DISPOSAL AREA MONITORING SYSTEM

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VOLUME III

VISUAL OBSERVATIONS

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8.0 VISUAL OBSERVATIONS

8.0 Visual Observations

8.1 Introduction

Visual observations at New England dredged material disposal sites continued during 1979 and 1980 with particular emphasis placed at the Central Long Island Sound and the Portland, Me, disposal sites. The work at the Central Long Island Sound Site was oriented toward evaluation of the Stamford-New Haven disposal operation through in-situ diver observation while that at Portland was conducted primarily with remote underwater television and photography, supplemented by diver observations. In addition to studies at the above sites, continued monitoring of the New London disposal site was also conducted over this period.

The major objectives of the visual observation were to:

- define characteristics of disposed dredged material
- document these characteristics and changes in the sediment surface through underwater photography
- conduct systematic sampling at specific locations to evaluate dredged material stability
- develop procedures for measuring the boundaries of dredged material mounds through visual observations
- evaluate the effectiveness of capping procedures in isolating contaminated dredged material
- investigate post-disposal recolonization, faunal behavior and biological reworking of surface sediment
- define characteristics of the benthic environment surrounding disposal sites and monitor these areas for potential impact from disposal operations

The following sections will describe in detail the results obtained through in-situ observations at the various

disposal sites.

8.2 Central Long Island Sound Disposal Site

Prior to disposal of dredged material from Stamford and New Haven harbors, the Central Long Island Sound (CLIS) Disposal Site was surveyed in March and April 1979. These surveys were made to install diver transect cables and relocation aides, to provide baseline data on the sedimentary and biological features of the disposal area, and to establish stations for repetitive sampling during monitoring of the disposal operation. Between June and November 1979, these previously established stations were revisited in order to evaluate the efficiency and impact of the disposal and capping procedures.

Data and observations resulting from the March-April 1979 surveys and June-November 1979 surveys are presented in Sections 8.2.1 and 8.2.2.

From April to December 1980, surveys were continued at the Stamford-New Haven North and South 'capped' disposal sites and a pre-disposal survey was conducted at the designated Norwalk Disposal site. Data and observations resulting from these surveys are presented in section 8.2.3. Table 8.2-1 contains a chronological record of diver observations at each site for all surveys. Table 8.2-2 lists the captions corresponding to the photographs which are presented in Plates 8.2-1 to 58.

8.2.1 Stamford-New Haven (STNH) Disposal Site Monitoring (March-April 1979)

TABLE 8.2-1 Summary of diver observations at Central Long Island Sound Disposal Site. March 1979 - September 1980.

Date	Site	Operation	Dive Observation
21 March 79	South Pre-Disposal	Deployed west-east transect line. (440 m), (SW 8 - SC - SE 8).	
22 March 79	South Vis. 4 feet		Pre-disposal on transect line. Bottom at SC cohesive but very soft. SC anchor buried to approximately .5 cm. At SE 1 to SE 3, bottom cohesive and firm. Boulder north of SE 1. Species - Homarus americanus in mud burrows (2) Corymorpha pendula (100+) Urophycis sp. (1) Psuedopleuronectes americanus (10) Cancer irroratus (25+) on surface. Pleurobrachia pileus Ctenophore. Bryozoan (Bugula turrita 2)
	North	Deployed west-east transect line (220 m), (NW 5 - NC - NE 5). Dives from SC to SW2 and SC to SE 1. Cores at SW 2, SC and SE 1. Calibrated stakes at SC, SW1, and SW 2. Photos taken along transect. Visual observations of surface sediment characteristic and macrofauna.	
23 March 79	North Vis. 3 feet	Dives from NC to NW 3 and NC to NE 1 Cores at NC, NW 1, NW 3 and NE 1. Calibrated stakes at NC, NW 1, NW 3 and NE 1. Epibenthic tow NC to NE 1. Photos taken along transect. Visual observation survey.	On transect line NE 1 - NW 3. Bottom soft and cohesive. Species - Cancer irroratus Asterias forbesi 5-10 cm Corymorpha pendula. Psuedopleuronectes americanus.
23 March 79	South Vis 3 feet	Dive at east end of site to SE 8. Epibenthic tow. Photos taken along transect. Visual observation survey.	At east end of transect line, SE 8. Surface ripple marks. Cylindrical vertical burrows - no lobster. Species - Scophthalmus aquosus (1) Pseudopleuronectes americanus (2) 15 cm. Corymorpha pendula - 15 ind./.25 m^2

Table 8.2-1 (continued)

Date	Site	Operation	Dive Observation
10 April 79	South Vis.12 feet	Interim Survey. Two dives made: A North-South transect and a southwest transect. Original transect lines found to be buried. Cores taken at SC on transect line and at southwest periphery of pile. Photos taken along transects. Visual observation survey.	Disposal in progress. Compass transect to SW of dump buoy and north-south. No distinct color difference between spoil and natural sediment. Possible silt veneer overlay on each tidal cycle. Cohesive clay clumps. 3 foot mounds at center. Height above original level 5 feet maximum. Clump splitting occurring (some due to benthic fauna). Debris on surface and partially buried (i.e. leaves, Phragmites, timber, aluminum, foil, plastic). Species - Pseudopleuronectes americanus (16) Urophycis sp. (4) 1 burrowed in side of clay clump. 1 adjacent to plastic debris on clump, excavating sediment. Myoxocephalus octodecemspinosus (8). Tautoga onitis (1) on base of dump buoy. Pagurus longicarpus (20) Libinia emarginata (9) Cancer irroratus (50) excavating clay clumps and surface sediment some burrowed over entire bottom. Crangon septemspinosa Mysids - over entire bottom. Shrimp - Pandalid shrimp. 2 cm vertical burrowed Galatheidae. Asterias forbesi Bugula turrita - on fouled clumps or eddy zone. Gastrodod on Laminaria blade Corymorpha pendula - none on spoil, buried at periphery (15/25 m^2) Gastropods - (10). Immediate colonization after dumping.
24 April 79	South	Grappled for and recovered end of west transect line, repositioned.	
25 April 79	South	Deployed north-south transect line to delineate north-south pile boundries. Dives to delineate spoil boundries. Loran C positions on divers surfacing at periphery locations. Located and buoyed (subsurface) calibrated stake south of SC clump. Photos along transects.	Dive on dump buoy to west periphery. Cable broken between SW 7 and SW 8. Divers did not find far end of cable. Concentration of Asterias forbesi in 20 m band at border of spoil 20-30 individuals. Divers surfaced after locating spoil periphery and Loran C fix obtained.

Table 8.2-1 (continued)

Date	Site	Operation	Dive Observation
25 April 79	South		Species - Pseudopleuronectes americanus (10) Myoxocephalus octodecemspinosus.(5-6) Syngnathus sp. (7) Urophycis sp. (5-7) Tautogolabrus adspersus - (2) Corymorpha pendula - 15-20/m^2 Uniform distribution 3-10 cm. height. Libinia emarginata (8). Cancer irroratus (25). North-South transect line deployed and followed to south periphery. Loran C position taken at surfaced diver positions. R/V UConn placed marker buoys at apparent east periphery (determined by Smith-McIntyre grab samples). Divers descended buoy and found Corymorpha evenly distributed over the area (apparently no spoil). The sediment had a 3 layered profile when diver excavated 10cm hole. The top layer was very loosely cohesive and aerobic. (Appeared to be organics that have adsorbed and settled on bottom). Beneath this is what appeared to be an anaerobic layer but may have been buried spoil and a clay layer under all.
26 April 79	North	Dives from dump buoy to north periphery (Loran C position on surfacing divers) and on NE periphery to visually delineate spoil periphery and compare to position found by grabs. Epibenthic tow at NE periphery. Photos along transect. Visual observation.	Divers descended dump buoy and headed on NNW compass course. At periphery, divers surfaced and a Loran C position obtained. An approximate 3 meter intermediate zone (patches of spoil and natural sediment) with sparse Corymorpha and clay clumps. Species - Cancer irroratus (6) Shrimp Crangon (2) Bryozoan Bugula turrita (3) Pagurus longicarpus (1) Pseudopleuronectes americanus (6) Nasaarius trivittatus (1) 6 cm burrow in spoil sediment and worm tubes near periphery.

Table 8.2-1 (continued)

Date	Site	Operation	Dive Observations
26 April 79	North		Descended approximately 200 feet east of dump buoy and followed edge of spoil to SE. Some debris noted from dumping observed on natural sediment surface past pile edge (i.e. Laminaria Anomia valves, clay clump). current transport of light debris further then heavier sediment. Corymorpha partially buried by surface sediments. Species - Urophycis sp. (3) Asterias forbesi (15) Pseudopleuronectes americanus (8) Tautogolabrus adspersus (5+) Homarus americanus (3) Shrimp Crangon (6+) Cancer irroratus (8) Bryozoan Bugula turrita (5) Pagurus longicarpus (4) Pagurus pollicaris (2) Corymorpha pendula - borders.
21 May 79	S/NH North Vis. 3 ft.	Interim survey - perimeter delineation on eastern border and visual observation survey. Epibenthic collections taken on and off spoil.	Located spoil border (Corymorpha as indicator) from east. Clay clumps were interspersed around a generally featureless surface sediment veneer. The 3 layer sediment strata condition still present. Corymorpha ubiquitous off spoil 25/.25 m^2 boundary area 10-15/.25 m^2. Urophycis - 3 Pseudopleuronectes 8 Scophthalmus - 1 Cancer irroratus - 7 Asterias - 15.

Table 8.2-1 (continued)

Date	Location	Procedure	Observation and Data
19 June 1979	North site Essayons capping operation	Dive inspection of sediment surface effective coverage. South free transect survey from N buoy to SSE spoil perimeter.	Sand overlay continuous to beyond Stamford spoil; mud-clay spoil not detected over entire course. Depth of New Haven sand at central mound region greater than .7 m excavation; depth of sand cap at periphery approximately 5-10 cm. Clay fragments noted on top of sand obviously of New Haven origin. Extensive shell fragment layers noted 2/3 distance from disposal buoy. Suspension of disposal material evident at 40 foot depth with visibility reduced from 8 to 4 feet. Abundant Cerianthus americanus (burrowing amemones) further confirmed natural bottom/sand border at perimeter. Predominant species noted on new cap material: Pagurus longicarpus (20+) P. pollicarus (15+) Cancer irroratus (20+) berried female active excavation. Axius serratus (2+) Prionotus carolinus (1) Urophysis (sp.) (3) Scophthalmus aquosus (12+) Pseudopleuronectes americanus (1) Raja (1), Libinia (2), Natid snails (3) Ceriantus americanus (natural bottom density 1/m^2). Other: ribbon worm fragments, cylindrical burrows common, all sand cap colonization by mobil macrobenthos. T°C = 14°, 3-4 ft. visibility, ½ kt. E bottom current.

Table 8.2-1 (continued)

Date	Location	Procedure	Observation and Data
19 June 1979	N site	Dive inspection survey to SW from 50 m west of buoy to SW periphery.	Course sand coverage with thin surface veneer of silt. Sand cap overlay appeared to "float" atop soft clay spoil base; resiliance noted on diver depression with flat object. After excavation, sand "flowed" to fill surface furrow. Vertical burrows numerous (6-10+). This region revealed thin sand cap coverage and recommendation for additional Essayons capping in SW sector were performed. Predominant species observed: Urophysis (6+) C. irroratus (12) Libinia emarginata (7) Pagarus pollicarus (3) P. longicarpus (6+) Ceriantus americanus (5) Epibenthic samples (2): Central cap and 15 m west of cap perimeter. Core sample (1): natural bottom SW perimeter: LC = 26545.0/43999.9
19 June 1979	South site	Dive inspection of cap from buoy to north perimeter.	Bottom surface sediment of soft silt with intermittant clay mounds .3 - 1 m diameter. Mound topography disappeared at distances further than 20 m from N buoy; bottom from this point flat and featureless with no debris observed. Diver surfaced where Cerianthus americanus (spoil edge) first detectable; Loran C fix obtained on both dives. Predominant species: C. irroratus (3) active excavation L. emarginata (5) Urophysis (3) P. pollicaris (4) Raja (2) (Biota sparse in relation to north site).

Table 8.2-1 (continued)

Date	Location	Procedure	Observation and Data
19 June 1979	South site		Epibenthic samples (3): S buoy to N (30 sec); LC = 26542.5/43994.8; LC = 26543.5/43995.4. Core samples (2): mound/interspace sediment at: S buoy base, 50 m south of 26542.5/43994.8. Graduated stake placement: 0 mark 1 m south of buoy chain.
20 June 1979	South site	Diver orientation transect cable (E-W, post cap) deployed from R/V U'Conn. 450 m total length with 8 logarithmic stations on east and west legs.	Dive: tie ground line from S buoy base to transect cable at SW 4+. Survey of east (Stewart and Auster) and west (DeGoursey) cable placement. Predominant species observed: Asterias (2) P. long. (2) P. poll. (3) Scophthalmus aquosus (J2+) (Benthos sparse, snail furrows and decapod tracks evident, vertical burrow density as high as $6/m^2$). Elevation stake placement (2): SE 4 set at 0 mark SW 4 set 1 m north of cable. Epibenthic samples (2): SE 6 to W (30 sec.). SW 4 - SW 5. Core samples (3) (mound/interspace): between SE 5 - SE 6 SW 1 50 m S of SE 4.
21 June 1979	South site	Dive photodocumentation of post-cap conditions in surveys to ENE and NNE from S buoy to post spoil periphery.	To investigate NE sector where bathymetry indicated thin cap coverage. Photo sequence obtained. Predominant species: P. americanus (4) juvenile S. aquosus (2) Libinia (4) Loligo pealei (20+) 1 cm juvenile

Table 8.2-1 (continued)

Date	Location	Procedure	Observation and Data
21 June 1979	South site		*Crangon septemspinosa* *Nassarius trivittatus* All 20+ with densities *Pagurus longicarpus* greatest at perimeter. Vertical burrows: 2/m^2 to 5/m^2 at border. Epibenthic samples (1): 26541.1/43994.4. Cores (mound/interspace) (1): 26541.1/43994.7. T°C = 15°, Vis.= 2 ft., Current = ½ kt W. flood.
21 June 1979	North site	New post-cap diver orientation cable deployed E-W. Five stations on each leg at 25, 30, 40, 60, 100 m from center. West leg cable and east leg kevlar.	Dive: to tie ground line from N buoy base to NW 3 station. (Few benthic organisms present; suction dredge mortalities- broken carapaces - noted for *Cancer* (6) and *Libinia* (3).
22 June 1979	South site	Photo survey along west transect leg SW 4 to SW 8.	Photography of sediment features, biota and elevation stake at SW 4. Current: ½ kt W to E. T°C =15°, Vis. = 2 ft. Species observed: *C. irroratus* (5+) *Libinia* (2) *Scophthalmus aquosus* (4) Photograph station at SW 5; SW 6; SW7.
	North site	Photo survey along west transect leg NW 3 - NW 5.	Photography of sediment features, biota directly south of each cable station. Hard packed sand along entire transect. Sand wave formation evident, alternate ripple burial of cable. Vertical burrows numerous to west of NW 5 on natural bottom, no abundant indicator species at NW border. T°C = 15° Vis. = 0-2 ft., Current = ½ kt. E Elevation stake placement at NE 2 to south of kevlar line.

Table 8.2-1 (continued)

Date	Location	Procedure, Observation and Data
19 July 1979	North site.	Sup 8 mm (50') along E-W transect on baseline cable; Placement of calibrated stakes at NW 3 and NW 4 (60 m). In-situ penetrometer measurements at NC, NW 4, and 75 m north of transect line on natural bottom; 200 m N of N pile buoy. Epibenthic samples (2): NW 1 (tie-in to NW 4), and 200 m N of buoy. Macrobenthos observations: predominant species: Axius burrow densities at location 200 m N of N buoy 15/m^2. Winter flounder, Pseudopleuronectes americanus (5-15 cm) 10+ Sand dabs, Scophthalmus aquosus - 4, Hermit crabs, Pagurus longicarpus - 6, P. pollicarus - 2, Starfish, Asterias - 15+ Snail, Natid (egg cases) - 3, Hydroids, Tubularia (on line) - 3.
	South site.	Sup 8 mm (50') along E-W transect cable leg (SW 3- SW 8); Placement of additional calibrated stake at SW 6. In-situ penetrometer measurements: SW 4, SW 6, SW 8; Epibenthic samples: SW 7 to W 30 sec, and 2-0 m N of S Buoy. Macrobenthos observation and 35 mm photography; attempts to sample Axius burrows on newly deposited spoil and obtain cast of burrow configuration. Hydrogen sulfide and "white slime" area 1 x 2 m noted at SW 5; Note and record pot trawl identification numbers deployed in immediate vicinity of both disposal sites. Hake, Urophysis - 6, Winter flounder, P. americanus - Sand dab - 2, Hermit crab, P. longicarpus - 4, Squid - 1 Hydroid Tubularia.
7 August 1979	50 m SE of N buoy.	Field trials of BOLT system: underwater inspection after deployment; photograph rotors, pod position in sediment, and surrounding surface terrain.
	South site.	Exchange south pile marker with hemispherial buoy.

Table 8.2-1 (continued)

Date	Location	Procedure, Observation and Data
7 August 1979	North site:	Photography (35 mm) and benthic sampling along west and east sections of transect cable: Calibrated stakes at NW 3 and NW 4 remain at 0 mark: Epibenthic sample NC to NW 3; Penetrometer measurements at NC, NW 4 and 10 m west of NW 5; spoil cap periphery determined to east at 50335.4 and 69703.7; Sediment profile photographs taken between NE 4 and NE 5 (1 m south of cable) and at NC tie in. Winter flounder, *Pseudopleuronectes americanus* - 10+; Sand dab, *Scophthalmus aquosus*, *P. longicarpus* - 200+, *P. pollicarus* - 6+, *Busycon* - 2; Mysids 9 worms.

Table 8.2-1 (continued)

Date	Location	Procedure, Observation and Data
8 August 1979	South site.	Dive observation, photography (35 mm) and sampling conducted along west transect cable SW 3 to SW 8 and east transect cable SW 3 to SE 5. Epibenthic samples: SW 3 to east 30 sec, SW 7 to SW 30 sec at periphery on natural bottom. Penetrometer measurements at SW 3 and SW 7. Calibrated stake reading remain at 0 mark at SW 3 and SW 6 stations.
	North site.	Photography (35 mm) along NW transect cable NW 3 - NW 5, 50 west. Sediment profile photos taken at point ENE of N buoy on natural bottom near cap periphery. Epibenthic sample at ENE location on natural bottom.
	Shellfish station (CG buoy)	Locate (sonic receiver) lost platform and service acoustic release and current meter. Note new dredge material in vicinity during platform sonic receiver search. Sampled Mytilus (3 bags) from retrieved platform.
7 November 1979	South site.	Search for tie-line, not located. Southeast survey conducted 16 mm (100') cinema sequence. New spoil border reached approximately 50 m SSE of S disposal buoy. Apparent new spoil overlaying station transect cable in 50 m diameter central mound area. 35 mm photography. Calibrated stakes not located - buried by recent dredge disposal.
	North site.	Dive search for north site transect cable (N disposal buoy lost). Loran fix and free transect to NW conducted. 16 mm (50') cinema sequence and 35 mm photography. Epibenthic sample at NW sand cap bank (30 sec to NE). Transect cable and stakes not located.

Table 8.2-1 (continued)

Date	Station	Transect Location and Distance	Physical Condition (Depth, Temp. Vis. Tide Bottom Type)	Biological Observations
2 April 1980	Norwalk Site	75 m SE from disposal buoy	Bottom typical (pre-disposal). Flat, featureless topography. Unconsolidated floc. material.	Corymorpha pendula dominant epifaunal organism. Psuedopleuronectes americanus and Cancer irroratus abundant and active. C. irroratus females berried. Sygnathus fuscus. Crangon septemspinosa. Pagurus pollicaris. Asterias forbesi . Axius burrows
	South Stamford/ New Haven site.	Entered 200 m west of disposal buoy to NE and SE.	Area typical of recent disposal operations. Topographic relief on order of 2 meters. Clay clumps up to 1 meter height beginning to fracture and erode. Bottom cohesive clay/ silt. Peaks and valleys along bottom probably represent individual barge release.	Cancer irroratus burrowing in spoil and excavating clay clumps. Crangon septemspinosa ubiquiotous over and on pile. Pagurus longicarpus active on spoil. Nassarius trivittatus on pile (transplanted?) Libnia emarginata burrowed. 5-6 cm and 8-10 cm burrows Axius Homarus Cancer Corymorpha pendula occurence delineating spoil perimeter.
	North Stamford/ New Haven site.	Entered at temporary North Site buoy. Swam 20 m to S, then 100 m to North.	Shell debris over hard packed sand with thin silt veneer. No clay clumps.	Cancer irroratus abundant. Some still burrowed. Many berried females. Individuals showing thigmotactic response to large shell debris in area. 2-5/m^2. Pagurus pollicaris excavating spoil. Pagurus longicarpus traversing spoil surface. Juvenile Pseudopleuronectes americanus 2/m^2. Metridium senile on large shell. Libinia emarginata burrowed. No Corymorpha until periphery. Barnacle set on shell debris.

Table 8.2-1 (continued)

Date	Station	Transect Location and Distance	Physical Condition (Depth, Temp. Vis. Tide Bottom Type)	Biological Observations
3 April 1980	Norwalk Site	Base of Norwalk Buoy to N - 50 m	Flat, featureless, topography.	Obtained density data on Corymorpha pendula. Cancer irroratus sparse over site- no berried females. Nassarius trivittatus on surface - sparse. Pagurus longicarpus on surface - sparse.
	North Stamford/ New Haven site.	Transect line. E - W	Hard packed sand and shell debris with thin silt veneer.	Total coverage of buoy mooring chain with Mytilus, Balanus, Metridium, Asterias, Tubularia. Cancer irroratus dense 4-6/m^2 in area. Libinia emarginata - large individuals active (10-12 cm carapace width). Pagurus spp. abundant. Transect lines and stakes fouled with barnacles. Pleurobrachia in water column. Some C.irroratus in post molt (paper shell) condition. Some with black and partialy eroded carapace - from overwintering in anoxic sed.
	South Stamford/ New Haven site.	At disposal buoy.	Recent barge disposal of spoil. Vis 0-2 ft. Spoil very soft and cohesive. Clay clumps eroded and fractured Relief 2-3 meters.	Buoy chain heavily fouled by organisms cited on previous dive. Crassostrea shell debris. Mercenaria - 1. Cancer irroratus on clay clump excavating material.

