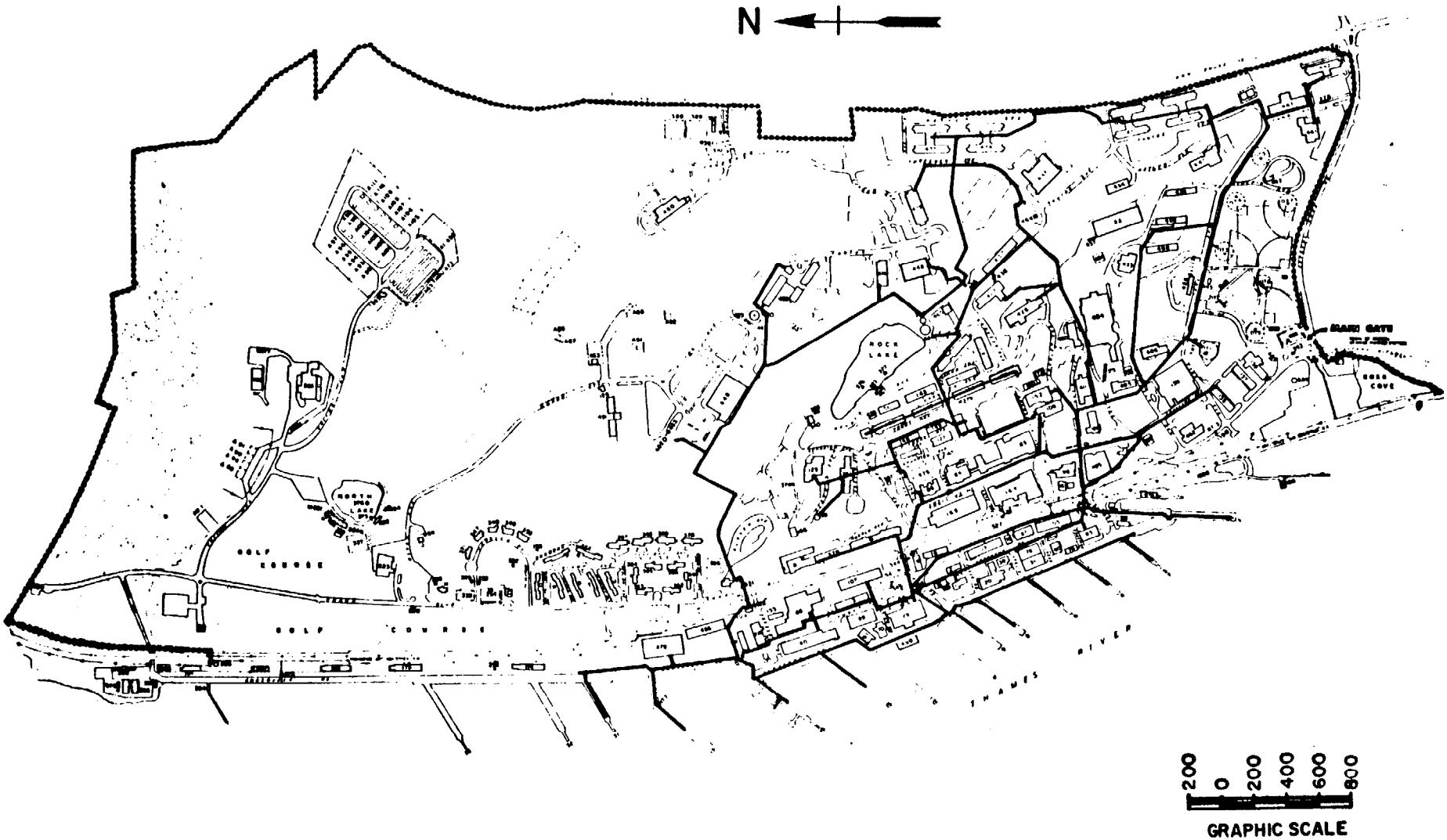

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FIGURE 6.3-1

STEAM AND CONDENSATE DISTRIBUTION SYSTEM

Source: Subase Master Plan

Building 449. A 5-inch steam main along the waterfront serves the north base and piers north of Pier 15.

The east steam distribution system contains two 8-inch steam mains running from the power house to the valve house, Building 318, located adjacent and east of the power plant. An 8-inch steam line from the valve house furnishes steam to the central section of the base and extends east to Grenfell Hall, Building 439. Two 6-inch steam mains from the valve house supply steam to the buildings located in the southern section of the lower and upper base. These lines terminate at the EM Barracks alongside State Highway Route 12.

The 6-inch and 8-inch steam distribution mains are interconnected in two areas. One connecting steam line is along Grayling Avenue between Grenadier and Trigger Avenues. The other line connects the steam main along Thresher Avenue to the steam main between EM Barracks, Buildings 434 and 435.

The third system provides steam to the submarines berthed at the piers. The pier steam distribution system is supplied through a 6-inch steam line from the power house. The steam distribution header for the piers runs alonside the waterfront and serves all the piers with the exception of those piers north of Pier 15. There is a supplementary 4-inch steam connection from the east steam distribution system to the southern end of the pier steam system in the vicinity of Pier 4. A second supplementary steam connection exists between the north steam distribution system and the pier steam system in the vicinity of Pier 15. A third supplementary steam line running along Corvina Road connects to the pier steam system in the vicinity of Pier 9.

Steam is supplied from the power plant through a 200 psig pressure steam header. For the north and east steam systems, the steam pressure is reduced from 200 to 125 psig pressure. For the pier steam distribution system, the steam pressure is reduced to 100 psig pressure. Flow meters record the steam supplied to the north and east distribution systems.

All steam condensate is returned to the power plant condensate receiver tank with the exception of that supplied to the piers and oil tank heating coils, which is not recovered. Most of the condensate system is under a positive pressure.

The condensate return system receives condensate from the building low pressure heating systems through either Sterling Steam lift traps or motor driven condensate return pumps and from the steam distribution system bucket traps. The condensate return piping, in general, runs in parallel with the steam distribution piping.

The steam distribution and the condensate return piping is installed mainly in concrete tunnels, trenches or above grade. A small portion of the piping systems is buried. The tunnels have manholes for access, and the trenches have removable concrete covers at grade level.

6.3.1.2 Electric Power and Distribution - The base electric power is supplied by the local utility company, the Town of Groton. The power is provided to the activity through two 13.33/17.9/22.4 MVA KV - 13.8/7.9 KV government owned transformers, located in the main government substation. The purchased power is used as the primary source of electricity, with a government owned generator providing back-up for the base. One station generator is kept on-line running in parallel with the utility company power supply. The maximum electric power available to the activity is 52,500 KW, broken down as follows:

Purchase from Utility: 24,000/3,200/40,000 KV

Generator No. 3: 3,500 KW (2.4 KV)
(Manufactured by G.E. in 1949)

Generator No. 4: 4,000 KW (2.4 KV)
(Manufactured by Elliot in 1940)

Generator No. 5: 5,000 KW (13.8 KV) Not operating
(Manufactured by Electric Machinery in 1974)

The electrical distribution system consists of a 13 KV loop, originating at the main substation, which encircles the Subase and supplies a 13 KV ring bus at Building 29. Power is transformed at the power house to 2,400 volts which are distributed throughout the base via radial feeders.

6.3.1.3 Compressed Air Systems - High and low pressure air systems are located in the Power Plant, Building 29. The high pressure system consists of two Norwalk 3,000 psi, 300 hp, electric driven air compressors. The rated capacity of these compressors is approximately 200 CFH. The low pressure air system is comprised of two Ingersoll-Rand 125 psi, 400 hp, electric driven compressors. This system has a capacity of 6,000 CFM.

6.3.1.4 Hot Water Heating System - The hot water heating system consists of two steam/water heat exchangers and three 2,500 gpm pumps in Building 29. Five pound steam is used as the heat source for the exchangers. The hot water system has four distribution lines emanating from Building 29. These lines are 14 inches and 16 inches in diameter and serve the shop area, schools, BOQ, and the waterfront facilities. This system can deliver 6,000 gpm of hot water. The average flow rate is approximately 2,500 gpm. The water temperature varies from 120°F to 180°F, depending on outside ambient conditions.

6.3.1.5 Pure Water System - The pure water system is used to supply reactor water to the submarines. The existing pure water system, located in the power plant, Building 29, has a capacity of 400 gallons per hour. Two 5,000 gallon trailers and a 1,000 gallon truck are utilized for storage and distribution of pure water to the submarines.

6.3.1.6 Potable Water System - The Subase purchases all of its potable water from the city of Groton for domestic and fire protection purposes. The city treats the water, which is drawn from the Poquonnock River Drainage Basin, using coagulation, flocculation, and sedimentation followed by sand filtration, pH control and chlorination. The base has an extensive water distribution system which is connected to the city system through 8-inch and 12-inch cast iron mains. The system is broken into two distinct sections, a low and a high service area (Figure 6.3-2).

The low service area, which is considered the industrial area, is supplied by both the 8 and 12 inch mains, the 12-inch line contributing roughly 90 percent of the total water supplied. This system contains sub-systems, many being closed loop networks which provide all potable water to the pier and berthing areas. There are three water storage tanks in the lower service system having a combined capacity of one million gallons.

The high service area consists of several 8-inch trunk lines, some of which require boosting systems to maintain proper water pressure. Two major sub-systems having booster stations are the Hospital and Ammunition Holding areas. The high service maintains a 0.2 million gallon tank at the Hospital. The city water supply is rechlorinated by the activity at the 12-inch service connection at the east gate of the Subase. This is done to maintain a chlorine residual throughout the Navy's distribution system as required by U. S. Navy regulations.

6.3.1.7 Non-Potable Salt Water System - The Subase has two non-potable salt water systems used for fire fighting on the lower base (Figure 6.3-3). Both of these systems originate at Building 29. The newer system, built in 1962, extends to Balloon Hall, Building 88. The 10-inch, cement lined, cast iron pipe is reported to be in generally good condition. The other salt water system, constructed in the mid-1940's, consists of 8-inch and 10-inch lines extending to Pier 2 to the south and Pier 17 to the north of the power plant. This system is allegedly in poor condition due to the age of the system and the corrosive environment along the waterfront.

6.3.1.8 Stormwater System - The Subase has an extensive stormwater system which discharges directly to the Thames River (Figure 6.3-4). This system is reportedly in adequate condition, however, certain sections of the system have experienced flooding conditions during heavy rains. An extensive stormwater analysis program was conducted by NEPSS in 1976. This study was performed to determine potential contaminants in the storm sewer. Sanitary wastes were discovered in the storm system at the northwest side of Building 3. The facility's stormwater system has also been subject to periodic oil intrusion in the past. The oil reclamation tank located at the power plant is suspected as the potential source of this oil.