Table 8.2-1 (continued)

Date	Station	Transect Location and Distance	Physical Condition (Depth, Temp.Vis.Tide Bottom Type)	Biological Observations
5 May 1980	Norwalk Site	In 95 m N of Buoy. 20 m N of spoil perimeter - at mussel platform. 20 m to NE	Typical of pre-disposal conditions. 1/2 kt. E - W.	Corymorpha pendula dominant epifaunal organism. Size and distribution data collected. Callinectes - 1 - active. Pseudopleuronectes - Asterias - Libinia - burrows 12 cm and 4-5 cm - Cyanea tentacles on mooring lines.
	Norwalk Site	Base of Buoy 75 m to N.	Typical soft, cohesive mud. Bottom topography irregular. Clay clumps .5 m dia. and trough areas ~ .5 m deep. Spoil perimeter 75 m north of buoy.	Few megafaunal organisms - Asterias. Pseudopleuronectes.
	South Site	Buoy chain inspection.		Epifaunal organisms present in previous survey mostly eliminated. Only fouling organisms present Mytilus, and Balanus. Cyanea tentacles streaming from chain.
29 May 1980	North Stamford/ New Haven Site	Mussel platform to NW - 100 yds and SE - 50 yds.	Bottom hard packed sand with 2-3 cm silt veneer. Some areas with oyster, scallop and jingle shell debris. .5 cm shell hash. 5cm period ripple marks in sand. Piling debris.	Tracks of naticid snail 8-10 cm wide. Crab tracks noted but no active crabs observed on traverse to NW. 8 molts of Cancer irroratus. C.irroratus active on SE traverse. 15 Pagurus longicarpus - 4 Urophycis sp. Scophthalmus aquosus. 6 Tautogolabrus adspersus Asterias forbesi

Table 8.2-1 (continued)

Date	Station	Transect Location and Distance	Physical Condition (Depth, Temp. Vis. Tide Bottom Type)	Biological Observations
	Norwalk Site		Dense, large,. 5m to 1.5 m high clay clumps on soft cohesive sediment. ~1.5 m topographic relief. Vertical fissures in clumps, floc material filling in irregularities. Debris-metal conduit, foil, plastic. Peat and shell debris (Mya) embedded in clumps.	1 - Urophycis sp. thigmotactic response to metal conduit. 1 - Scophthalmus aquosus. Molts of Libinia emarginata and Cancer irroratus.
	Norwalk Site	100 m North of Dump Buoy - Mussel Platform Area.	Flat, featureless, with soft, cohesive sediment and thin unconsolidated floc veneer. Typical as in pre-disposal survey.	Corymorpha pendula dominant hydroid. Densities 5, 8, 14/ .25 m^2 measured and animals collected. Noted "pinched" stalk (just below hydranth) on several individuals.
12 June 1980	Stamford/New Haven North Site	Museel Platform location to SE	Hard packed sand 1-2 cm silt veneer.	Jingle shell debris. Cerianthus americanus 1-4/.25m^2 (visual) Pagurus longicarpus - abundant. P.pollicaris - 4 Cancer irroratus - 12 Libinia emarginata - 4 Nassarius sp. - abundant. Crangon septemspinosa - large - abundant. Psuedopleuronectes americanus -2 Urophycis sp. - 1.
25 June 1980	Stamford/New Haven North Site.	Transect line tie into West	Hard packed sand 1 cm silt veneer. 2-3 cm veneer towards periphery. Small piles of spoil material (1 m height x 2-4 m length) encountered 20 yds. past west periphery.	Jingle shell and shell hash debris. Balanus set extensive on transect line, stakes, shell debris. Cerianthus sparse but increasing towards periphery. Past spoil periphery - similar to pre-disposal conditions. Libinia emarginata - 1 Tautogolabrus adspersus - 1

Table 8.2-1 (continued)

Date	Station	Transect Location and Distance	Physical Condition (Depth, Temp. Vis. Tide Bottom Type)	Biological Observations
		Tie into east	Increasing silt veneer depth to (4-6 cm)	No biological observations.
30 June 1980	Stamford/ New Haven North	Transect line tie in to east	Substrate is hard packed sand, shell debris with thin 1-3 cm silt veneer. Towards the periphery "pockets" of silt (> 5 cm depth) increase - aerial extent not determined.	All suitable substrate colonized - Balanus on trasect cables, shell debris. Buoy chian colonized - Metridium Mytilus, Asterias, lower chain - Bugula, Tubularia spp. Stanotomus - 1 Hippoglosius oblongus - 1 Libinia emarginata - 6 Pagurus pollicarus 3 Pagurus longicarpus - 8 Nassarius sp. - 20 Busycon sp. - 4 Sand collar - 1.
	Stamford/ New Haven South	Ground line from dump buoy to platform.	Bottom relatively flat, no large clumps. Homogeneous layer of silt.	Mysids most abundant organism (~20/.25 m^2). Crangon - 20 Anguilla - 1 Scophthalmus - 1 Tautog - 1 Asterias Busycon - preying on mussels in bag which fell from platform.
	Norwalk	Disposal buoy to 50 yds. north.	Topography typical of active disposal site. Clay clumps .5 to .75 m in height. Total topographic relief in survey area ~,5 to 2.5 meters.	Shell debris in clay clumps and scattered over substrate. Mya (1-3 cm) Crassostrea 10-15 cm length. Pagurus longicarpus 3 Nassarius sp 20. Libinia emarginata 5.
	110 yds N of Norwalk Buoy	15 m to N	Bottom typical of pre-disposal conditions. Flat featureless.	Many tracks on substrate surface - crabs - snails. Burrows (not Axius type). No Cerianthus observed.

Table 8.2-1 (continued)

Date	Station	Transect Location and Distance	Physical Condition (Depth, Temp. Vis. Tide Bottom Type)	Biological Observations
31 July 1980	S/NH North Site	West of dump buoy to West	Vis. 1 ft. cur. E - W 1 kit. Thin silt veneer over sand near periphery of spoil. Jingle shell debris still visible but natural sediments thicken rapidly at edge. Substrate boudry layer flowing with current. Material loose and unconsolidated.	Pagurus longicarpus - 23 Pagurus pollicaris - 4 Libinia emarginata - 2 Bugula territa - 3 Burrows 4-5 in dia.- off site 3 cm worm tubes. No Cerianthus observed No Axius type burrows observed.
	Norwalk Site	20 yds. N of dump buoy. 70 yds to N.	Eroding clay clumps to 35 yds N of buoy - topography flattens towards perimeter.	Mysids abundant - reworking substrate surface. Most abundant around topographically differentiated features. Worm tubes in clay clumps. Axius type burrows - 15 in groups of 3-4. Nassarius trivittatus abundant - 150. Pagurus longicarpus - 20 Scophthalmus aquosus - 3 Dead, partially buried Callinectes No Cerianthus observed.
3 Sept. 1980	S/NH North Site	Dump buoy to north perimeter.	Cur. W - E 1/2 kt. 22.2°C. vis 3 ft. Natural sediment pockets over sand in several depression areas. Mostly thin silt veneer over sand skirt under natural sediments to depth of 6-12".	spp. on spoil. Nassarius - 50 Pagurus longicarpus - 20 P. pollicaris - 2 Asterias - 8 Sygnathus - 1 Prionotus carolinus -juv. 1 spp. off spoil Nassarius - 3 worm tubes 5/.25m² P. longicarpus - 1 burrows 3-5cm dia. 5.

Table 8.2-1 (continued)

Date	Station	Transect Location and Distance	Physical Condition (Depth, Temp. Vis. Tide Bottom Type)	Biological Observations
3 Sept. 1980	S/NH South Site	Dump buoy to NW perimeter	Cur. E - W .75 kt. vis. 2 ft. 22.2°C Ending clay clumps at pile center to 75 meters. Clay clumps eroding and fracturing. Flattening of topographic features along apron to perimeter.	Dense worm tubes and burrows in clay clumps. Lobster burrows -3 around debris - logs - cables. Crassostrea and Mya shell debris at center of pile. Not extensive along transect. Mysids abundant in depression and irregular areas. Hippoglossus oblongus - 1juv. Scophthalmus aquosus - 3 on spoil
	Norwalk Site	Buoy to SE sector		
4 Sept. 1980	Natural Bottom Between S/NH North and South	75 m to W of descent.	Cur. W-E .25 kt. 22.2°C vis 3 ft. Flat featureless bottom. Soft, cohesive sediment. Surface loose and unconsolidated.	Mysids and Nassarius most abundant. Pandora shell debris common. Worm tubes and Axius type burrows - 4. Recent burrowing evident. Anoxic sediments adjacent to worm tubes. Sediment plumes from tubes observed. Mysids dense at substrate irregularities. Nassarius burrowing.
	Norwalk Site	100 yds S of dump buoy to SE perimeter then WSW on natural bottom.	Cur. E - W .25 kt. vis. 3 ft. 22.2°C. Large clay clumps present to 20 m before edge. Fracturing and erosion of clumps.	Worm tubes and burrows in clay clumps. Crassostrea and Mya shell debris on spoil to apron area. Barnacles on shell debris. Hydractinia on Pagurus longicarpus shells. Lobster burrows around debris - 4. Psuedopleuronectes americanus - 1. At apron Pandora shell debris more common Pagurus longicarpus - 20

In-situ investigations at the Central Long Island Sound Disposal Site for both the STNH-South and STNH-North target areas commenced in March 1979. Initial monitoring efforts involved the installation of diver transect cables with station markers (Fig. 8.2.1-1) and baseline surveys.

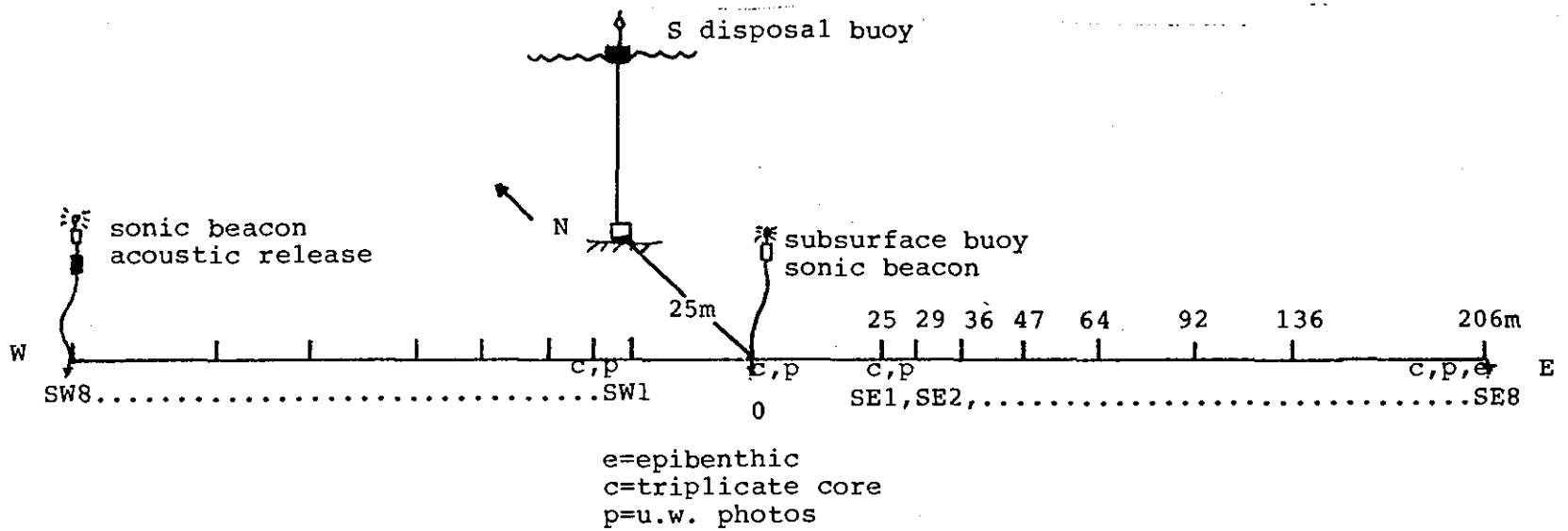
Diver orientation cables were laid E-W at the north and south sites on March 22-23, 1979. Underwater photographs, quantitative sediment core samples, and epibenthic net samples were collected at various sites along the established transects to supplement samples taken with a Smith-McIntyre grab operated from the ship. Diver collected core samples allowed discrete sampling of the soft sediment with exact reference to station location and benthic topography. The core sampling device consisted of three 7 cm (diameter) x 20 cm (height) plastic cylinders secured in line approximately 2 cm apart. Six plastic caps were cemented to short lines for closure of each core top and bottom immediately after complete sediment penetration.

In order to measure the depth of dredged material after disposal and to detect subsequent changes in the sediment surface, calibrated elevation stakes over one meter long, were placed along the transect cable at various stations. The stakes were installed such that 40 cm of calibrated marks were visible above the sediment surface at all stations at the time of installation.

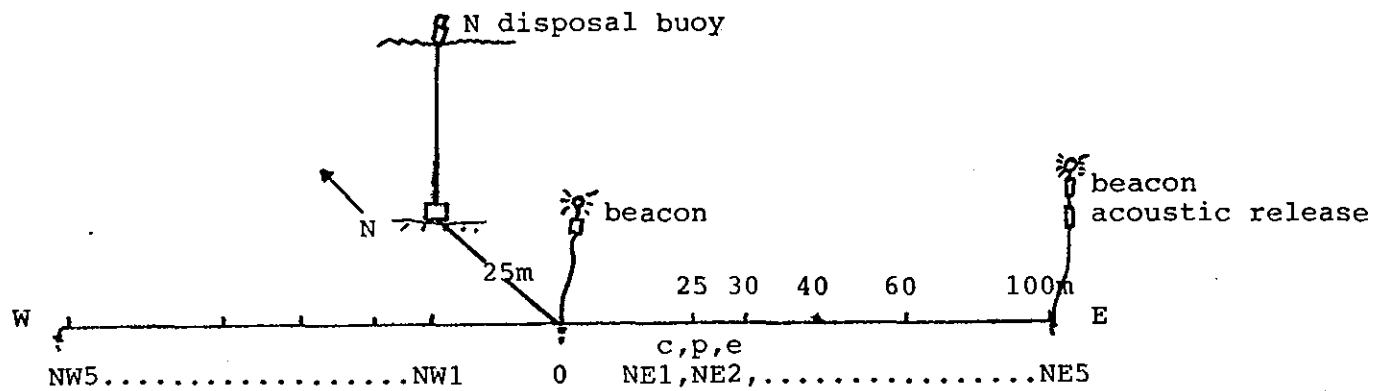
Epibenthic net samples were also obtained. The 50 cm x 20 cm (1 mm mesh) net was diver operated over a 30 sec transect of the bottom. Collection by this method allowed a standard timed course over known distance to be sampled. The net

Figure 8.2.1-1 *CENTRAL LONG ISLAND SOUND DISPOSAL SITE*

STNH-South - baseline transect cable and stations. March 1979



STNH-North - baseline transect cable and stations



attitude was adjusted to fish over both extremely soft sediment and variable topography. A base bar depth of approximately 2 cm beneath the sediment surface was maintained throughout the transect sampling.

The pre-disposal sediment surface of both the STNH-North and South sites was found to be generally soft but cohesive. The SE transect at the South disposal site was, however, more consolidated.

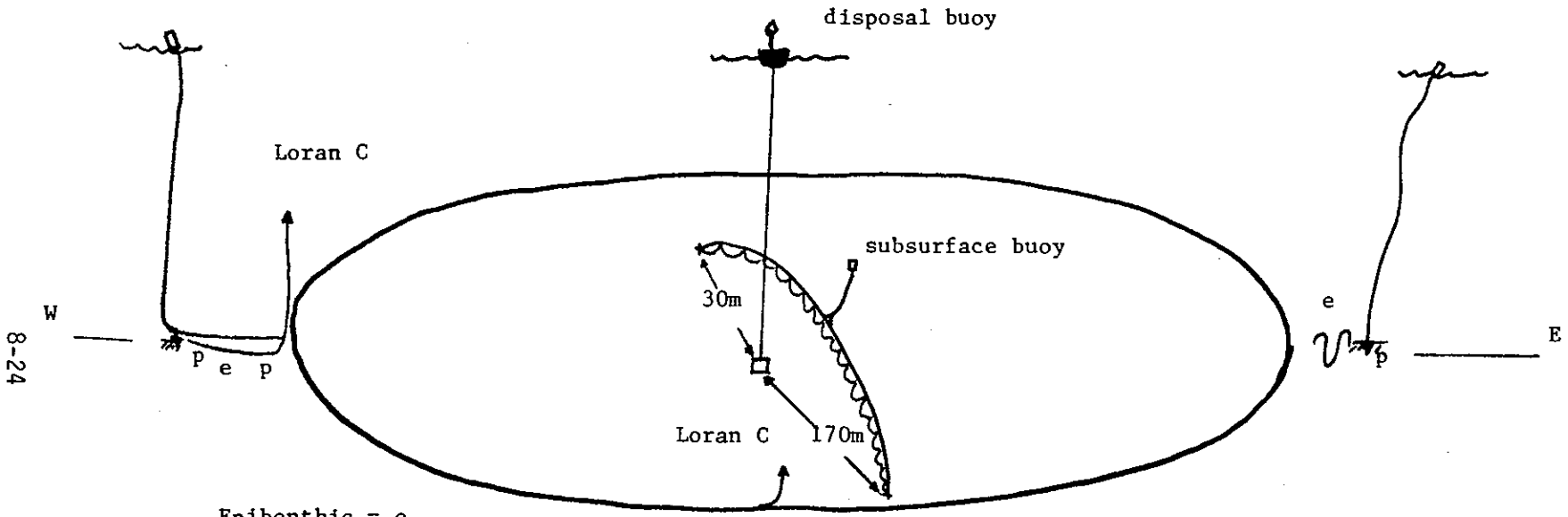
On 10 April 1979, a dive inspection of the STNH-South site provided evidence of the initial disposal operations resulting from Stamford dredging (Figure 8.2.1-2). The limits of the Stamford material distribution were indicated by the presence of cohesive clay mounds and slight textural and color differences from the natural bottom. However, the clearest evidence of the presence of new material was the absence of the solitary hydroid, Corymorpha pendula, which were buried by the disposal operation. Colonies of this ubiquitous hydroid were found inhabiting the adjacent bottom in densities averaging approximately 30 per m^2 (diver count).

Distribution of dredged material in the target area appeared to be the result of sequential dumping operations and not the result of dispersion due to current transport. The Stamford material observed on the bottom was characterized by cohesive clay masses with loosely consolidated interspace areas. This first phase material inspected in transect dives appeared stable, not prone to migration, and a distinct north and south perimeter could be detected. In general, Stamford material appeared more compact and of higher density than the surrounding natural sediment.

Figure 8.2.1-2 CENTRAL LONG ISLAND SOUND DISPOSAL SITE

Post Disposal Survey

STNH-South - Post Stamford disposal reference line. April 1979



Epibenthic = e

Photos = p

A gradual mounding occurred in the central target area, tailing out to greater than 50 m in the east, and greater than 100 m to the west. Irregular clay mound topography (1 m elevations) typified this central region which was approximately 50 m in diameter, located 25 m south of the disposal buoy.

Toward the perimeter of the mound, evidence of individual barge sections (2 m mounds) were more common. Limits of E - W spoil coverage were not determined by diver survey, however, subsequent surveys were directed to assess the E - W spoil boundary and station characteristics on the transect orientation line. Visibility was exceptionally good (in excess of 3 m) and no evidence of spoil resuspension was noted in the course of the dive inspection.

At the spoil periphery, the normal flux of bottom silt veneer had migrated a horizontal distance of three meters onto the apron regions of the mound. (Considerable debris was observed to be incorporated in the Stamford material; i.e. steel bulkheads, pipe, rope, sheet metal, plastics, bottles, cans, etc.). Tracks of mobile epifaunal invertebrates were evident. Cohesive clay clump fragmentation and excavation about basal areas had occurred indicating a high degree of thigmotactic response from organisms recolonizing the site. In general, a greater representation and assemblage of megabenthic organisms was noted on and within Stamford material than had been observed in the baseline survey of this area on 22 March 1979.

From 24-26 April 1979, diver investigations were conducted at the STNH-South site following the completion of disposal of material dredged from Stamford. A similar

investigation was conducted at the STNH-North site to assemble baseline information prior to the disposal of additional Stamford material. All standard operations were completed including a biological census, epibenthic sampling, spoil border Loran-C location, and transect photography.

At the South site, an elevation line was staked down across the Stamford material, starting from the chain connected to the buoy marking the disposal site. The line extended 30 m to the north, and 170 m to the south (within 10 m of the southern perimeter of the dredged material). Stakes were used to position the line to indicate the horizon of the final Stamford disposal operation, and to provide a reference for New Haven capping effectiveness (Figure 8.2.1-2).