6.3.1.9 Sewage Collection and Treatment Systems - The Subase sanitary sewage collection system was connected to the municipal "Water Pollution Control Facility" located in the Town of Groton in 1977 (Figure 6.3-5). The town's treatment plant, completed in November 1974, is a 5 million

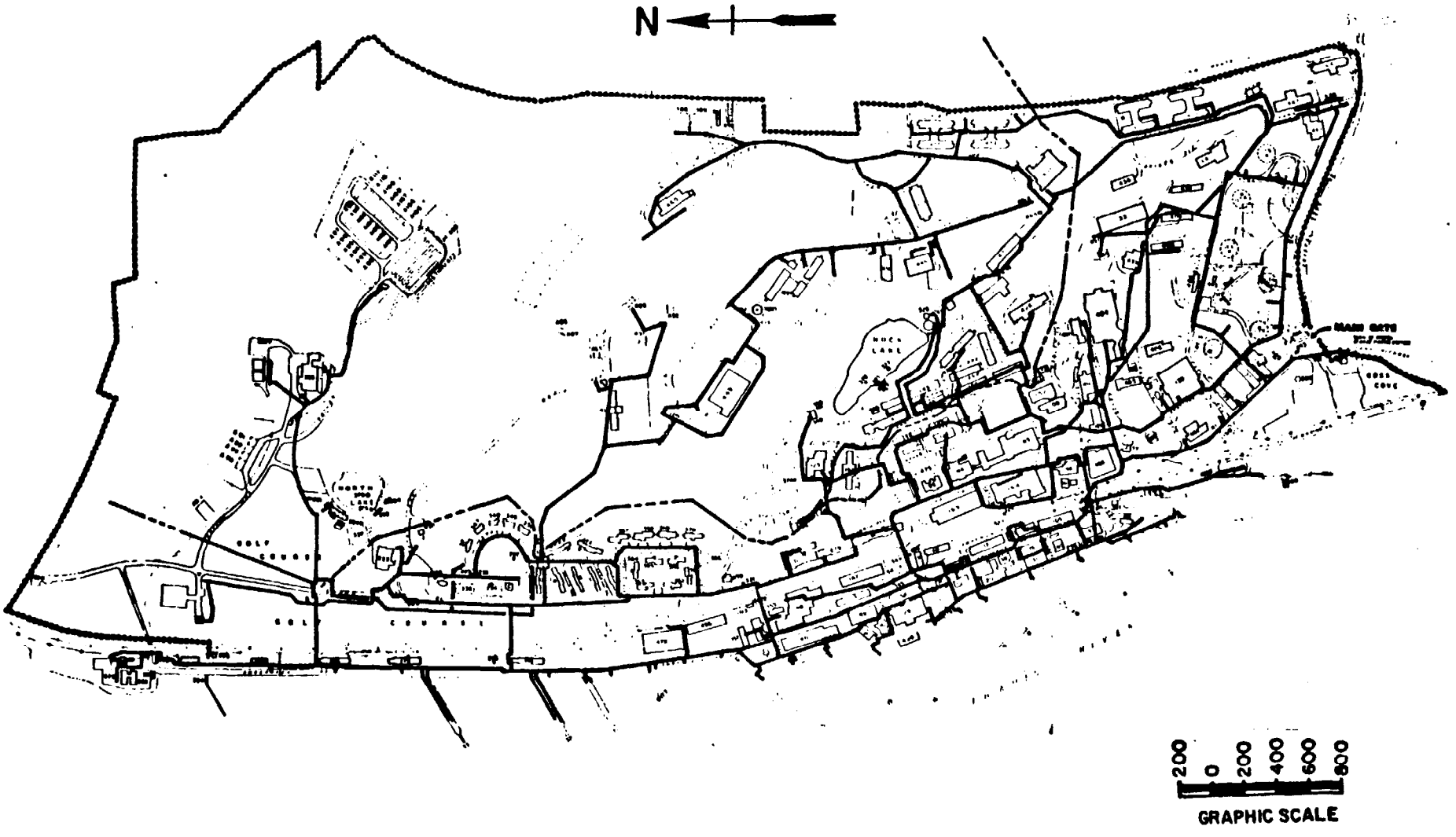

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FIGURE 6.3-2

POTABLE WATER SYSTEM

Source: Subase Master Plan

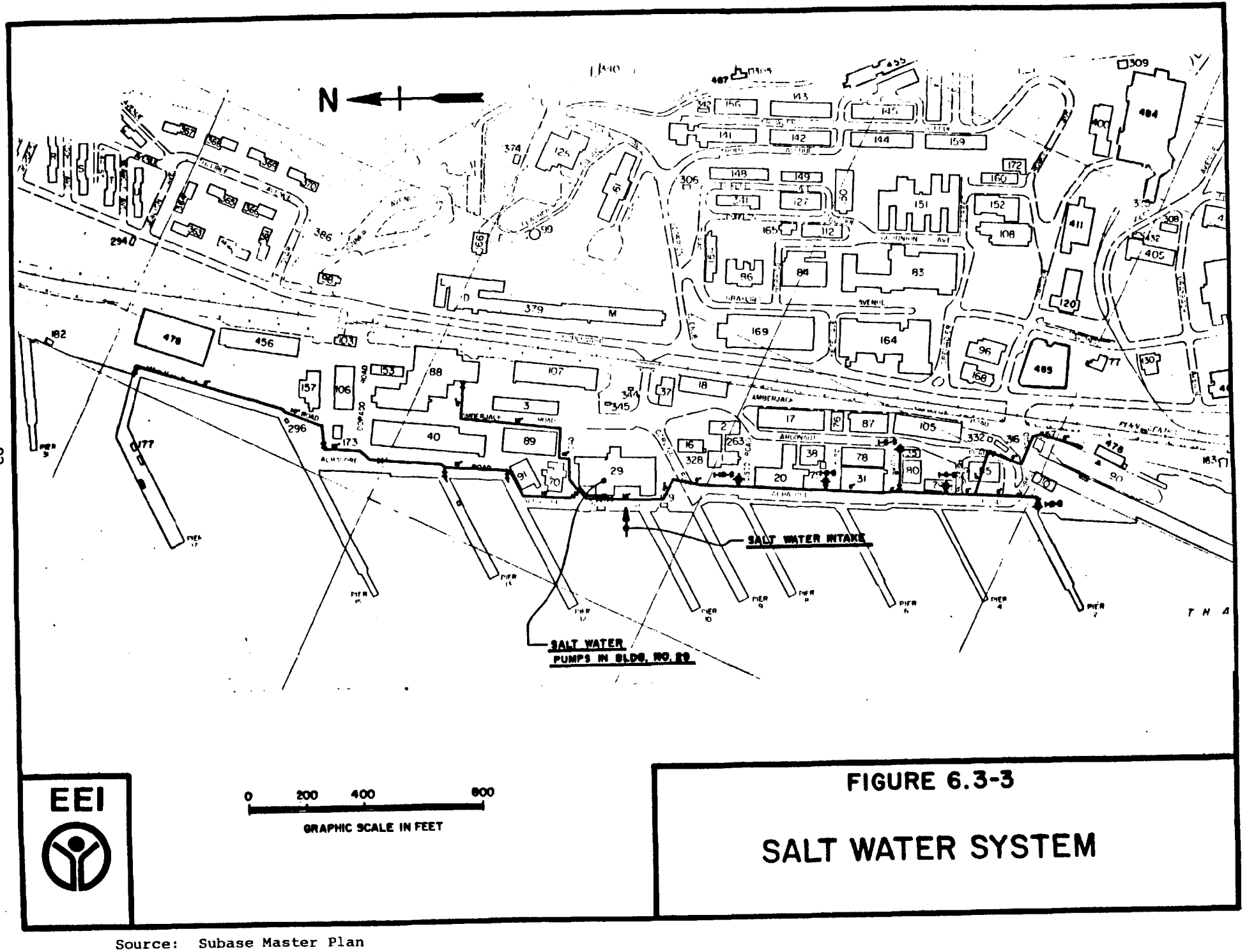

FIGURE 6.3-3

SALT WATER SYSTEM

Source: Subase Master Plan

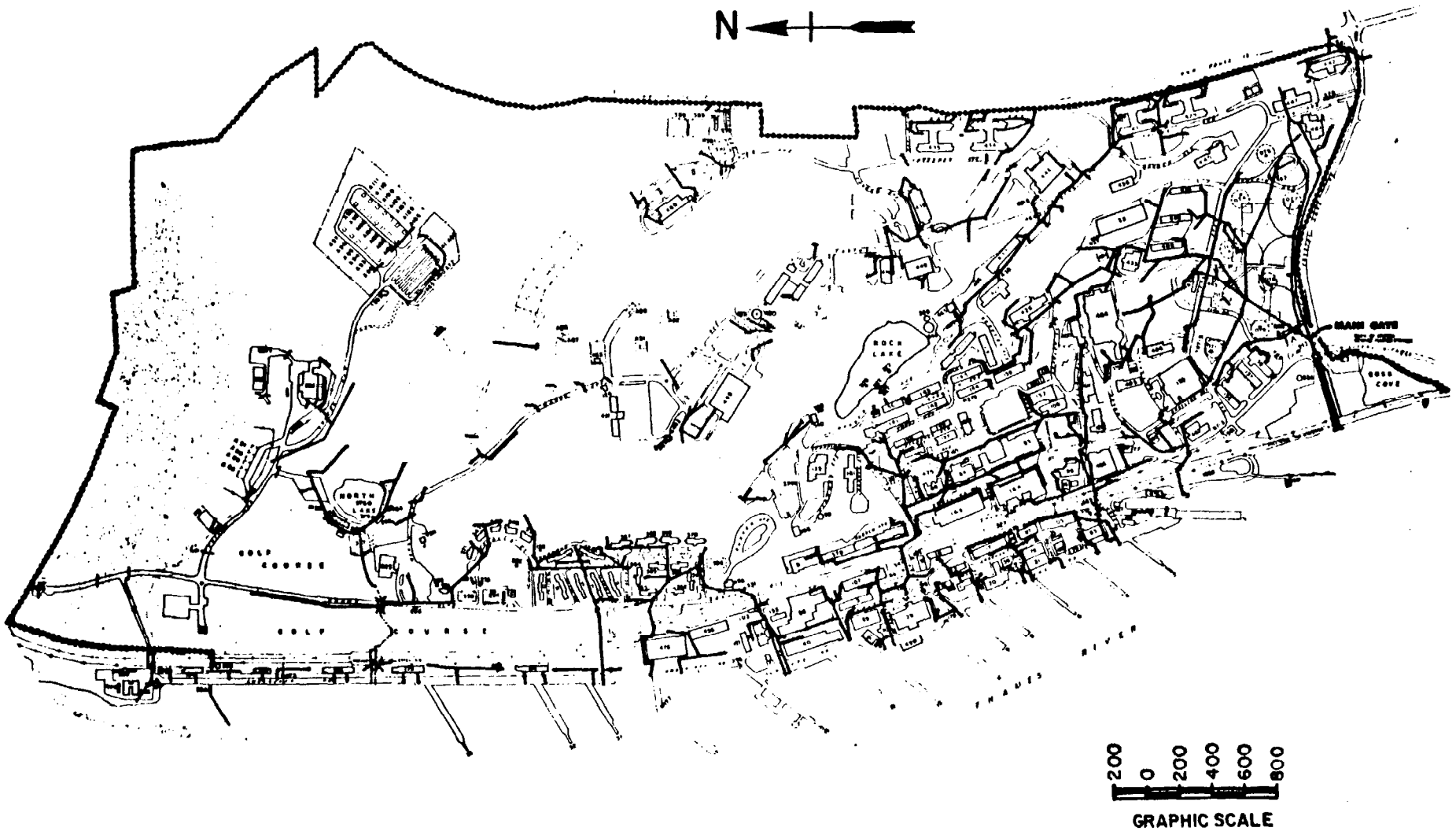

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FIGURE 6.3-4

STORM SEWER SYSTEM

Source: Subase Master Plan

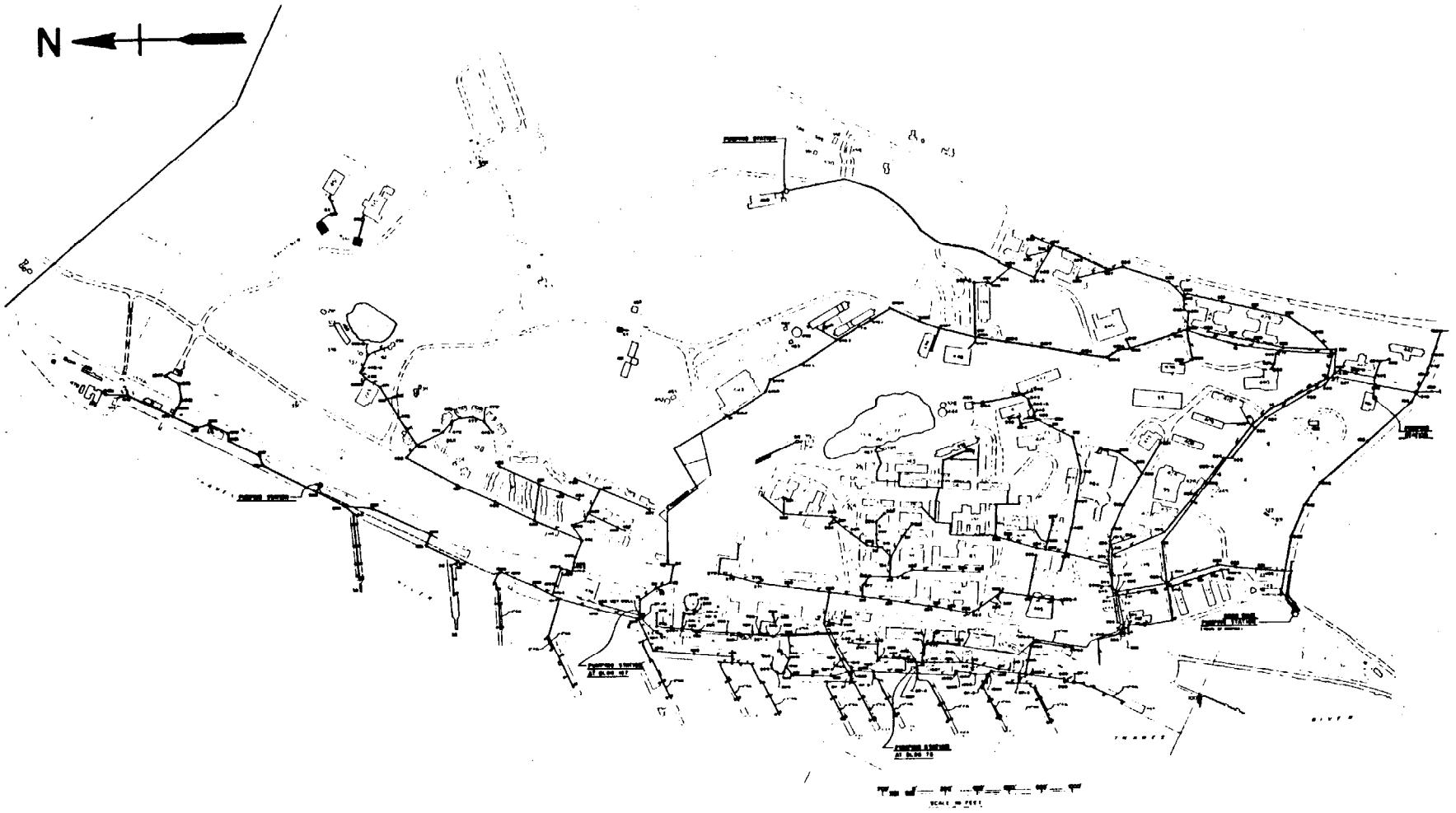

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FIGURE 6.3-5

SANITARY SEWER SYSTEM

Source: Subase Master Plan

gallon per day (MGD) activated sludge treatment facility. The Subase, on an average, discharges approximately 1.5 MGD of sanitary wastewater into the municipal system. However, flows above 2.0 MGD have been recorded indicating a possible infiltration/inflow problem with the Navy's sanitary sewer system. There are also 15 septic tanks/leaching field systems in areas not served by the sewer system.

Prior to 1977, the Subase operated four sewage treatment plants. These facilities provided primary treatment to the housing area and the main base. All four plants discharged treated effluent into the Thames River.

There were two plants serving the Subase, one for the upper base collection system, and one for the lower base. Each plant consisted of two Imhoff tanks (Buildings 116 and 117 - upper base and Buildings 71 and 72 - lower base), covered sludge drying beds (Buildings 114 and 73) and a chlorinating house (Buildings 115 and 74) (Figure 6.3-6). Post-effluent chlorination was provided during the summer months as required by the state. Based on a surface loading rate of 600 gpd per square foot, the upper base plant had a capacity of 0.66 MGD average flow, and the lower base facility an average flow capacity of 0.43 MGD. Flows generally averaged about 0.21 MGD and 0.20 MGD, respectively, at the time of shut-down. Both plants were in poor operating and physical condition at the time of abandonment.

The Navy Housing had treatment plants at Conning Towers and Nautilus Park before connecting to the city's system. The Conning Towers facility contained a comminutor, two Imhoff tanks, a chlorinator and sludge drying beds. The area also contained an independently operated septic tank. The average design flow for the treatment plant was 0.2 MGD. The Nautilus Park treatment plant consisted of a comminuter and bar rack, aerated grit chamber and a grit channel, pre-chlorination, three settling tanks, two heated digesters and one open digester. This facility had an average design flow capacity of 1.0 MGD.

Sewage from ships and submarines berthed at the Subase piers was discharged directly to the Thames River before the ship-to-shore collection system was installed in the mid-70's (but not utilized until the late 70's due to design deficiencies). The pier facilities consist of several ship-to-shore hose connections on each pier for discharge of sewage from ships and submarines berthed at the piers. These connections are tied into the under- pier piping system which acts as a force main discharging into the activity's sanitary sewer system.

The City of New London has been treating wastewater from the Subtender USS Fulton (AS-11), located at the State Pier, since late November 1971. The Fulton has three treatment sub-systems: the on-board "Sewage Treatment System," the "Internal Manifold System," and the "Submarine Alongside System" (Figure 6.3-7). The on-board sewage system collects sewage and disposes of it through incineration and electrochemical processes (Figure 6.3-8). The manifold system collects shipboard wastes, including sanitary sewage, galley, laundry, medical and