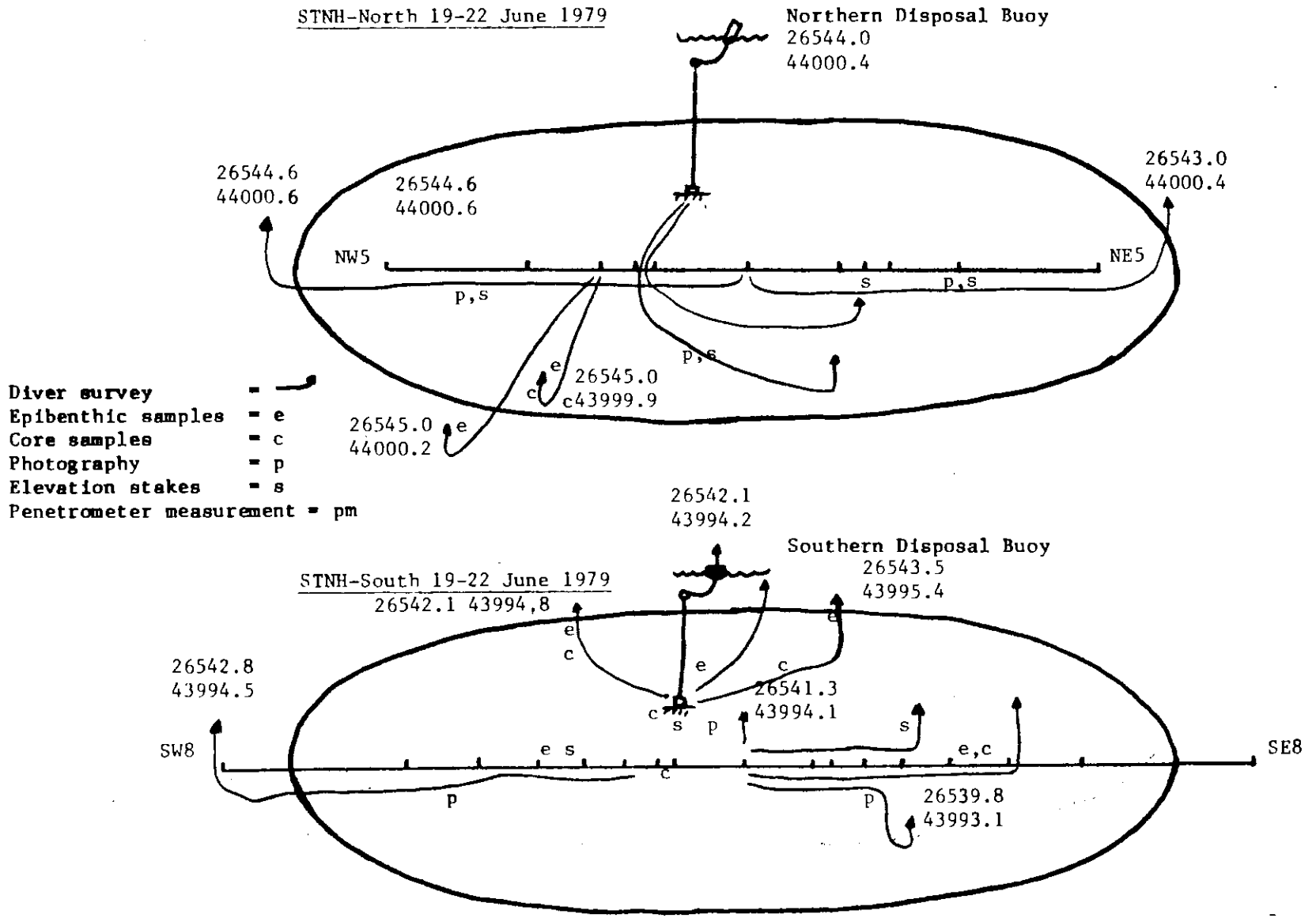
Reduced visibility in the central portion of Long Island Sound did not limit the divers' abilities to photograph benthic conditions or to perform biological inventories at either the North or South sites. Selected photographs representing features of the natural bottom sediment, topography of the disposed Stamford dredged material, epifauna and motile megabenthos occuring on both the North and South disposal sites are presented in Plates 8.2-1 to 16. See Table 8.2-2 for photograph captions.

8.2.2 Stamford-New Haven Disposal Site Monitoring (June-November 1979)

Following deposition of New Haven silt on the STNH-South site, and sand on the STNH-North site, both locations were surveyed in June (Figure 8.2.2-1) to evaluate the

Figure 8.2.2-1 CENTRAL LONG ISLAND SOUND DISPOSAL SITE

Post Capping Survey



effectiveness of coverage of the Stamford sediment by the capping material. Objectives of the dive were to characterize the differences between sand and silt capping material, to assess the stability of the final 'cap' deposits, and to delineate the boundaries of the disposal mound at both sites.

At the STNH-North site divers performed a cap coverage survey at locations where bathymetry indicated a thin sand overlay. This condition was confirmed and additional dumping of New Haven sand by the hopper dredge Essayons achieved greater cap depth in those areas. Observations on the sand cap indicated a dense "resilient" sand layer on the disposal mound which would flow into and fill depressions in the surface. Consequently, a very smooth sand surface developed.

At the STHN-South site there was some difficulty in distinguishing the New Haven silt cap from similar, previously deposited Stamford material, however, the occurence of numerous clay mounds with angular facets and extremely irregular topography was used as evidence of New Haven capping material. Later chemical analyses indicated that this was a consistent and valid indicator. The N-S ground line marking the N-S horizon and margins of the final Stamford mound (April 1979), was not found on the divers' search, and further confirmed cap coverage. At the periphery of the mound, new faunal activity (burrows, cones, mollusk trails, clay base excavations) suggested that sediment along the entire diver transect was of recent New Haven origin. At the north and south sites, new diver orientation cables were laid E-W identical in length and station interval to the original baseline orientation cables (Figure 8.2.2-1). All subsequent monitoring was referenced to these cable stations permanently

located over the final Stamford-New Haven capped surface.

The post-capping survey (July & August '79) included standard biological and sediment observations with super 8 mm cinema film sequences along both north and south site orientation cables. Emphasis was directed on the placement of calibrated elevation stakes at several station locations and preliminary penetrometer tests (Figure 8.2.2-3).

The penetrometer (Fig. 8.2.2-4) is a diver-operated device designed to measure the degree of consolidation of the surface sediments. It was designed and standardized using different vertical pressures (5 to 20 lbs.) and disc areas. Several substrate types were tested and a calibration curve was generated for the instrument. The operational specifications were 10 lbs. pressure with a 15 cm diameter disk selected to correspond to soft Central Long Island Sound sediments and dredged material. The location, dates, and actual data collected with the penetrometer are recorded in Table 8.2.2-1.

Documentation of transect cable conditions consisted of readings from previously placed elevation stakes. No detectable erosion or accretion was noted at any station locations and additional stakes were deployed along the transect cables to permit a more thorough evaluation. Elevation stake data appear in Table 8.2.2-2.

The fall (November 1979) survey revealed additional disposal on top of the STHN-South site. New sediment covered the distance from the bouy chain tie line to the diver orientation cable, thus normal cable station observations could not be

Figure 8.2.2-2 CENTRAL LONG ISLAND SOUND DISPOSAL SITE

Post Disposal Monitoring Survey

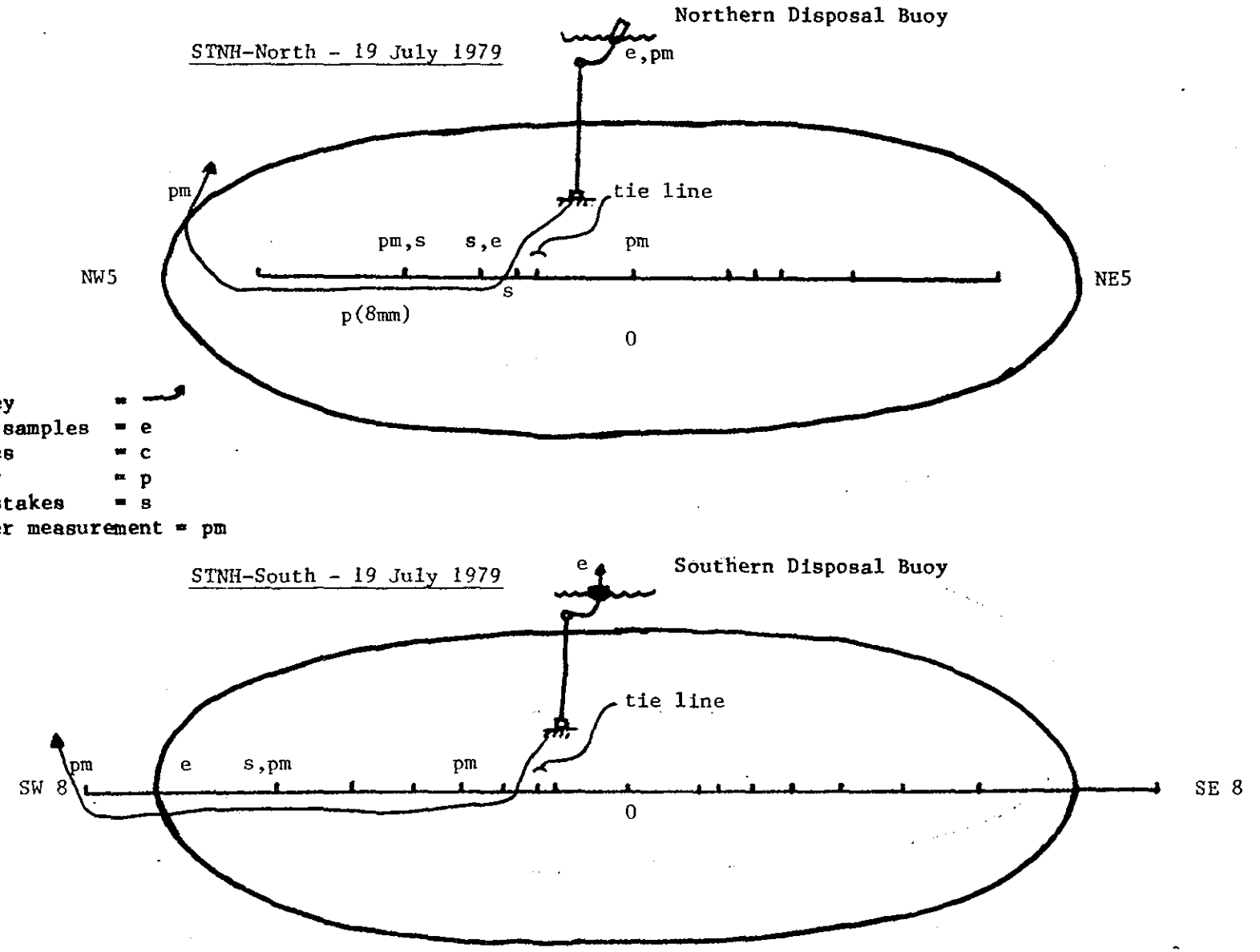
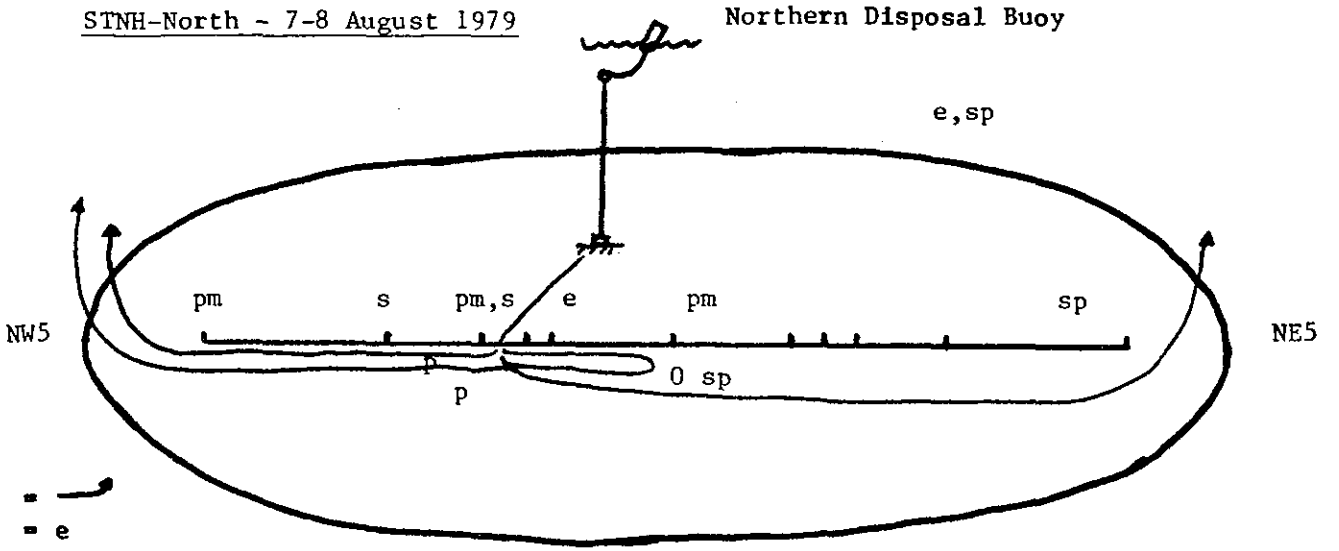


Figure 8.2.2-3 CENTRAL LONG ISLAND SOUND DISPOSAL SITE

Post Disposal Montioring Survey

STNH-North - 7-8 August 1979



Diver survey = →
Epibenthic samples = e
Core samples = c
Photography = p
Elevation stakes = s
Penetrometer measurement = pm
Sediment profile = sp

STNH-South - 7-8 August 1979

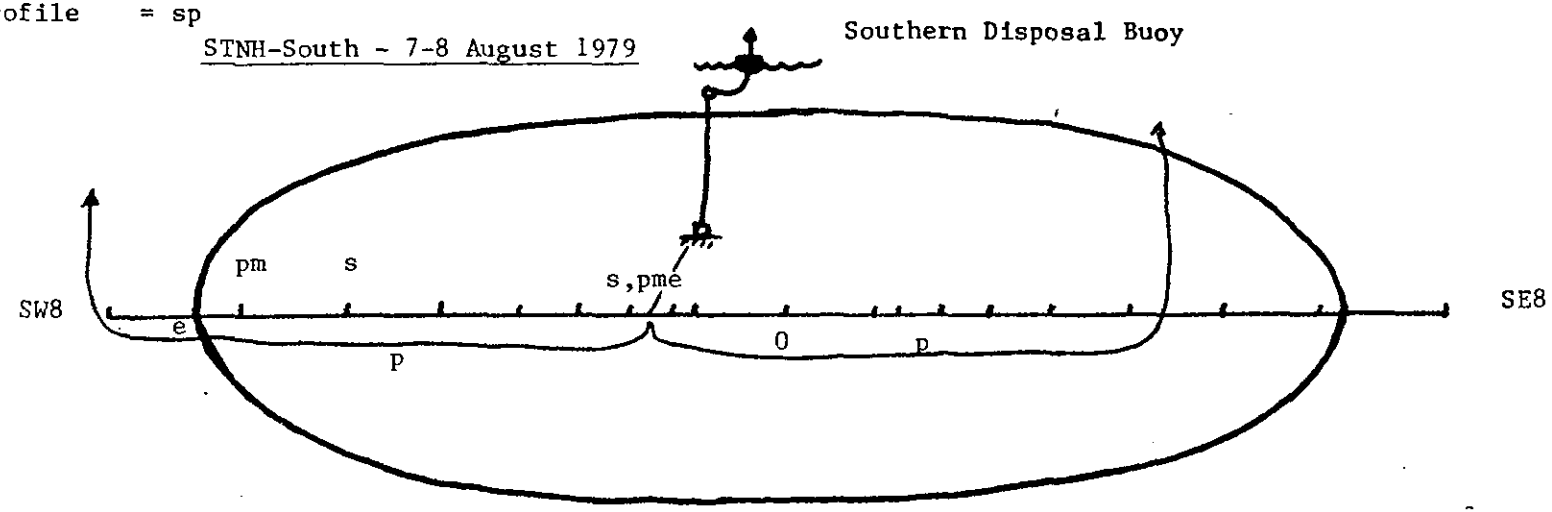


Figure 8.2.2-4 Schematic of diver-operated penetrometer, used for measuring relative sediment compaction values.

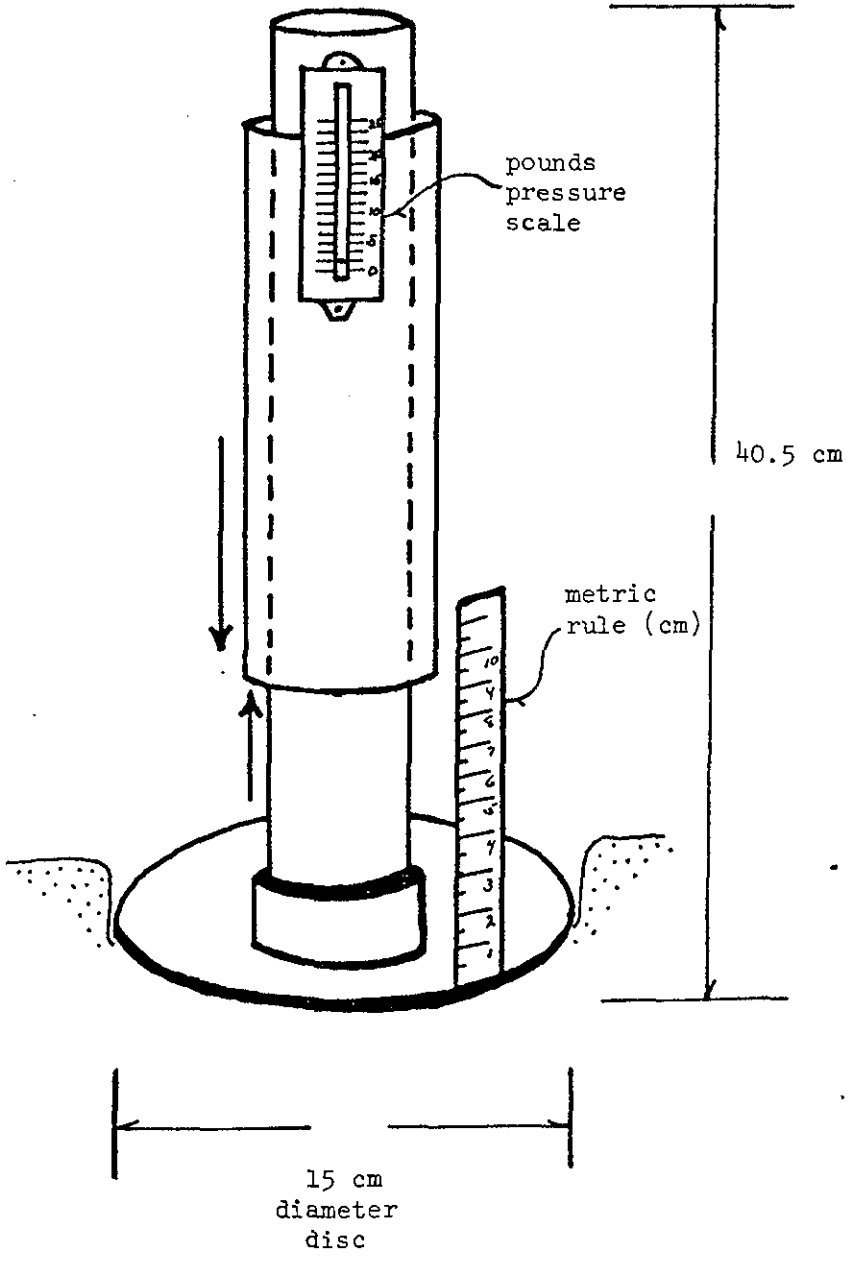


TABLE 8.2.2-1. In-situ penetrometer measurements at the Stamford-New Haven disposal sites in Central Long Island Sound (1979).

Date	Location	Lbs. pressure	Depth Depression (15 cm diam. disc.)
19 July 79	North site		
	NC tie (sand cap)	15	0.2 cm
	NW 4 (sand cap)	15	1.0 cm
	75 m N of		
	NW 5 (natural bottom)	15	3.0 cm
	South site		
	SW 4 (silt-clay spoil)	10	7, 8 cm (2 tests)
	SW 6 (" " ")	10	8 cm
	SW 8 (" " ")	5	4,5 cm (2 tests)
7 Aug 79	North site		
	NC (sand cap)	20	0.3 cm
	NW 4 (sand cap)	20	0.3 cm
	10 m W of NW 5 (apron)	20	1.0 cm
8 Aug 79	South site		
	SW 3 (spoil)	10	4,5,5 cm (3 tests)
	SW 7 (spoil)	10	6,8 cm (2 tests)

TABLE 8.2.2-1. cont.

Date	Station	Lbs. Pressure	Depth Depression (15 cm diam.disc)
5 May 80	Norwalk - Disposal Buoy on spoil	5	3.5, 3.5, 3.5 cm
29 May 80	North Stamford/New Haven Site - metal platform - on spoil cap	10	0.3, 0.3, 0.4 cm
	Norwalk Site - on spoil 20 yds N of dump buoy	10	4.5, 5.2 cm on spoil 3.8 cm on clay clump
19 July 80	North New Haven/Stamford Site		
	Tie-in	15	0.2 cm - spoil
	60 m W	15	1.0 cm - spoil
	75 m W	15	3.0 cm
	South Stamford/New Haven		
	SW 4	10	7.8 cm - spoil
	SW 6	10	8 cm - spoil
	(W) SW 8	5	4.5 cm - natural bottom
	North of North pile on natural bottom	15	3.5 cm
3 Sept 80	Stamford/New Haven North Site	10	NL- N 3 0.1-0.2 cm - practically no penetration sand NW 5 0.4, 0.3, 0.4 cm - thin surface veneer 50 m SW NW 5 1.1, 1.0, 0.8 cm
	Stamford/New Haven South Site 75 m NW of buoy - on spoil	10	.75, 0.8, 1.0 cm
4 Sept. 80	Natural bottom between Stamford/ New Haven North and South	10	2.6, 2.75, 3.0 cm

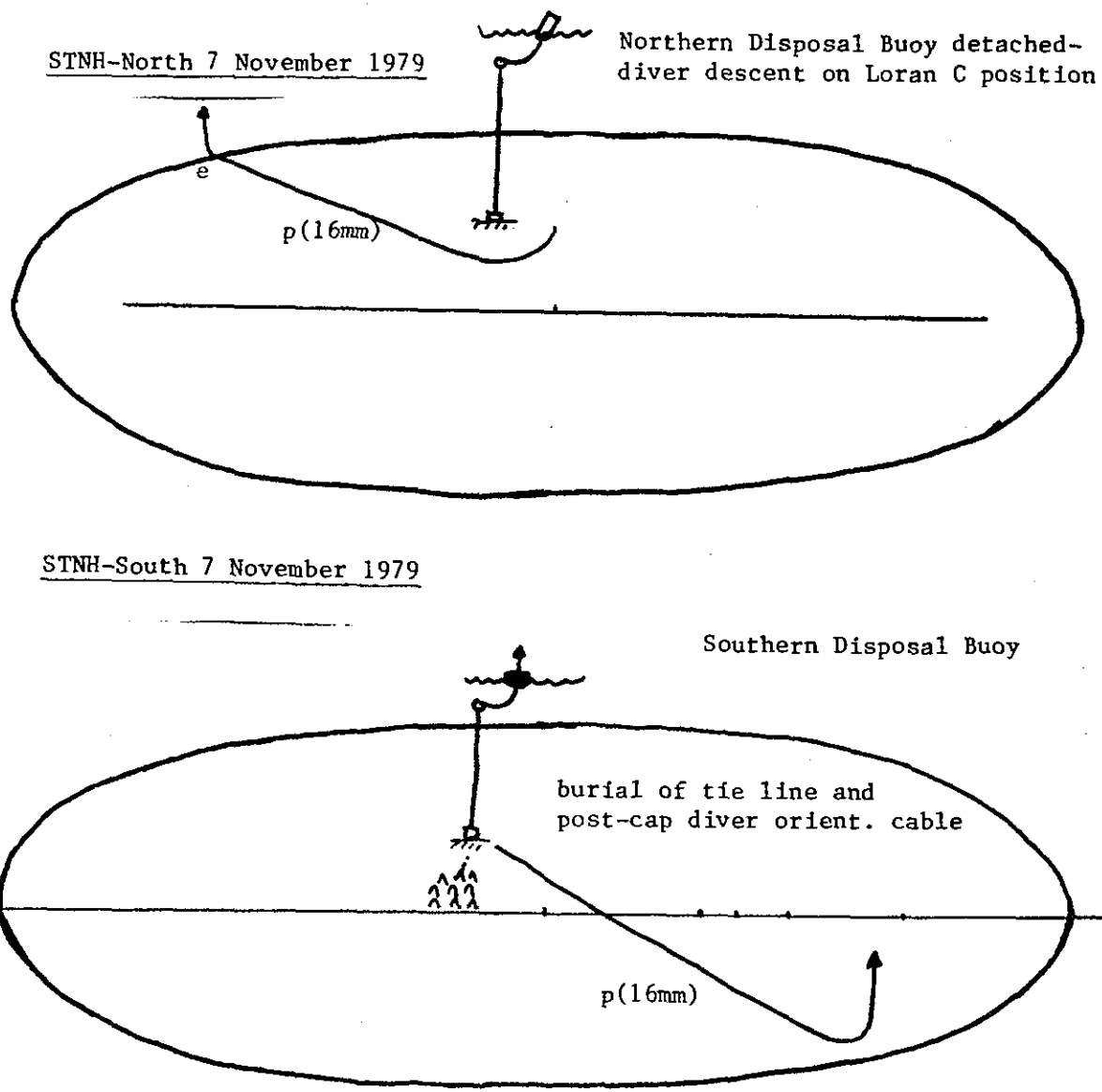
TABLE 8.2.2-2. Periodic stake readings at Stamford-New Haven disposal sites in Central Long Island Sound, March 1979 - September 1980.

Station	Date Deployed	No. Stakes	Observation Date	Level
STNH North	23 March 79	4 (NC, NW1, NW 3, NE 1)	26 April 79	0 Baseline transect cable buried
	22 June 79	1 (NE w)		Post disposal cap 0
	19 July 79	2 (tie in NW 4)		0
			7 Aug 79	No change
			8 Aug 79	No change
			7 Nov. 79	Transect cable location lost -
			3 Apr 80	Relocated - no change
			29 May 80	Transect cable lost
			25 June 80	Relocated - no change
			30 June 80	No change
			3 Sept 80	No change
STNH South	22 March 79	1 (SW 1)	10 April 79	No visibility - level. Transect line buried
	19 June 79	1 (south of buoy chain)		Post disposal cap 0
	20 June 79	2 (SE 4, SW 4)		0
			22 June 79	No change (SW 4)
			19 July 79	No change
			8 Aug 79	No change
			7 Nov 79	Transect line buried

performed. The disposal buoy marking the North site had broken free and similarily, a successful transect cable survey was not possible. Therefore, a free transect 16 mm cinema sequence was taken on both North and South sites (Figure 8.2.2-5).

During the July survey, anoxic, white slime sediment and the presence of H_2S were noted on the South site at one location. This area (1 x 2 m) was the first and only 'foul' surface condition noted to date. Benthic organisms (epifauna and infauna) were found to be less abundant in the vicinity of the South site than the North site although no correlation with sediment 'fouling' is suggested. The previously ubiquitous solitary hydroid, Corymorpha pendula, was not present at either site during the summer surveys, however, the burrowing anemone Ceriantheopsis americanus, was present on natural bottom in sufficient densities to distinguish disposal boundaries at most sectors. Demersal finfish (Prionotus carolinus, Raja sp., Scophthalmus aquosus, Pseudopleuronectes americanus, Urophysis sp.) were sighted consistently. They were, however, generally in the juvenile size range (5-20 cm) and their occurrence did not suggest dense populations or distinct areas of congregation. Numerous vertical burrows were sighted along north and south transect cables. The majority of these were assumed to be inhabited by Axius serratus (two live specimens were collected on 19 June) but burrows formed by Squilla empusa cannot be discounted. The burrows occurred in densities of up to 6 per m^2. The ecological significance of these excavations on the disposal mound is that they permit, and accelerate, ventilation of subsurface sediments. This, and the associated reworking of the

Figure 8.2.2-5 CENTRAL LONG ISLAND SOUND DISPOSAL SITE
Post Disposal Monitoring Survey



sediment (bioturbation), may facilitate subsequent recolonization of the disposed dredged material. Photographs of significant biological and geological features observed during this period are presented in Plates 8.2-17 to 24. See Table 8.2-2 for photograph captions.

8.2.3 Central Long Island Sound Disposal Site Monitoring (April-September 1980)

Diver inspection of the CLIS Disposal Site from April to September, 1980, included continued monitoring of the Stamford-New Haven north and south sites and a pre-disposal survey of the designated Norwalk Disposal Site. Underwater photos illustrating microtopographic features, burrows, fecal mounds, excavations and invertebrate tracks encountered on survey transects during this period are presented in Plates 8.2-33 to 58. See Table 8.2-2 for photograph captions.

The pre-disposal investigation at Norwalk produced photographic records, in-situ species counts, and description of substrate characteristics which resembled the conditions at the STHN-South site prior to the disposal of Stamford material. The Norwalk region (within 100 m of the Norwalk buoy) was typified by featureless bottom covered by a loosely consolidated silt veneer. This thin (1 cm) surface veneer of flocculent material remains a bottom sediment condition present throughout the year in central Long Island Sound. Potential margin indicator species continued to be the stalked solitary hydroid, Corymorpha pendula, in spring, and the burrowing anemone, Ceriantheopsis americanus, in summer.

The Stamford-New Haven south site had received new

dredged material (November 1979) which covered the diver orientation cables and prevented the continuation of post-disposal monitoring of permanent stations and elevation stakes. Furthermore, there was substantial evidence, of more recent disposal during the April 1980 survey. The surface of the mound displayed an uneven topography with vertical relief on the order of two meters, produced by cohesive clay clumps just beginning to fracture and erode. Inspection of new spoil topographic relief, and limits of coverage, was accomplished in free transect courses radiating from the STNH-South site buoy. Corymorpha pendula were again present during the April survey and proved useful in defining the margins of disposed material.

A rapid smoothing of the disposal surface occurred during the summer and coincided with a sparsity of visible biological activity. The September 1980 survey revealed fractured clay mounds, and evidence of extensive repopulation of the sediment surface. Polychaete worms had colonized the clay clumps (Plate 8.2-30); dense populations of mysids occurred on the surface, and the surface was extensively burrowed.

The STNH-North site transect cable had remained in place and allowed repetitive inspection of the sand cap sediment 100 m to the east and west of the disposal buoy. The hard sand substrate with considerable shell debris accumulation appeared extemely stable with no evidence of Stamford material protruding through the cap layer. Elevation stakes and penetrometer tests produced consistent readings through the 15 month post-disposal monitoring period (Tables 8.2.2-1 and -2). There was evidence of gradual deposition of natural silt over the original sand cap

apron region. September 1980 measurements indicated deposition of 4-6 cm at border stations.

The boundaries of the cap were easily distinguished in late spring by the presence of Corymorpha pendula. Ceriantheopsis americanus was not particularly abundant during the summer surveys, however, the shell debris associated with the sand cap made the spoil boundary easily detectable. Demersal fish (flounder, hake) and scavenging epifaunal invertebrates such as Cancer and Pagurus were observed on the cap during all surveys.

In April 1980, Loran-C fixes were obtained for the buoys marking the Stamford-New Haven North and South, and Norwalk disposal sites. By September 1980, Loran-C coordinates were established for the perimeter of the spoil mounds at all three sites (Table 8.2.3-1). Large Loran-C (9960 GRI) grids were computer generated and the location of each site plotted on them (Fig. 8.2.3-1). A Northstar 6000 Loran receiver, interfaced with an Epsco C-plot Model 4050, was used to chart disposal mound boundaries, dive sample stations, diver survey transects and mussel platform locations. This tracking system is expected to reduce loss of sonic beacon stations and diver orientation cables, and allow more rapid site relocation for spot dive inspections in the future.

An additional project during the 1980 surveys of the New Haven and Norwalk disposal sites concerned the hydroid, Corymorpha pendula. It had proven to be an abundant and reliable indicator of the spoil margins during certain seasons. Yet, results of Smith-McIntyre grabs and epibenthic tows consistently underestimated the densities and distribution of Corymorpha

TABLE 8.2.3-1. Loran-C coordinates for disposal mound perimeter and target disposal buoys.

Central Long Island Sound Disposal Site

Buoys	L/C	Date Obtained
STNH- South	26542.0 43994.3	24 April 1980
STNH- North	26544.2 44000.7	24 April 1980
Norwalk	26549.7 43998.9	24 April 1980
SP	26547.6 43997.2	24 April 1980

Perimeters	L/C	Date Obtained
STNH- North	26542.6 44000.3	21 May 1979
	26544.6 44000.6	22 June 1979
	26544.9 44000.1	19 July 1979
	26543.8 44001.1	3 September 1980
STNH- South	26542.8 43994.3	25 April 1979
	26542.5 43994.8	19 June 1979
	26542.7 43994.7	3 September 1980
Norwalk	26549.7 43999.4	5 May 1980
	26548.6 43998.5	4 September 1980

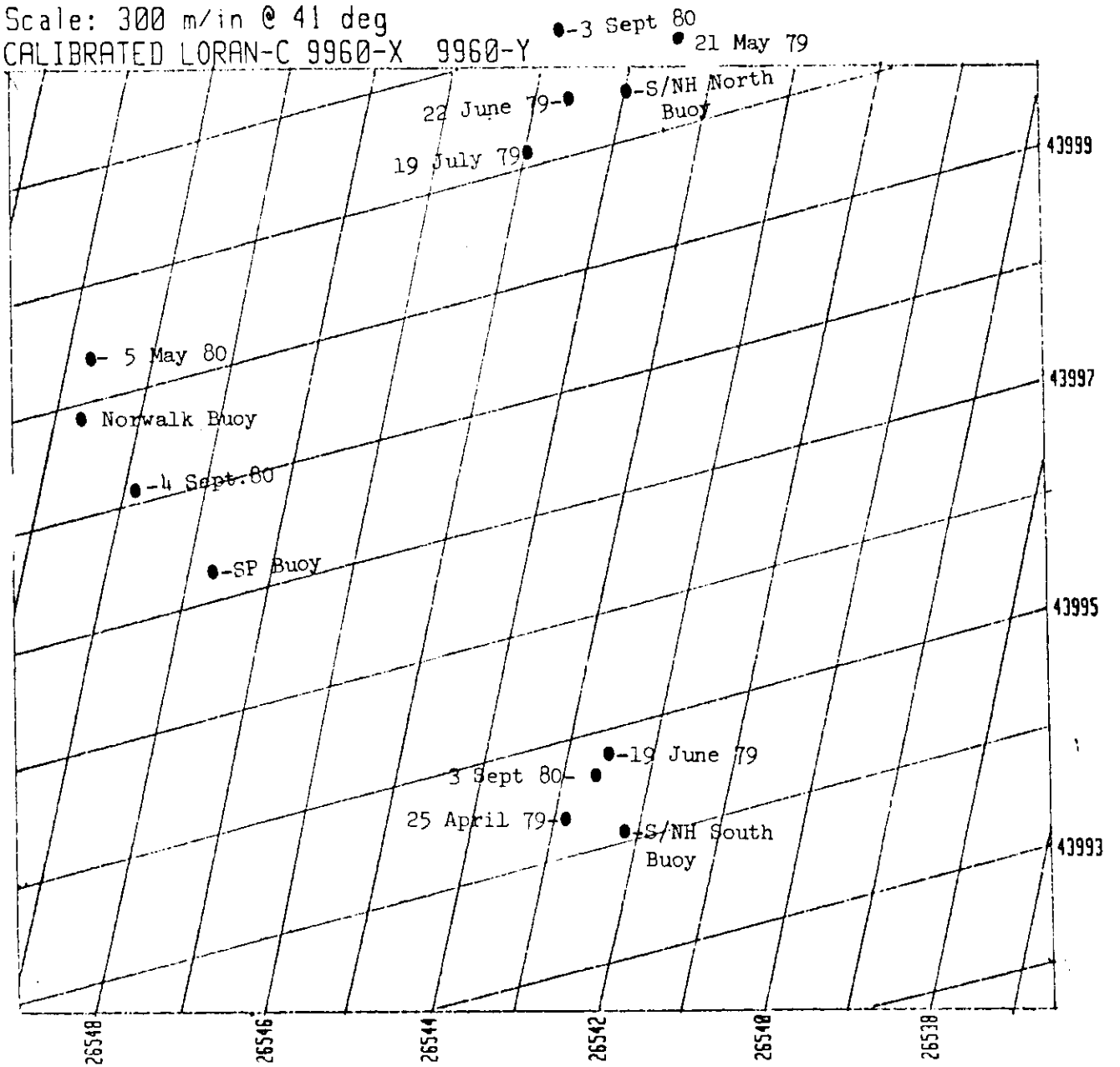


Figure 8.2.3-1. Disposal buoys and preliminary border locations on the Central Long Island Sound Disposal Site.

observed by the divers. Average densities of between 9.0 and 24.1 organisms per .25 m^2 were observed by divers at the CLIS site, however, much lower values were recorded in the grab sample analysis. This discrepancy may be due to the handling during the sampling and sorting processes, or the fragility of the animal, as the amorphous remains of some individuals are unidentifiable.

In order to document the importance of this species, during the course of diver transect surveys at both the CLIS and New London sites, Corymorpha densities and anatomical dimensions were obtained. Behavioral observations focussed on the animals' feeding and sessile securing mechanisms. Benthic boundary layer current speeds were also measured.

Densities were determined using a .25 m^2 PVC pipe quadrant, or by demarcation of a .25 m^2 area and counting individuals within the boundary. Areas of study were selected randomly. Hydroid dimensions (stalk height, hydranth diameter, holdfast depth, holdfast diameter) were all measured in-situ with a metric ruler. Benthic boundary layer currents were measured by timing the path of illuminated surface particles past a .50 meter rule. Table 8.2.3-2 summarizes all data obtained on Corymorpha during survey dives in 1980. Preliminary data indicate Corymorpha is present as a sessile polyp from February to late May. The remainder of the year it exists in a medusa stage.

Population differences in Corymorpha are apparent between the Central Long Island Sound and New London sites with consistently lower densities occurring at the New London site. This may be a function of substrate (grain size), local resource potential, and/or low energy required for resuspension of organic

TABLE 8.2.3-2. Population occurrence and density, and ecological observations on Corymorpha pendula.

Date	Site	Density (.25 m^2)	Ecological
3 April 80	NH Disposal Site Norwalk Buoy to N	36, 23, 17, 18, 22 25, 28 $\bar{X}$ = 24.14	Stalks at various angles to substrate - all in downcurrent position. No withdrawl response noted after disturbance of several individuals.
5 May 80	NH Disposal Site Norwalk Mussel Platform (20 m N)	16, 18, 19, 20, 17, 19, 31, 12, 20 $\bar{X}$ = 19.11	Current E - W 8 sec/50 cm 1145 = 6.25/cm/sec. 4 sec/50 cm 1230 = 12.5 cm/sec. Hydroid Dimensions: (cm) Stalk Height 6 5 5 5 Hydranth Dia. .7 .5 .5 .4 Holdfast Depth 1.7 1 1.5 1.5 Holdfast Dia. .7 .5 .5 .7 Height 3.5 4.5 Diam. .3 .3 Depth .9 .8 Diam. .45 .4 Four postures noted for hydroids - tentacles on and over substrate - tentacles streaming or coatroled (see notes) - Photos. Substrate feeding noted.
14 May 80	NL Disposal Site DI platform	1, 1, 0, 0, 1, 0, 2, 0 0, 0, 1,2 $\bar{X}$ = 0.67	Current W - E 6-7 sec/50 cm 7.14 = 8.33 cm/sec. Hydroids low density compared to New Haven site. No substrate feeding noted. Sediment coarser grained with more shell debris then New Haven.
29 May 80	New Haven Disposal Site - Norwalk Site Platform location.	5, 8, 14 $\bar{X}$ = 9.00	15 animals collected and returned to lab. Noted constricted stalk on several individuals (just below hydranth).

TABLE 8.2.3-2. cont.

Date	Site	Density	Ecological
10 June 80	New London Site SE Perimeter		Corymorpha not present. Tubularia spp - colonial and solitary - dominant hydroid.
12 June 80	Stamford/New Haven North Site.		Corymorpha not present. Cerianthus americanus ~ 4/.25m^2

particulates. Central Long Island Sound sediments, where Corymorpha are present, are generally a fine silt-clay with high organic content. The New London site sediments are typically coarser with lower percent organics. Corymorpha, a suspension feeder, is clearly better adapted to the fine-grained substrates and, conversely, a high density population may contribute to the stability of these unconsolidated sediments. This may be a function of the organism's holdfast, which may physically prevent sediment particle movement or an indirect effect of large animal densities reducing boundary layer current speeds.

A preliminary laboratory test was conducted to determine the ability of Corymorpha to survive burial. Experimental animals were collected by divers at the Central Long Island Sound disposal site (natural bottom) on 5 May 1980. While on the bottom, animals were placed directly into nalgene containers, which were then placed in a cold water bath and transported to the Marine Research Laboratory in Noank, Conn. Every effort was made to avoid handling and temperature stresses and no mortality was observed during transport. Eleven animals were placed in an aquarium connected to an unfiltered flow-through seawater system (Plates 8.2-56 to 58).

On 7 May 1980 at 1030 hrs., the animals were buried by 2 cm of fine-grain sediments which had previously been defaunated with fresh water and then reoxygenated. By 1145, three polyps had emerged so the the hydranth was at the surface of the sediment. By the third day, (May 10) five polyps had emerged from the sediment surface to at least the hydranth level and several had parts of the stalk exposed. By the fifth day (May 12) five

animals were visible and one of these had totally migrated to the surface (i.e. holdfast at surface level). At this point the experiment was terminated.

These preliminary data document the ability of Corymorpha to migrate vertically in the sediment after minor surface burial. The fact that five of eleven animals emerged after burial agrees with field observations along the apron areas of the disposal mound, that partial mortality occurs after disposal operations. Low densities of Corymorpha were observed in the apron area, and increasing densities were found on natural substrate. This conclusion applies only to animals subjected to burial under a few centimeters (~ 2 cm) of material. Field observations indicate Corymorpha is unable to migrate vertically after burial by any substantial amount (i.e.~ 10 cm) of sediment.

Further observations and measurements during the next winter and spring season will include measurements of population density, comparative benthic boundary current flow in high density and low density areas, animal growth rates, substrate type and / density comparisons, and hydroid-benthic fauna interactions.

TABLE 8.2-2. List of captions corresponding to Plates 8.2-1 to 58 at Central Long Island Sound Disposal Site.
- Underwater photography, March 1979 - September 1980

PLATE#	
8.2-1	22 March 79. South site, west transect. HFVP - 15". Abundant juvenile flounder, Pseudopleuronectes americanus, were observed on natural bottom at N and S sites during predisposal inspection.
8.2-2	23 March 79. South site. SE 8 vicinity. HFVP - 15". Plastic cohesive nature of the natural sediment surface is demonstrated by creation of lateral fin-ray depressions of the sand dab, Scophthalmus aquosus.
8.2-3	22 March 79. South site. West transect. HFVP - 8". The stalked solitary hydroid, Corymorpha pendula ubiquitous at all pre-disposal sites, occurred in sufficient densities on natural bottom to be used as evidence of spoil coverage limits during initial disposal phases.
8.2-4	23 March 79. South site. SE 8 vicinity. HFVP - 4". Close microtopographic detail of sediment surface illustrates Corymorpha with fecal mound discharge from infaunal polycheates. Note fecal ribbons collected at base of Corymorpha stalk.
8.2-5	22 March 79. South site. Transect baseline. HFVP - 12". Unconsolidated surface veneer is illustrated after passage of the rock crab, Cancer irroratus through a Corymorpha community with cast agglutinated tubes scattered on surface.
8.2-6	22 March 79. South site. Mid west transect. HFVP - 8". Other structural and textural features (fecal mounds, agglutinated tubes, burrows) of the natural bottom provided additional means for differentiation between natural and spoil bottom. Juvenile hake resides in vertical hole in inverted position.
8.2-7	23 March 79. North site. Station "NC". Elevation stake. HFVP - 4". Placement of calibrated (cm) elevation stakes, located at selected station markers, were to provide reference on depth of initial spoil overlay at distant stations.
8.2-8	23 March 79. North site, Station NC - N3. HFVP - 6". The diver orientation cable with logarithmically spaced station markers, was often buried by its own weight in the soft natural sediments.
8.2-9	10 April 79. South site. Stamford spoil interim inspection. HFVP - 24". Immediate disposal surface topography consisted of large clay block with soft interspace sediment. Stamford material was black and coarse granular sediment with a high quantity of detrital material.

TABLE 8.2-2. cont.