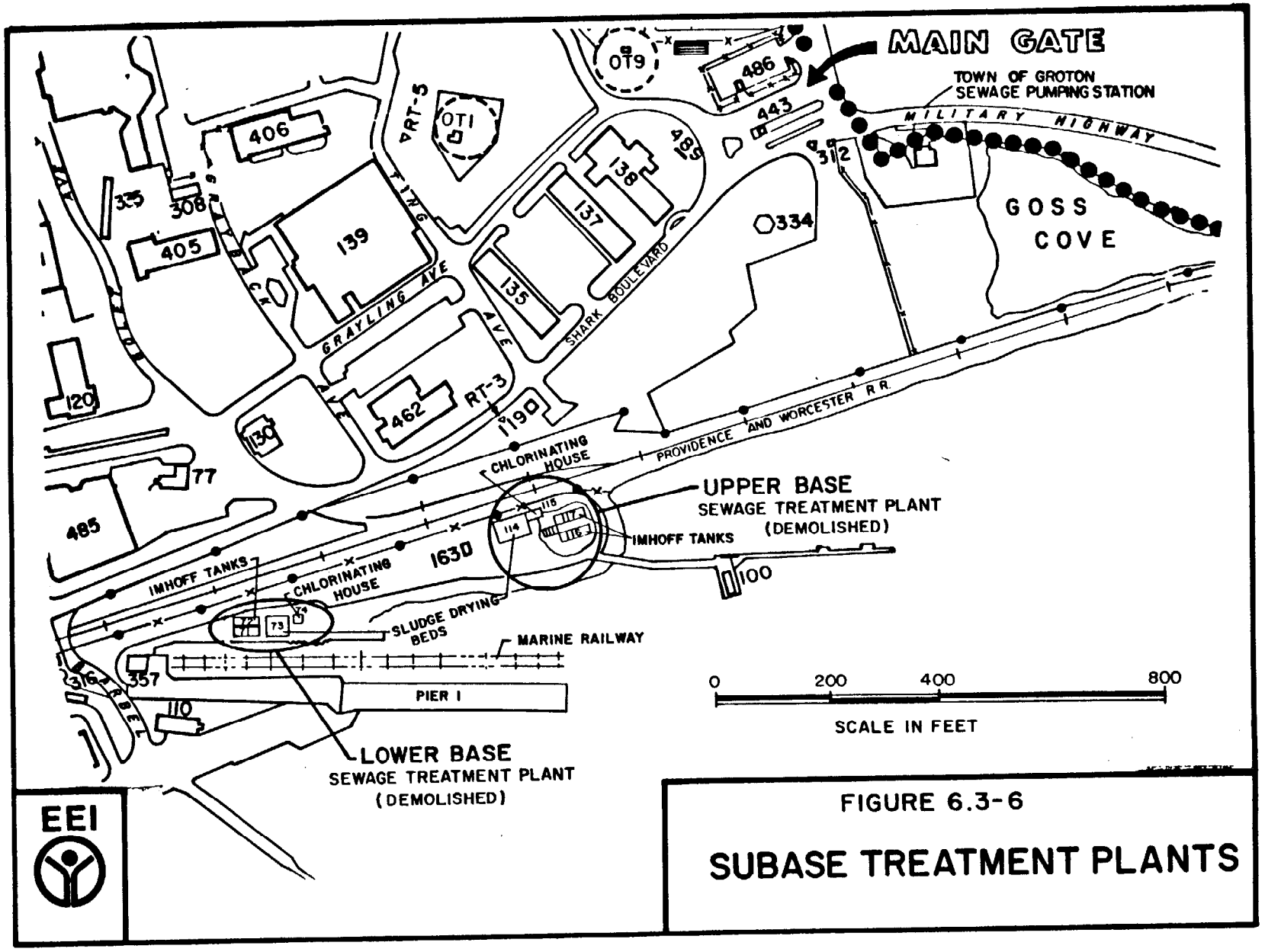

FIGURE 6.3-6

SUBASE TREATMENT PLANTS

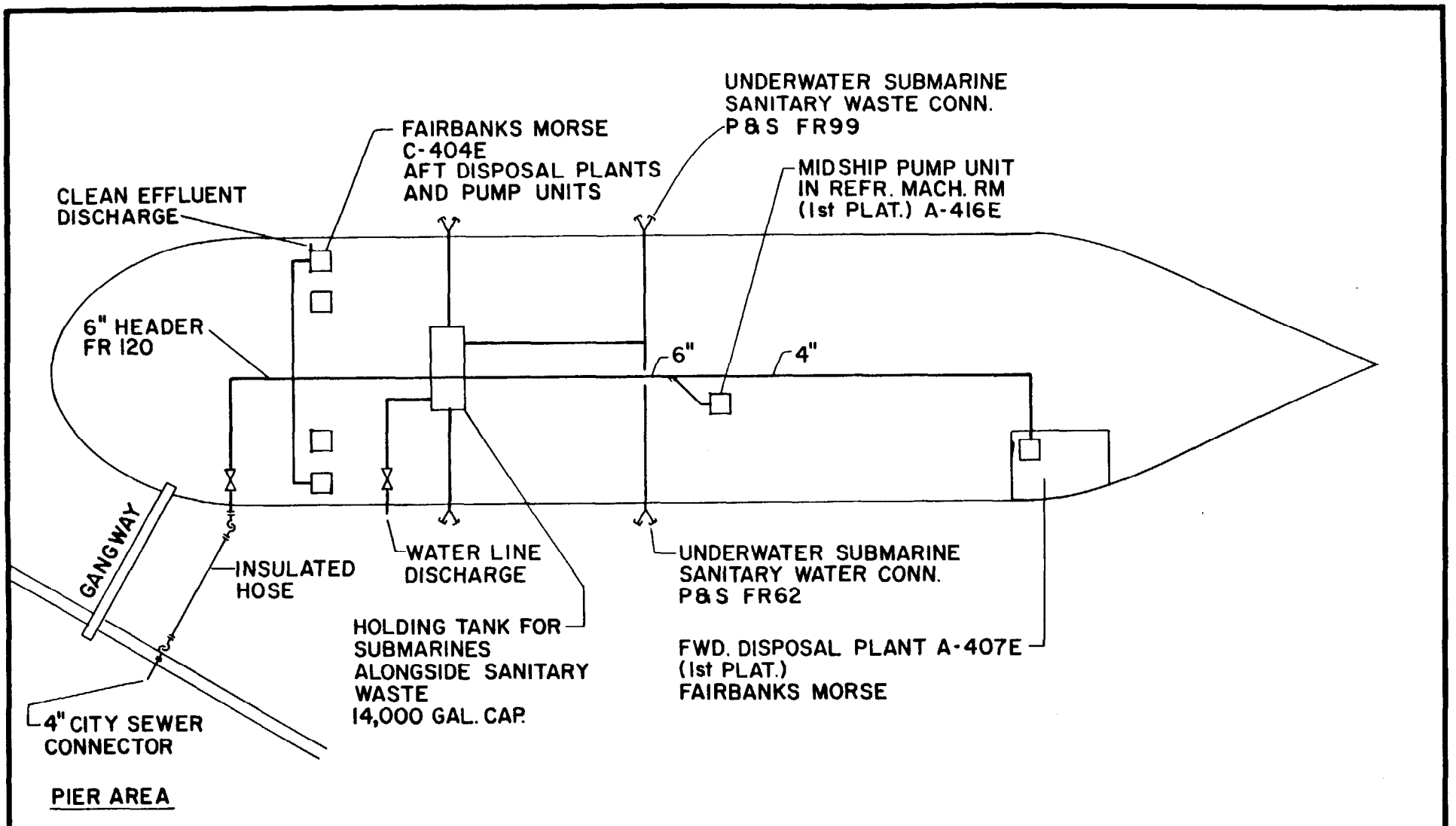

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FIGURE 6.3-7

SEWAGE TREATMENT UNITS
IN USS FULTON

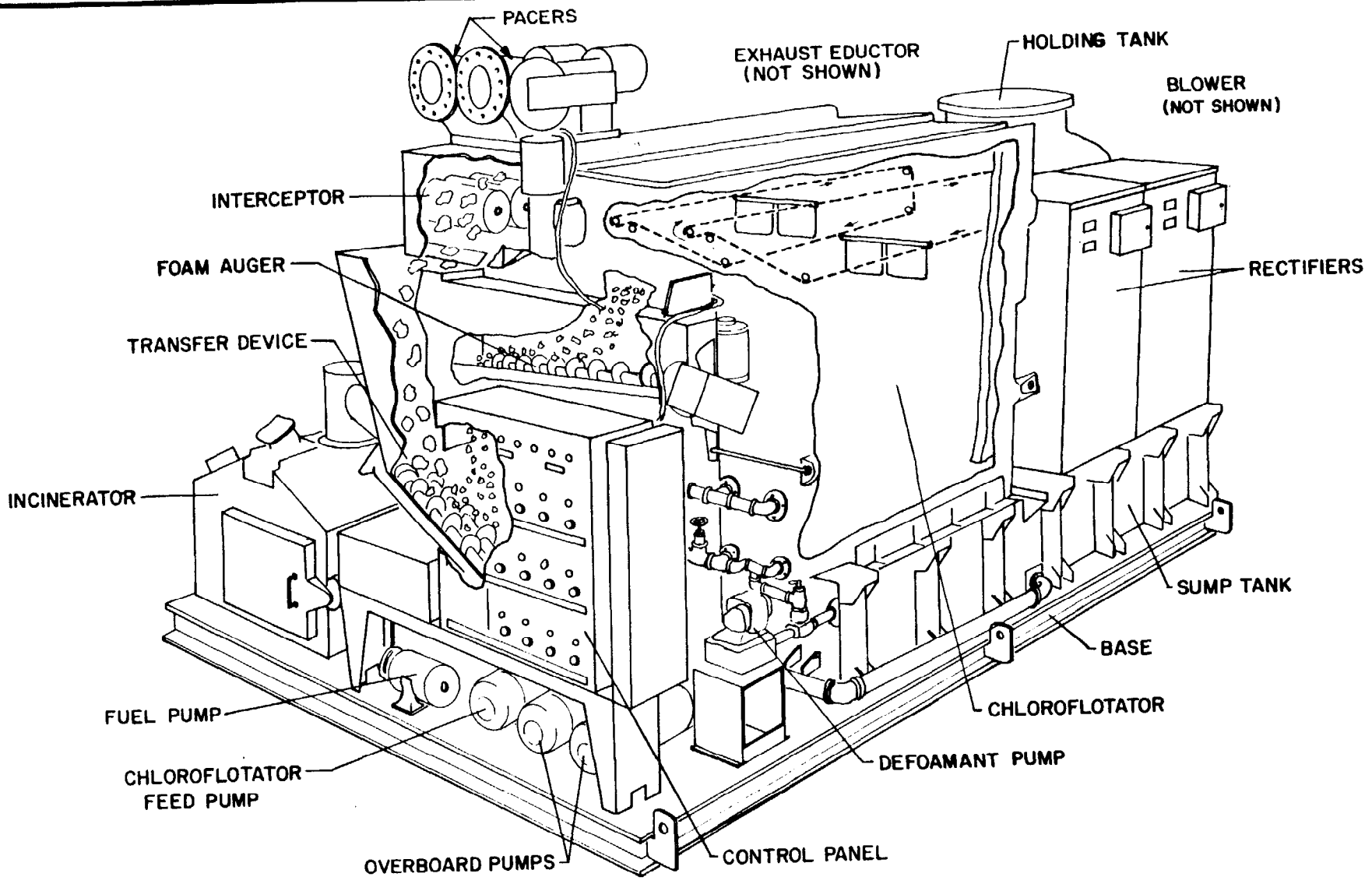

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FIGURE 6.3-8

ON-BOARD SEWAGE SYSTEM

industrial wastes, and transfers them to the city sewer system. An estimated 63,000 gallons are discharged from the Fulton daily. The third system, the Submarine Alongside System, permits the Fulton to receive sewage from submarines moored alongside and transfers it from a holding tank to facilities ashore via the Internal Manifold System. Water is taken from the river to act as a cooling agent for certain equipment, and this water is returned directly to the Thames. Condensate from air conditioning units, city water used in washing down decks, as well as rain water, all discharge overboard. The effluent from the on-board treatment system also is discharged overboard after undergoing processing which is equivalent to secondary treatment when the Fulton is not berthed at the pier. While berthed at the State Pier, the on-board system is not used but is tied directly into the pierside sewer system for treatment at the municipal plant.

6.3.1.10 Foreign Generated Garbage Disinfection System - The Subase has two dumpsters converted into foreign garbage cookers. When a vessel berths with foreign garbage, Port Services contacts the Maintenance Division of Public Works. The State Department of Agriculture is then contacted and notified about the operation. A garbage cooker is then taken down to the pier where the crew loads the cooker with all the food and garbage on board. The cooker is then hauled to Building 400 for processing. The design concept has been adopted by several naval activities and approved in accordance with U. S. Department of Agriculture (USDA) regulation and OPNAVINST 6240.36 of 5 July 1977 (Figure 6.3-9). The normal operating procedure is to connect the unit to a steam line and add water until it is approximately two-thirds full. The garbage is then cooked for approximately 30 minutes at 212°F. The cooked garbage is ultimately disposed of in the municipal landfill.

6.3.1.11 Diesel and Fuel Oil Systems - The base diesel and fuel oil systems are reportedly in fair condition due to their age and concrete construction. The diesel system includes four 750,000 gallon underground storage tanks (OT 4, 7, 8, and 9), located at the upper base tank farm, and four 125,000 gallon tanks (54 C, E, F, and G) on the lower base. The diesel oil distribution system is comprised of approximately 11,000 linear feet of 6-inch pipeline. The fuel oil system contains three 750,000 gallon upper base storage tanks (OT 1, 2, and 3) and two 250,000 gallon tanks (54 A, and B) near the power plant. The fuel distribution system consists of approximately 3,700 linear feet of 12-inch line which is placed in steam heated trenches to aid in pumping.

6.3.1.12 Oily Waste Handling/Reclamation - The oily waste at the Subase consists principally of ship's bilge and ballast water together with steam turbine lubricants, hydraulic oils, internal combustion engine lubricants, and various fuel from tank bottom strippings. The base annually produces approximately 1,200,000 gallons of oily wastewater, of which some 180,000 gallons are reclaimable waste oil. About 95 percent of the total waste volume originates on board subs with the remaining quantity generated from land-based facilities. The Subtender USS Fulton contributes a large percentage of this wastewater.

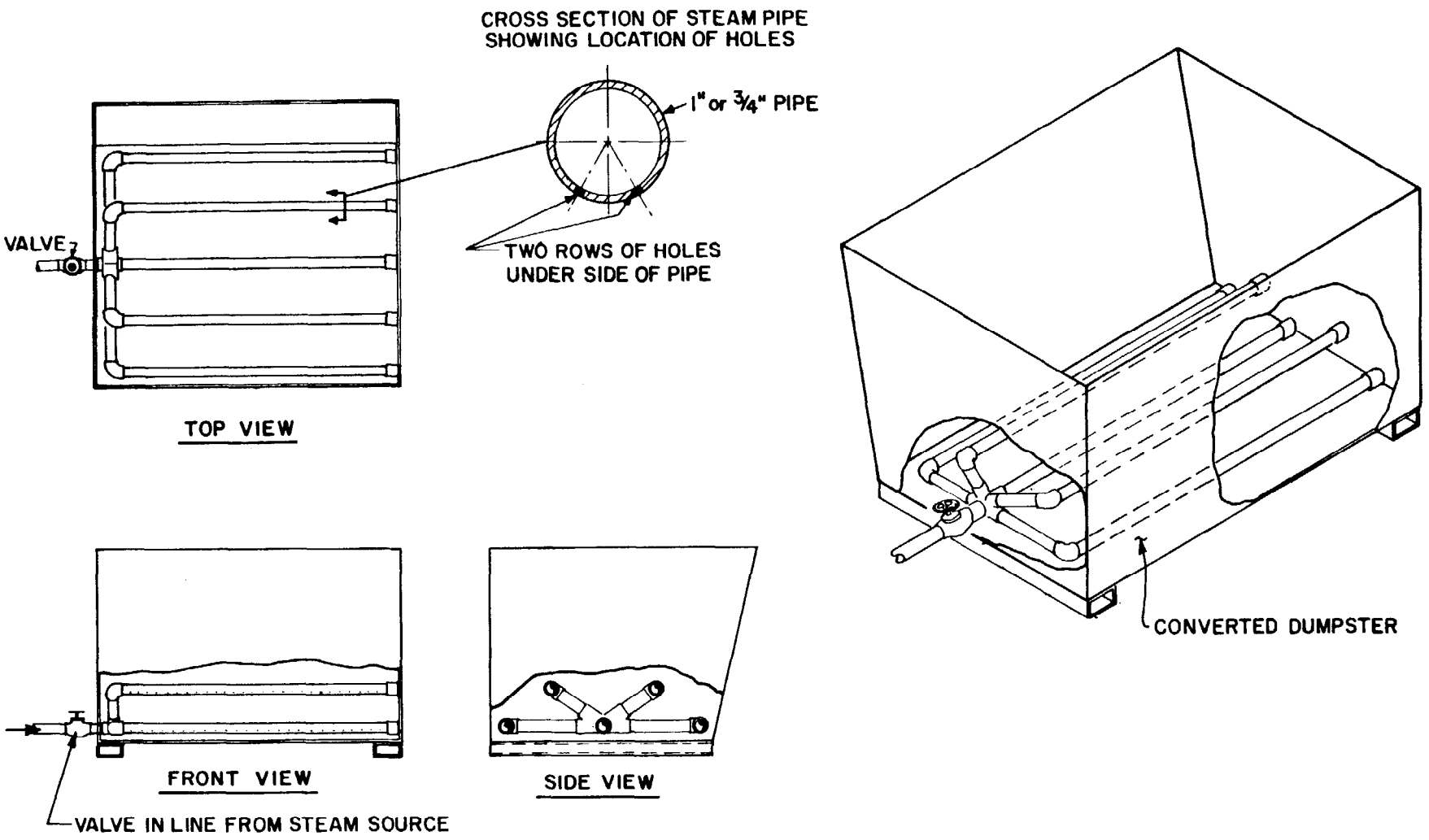

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FIGURE 6.3-9

FOREIGN GARBAGE COOKER

Currently, oily wastes are pumped from the submarines into base tanker trucks and hauled to Tank No. 5 in the fuel farm area for separation. The transported oily wastewater is held in the 750,000 gallon underground concrete tank where gravity separation occurs. The layer of separated oil above the wastewater is pumped from the tank by a contract hauler several times each week.

The wastewater is pumped from beneath the oil layer and discharged to the sanitary sewer. Unfortunately, there are some problems associated with this treatment scheme. The long settling times required to provide adequate separation of the oil and water results in anaerobic decomposition of the tank's contents, forming hydrogen sulfide in solution. Therefore, the wastewater has to be pumped at a very slow rate, 20 gpm, to reduce the odor problem. Tank No. 5 has been used for oily wastewater treatment since the early 70's. Prior to that time, a smaller, 100,000 gallon tank was used to accommodate this waste. The accidental oil discharge, which occurred in 1980, prompted redesign of this treatment scheme. The new system contains automatic oil level sensor controls with alarms and a new A.P.I. separator. Tank No. 5 is still used for the primary holding tank in this system.

The base also reclaims the oil from the bilge water generated at the power plant. Until recently, the facilities used to separate the oil from the wastewater were undersized and did not provide sufficient safety against contamination of the Thames River. In fact, on the morning of 14 July 1977, an oil spill estimated to be 1,300 gallons of heavy black oil was discovered adjacent to the pier at the Subase. The origin of this spill was identified by the Coast Guard Research and Development Center, Groton, Connecticut, as being the reclamation tank and/or the oil/water separator in the power house. This incident prompted design of a new reclamation system which was recently completed. The new system provides a positive displacement pump with an automatic oil-water interface detector and API coalescent oil/water separator. The wastewater effluent line was rerouted to the sanitary sewer. Unfortunately, the system is not operating properly because back flushing capabilities were not provided. At this time, the system is being run in a manual mode. Oil obtained in the operation is pumped to the oil reclamation tank, 54-D.

Before the new unit was installed, bilge water was pumped from sumps within the power plant to the 30,000 gallon reclamation tank in the building. During the night shift, the level of oil within the tank was determined visually by bleeding the liquid off from the lowest (tri-cock) level to the highest until oil could be seen in the liquid. The wastewater, approximately 4,000 gallons per day, was pumped to a small gravity oil/water separator on top of the reclamation tank. The pump was manually controlled by the operator who visually monitored the treatment operation. Wastewater drained from the separator was discharged with steam generator softening wastes directly to the Thames River.

The Port Services, NAVSUBSUPFAC, is responsible for maintaining the floating oil spill prevention equipment for the Subase. The cleaning equipment is stored in the vicinity of the waterfront, near Pier 1. Subase has an Oil Spill Prevention Control and Countermeasures (SPCC)

Plan. This plan identifies the improvement actions for oil storage and handling facilities. The Oil Spill Cleanup Contingency Plan is also on file at the activity.

6.3.1.13 Solid Waste Disposal - The activity generates an estimated 26 tons of solid wastes daily, or some 10,000 tons annually. All solid wastes generated at the Subase (including Navy housing) is collected, hauled, and disposed of by private contractors under two separate contracts. The waste is disposed of in the sanitary landfill owned and operated by the town of Groton. The city has recently purchased additional land in order to expand and extend the life of the municipal landfill.

Recycling of specific solid wastes is presently accomplished in accordance with Navy regulations. Approximately 30 tons of glass and 0.5 ton of aluminum cans are reclaimed each year. Receipts from the sale of these materials are placed in a fund administered by the comptroller and reserved for environmental enhancement programs. Additionally, computer cards and corrugated containers are source separated and sold for recycling as required by OPNAVINST 6240.3E.

The activity has destroyed all classified materials by shredding since December 1977. Classified waste is shredded at various locations on the base. The Public Works Department operates a central classified material shredder in Building 35. Prior to 1977, a classified materials incinerator, Building 97, was also used; however, it became uneconomical and infeasible to continue using the incinerator because of its age and passage of the Clean Air Act of 1977.

6.3.1.14 Industrial/Hazardous Waste Storage and Disposal - The primary generators of industrial or hazardous wastes at the activity are the submarines, support operations, and hospital laboratory. A list of commonly generated wastes by activity function is provided in Table 6.3-1.

Prior to the passage of the RCRA regulations, the Subase stored industrial wastes generated by various acitivities in a remote area of the base adjacent to the marsh south of Area A. Storage of materials at the site began in mid-1972, and by 1976, the condition of the holding area was reportedly generally poor. Some barrels marked acid or caustic were rusted through and the contents gone. Other drums contained small glass containers of acids, and many of the drums were not capped. There were other problems associated with the site also. Since the area was located near the marsh area, the potential of contaminating the marsh, and eventually the Thames, is highly likely. Acess to the site was not restricted, adding to the safety and environmental hazards. This led to the development of a program to dispose of these wastes. Techniques used for their eventual removal in the late 70's included: collecting and disposing of the waste oils via normal operating procedures at the base; using recovery techniques and disposal contractors.

TABLE 6.3-1

INDUSTRIAL/HAZARDOUS WASTE GENERATION

Activity	Waste Generated
Naval Submarine Support Facility (NSSF)	Waste paints Xylene Hexane Alcohol Hydrazine Trichloroethylene Metal plating waste Acids Otto fuel Otto fuel residues
Submarine Squadrons	Ammonium hydroxide Sodium chromate solution Mercuric nitrate solution Monoethylamine Hydrogen peroxide Lithium hydroxide canisters Oxygen candles (sodium chlorate) Morpholine Lithium bromide
Subase	Halogenated solvents Non-halogenated solvents Monoethylamine Pesticides Paints PCB Polyvinyl chloride
Naval Submarine Medical Center (NAVSUBMEDCEN)	Xylene Hydrogen peroxide
Subtender USS Fulton (AS 11)	Sulfamic acid MEK
Naval Submarine Medical Research Laboratory (NAVSUBMEDRESLAB)	Acids X-ray developer

An inventory of materials stored at the site was conducted in mid-1973 by base personnel. This inventory also provided estimated annual quantities which would be generated by the activity. This information is presented in Table 6.3-2.

The Subtender USS Fulton, berthed at the State Pier, generates a considerable amount of its own wastes from on-board operations in addition to wastes obtained by pumping operations from submarines in the squadron. A survey was taken in mid-1971 to determine the types of wastes generated on the Fulton and their compatibility with the municipal system prior to connection of the ship-to-shore disposal facility. In the agreement with the city, the Navy promised not to discharge hydrazine into the sewer system. The agreement also reaffirmed that discharges would be within the pH range of 5.5 to 9.0, silver compounds were recovered, and mercuric compounds were also not discharged. The Fulton was connected to the New London municipal system near the end of 1971. Prior to this time, all wastes were probably discharged overboard.

A more thorough determination of the types and quantities of industrial wastes drained into the ship's drainage system was undertaken by the Fulton Engineer Officer in January 1981. These findings are summarized in Table 6.3-3. The exact disposition of each waste could not be ascertained, but most of the wastes were probably discharged to the sewer system.