PLATE#	
8.2-10	10 April 79. South site. Stamford spoil interim inspection. HFVP - 12". The most prominent crustacean species to assume residence on newly deposited spoil were Cancer irroratus and Libinia emarginata.
8.2-11	10 April 79. South site. Stamford interim. HFVP - 9". Partial burial of Corymorpha basal stalk was indication of spoil dispersion limits in most sectors surrounding the N and S piles. Border regions revealing this condition could be followed by diver for several (10-100) meters.
8.2-12	10 April 79. South site. Stamford interim. HFVP - 9". The surface textural features of underlying sediment are barely evident at the northern spoil apron and .5 cm of Stamford material abuts the base of Corymorpha.
8.2-13	25 April 79. South site. 150 m to east of S disposal buoy. HFVP The three strata layer conditions evident due to diver excavation (sediment profile) at peripheral regions in the S site eastern sector.
8.2-14	25 April 79. South site - buoy base post Stamford HFVP - 24". Fractured clay mounds (.5 - 1m), coarse sand mixtures, and soft interspace silt characterized the range of post disposal sediment type.
8.2-15	25 April 79. South site - 150 m East of buoy - HFVP - 9". Dense concentrations of Corymorpha were typical at the immediate border regions.
8.2-16	26 April 79. North site - northeast sector. HFVP - 6". Juvenile hake, Urophysis, were observed in niche space available on new spoil irregular topography.
8.2-17	19 June 79. North site - Southeast transect to border. HFVP - 10". The mud shrimp. Axius serratus, observed alive on recently deposited spoil. These crustacea excavate vertical cylindrical burrows to 3m depths.
8.2-18	19 June 79. North site - southwest transect. HFVP - 12" The sand dab, Scopthalmus aquosus, utilized the soft spoil surface for camoflage and as resting depressions.
8.2-19	7 August 79. North site - 100 m east of N buoy BOLT vicinity - HFVP - 15" Isolated clay mounds were rapidly colonized by dense clusters of tube-building polycheates.

TABLE 8.2-2. cont.

PLATE#	
8.2-20	8 August 79. North site- station NW 3 - NW 4. HFVP - 4" The hermit crab, Pagurus longicarpus, was abundant (20/½m^2) and actively probed the sand cap surface scavanging for food. Note granular surface texture and shell components.
8.2-21	8 August 79. North site - station NW 3 - NW 4. HFVP - 4". The mud snail (Nassarius trivittatus) was also observed on the sand cap surface in dense concentrations (~20/¼ m^2). Patch areas of the sand cap exhibited a "shell hash" layer comprised of Anomia, Crepidula and Crassostrea valves.
8.2-22	20 June 79. South site - E transect line. HFVP - 12" The kevlar diver orientation cable provided a reference to revisit marked stations and observe sediment changes in the post disposal period.
8.2-23	3 April 80. South site - free traverse to SSE on new spoil. HFVP - 3". The sand shrimp, Crangon septemspinosa, was frequently observed burrowed to carapace depth in new spoil sediment.
8.2-24	South site - buoy base to SSE. HFVP - 15" Faceted, irregular clay mound topography was common in the central spoil pile region. Embedded shell debris contributes to eventual "shell hash" surface accumulation.
8.2-25	3 April 80. South site - new spoil central. HFVP - 8" Fissure lines (3-5 m in length) indicate cohesive aspects of spoil and appear to be recurrent surface features involved with the compaction process.
8.2-26	3 April 80. South site - new spoil central. HFVP - 20" Illustrative of partially erroded clay mounds and small spherical clay fragments resulting from disintegration.
8.2-27	30 June 80. South site - NE sector HFVP - 6" The american eel, Anguilla, was observed occupying a complex tunnel network excavated in a clay mound. Bioturbation and consequent sculpturing of cohesive clay material contributes to eventual fragmentation of large clay mounds.
8.2-28	3 Sept.80. North site - station NW 2 HFVP - 3" Fouling growth (Balanus, Tubularia, sponge (sp)) covered all exposed surfaces of north pile diver orientation cable.

TABLE 8.2-2. cont.

PLATE#	
8.2-29	3 September 80. North site - station NW 4. HFVP - 4" Elevation stake indicated no net change in depth of cover (at 0 mark after 14 month period) and was heavily encrusted by barnacle spat.
8.2-30	3 September 80. South site - vicinity buoy position HFVP - 6" Colonization by polycheate tube worms in small exposed clay mound surface.
8.2-31	3 September 80. North site - west periphery. HFVP -6" Sediment profile photography indicating deposition of (2-4 cm) natural silt over coarse sand/shell cap layer. Note unconsolidated flocculent surface venner.
8.2-32	3 September 80. North site - west (20 m) of station NW 5. HFVP Penetrometer depression in soft sediment overlay with sand cap underneath.

TABLE 8.2-2. cont.

PLATE#	
8.2-33	3 April 80. Norwalk site - buoy baseline. HFVP - 10" Densities of Corvmorpha ranged from 16-36/$\frac{1}{4}m^2$ throughout the predisposal region.
8.2-34	3 April 80. Norwalk site - buoy baseline. HFVP - 6". Sediment surface features (agglutinated tubes, fecal mounds, invertebrate tracks, Corymorpha) will function to distinguish natural bottom from spoil material.
8.2-35	3 April 80. Norwalk - baseline. HFVP - 8". The rock crab Cancer irroratus was the most common mega-benthic crustacean noted: frequent excavation beyond the carapace depth (3 cm) causes considerable sediment turnover and initial spoil surface conditioning.
8.2-36	3 April 80. Norwalk site - buoy baseline. HFVP - 12". The winter flounder, Pseudopleuronectes americanus, actively disturbs surface sediment in fin-fanning feeding behavior. Polychaate, mysid and sand shrimp species constitute readily available food sources.
8.2-37	3 April 80. Norwalk site - buoy baseline. HFVP - 9". The sediment profile on predisposal natural bottom, illustrates the 1-2 cm soft oxygenated surface layer and the soft cohesive silt basal sediment characteristic of 95 percent of the New Haven Disposal Site sediment type.
8.2-38	5 May 80. Norwalk site - beyond northern spoil border. HFVP - 3". The hydranth, stalk and holdfast anatomy of Corymorpha, in close proximity to the sediment surface, demonstrate sessile epifaunal "binding effect".
8.2-39	5 May 80. Norwalk site - northern border. HFVP - 3". Suspension-feeding hydroid, Corymorpha may appreciably effect boundary layer current/turbulence flow in regions of Long Island Sound where densitites approach those cited.
8.2-40	11 September 74. Bridgeport Disposal Site (70") natural bottom. HFVP - 20". Elaborate excavation and tunnel networks form "grottos" which support concentrations of lobster, Homarus americanus. Similarly productive bottom habitat, important to the LIS lobster fishery, has not been observed elsewhere in the New Haven disposal area.
8.2-41	29 May 80. Norwalk site - active disposal at buoy. HFVP - 20". Clay masses rest on spoil substrate.

TABLE 8.2-2. cont.

PLATE#	
8.2-42	29 May 80. Norwalk site - active disposal at buoy. HFVP - 12". The gradual disintegration process eventually results in a flat spoil pile profile, markedly similar to the sequence observed at all LIS sites.
8.2-43	29 May 80. Norwalk site - buoy base. HFVP - 10". New spoil fractured on impact yet low interface turbidity was noted on full tidal flow (+ 1 kt).
8.2-44	30 June 80. Norwalk site - central pile - 50 m north. HFVP - 5". The large hermit Pagurus pollicarus probes surface sediment (2-4 cm) with chelipeds in food-seeking behavior.
8.2-45	30 June 80. Norwalk site - buoy 50 m north. HFVP - 3". The mud snail Nassarius trivvittatus mucoid track across flocculant sediment layer illustrates mobility and feeding behavior on new spoil surface.
8.2-46	30 June 80. Norwalk site - 50 m north. HFVP - 3". Microhabitat excavations and exposed shell fragments produced by Pagurus longicarpus populations.
8.2-47	3 Sept 80. Norwalk site - southeast sector. HFVP - 12". The four spot flounder, Hippoglossus oblongus was observed on new spoil.
8.2-48	4 Sept. 80. Norwalk site - 100 m S of buoy. HFVP - 6". Typical "shell hash" surface layer formed after irregular spoil surface had flattened.
8.2-49	4 Sept. 80. Norwalk site - natural bottom at SE border. HFVP - 3". Conical mounds of anoxic sediment exhibit bioturbation and sediment turnover.
8.2-50	3 Sept. 80. Norwalk site - SE transect. HFVP - 12". Juvenile winter flounder buried deep in spoil sediment depression.
8.2-51	3 Sept. 80. Norwalk site - SE transect. HFVP - 10". Another example of extensive polychaete colonizations of clay mound surfaces.
8.2-52	3 Sept. 80. Norwalk site - SE transect. HFVP - 6". Penetrometer illustrating clay mound density - no depression at 10 pounds pressure.

TABLE 8.2-2. cont.

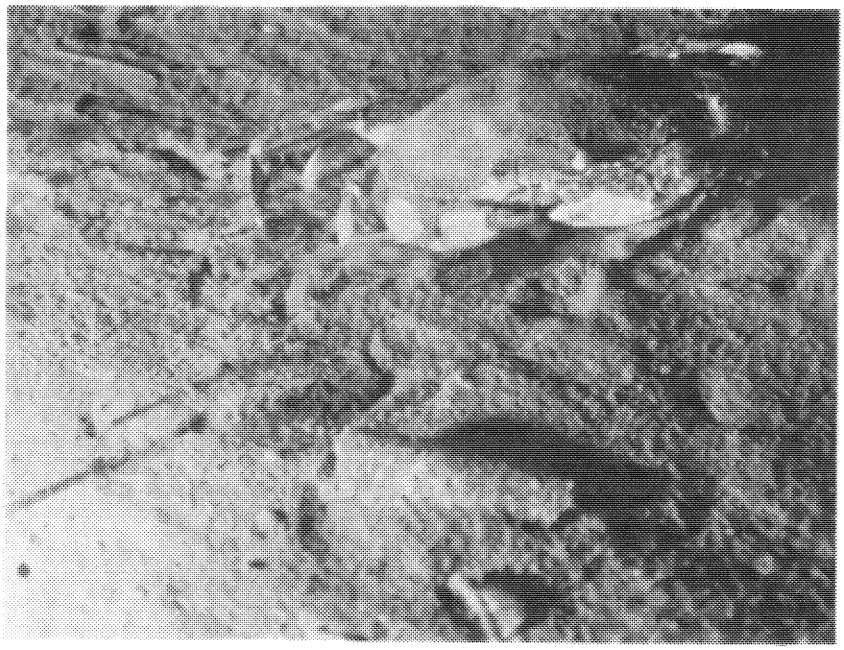
PLATE#	
8.2-53	3 Sept 80. Norwalk site - SE transect. HFVP Penetrometer illustrating adjacent soft spoil sediment - 4-5 cm depression at 10 pounds pressure.
8.2-54	22 March 79. South site diver orientation cable to be deployed E-W over central pile with tie to target buoy. Polypropylene station markers and acoustic release buoy at western anchor are illustrated.
8.2-55	19 June 79. Army Corps dredge vessel,"Essayons", applying final sand cap at north site in region where bathymetry and diver inspection indicated thin coverage.
8.2-56	7 May 80. Corymorpha burial experiment - natural holdfast orientation. Pre-burial arrangement of 11 individuals.
8.2-57	7 May 80. Detail of individual hydroids. Note gonophores at center of hydranth (left)and stalk/ hydranth orientation (right).
8.2-58	7 May 80. Hydranth and stalk emerging 45 minutes after burial.

PLATE 8.2-1

PLATE 8.2-2

PLATE 8.2-3

PLATE 8.2-4



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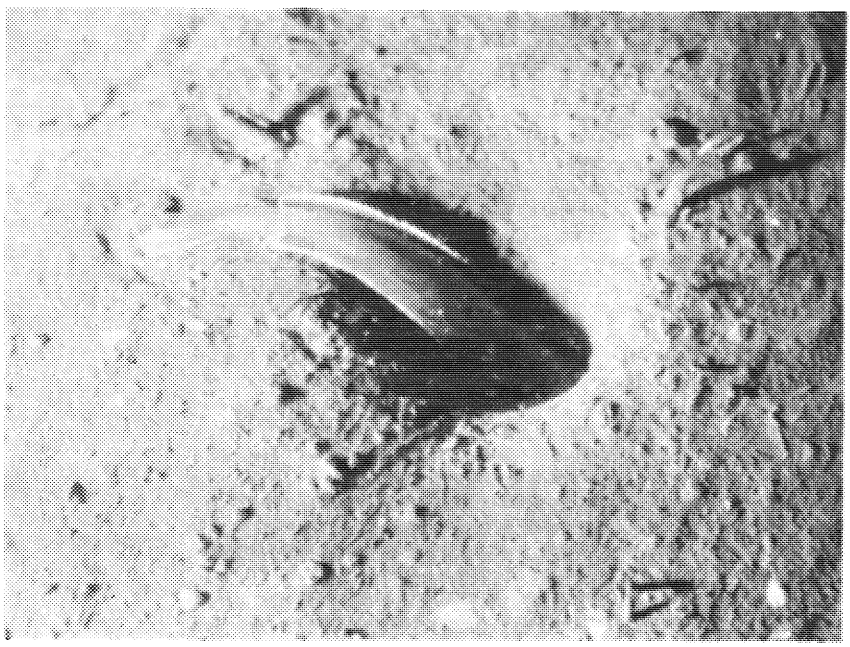
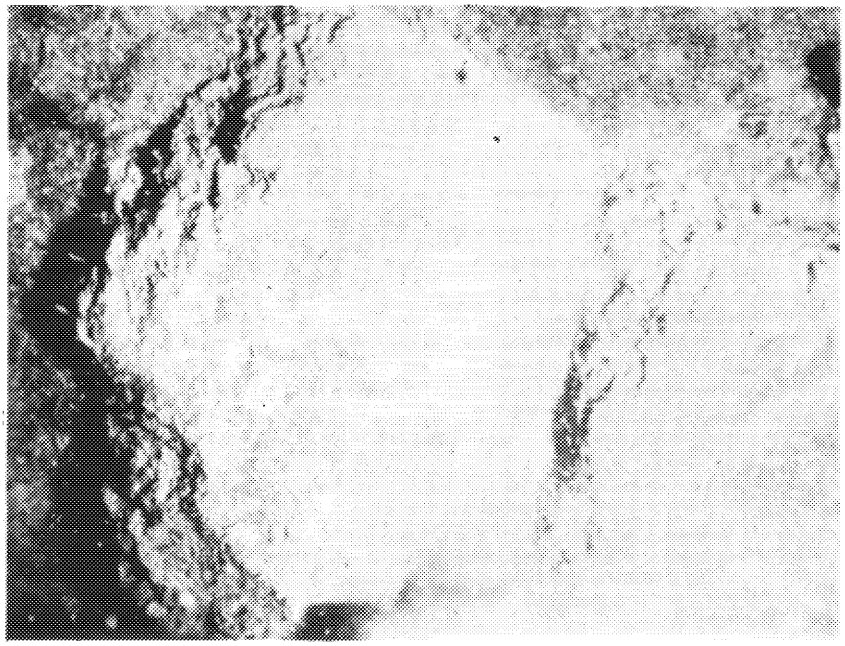


PLATE 8.2-6

PLATE 8.2-7

PLATE 8.2-8



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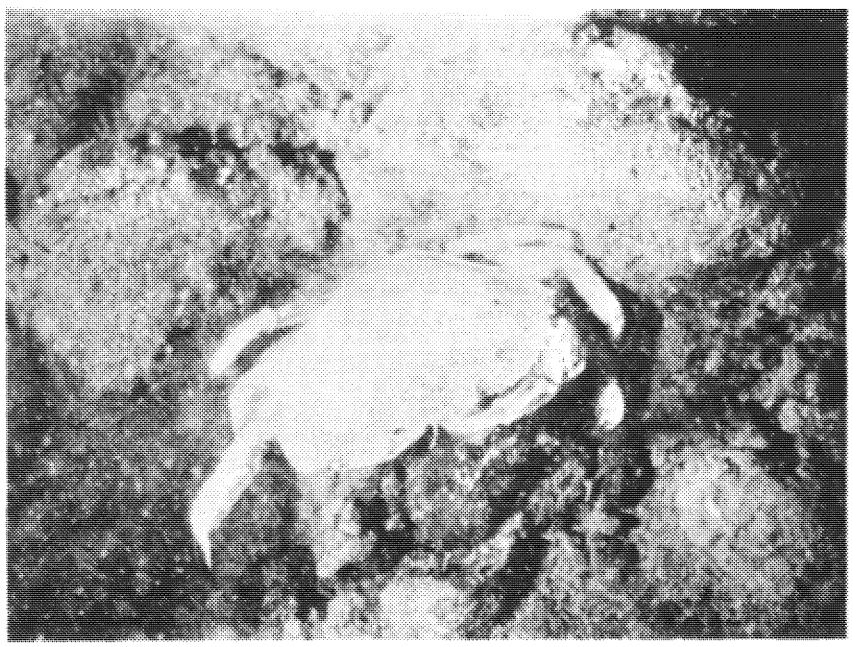

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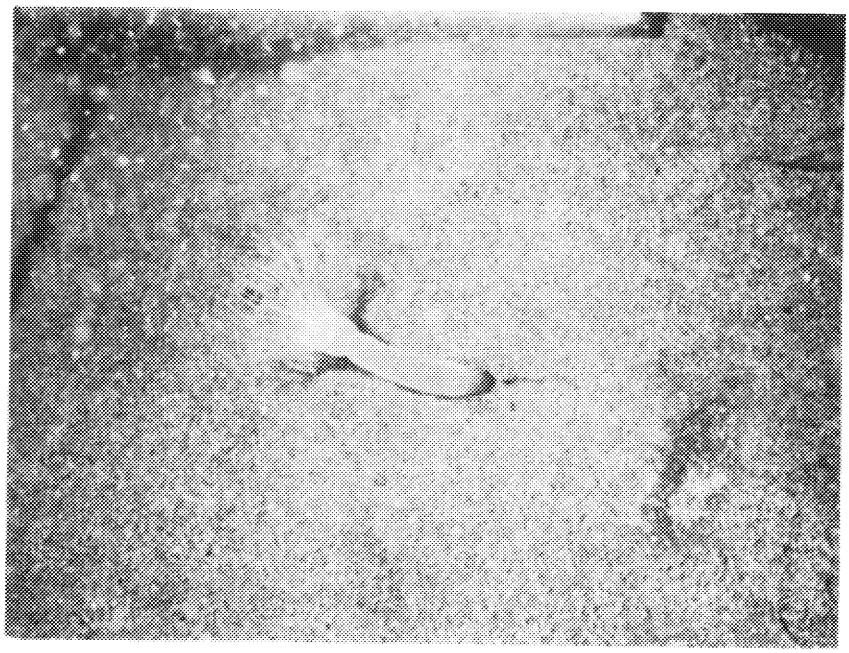


PLATE 8.2-11

PLATE 8.2-12

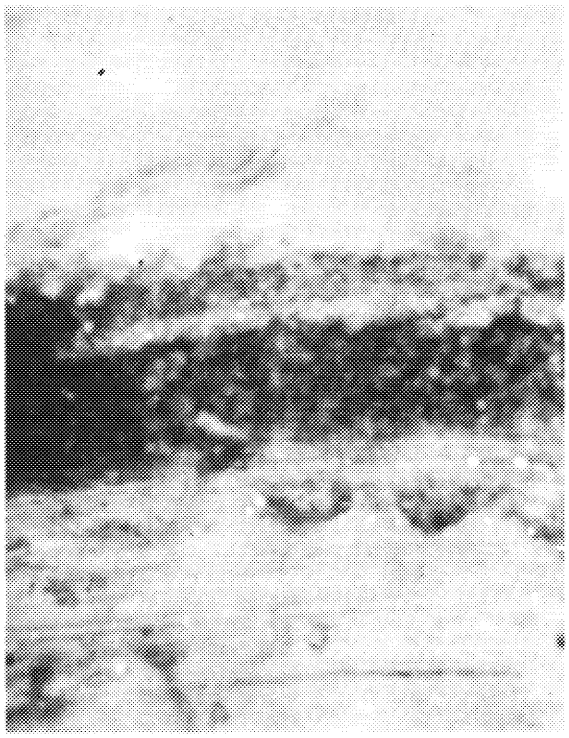
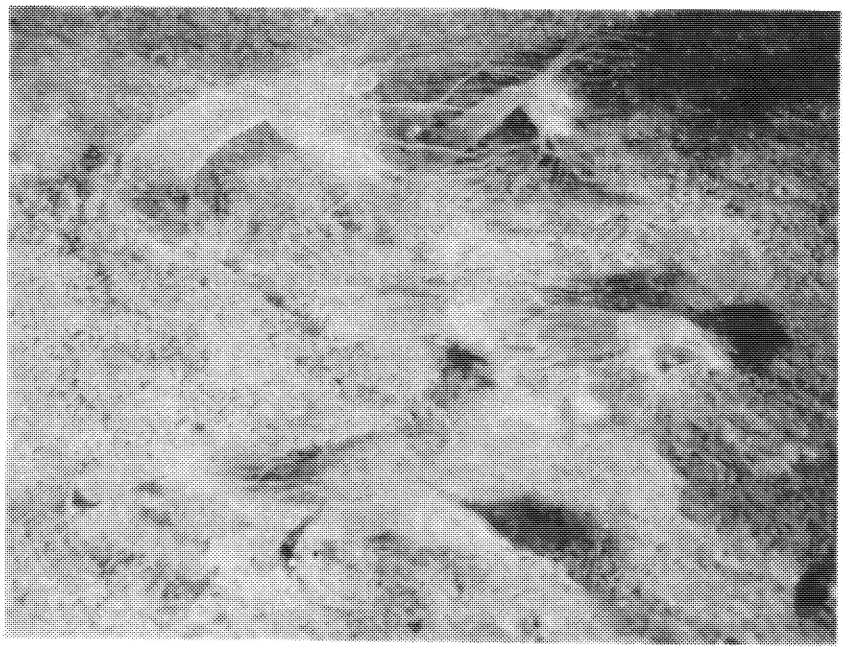