6.3.2 Pesticide Operations

6.3.2.1 Pesticide Operations - The Endangered Species Act (PL 93-205) requires all federal agencies to ensure that their activities do not jeopardize any endangered or threatened species. Navy policy states that mammal or bird damage control programs be conducted in a manner which contributes to the maintenance of environmental quality and to the conservation and protection of the wildlife resources. The field use of chemical toxicants which cause secondary poisoning effects for bird or mammal control is generally prohibited on the base. The outdoor use of rodenticides will normally be limited to multiple dose anti-coagulant rodenticides. The outdoor use of all toxic baits for bird and mammal control, except in base housing and industrial areas, has to be approved by Northern Division.

Since the Subase is situated on the Thames River Estuary, outdoor pesticides applications are carefully planned to prevent introduction of pesticide materials into this habitat. Measures to minimize drift and prevent runoff are implemented whenever outdoor applications are conducted.

6.3.2.2 Pesticide Disposal - Disposal of pesticides and pesticide containers is conducted in accordance wth federal, state, and Navy regulations. Disposal of excess dilute pesticide is minimized by carefully estimating the amount needed. Applications performed in strict accordance with the pesticide label instructions are the best method of disposal. Hand spray equipment wash water is used as diluent for the next

TABLE 6.3-2

INDUSTRIAL/HAZARDOUS WASTE INVENTORY

June 1973

Waste	Actual Quantity (gallons)*	Estimated Annual (gallons)*
Ammonium hydroxide (NH_4OH)	6.6	-
Lithimu bromide ($LiBr_2$)	250	250
Phosphoric acid (H_3PO_4) (pH - 1.0)	200	600
Trichlorotrifluoroethane (solvent)	165	1,000
Penetone 423 (caustic)	25	50
Ion exchange resin	0.5	3
Manganous sulfate	0.5	3
Trisodium phosphate (powder)	175 lbs	-
Hydrazine (N_2H_4)	3	20
EDTA (powder)	75 lbs	200 lbs
Fluorescein (uranine yellow)	110	300
Paint thinner	165	300
Power plant soot	4 - 55 gal drums	1,650 30 drums
Sodium bisulfate solution (pH - 1.7)	275	600
Nitric acid (HNO_3) (pH - 1.0)	1	5
Insectrocide	1 qt	-
Potassium hydroxide (KOH)	14	100
Hydrochloric acid (pH - 1.0)	3.5	10
Mercuric nitrate ($HgNO_3$)	0.5	-
Sodium thiosulfate	1 qt	-
$H_2O + N_2H_4$ + EDTA	200	2,400
Sulfamic acid (pH - 4.0)	955	2,000
Agitene cleaning solvent	165	165

NOTE: *Quantities in gallons unless otherwise noted.

TABLE 6.3-3

FULTON DRAINAGE SYSTEM INDUSTRIAL WASTES

Waste	
Trisodium phosphate	10 lbs/month
Hydrazine	18 gal/2 months
Ethlenediaminetetracedic acid (EDTA)	88 lbs/months
Non-ionic detergene	4 gal/month
HCL and H_2SO_4 acid (weak dilution)	5 gal/month
Freon	10 gal/month
Naptha and acetone	5 gal/month
Dry cleaning fluid (for cleaning electric motors)	1 gal/month
QXL Detergent	18 gal/month
Film developer (made up of 9 different chemicals)	18 gal/month
Detergent (ultrasonic)	15 gal/month
Laundry:	
1. Detergent	250 lbs/month
2. Starch	100 lbs/month
3. Bleach, whitener	125 lbs/month
4. ARLAC soup builder	200 lbs/month
5. Sour, removes soap and stain	50 lbs/month
Scullery: detergent, general purpose water soluble, non-toxic, liquid	40 gal/month

formulation of the same pesticide. Power spray equipment is triple rinsed in the field using approximately 10 percent of the tank capacity divided into three doses. The rinse material is sprayed on the application area consistent with the pesticide label.

Empty organic pesticide containers are triple rinsed with about 10 percent of the containers' capacities divided into three doses. The rinse material is saved for the next formulation of that pesticide. Drums are returned to the manufacturer for recycling whenever possible. After rinsing, small containers destined for disposal are punctured, crushed and placed in the base dumpster for disposal in the town of Groton landfill. Disposal of excess quantities of usable registered pesticides is accomplished by transfer to other DOD activities. A summary of pesticide usage at the Subase in 1981 is presented in Table 6.3- . The nearly 94,000 pounds of pesticide formulated in 1981 are considered typical for Subase operation. This work was conducted totally by in-house certified personnel.

6.3.2.3 Pesticide Storage and Mixing Facilities -

6.3.2.3.1 Golf Course: The golf course pest control shop has been located in Building 281 near North Lake at least since 1975. Pesticides used on the golf course are stored in a portable utility building situated adjacent to Building 281. The storage and mixing facilities do not meet specific requirements. A new storage and mixing facility was scheduled for Fiscal Year 82 but will be delayed due to funding cutbacks. A list of golf course pesticides stored in the temporary structure is presented in Table 6.3- .

6.3.2.3.2 Public Works: The Public Works Department conducts building and outdoor spraying not associated with the golf course. The PWD pesticide storage and mixing facility has been located in Building 400 since the early 1970s. Office space for the Pest Control Supervisor is located in Building 406.

6.3.2.3.3 Medical Department: The Medical Department storage and mixing facility is located in the basement of Building 86. This facility is reported to be inadequate for this purpose because of insufficient ventilation. Also, separate areas for mixing, equipment and pesticide storage are not provided.

6.3.3 Photographic Laboratory

The Subase photo lab is located in Building 106 on the lower base. Lab personnel indicated that about 150 gallons per month of chemical waste is produced from photo developing operations. In August of 1975, the lab initiated a silver recovery program. The recovery unit is physically located at DPDO. The hypo-solution, used as a fixer, is collected and treated within DOD. The hypo-solution is passed through ion exchange cartridges at DPDO. The cartridges are then shipped to Fort Monmouth, New

TABLE 6.3-4

PESTICIDE USAGE

Pesticide	Use	Pounds Formulated	Active Ingredient (pounds)	Type Area Treated
Anticoagulant	Rodent	1,465	<1	Industrial, offices, warehouses
Baygon	Insect	99	<1	Exchange, industrial, residence
Chlorone B	Fungi	2,575	22	Golf course
Daconil	Fungi	75,008	<1	Golf course
Dichlorvos	Insect	12	<1	Residence
Diazinon	Insect	76	<1	Residence
Dursban	Insect	11,809	48	Barracks, exchange, food handling, hospital, industrial, offices, chapel, residence, warehouses
Metaldehyde	Mollusc	16	<1	Hospital
Misc. Fungicides	Fungi	2,575	<1	Golf course
Pyrethrum	Insect	56	<1	Residence, sewer, warehouses
	Totals	93,691	70	

TABLE 6.3-5

GOLF COURSE PESTICIDES

Manufacturer	Form[a]	Product	Active Ingredient	Classification
Scotts	G	Fungicide II	Chloroneb 6.25%	Fungicide
Gordons	WP	Topmec 70W	Dimethyl 4, 4-0 Phenylenebia 70%	Fungicide
DuPont	WP	Tersan 1991	Benomyl 50%	Fungicide
DuPont	WP	SP	Chloroneb 65%	Fungicide
Gordons	WP	DYMEC 50	Dyrene 50%	Fungicide
Prhonepoulene, Inc.	WP	Chipco 26019	Iprodione 50%	Fungicide
Diamond Shamrock	WP	Daconil 2787 WP	Chlorothalonil 75%	Fungicide
Mallinckrodt	WP	Duosan	Thiophanate-Methyl 15% Manganese (MN ++ 12%) Zinc (ZN) ++ 1.5% Ethylenerbis Dithiocarbamate 46.5%	Fungicide
Tuco (Upjohn)	WP	Acti-dione Thiram	Cycloheximide .75% W/W Thiram 75% W/W	Fungicide
Mobay Chemical	WP	Bayleton	Triabimefon 25%	Fungicide
Scotts	G	Fungicide VII	Triabimefon 0.59%	Fungicide
Pratt*	EML	Diazinon AG4E	Diazinon 73.7%	Insecticide
CIBA-Geigy*	EML	Diazinon AG 500	Diazinon 74%	Insecticide
Dow*	EML	Dursban M	Chorpyrifos 70.7%	Insecticide
Scotts	G	Insecticide One	Diazinon 4.5%	Insecticide
Tuco (Upjohn)	WP	Proxol 80SP	Dimethyl (2,2,2-Trichlorol-Hydroxyethyl) Phosphonate 80%	Insecticide
Alfco*	EML	MCPP-K	Chlorophenoxy Herb 48.3%	Herbicide
Rhodia*	EML	CHIPCO D	2,4-D 49.8%	Herbicide
DuPont	WP	Tupersan	Siduron 50%	Herbicide
Gordons*	EML	Trimec Bent Formula	2,4-D 6.5% MCPP 19.8% Dicamba 2.6%	Herbicide
Monsanto*	EML	Roundup	Isopropylamine Salt of Glyphosate 41.0%	Herbicide
Scotts	G	Starter fertilizer with pre-emergence weed control	Siduron 3.1%	Herbicide
Scotts	G	Fertilizer Plus Dicot Weed Control II	2,4-D 1.15% MCPP 1.15%	Herbicide

NOTES: [a] G = granular
WP = wet powder
EML = emulsion

*Product which will be phased out.

Jersey for further processing. After passing through the ion exchange system, the hypo-solution is discharged to the sanitary sewer. Developer is collected and put into 55 gallon drums which are sent to the hazardous waste storage area. Black and white photo rinse water is discharged to the sanitary sewer.

6.3.4 Damage Control Center

The Damage Control Training Center, Building 465, has a mock-up boiler room, known as the "Firebird," which was used for fire fighting training exercises. However, since the passage of more stringent air pollution regulations in the early 1970s, this training was discontinued. After that time, only classroom training was conducted. OBA canisters, which continue to be used to produce oxygen in training breathing masks, are disposed of at the Center. Oxygen is generated by the chemical reaction $2KO_2 + H_2O = 2KOH + 3/2\ O_2$. The expended canisters are placed in a 100 gallon tank of water for 24 hours. This operation forms a highly basic solution which is still bled slowly into the sanitary sewer.

6.3.5 PCB Transformers

There has been a large number of PCB transformers located throughout the Subase for many years. The ones located on Piers 2, 6, 15, 31 and 32 and at Buildings 29, 40, and 456 present a particular hazard due to their locations on or adjacent to the Thames River. An inventory of in-service equipment, as of November 1980, is presented in Table 6.3- . Out of service transformers are stored on the pad at Area A. This equipment contains approximately 140 gallons of PCB-containing dielectric fluid.

6.3.6 Supply Department

The Supply Department at the Subase provides complete supply support to the center and tenant commands.

6.3.6.1 Storage Branch - The Storage Branch of the Supply Department stores, maintains, and issues material as well as providing temporary storage for local commands. Personnel in the Storage Branch provide general hazardous material and bulk storage information for the Supply Department. Hazardous and incompatible materials are segregated and stored in a manner to provide safe storage until issued. Building 31 is the primary Hazardous Materials Storage location on the Subase and is discussed in detail in Section 6.5.2. No significant spills were reported by base personnel.