PLATE 8.2-13

PLATE 8.2-14



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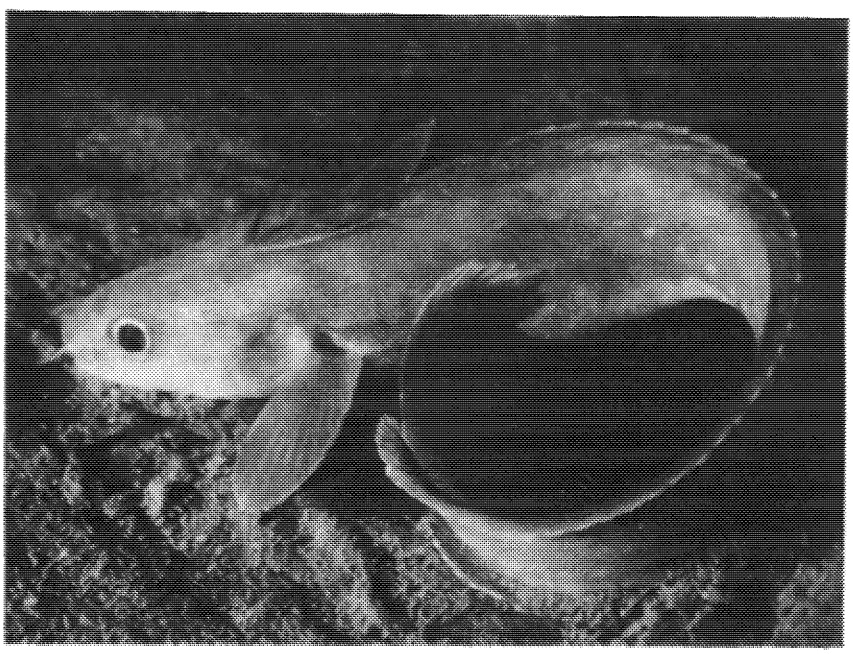
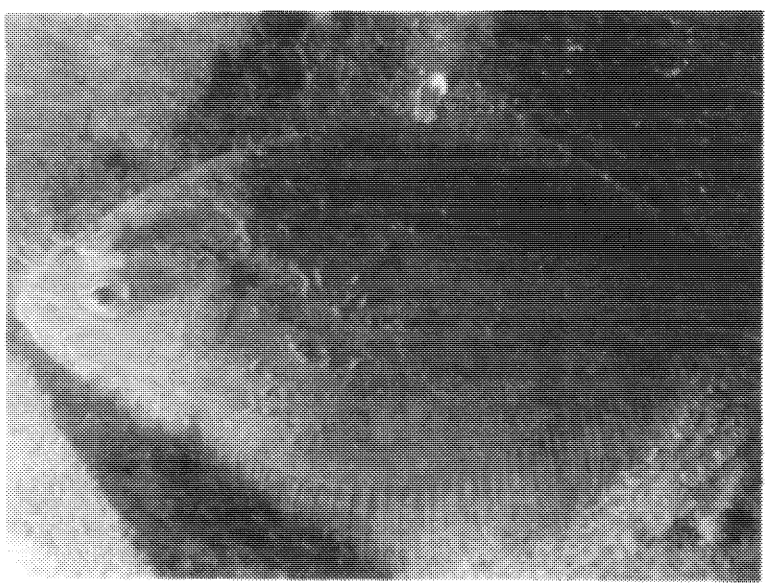


PLATE 8.2-16

PLATE 8.2-17



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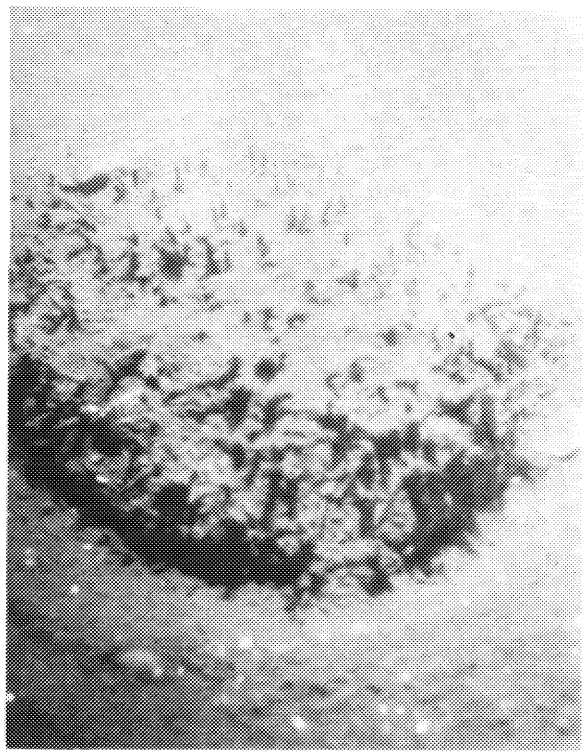

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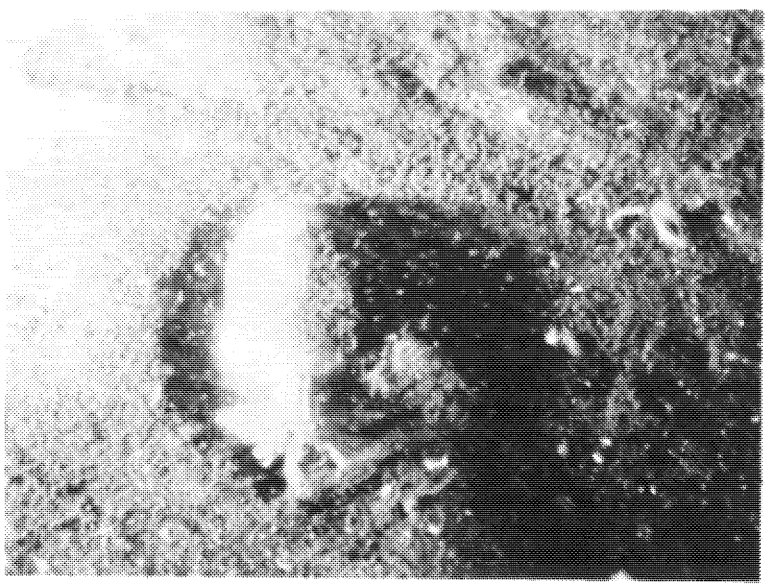


PLATE 8.2-20

PLATE 8.2-21

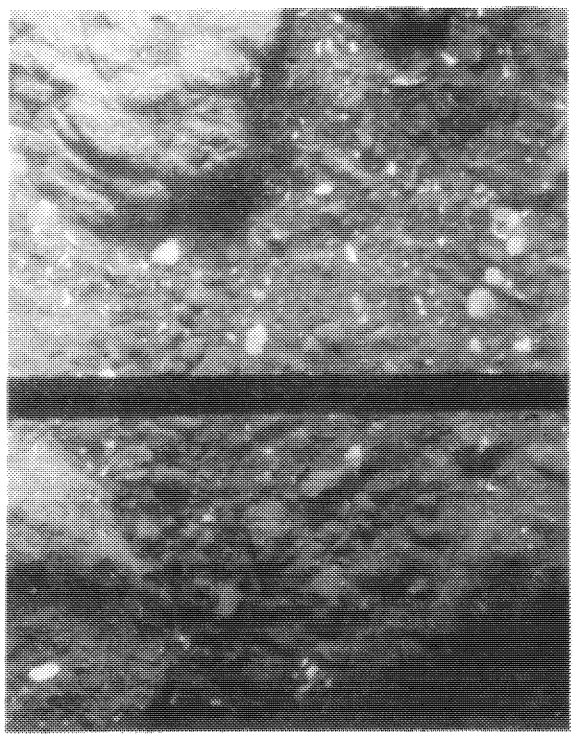
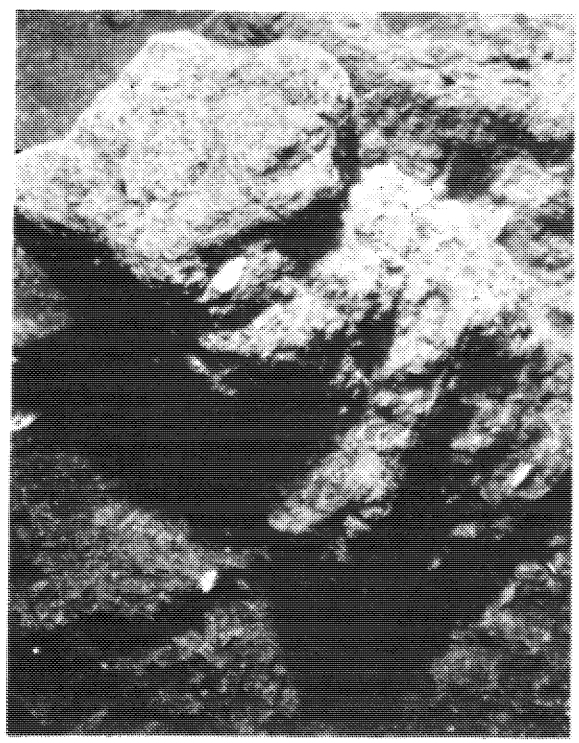


PLATE 8.2-22

PLATE 8.2-23



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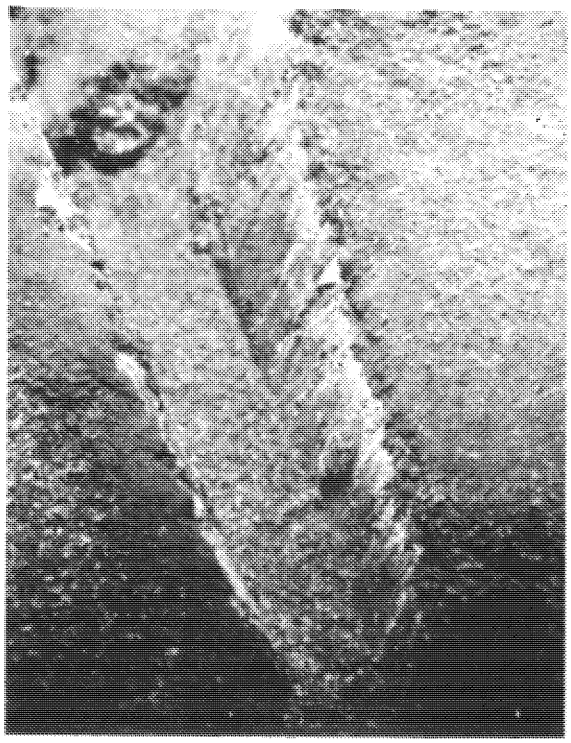

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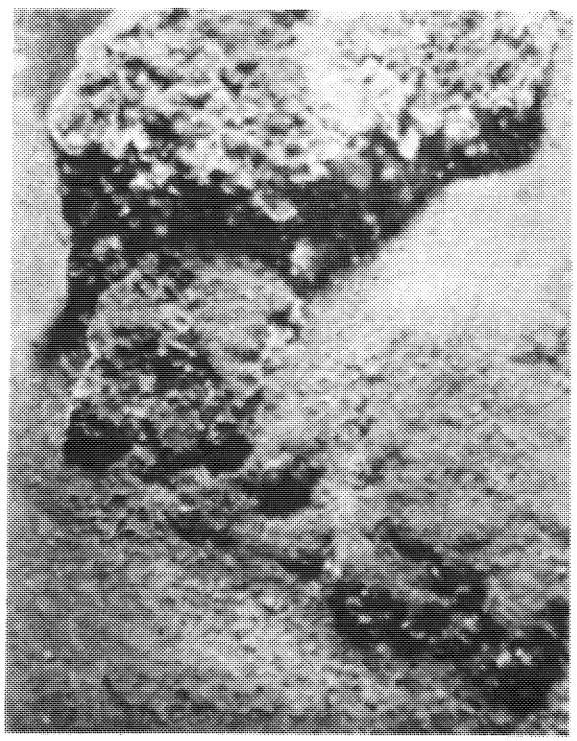

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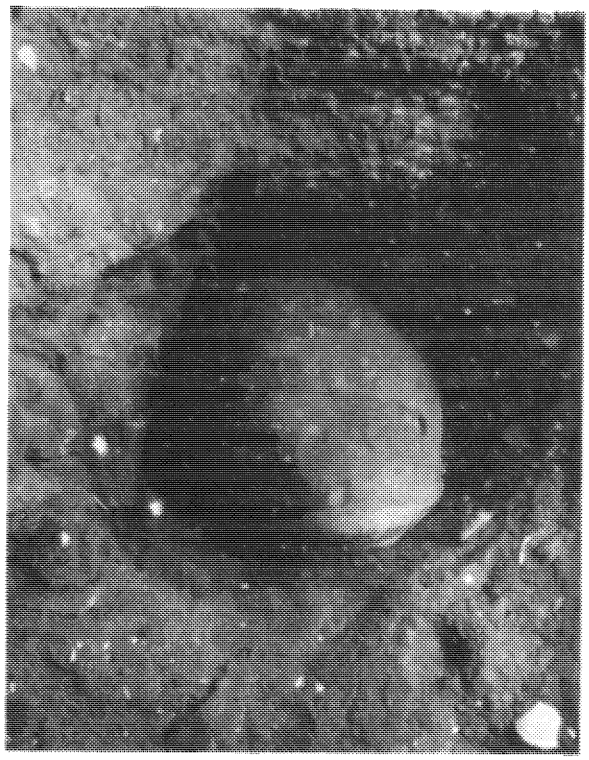

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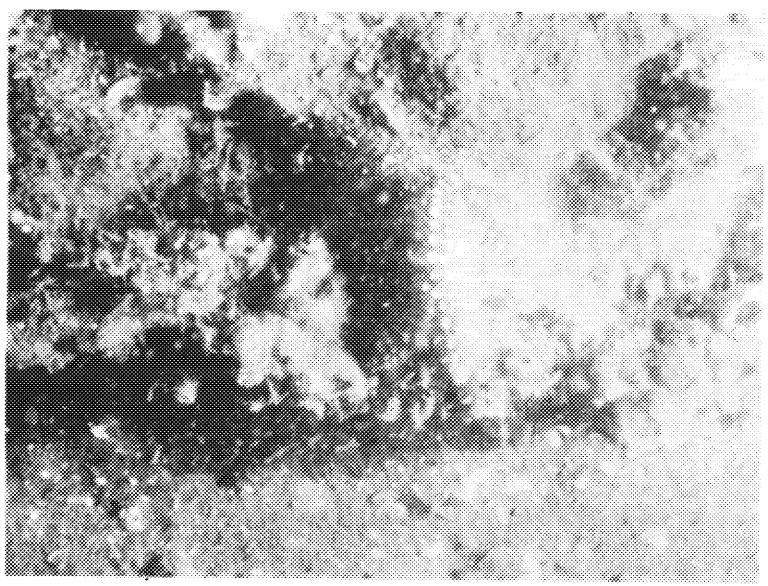

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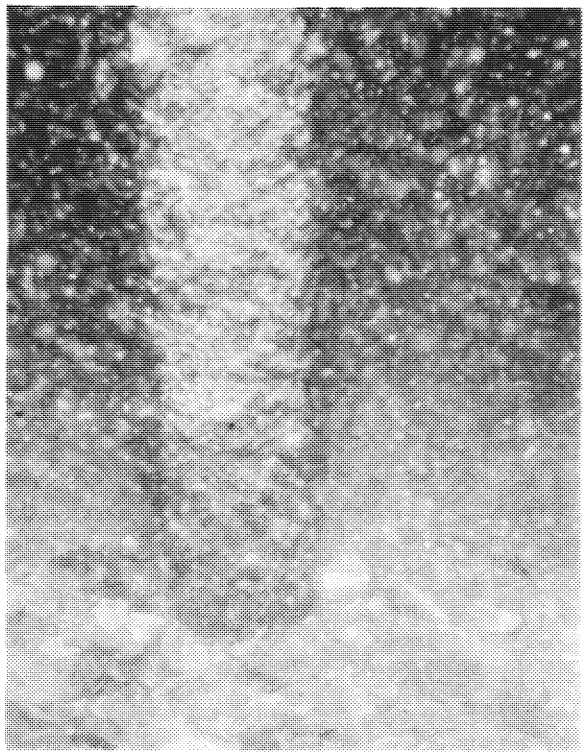

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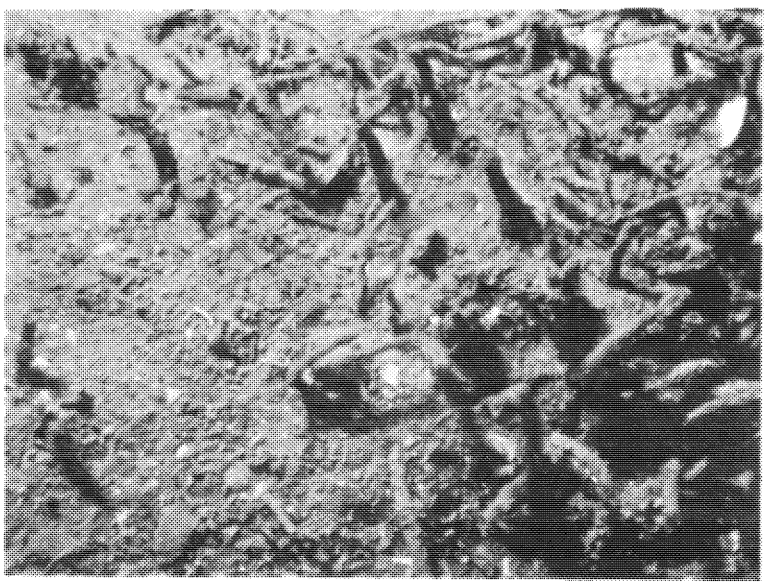

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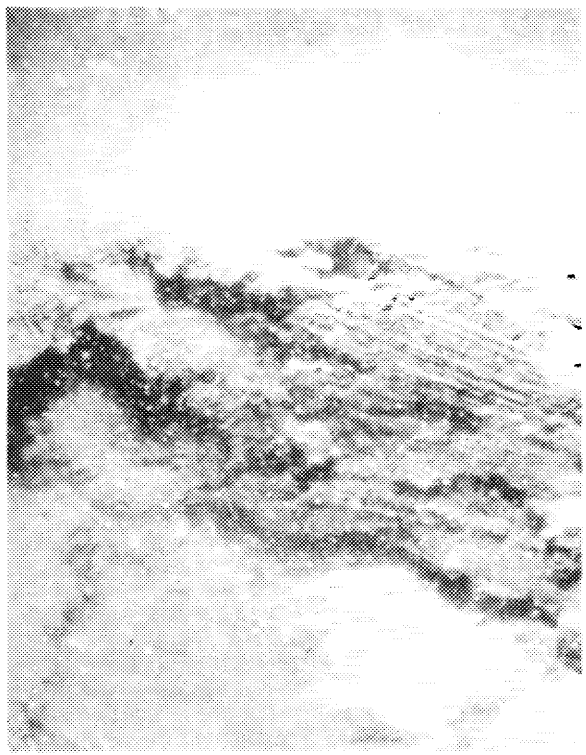

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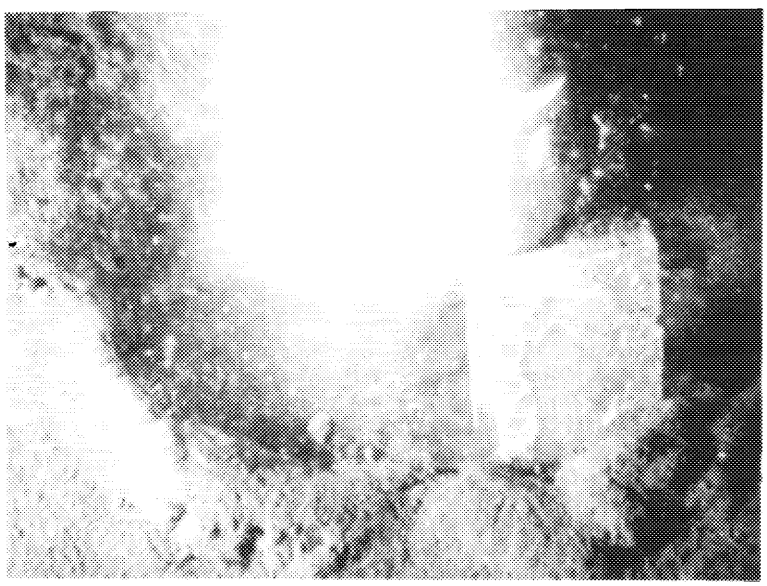
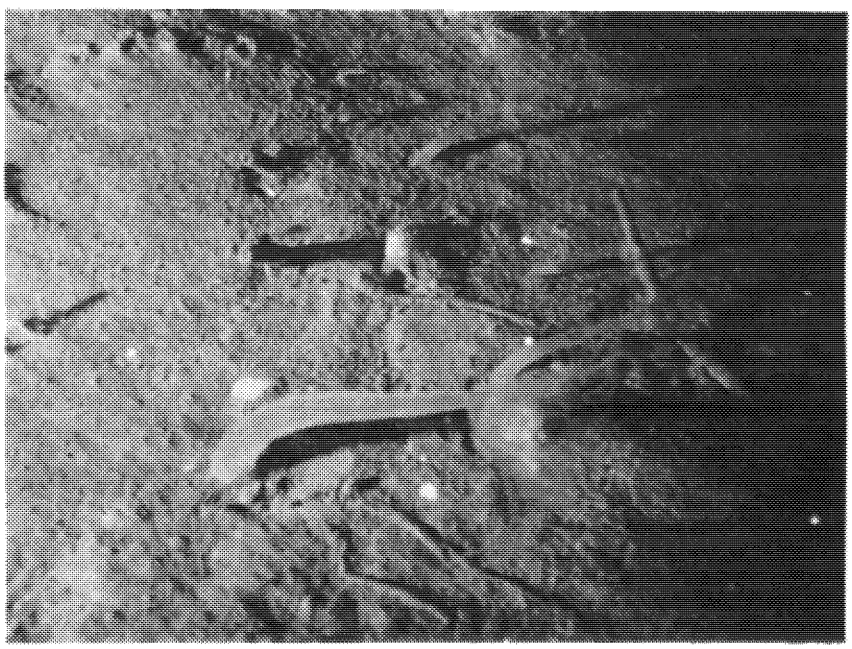


PLATE 8.2-32

PLATE 8.2-33



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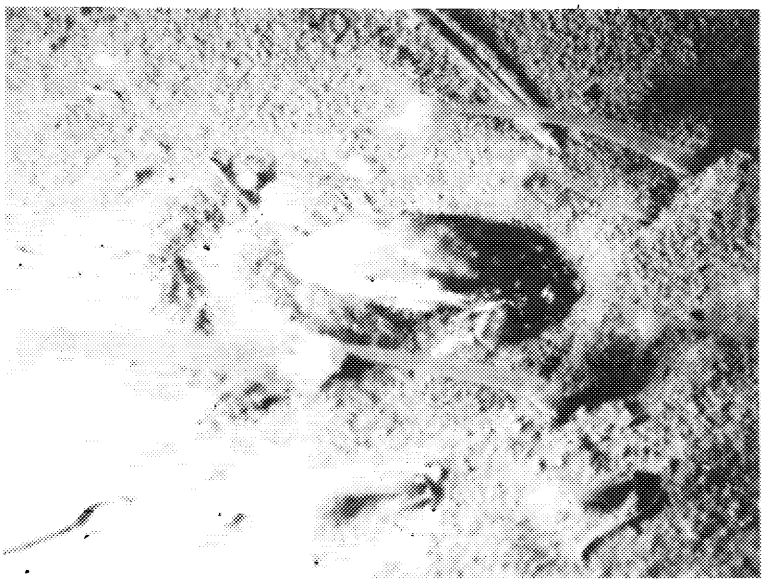
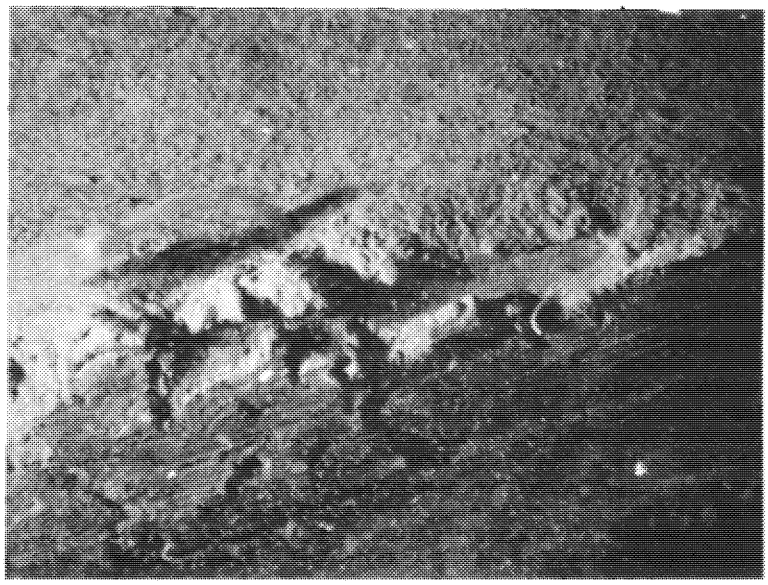


PLATE 8.2-35

PLATE 8.2-36



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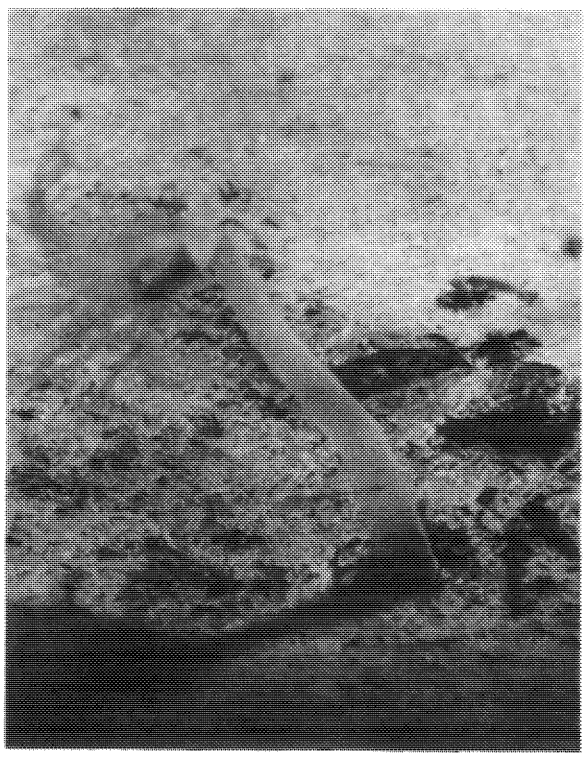

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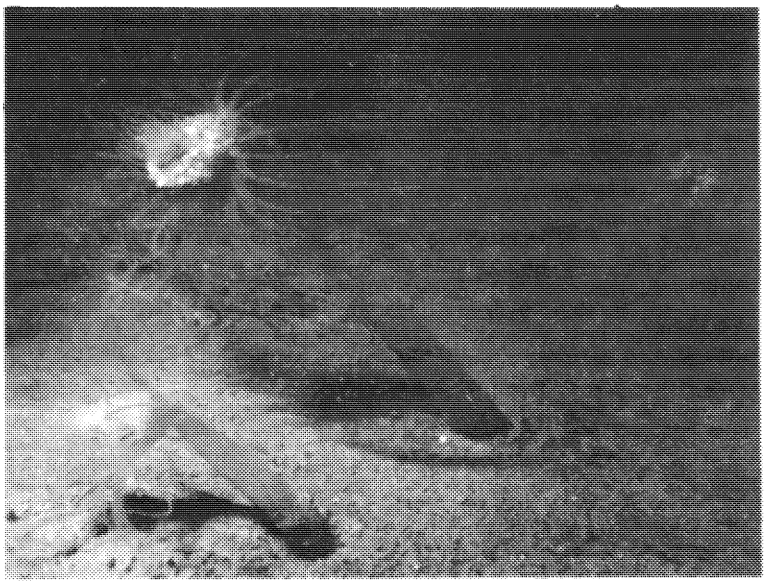


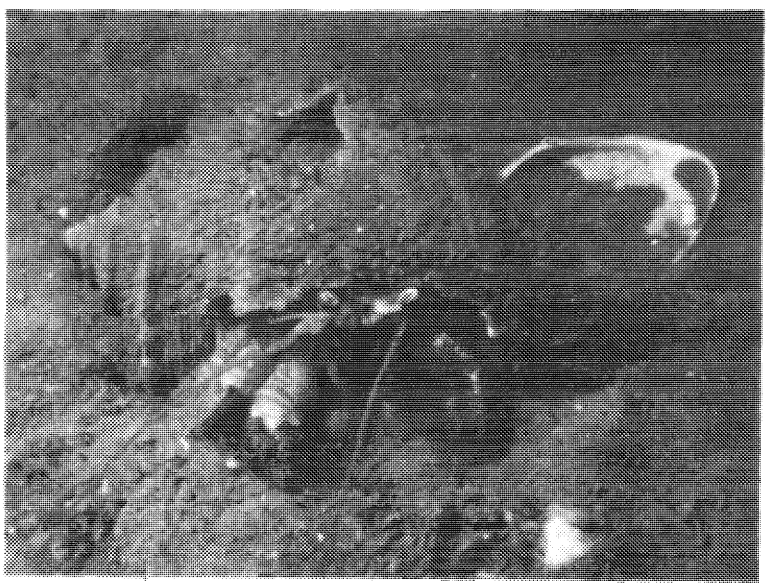
PLATE 8.2-39

PLATE 8.2-40

PLATE 8.2-41

PLATE 8.2-42

PLATE 8.2-43



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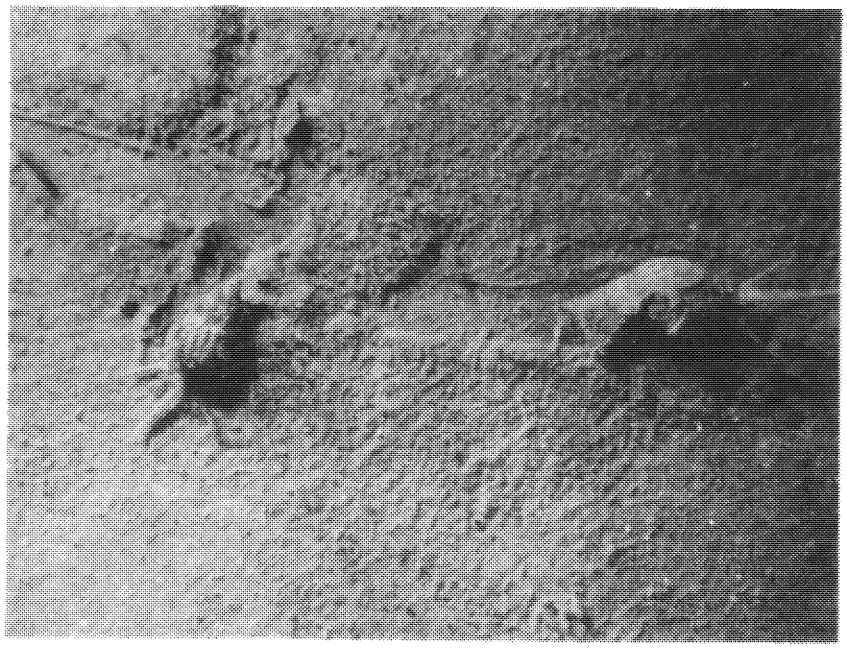


PLATE 8.2-45

PLATE 8.2-46

PLATE 8.2-47

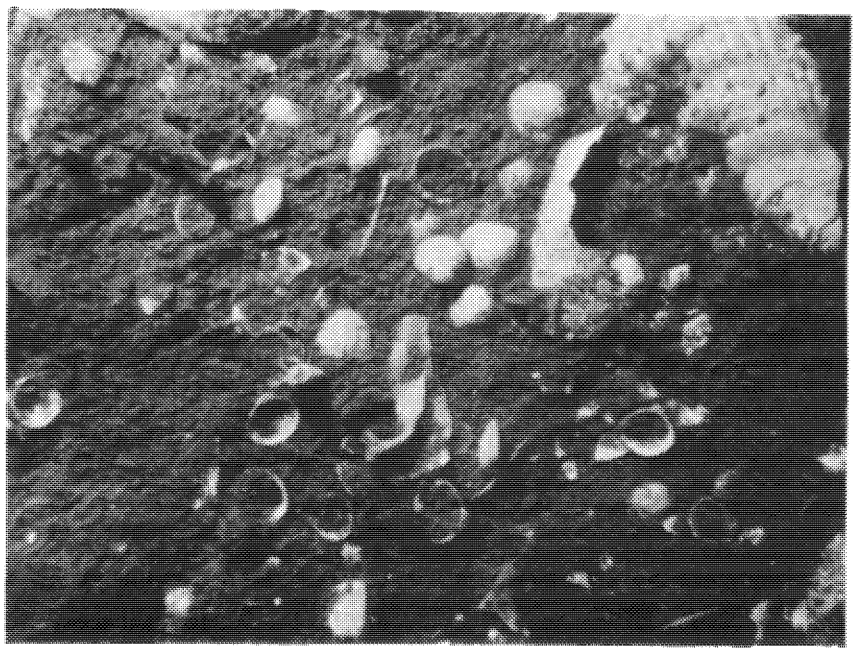


PLATE 8.2-48

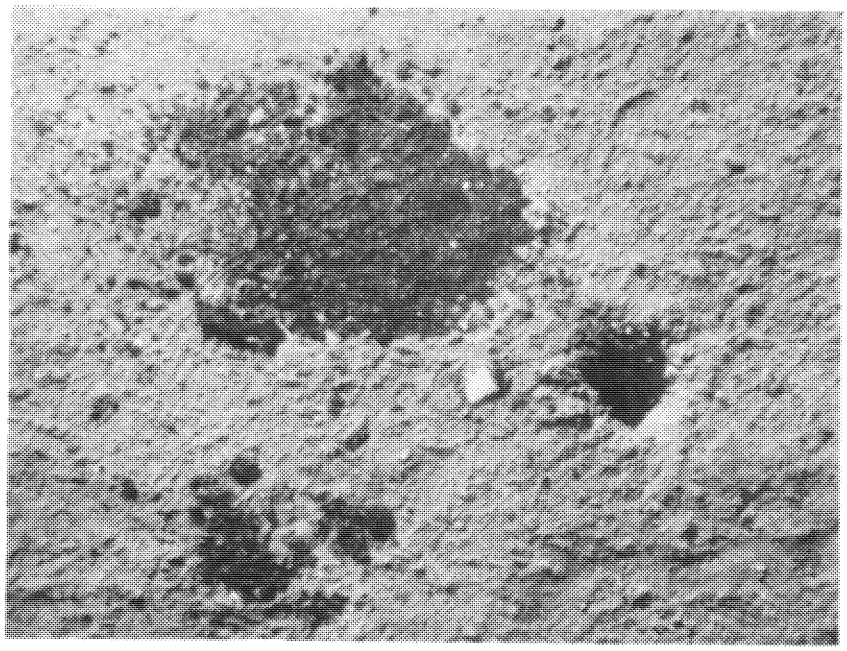
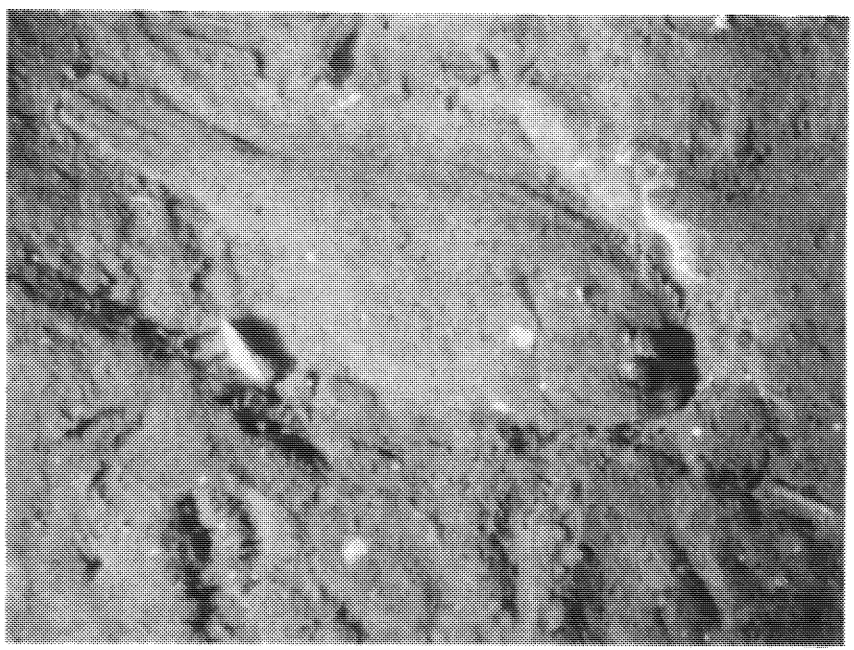


PLATE 8.2-49



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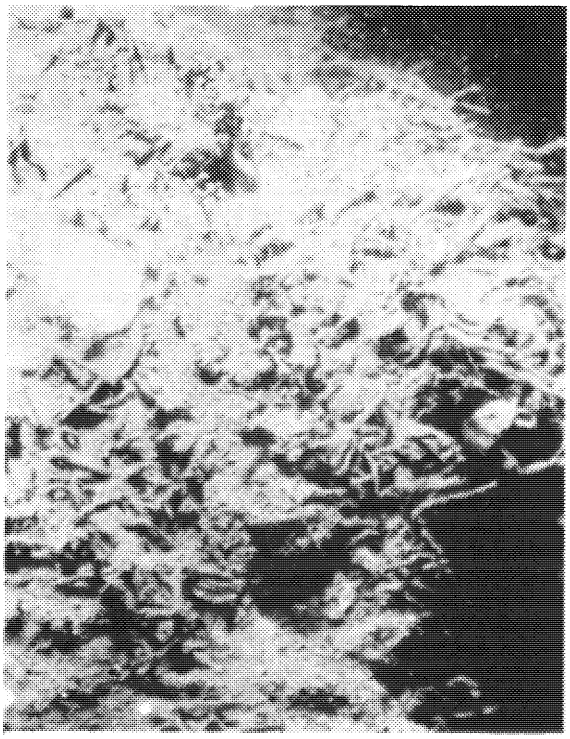
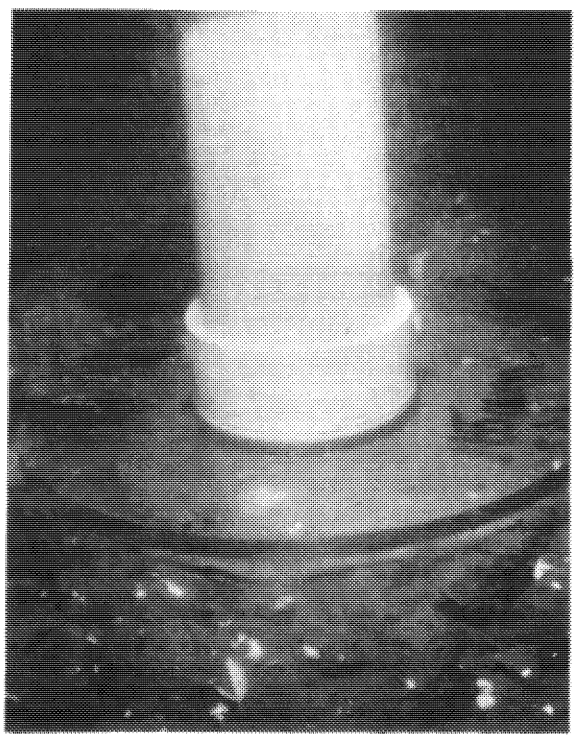


PLATE 8.2-51



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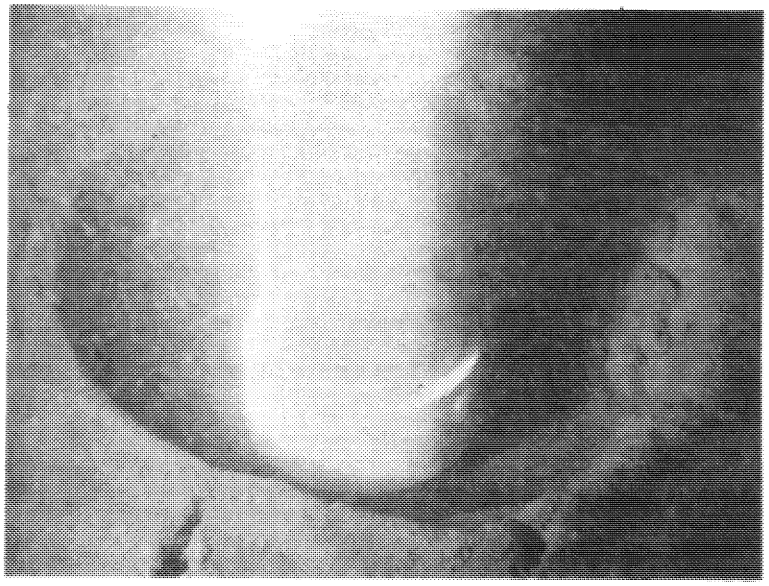
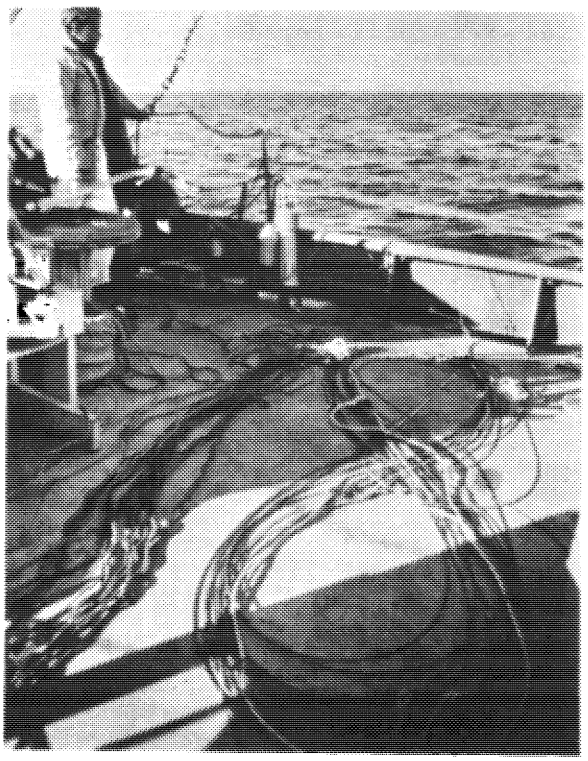


PLATE 8.2-53



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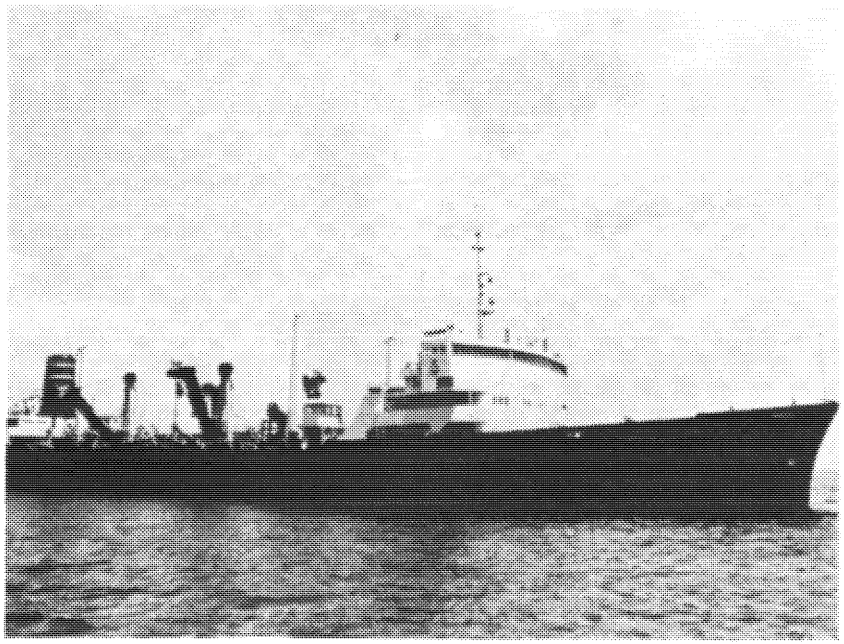