6.3.6.2 Fuel Branch - The Fuel Branch furnishes #6 low sulphur (L/S) fuel, Navy Marine Diesel (DFM), 9250 lube oil, and 2190 TEP lube oil, all in bulk form, to fleet units and shore activities. The Subase contains 13 fuel storage tanks and one holding tank, used solely for receiving DFM defuelings. These tanks are situated on both the upper and lower base.

TABLE 6.3-6

PCB TRANSFORMER INVENTORY

Location	Number of Transformers	Quantity (gallons) Per Transformer	Subtotal	Type of PCB Liquid	KVA
Pier 2	1	615	615	Askarel N-3	2300
Pier 6	1	585	585	Askarel N-4	3125
Pier 15 (RDM 4)	1	465	465	Inerteen	
Pier 31	1	581	581	Askarel N-3	3125
Pier 32	1	433	433	Inerteen	4687
Building 29	3	890	2670	Pyranol	5250
Building 40 (West Side)	1	247	247	Inerteen	750
Building 448	1	110	110	Pyrnaol	500
Building 173 (NE)	1	683	683	Askarel N-3	3750
Building 456	1	245	245	Inerteen	750
Building 462	1	125	125	Pyranol A13B3B	225
Hospital	2	360	720	Inerteen	1000
Vault 3	3	82	246	Pyranol	333
Vault 3	3	155	465	Askarel	333
Vault 6	1			Inerteen	15
Vault 19	2	25	50	Pyranol	25
Vault 20	1	227	227	Askarel N-3	862
Vault 24	1	550	550	Inerteen	1000
Valut 24	1	436	436	Askarel	1000
Vault 26	1	40	40	Abestol	100
Vault 26	1	49	49	Pyranol 1467	10
Vault 27	1	40	40	Abestol	100
Vault 28	1	40	40	Abestol	100
Vault 41	1	265	265	Askarel	500
Vault 45	1	125	125	Pyranol	150
Vault 50	1	340	340	Pyranol A1383B	750
Vault 59	2	150	300	Askarel	225
Vault 59	2	122	244	Askarel	150
Vault 68	2	734	1468	Askarel	2000
Vault 82	1			(ORTO-Line Material)	75
Vault 85	2	99	198	Pyranol A50P524	75
Vault 96	1			(ORTO-Line Material)	500
		Total	12,838 gallons at Subase		

Storage capacity of these tanks totals approximately 143,000 barrels of product. There are approximately 14,000 feet of pipeline throughout the facility used to transfer fuels. The facility has fueling capabilities at Piers 1, 8, 10 and 12. Piers 12 and 13 have defueling capabilities which are segregated from the fueling system. Interviewed personnel were not aware of any significant spills from fueling operations.

6.3.7 Defense Property Disposal Office

The Defense Property Disposal Office (DPDO), Groton, is located at the northern end of the base. DPDO arranges for the sale or disposal of a wide variety of "used" or surplus items. DPDO at NSB New London occupies six buildings and a large storage lot. The six buildings are:

Building 397 - Disposal Administration

Building 353 - Retail Sales

Building 385 - Weighing Facility

Buildings 355, 479, 491 - Storage/Disposal

The general storage lot to the north of the buildings contains piles of scrap metal, wood and tires, and a number of empty 55 gallon drums. Before promulgation of the Clean Air Act, open burning of these materials was conducted in this area, then called "Burning Point." A permitted hazardous waste storage facility also occupies some space at DPDO.

6.3.8 Past Facility Operation

6.3.8.1 Lead/Acid Battery Overhaul - Battery overhaul was probably the largest operation conducted on the Subase prior to nuclear power. The old diesel submarines each contained approximately 100 large batteries, each weighing many hundreds of pounds. These batteries were routinely serviced in the Battery Overhaul Shop located in Building 31 on the lower base from approximately 1920 until the mid-1950s. This operation provided complete service from charging to complete battery overhaul. When a battery required complete overhaul, the spent sulfuric acid solution was dumped into a spent acid tank located between Buildings 409 and 410. Acid was poured from the batteries into the inground rubber lined tank approximately 4 feet wide by 4 feet high by 12 feet long. Minor amounts of acid would leak from the batteries during dumping and disassembly, but no major spills were ever reported. When the tank became full, acid solution was transferred to barrels and transported to Area A for disposal. On several occasions, acid was poured into large trenches dug with a bulldozer and subsequently covered with soil. Interviewed personnel were unable to estimate the quantities of solution disposed of in Area A or used in filling batteries.

6.3.8.2 Old Drydocking Operations - The drydocking operations were located inside Pier 1. This facility was used for drydocking operations from approximately 1920 until the mid-1960's. Sand blasting was routinely conducted at this facility. Large amounts of blasting material probably fell into the river from the operation, but no persons were available to determine quantities of waste.

6.3.8.3 Diesel Engine Overhaul/Service - Engines were serviced in Building 79 during World War II and through the 1950's. As part of this operation, waste lubricating oil was drained into the sump pit located at the northwest corner inside the building. Potential leakage from this sump is suspected to be one of the sources of oil contamination on the lower base. A 1979 NESO report, #1-026, entitled "Oil Contamination of the Groundwater at Subase, New London, Connecticut," states that drilling logs and soil analyses indicate contamination in the vicinity of the building.

6.4 ORDNANCE OPERATIONS

6.4.1 Weapons Storage and Handling

The Weapons Department of the Naval Submarine Support Facility at New London is responsible for the storage, issue, overhaul, and testing of assigned types of submarine weapons. These operations are conducted in the northern portion of the base (Figure 6.4-1). The terrain of this area is partly wooded and includes the marsh land, Area A, and North Lake. This section of the base is somewhat inaccessible from the main operating area of the base. Because of this isolation, the area is well suited for the weapons functions. Also, in this location, the explosive-safety hazard zone radii generally encompass land not otherwise useable. The central area of the base, adjacent to the existing developed southern section, is not affected by the Explosive Safety Quality Distance arcs.

The consolidation of all weapons facilities to the northern portion of the base has had a beneficial effect on receipt and handling of weapons. Presently, all ammunitions enter the Subase through the North Gate and are transported to the ammunition storage area, Bunkers A-88 through A-91. Assembled weapons are transported to and from the waterfront via Barb Road, where loading or unloading operations are accomplished at a number of piers. Magazines A-1 through A-50, A-65 through A-77, and A-92 through A-111 are all used for a wide variety of high explosives including demolition charges, boosters, hand grenades, igniters, detonators, primers, and MK 37, 48, and 107 warheads.

Building 325 serves as the Weapon Administraton Office and contains a Quality Assurance Office and an MK 37 torpedo shop. Building 393 is used as the Ordnance Operations Office. The MK 48 Warshot torpedoes are overhauled in Building 450. This operation generates wastewater contaminated with OTTO Fuel II. This wastewater is piped to a 1,500 gallon underground holding tank located just outside the building. Torpedo servicing in Building 450 generates approximately 2,950 gallons of OTTO Fuel contaminated wastewater each month. This material is hauled

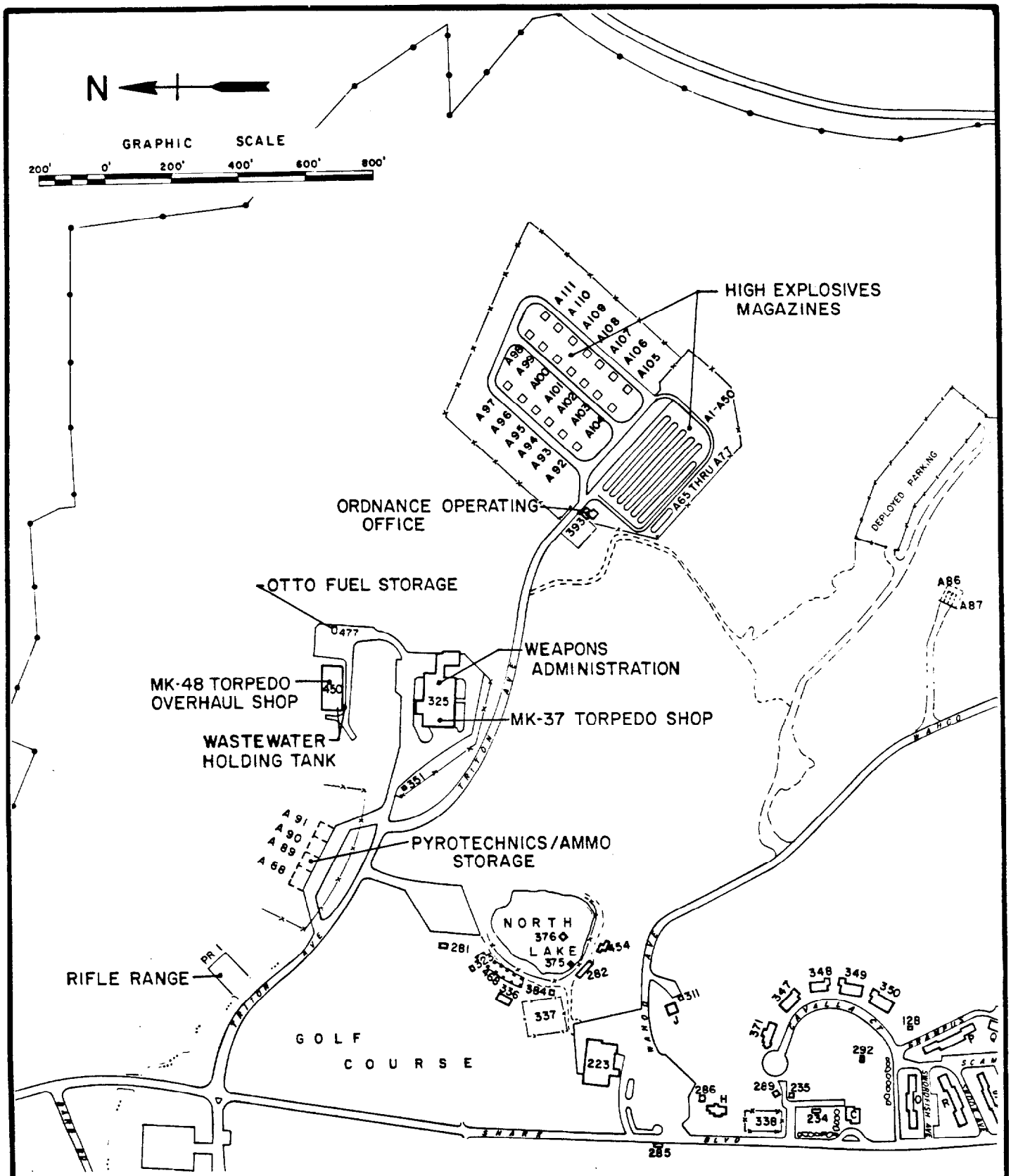

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FIGURE 6.4-1

ORDNANCE OPERATIONS AREA

away by a private contractor on a routine basis. OTTO Fuel is stored in 55 gallon drums in Building 477. A new fuel tank was recently installed directly behind Building 450.

The sanitary wastewater from Buildings 325 and 450 is treated by a septic tank/leach field system. Water and waste from various rework operations have accidentally entered the septic sewer system in the past through uncapped floor drains. Construction of sewer lines connecting this area to the town of Groton sewer system is now being completed. This should alleviate any potential problems associated with the leach field and drainage to the Thames River.

The OTTO Fuel II, propylene glycol dinitrate, is a liquid propellant currently being used in the MK 48 torpedoes. This fuel can be absorbed through the skin, and its vapor can be inhaled. Headache is the most characteristic symptom of OTTO Fuel absorption through the skin or the respiratory tract. The threshold limit value of this material is 0.2 ppm (1.3 mg/m^3). Contaminated rags and other solid hazardous wastes are disposed of in an approved manner. No significant problem areas were uncovered during the site visit by the team.

6.4.2 Pistol Range

The Subase maintains a small pistol range in the northern end of the upper base, PR-1, located just east of the Triton Avenue and Shark Boulevard intersection. The 25-yard range has 10 firing stations, and its use is limited to .22, .38, and .45 caliber pistols and 12 gauge shotguns.

The wing walls and overhead baffle system are constructed of inner and outer walls of 2 inch thick wood with the space between the walls filled with sand and gravel. The floor of the range is comprised of sand that extends 6 feet out from the firing stations, wood chips for an additional 10 feet out from the sand, and dirt from the wood chips to a point approximately 10 feet behind the targets. From this point, there is a 30 foot deep sand backstop with an "eyebrow" bullet stop about 10 feet above ground level up on the sand slope. Behind the sand slope is a rock cliff that is part of the natural topography.

6.5 MATERIALS STORAGE

6.5.1 General

The Supply Department orders and stores most of the materials awaiting use at the Subase. The Supply Department Administration offices are located in Building 17, and Materials Division offices are located in Building 87. The Materials Division contains five departments as follows: MTIS, Fuels, Traffic, Storage, and Packing/Shipping.

The Storage Branch uses a number of buildings for safekeeping of materials awaiting use. Dry provisions are stored in Buildings 408, 409, and 410. Building 433 is used for cold storage. Buildings 17, 105, and 316 are used to store a variety of materials. There were no reports of any spills at these buildings.

6.5.2 Hazardous Materials Storage

Building 31 has been used as the main Hazardous/Flammable Materials Warehouse since the 1970s. A large number of hazardous materials in containers up to 55 gallon capacity are stored in this building. All items are segregated and kept on pallets to prevent potential problems. Typical items stored in this warehouse include:

Nitric Acid
Sulfuric Acid
Hydrofluoric Acid
Hydrogen Peroxide
Sodium Sulfate
Potassium Tetraborate
Potassium Hydroxide
Sodium Phosphate
Chloride Standard Solution
Methyl Isobutyl Ketone
Oxygen Candles

Building 33 has been used for the storage of solvents in 55 gallon drums and gas cylinders since approximately 1970. Solvents such as trichloroethylene and dichloroethylene are reportedly stored here. Building 316 is used to store 5 gallon drums of acetone and MEK. There were no reports of any spills at Buildings 316, 33 or 31. A summary of hazardous substance storage locations is provided in Table 6.5-1. PCB transformer and pesticide storage areas are discussed separately in Sections 6.3.6 and 6.3.3, respectively.

6.6 RADIOLOGICAL OPERATIONS

6.6.1 General

Information concerning low-level radiological operations was not available either through records searching or interviews with appropriate personnel.

TABLE 6.5-1

SUMMARY OF HAZARDOUS MATERIAL STORAGE

Location	Material	Type of Storage	Estimated Quantity
Building 29 Tank 771	EDTA	Above ground tank	2000 gals
Building 329 Intake Structure	Sodium Hypochlorite	Above ground tank	2000 gals
Building 29 Tank 743	Monoethylamine	Above ground tank	2000 gals
Building 400	Pesticides	Small containers	50-100 lbs
Building 465	Chlorine	150 lbs gas cylinders	300 lbs
Chlorinator at Crystal Lake Road	Chlorine	150 lbs gas cylinders	300 lbs
Chlorinator at North Lake	Chlorine	150 lbs gas cylinders	300 lbs
Chlorinator at Rock Lake	Chlorine	1 ton gas cylinder	1 ton
Building 120	Chlorine	150 lbs gas cylinders	300 lbs
Building 295	Chlorine	150 lbs gas cylinders	150 lbs
Miscellaneous piers, vaults and buildings	PCB	In service transformers	variable
Building 31	Mixed corrosive flammable substances	Boxes of small containers, drums and barrels on pallets	100-200 boxes (from 1000-2000 gals)
Building 33	Solvents	55-gal drums	≈600 gals

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APPENDIX A

LISTING OF PRIORITY POLLUTANTS

Compound Name

1. *Acenaphthene
2. *Acrolein
3. *Acrylonitrile
4. *Benzene
5. *Benzidene
6. *Carbon tetrachloride (Tetrachloromethane)

*Chlorinated benzenes (other than dichlorobenzenes)

7. Chlorobenzene
8. 1,2,4-Trichlorobenzene
9. Hexachlorobenzene

*Chlorinated ethanes (including 1,2-Dichloroethane, 1,1,1-Trichloroethane and Hexachloroethane)

10. 1,2-Dichloroethane
11. 1,1,1-Trichloroethane
12. Hexachloroethane
13. 1,1-Dichloroethane
14. 1,1,2-Trichloroethane
15. 1,1,2,2-Tetrachloroethane
16. Chloroethane

*Chloroalkyl ethers (chloromethyl, chloroethyl and mixed ethers)

17. bis(Chloromethyl) ether
18. bis(2-Chloroethyl) ether
19. 2-Chloroethyl vinyl ether (mixed)

*Chlorinated naphthalene

20. 2-Chloronaphthalene

*Chlorinated phenols (other than those listed elsewhere; includes trichlorophenols and chlorinated cresols)

21. 2,4,6-Trichlorophenol
22. Parachlorometa cresol
23. *Chloroform (Trichloromethane)
24. *2-Chlorophenol

*Dichlorobenzenes

25. 1,2-Dichlorobenzene
26. 1,3-Dichlorobenzene
27. 1,4-Dichlorobenzene

*Dichlorobenzidine

28. 3,3'-Dichlorobenzidine

*Dichloroethylenes (1,1-Dichloroethylene and 1,2-Dichloroethylene)

29. 1,1-Dichloroethylene
30. 1,2-trans-Dichloroethylene

31. *2,4-Dichlorophenol
*Dichloropropane and Dichloropropene
32. 1,2-Dichloropropane
33. 1,2-Dichloropropylene (1,3-Dichloropropene)
34. *2,4-Dimethylphenol
*Dinitrotoluenes
35. 2,4-Dinitrotoluene
36. 2,6-Dinitrotoluene
37. *1,2-Diphenylhydrazine
38. *Ethylbenzene
39. *Fluoranthene
*Haloethers (other than those listed elsewhere)
40. 4-Chlorophenyl phenyl ether
41. 4-Bromophenyl phenyl ether
42. bis(2-Chloroisopropyl) ether
43. bis(2-Chloroethoxy) methane
*Halomethanes (other than those listed elsewhere)
44. Methylene chloride (Dichloromethane)
45. Methyl chloride (Chloromethane)
46. Methyl bromide (Bromomethane)
47. Bromoform (Tribromomethane)
48. Dichlorobromomethane
49. Trichlorofluoromethane
50. Dichlorodifluoromethane
51. Chlorodibromomethane
52. *Hexachlorobutadiene
53. *Hexachlorocyclopentadiene
54. *Isophorone
55. *Naphthalene
56. *Nitrobenzene
*Nitrophenols (including 2,4-Dinitrophenol and Dinitrocresol)
57. 2-Nitrophenol
58. 4-Nitrophenol
59. *2,4-Dinitrophenol
60. 4,6-Dinitro-o-cresol
*Nitrosoamines
61. N-Nitrosodimethylamine
62. N-Nitrosodiphenylamine
63. N-Nitrosodi-n-propylamine
64. *Pentachlorophenol
65. *Phenol
*Phthalate esters
66. bis(2-Ethylhexyl) phthalate
67. Butyl benzyl phthalate
68. Di-n-butyl phthalate
69. Di-n-octyl phthalate
70. Diethyl phthalate
71. Dimethyl phthalate

*Polynuclear aromatic hydrocarbons

72. Benzo(a)anthracene (1,2-Benzanthracene)
73. Benzo(a)pyrene (3,4-Benzopyrene)
74. 3,4-Benzofluoranthene
75. Benzo(k)fluoranthane (11,12-Benzofluoranthene)
76. Chrysene
77. Acenaphthylene
78. Anthracene
79. Benzo(g,h,i)perylene (1,12-Benzoperylene)
80. Fluorene
81. Phenanthrene
82. Dibenzo(a,h)anthracene (1,2,5,6-Dibenzanthracene)
83. Indeno(1,2,3-c,d)pyrene (2,3-o-phlenepyrene)
84. Pyrene

85. *Tetrachloroethylene (1,1,2,2-Tetrachloroethene)
86. *Toluene
87. *Trichloroethylene
88. *Vinyl chloride (Chloroethylene)

Pesticides and Metabolites

89. *Aldrin
90. *Dieldrin
91. *Chlordane (technical mixture and metabolites)

*DDT and Metabolites

92. 4,4'-DDT
93. 4,4'-DDE (p,p'DDX)
94. 4,4'-DDD (p,p'TDE)

*Endosulfan and Metabolites

95. α-Endosulfan-Alpha
96. β-Endosulfan-Beta
97. Endosulfan sulfate

*Endrin and Metabolites

98. Endrin
99. Endrin aldehyde

*Heptachlor and Metabolites

100. Heptachlor
101. Heptachlor epoxide

*Hexachlorocyclohexane (all isomers)

102. α-BHC-Alpha
103. β-BHC-Beta
104. γ-BHC (Lindane)-Gamma
105. Δ-BHC-Delta

*Polychlorinated biphenyls (PCB's)

106. PCB-1242 (Arochlor 1242)
107. PCB-1254 (Arochlor 1254)
108. PCB-1221 (Arochlor 1221)
109. PCB-1232 (Arochlor 1232)
110. PCB-1248 (Arochlor 1248)
111. PCB-1260 (Arochlor 1260)
112. PCB-1016 (Arochlor 1016)

113.	*Toxaphene
114.	*Antimony (Total)
115.	*Arsenic (Total)
116.	*Asbestos (Fibrous)
117.	*Beryllium (Total)
118.	*Cadmium (Total)
119.	*Chromium (Total)
120.	*Copper (Total)
121.	*Cyanide (Total)
122.	*Lead (Total)
123.	*Mercury (Total)
124.	*Nickel (Total)
125.	*Selenium (Total)
126.	*Silver (Total)
127.	*Thallium (Total)
128.	*Zinc (Total)
129.	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)

*Specific compounds and chemical classes as listed in the Consent Decree (8ERC 2120).