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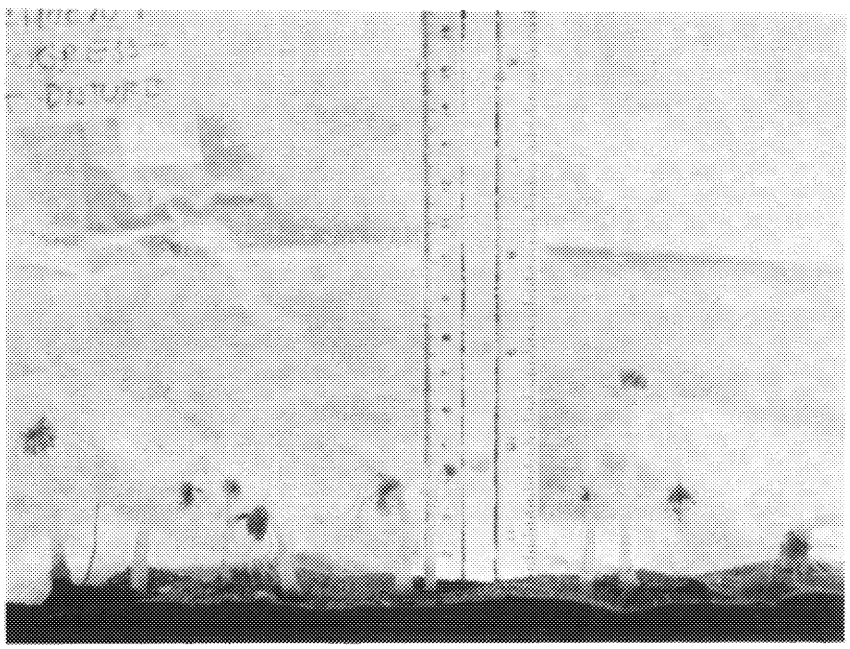


PLATE 8.2-56

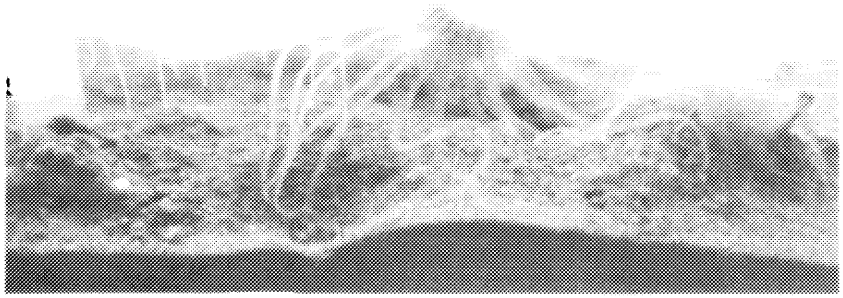


PLATE 8.2-57

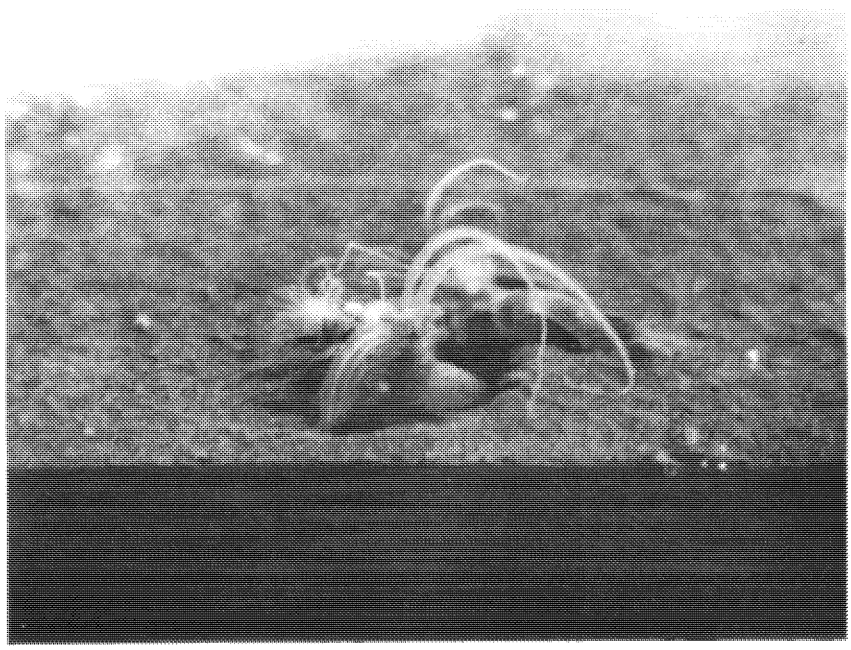


PLATE 8.2-58

8.3 New London Disposal Site (June, 1979 - September, 1980)

The New London disposal site was surveyed in 1977-78 to determine the boundaries of Phase I and II dredge material (DAMOS 1979, Vol. II, Biological Observations). Additional studies at New London in 1979-80, included mapping of Phase III and IV disposal margins, measurement of erosion or accretion on the disposal mound, penetrometer tests, and epifaunal observations and identification. A chronological summary of dives and observations made at the New London Site is presented in Table 8.3-0, and underwater photographs of the area are shown in Plates 8.3-1 to 14. Table 8.3-1 lists the captions corresponding to these photographs.

In July, 1979, the perimeter of the disposal mound was examined and permanent stations were established on the NW, SW and SE margins of dredged material (Fig. 8.3-1). At each of these stations a 50 m length of line was staked to the bottom perpendicular to the dredge material boundary and marked at five meter intervals to indicate movement of the boundary. Graduated elevation stakes were installed along the line and the entire station was positioned according to Loran-C coordinates and marked with an acoustic beacon. These stations were continually monitored during 1979 and 1980.

A calibrated Loran-C grid, using the 9960 GRI chain, was established over the disposal site and used to monitor the margins of the mound while controlling diving operations. A diagram of this grid relative to pertinent disposal area features is presented in Figure 8.3-2.

TABLE 8.3-0 Summary of diver observations at the New London Disposal Site - Underwater Photography June 1979 - September 1980.

Date	Station	Time	Transect location and Distance	Physical Condition (Depth, Temp.Vis.Tide Bottom Type)	Biological Observations
13 June 79	NW corner	1012-1044	NW corner of dumpsite on and off spoil at perimeter	Cur. E-W 1-1.5 kt. 14.5°C vis 8-10 ft. Natural bottom hard sand/silt type. Spoil material soft silt/clay.	Amphipod tubes and epifauna abundant over both natural substrate and spoil. Tautog - 1 (8 lbs.) Pseudopleuronectes 12-16 Urophycis - 3 Burrow 8-15 cm dia. Naticid egg collars 1-3/m^2.
	NL Buoy	1148-1154	NL buoy to SW	Cur. E to W 1 kt. 14.5°C. vis. 8 ft. Soft cohesive silt/clay sediments. Clay clumps on substrate surface fracturing. Clay balls present.	Psuedopleuronectes - 5
	SW Perimeter Station	1226-1240	Along transect line	Cur. E to W .5 kt. 14.5°C vis. 8-10 ft.	Epiphytes ubiquitous where substrate available. Psuedopleuronectes - 4 Tautogolabrus - 15 Tautog - 1.
24 July 79	NW Perimeter Station	1033-1047 1100-1125	Deploy transect line	Near flood vis. 6-10 ft. Cur E-W .25 kt. Spoil typical soft cohesive silt/clay. Perimeter distinct with 3 4' high ridges, running E-W. Bottom north of these ridges was flat, featureless and composed of coarse gravel. Encountered sediment cloud. Vis. dropped from 10-6 ft. due to large dump.	Patchy areas on spoil with extensive burrowing. (Homarus and Urophycis). Burrows ended at spoil perimeter. Homarus - 6+ Urophycis - 4 Psuedopleuronectes - 10 Pagurus pollicaris - 4 Busycnn - 3 Crangon ubiquitous. Epiphytes in all areas with available substrate.

TABLE 8.3-0 (Cont.)

Date	Station	time	Transect location and Distance	Physical Condition (Depth, Temp. Vis. Tide Bottom Type)	Biological Observations
14 Aug 1980 (continued)					Pseudopleuronectes americanus- 35, ubiquitous Paralichtys dentatus - 4 Busycon canaliculatum - 3 burrowing Asterias 4 - seeding on new mussel set. Bugula turrita - attached to shell debris Henricia - 1 Tautogolabrus - 8 in spoil trenches. Urophycis -1
	SE perimeter stn.	20 min.		No change in stake elevation. Vis. 15 ft.	Mytilus (0-yr. class) set on spoil. Asterias predation evident. Tautogolabrus - 15 - around wood debris and boulders. Pseudoplenronectes americanus 25 - ubiquitous. Asterias 4 - preying on Mytilus Prionotus carolinus - 1 reworking substrate.

TABLE 8.3-0 (Cont.)

Date	Station	Time	Transect location and Distance	Physical Condition (Depth, Temp. Vis. Tide Bottom Type)	Biological Observations
2 July 1980	SE perimeter		Traverse to NW to locate phase IV perimeter.	Substrate typical spoil consistency. Areas of current dumps (uncolonized mounds) encountered. Debris - poles, logs, metal sheeting. New perimeter approx. 100 meters north of phase IIIperimeter.	Amphipod tubes abundant on old spoil. Areas of extensive biogenic sculpturing of spoil. No animals observed. Lobster in burrow under log. Hake found under metal sheeting. Scophthalmus aquosus + 15. Pseudopleuronectes americanus +50 very dense. Tautogolabros adspersus 15. Homarus americanus - 1 Urophycis sp. - 1.
24 July 1980	Dump Buoy		200 yd. traverse to NE - to locate Phase IV perimeter.	At dump buoy - spoil was of typical consistency. areas along traverse of dense sand/cobble material	New spoil heavily colonized by amphipods (tubes). Pseudopleuronectes americanus - 35 abundant , distribution over spoil. Paralichtys dentatus - 20 Excavated clay mounds and burrows observed with no animals present.
	W of CG buoy		Swam to east over previously determined border.	Same as above. Unable to differentiate border.	Amphipod tubes ubiquitous on old and new spoil. Pseudopleuronectes americanus 45 Prionotus carolinus - 4 Stenotomus chrysops - 4 Tautogolabrus adspersus - 4 Homarus americanus - 2 burrowed under log. Cancer borealis - 1 Pagurus pollicaris - 1 All animals except P. americanus found in area adjacent to rocks or debris. Mnemiopsis abundant in water column.
14 Aug 1980	NW perimeter stn.			Vis. 10-12 ft. depth 75' No change in stake elevations.	Mytilus set (0-yr. class) on natural substrate - none on spoil. Could be due to differential grain size preference in settling.

TABLE 8.3-0 (Cont.)

Date	Station	Time	Transect location and Distance	Physical Condition (Depth, Temp. Vis.Tide Bottom Type)	Biological Observations
14 May 1980	D I		100 m to S	Natural bottom. Compact silt/sand with shell debris extensive. 10°C, W E 1/2 kt.	Corymorpha pendula dominant hydroid with low densities 1/.25 m^2. Amphipod tubes ubiquitous.
10 June 1980	SE perimeter Station.		Transect line.	Spoil less compact than natural sediment, but visually difficult to discern. All available substrate colonized. Vis. 3-4 ft. Cur W-E	Amphipod tubes ubiquitous. Naticid egg cases abundant and scattered. Tubularia spp. dominant hydroids. Tautogolabros adspersus - 1 Prionotus carolinus - 1 Urophycis sp. - 1 Scophthalmus aquosus - 1.
11 June 1980	NW perimeter station.		Transect line.	Gravel sand bottom off spoil. Soft cohesive material - spoil.	All substrate colonized. Amphipod tubes ubiquitous and dense. Naticid egg cases abundant and scattered. Asterias forbesii - 20 many with regenerating arms. Nassarius trivittatus - abundant. Tubularia spp - solitary and colonized - dominant hydroids. Pseudopleuronectes americanus - 3 Libinia emerginata - 4 Cancer borealis - 8 - burrowing.
	Traverse from NW perimeter to new spoil boundary.			Topographic relief to new spoil boundary ~ 2 meters minimum.	Amphipod tubes ubiquitous to new spoil boundary. Cancer borealis and Homarus americanus excavating burrows and sculpturing clay mounds. Asterias forbesii abundant. Naticid egg cases scattered Busycon - 1. Mercenaria - 1 on surface. Debris colonized by colonial Tubularia sp. Solitary Tubularia sp. common. Pseudopleuronectes americanus - 4. Lophius americanus 1. Area of dense oyster shell debris.

TABLE 8.3-0 (Cont.)

Date	Station	Time	Transect location and Distance	Physical Condition (Depth, Temp.Vis.Tide Bottom Type)	Biological Observations
1 May 80	D III		100 m S to N along tie in cable.	Bottom flat and composed of cohesive sand/clay material.	Dominant hydroid - Tubularia couthouyi. Amphipod tubes ubiquitous. Lunatia heros -3. Pseudopleuronectes americanus Pagurus longicarpus - dense concentration. Pagurus pollicaris - dense active. Homarus americanus - 2. Myoxocephalus ocodencem-spinosus. Metridium on clump. Heavy barnacle and Tubularia crocea set on platform. Many burrows under cable (various sizes) few occupied by Cancer sp. Community resembles that of SE perimeter station.
10 May 80	SW perimeter transect	1208-1228	Dive from W of Station to E 50 m.	Compacted silt/clay with mussel (Mytilus edulis) bed overgrown area. As approaching perimeter of spoil from off-spoil side distinct color change observed. Some debris off pile. Approaching pile, mussel patches partially or totally buried. Perimeter marked where no mussel patches occuring.	Mytilus edulis patches smaller then on previous surveys. Animals attached to shell debris. Crassostrea virginica. Asterias forbesi, Libinia emarginata. Cancer irroratus, Tubularia couthouy is dominant hydroid.
	SE perimeter station		Along transect line 25 m.		Corymorpha pendula abundant.
	NL Buoy		25 m SW and NE of chain.	Clay mounds present.	Excavation of mounds by crustaceans.

TABLE 8.3-0 (Cont.)

Date	Station	Time	Transect Location and Distance	Physical Condition (Depth, Temp, Vis. Tide Bottom Type)	Biological Observation
26 March 1980	SE perimeter station.	0959-1021	Along transect line.	Difficult to discern spoil and natural sediment boundaries. All available substrate colonized. Vis 8-10 ft. Temp. 5°C. 1/2 kt. E. 70 ft.	Amphipod tubes ubiquitous. Pagurus longicarpus and Pagurus pollaris very dense P.pollicaris individuals still burrowed but some already active. Cancer irroratus - active. Lunatia heros active and burrowing. Asterias forbesi present. Coryphella sp. and Tubularia couthouyi on hard rock substrate.
	Temporary Disposal Buoy	1041-1102	75 m E and W of buoy.	Cur. 1/2 kt. E . Vis 8-10 ft. 60 ft. depth. Large clay clumps 70-120 cm lenth, 1.5 m apart. No spoil "pulsing" observed as on previous dive. Greater frequency of clumps closer to buoy. Some degree of sorting of coarse grain sediment at base of clumps. 75 m from buoy showed more signs of a flattening apron effect. Clumps showed less fracturing then on previous day. Evidence of recent dumping operations.	Mytilus edulis embedded in some clay clumps. Actively respiring. Metridium senile attached to one clump of mussels.
18 April 1980	Coast Guard buoy.		100-150 m N of Buoy. Search for sediment/ current meter array.	During search encountered boulder and cobble area. Bottom relief on order of 5-8 ft. with 4' wide troughs- probably due to individual dumps. Some debris noted; plastic, wood, tree stumps.	Some rocks and cobble with Cliona colonizing. Some consolidated sediment with amphipod tubes. Asterias forbesi. Homarus americanus. Naticid snails.

TABLE 8.3-0 (Cont.)

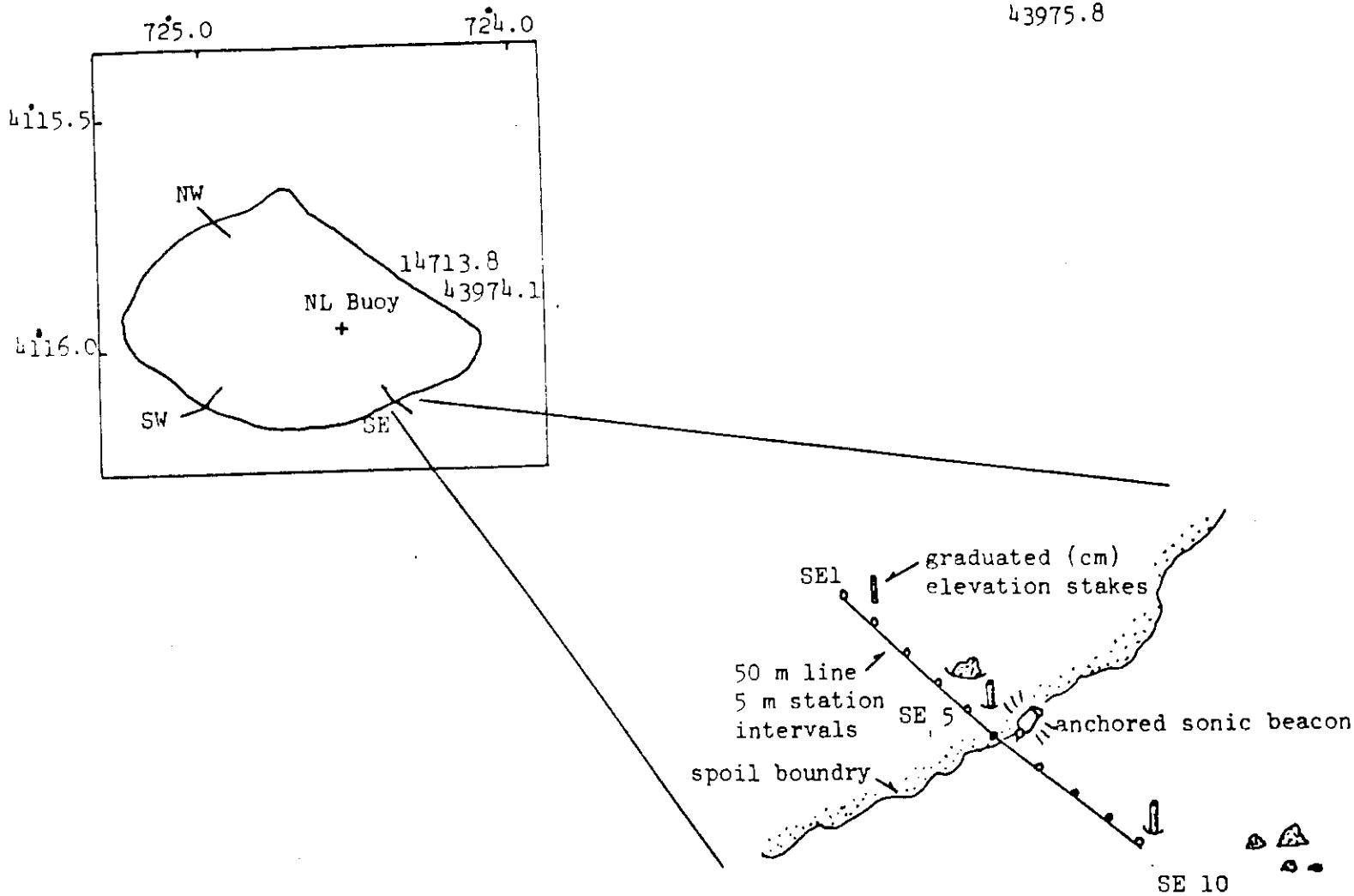
Date	Station	Time	Transect location and Distance	Physical Condition (Depth, Temp. Vis. Tide Bottom Type)	Biological Observations
25 March 1980	Temporary Disposal Buoy		DPV border delineation on NW transect approximately 250 m.	E - W Cur. Did not circumscribe circle but ran direct line NW towards NL harbor.	
	SE corner new pile		DPV border delineation on transect to ESE.	E - W Cur. DPV - low batteries. New spoil. Soft cohesive material flattening out on apron - no clay clumps.	
	Temporary Disposal Buoy	1434-1458	Transect 90 meters to East of buoy.	At buoy - clay clumps on spoil surface (20-70 cm dia.) 70-100 cm apart). 20 meters to E - size and frequency diminish (200 cm apart 20-60 cm dia.) eroding and fragmenting. 70 meters to E - large boulder size clumps (70-90 cm height, 70-120 cm length) many adjacent. Evidence of individual dumps. Fracture lines through spoil surface opening/closing. Sediment surface "pulsing" with surface swell (7-10 sec. period).	No organisms observed on spoil.
	SE perimeter station		25 m on transect line.	No surface buoy present. Located station on bottom with receiver. New buoy secured.	Species on spoil perimeter Naticid snails, Cancer borealis, C.irroratus, Pagurus pollicaris.

TABLE 8.3-0 (Cont.)

Date	Station	Time	Transect location and distance	Physical Condition (Depth, Temp. Vis. Tide & Bottom Type)	Biological Observations
20 Sept 79	SE perimeter station	-	Set fyke net & fish trap at Phase III spoil periphery. Search for sonic beacon and 50 m transect line. Sample Mytilus bed 100 m to SW for shell growth.	No recent spoil overlay or border advance. New spoil deposited over SW border station approximately .5-1 m deep.	Amphipod colonization dense. Only C.irroratus (2) evident and new Mytilus set on recent spoil.
24 Sept 79	SE perimeter station	-	Retrieve fyke net and trap and 4 day collection.	Photograph elevation stake, sediment features.	Photograph stations along transect cable.
17 Oct 79	SE perimeter station	1030-1100	Along transect line.	Cur. NW to SE .25 kt. 14.5°C vis. 10 ft. Sand bottom.	Psuedopleuronectes - abundant. Detached Laminaria fouling transect line. Photo stations SE1 and SE 10. Epibenthic samples SE 1-4, SE 10-7.
	NW perimeter station	1230-1300	Transect line detached.	Cur. NW to SE .5 kt. 14.5°C vis. 15 ft. Tend sonic beacon	Extensive burrowing and excavation of spoil material by Cancer borealis and HØmarus. ← Epibenthic samples on and off spoil.
31 Oct 79	SE perimeter station	AM	Set fyke net for motile species sample.	- -	- -
	NW border station	PM	SE free transect to new spoil.	Old spoil toward new spoil deposit.	35 mm photo along SE transect record burrows Amphipod densities.
5 Nov 79	SE perimeter station	AM	Retrieve fyke net and 5 day collections.	- -	- -
	New Disposal Buoy	PM	ESE transect	From new spoil toward eastern border.	Photodocumentation of new spoil surface and transient biota.
14 Feb 80	SW Mussel Bed		Collect natural Mytilus sample for growth and heavy metal analysis.		

FIGURE 8.3-1 Location of benthic perimeter stations at the New London Disposal site. July 1979. Detail of SE station.

SW Loran C = 14716.3
43973.2
SE Loran C = 14711.7
43972.6
NW Loran C = 14717.3
43975.8



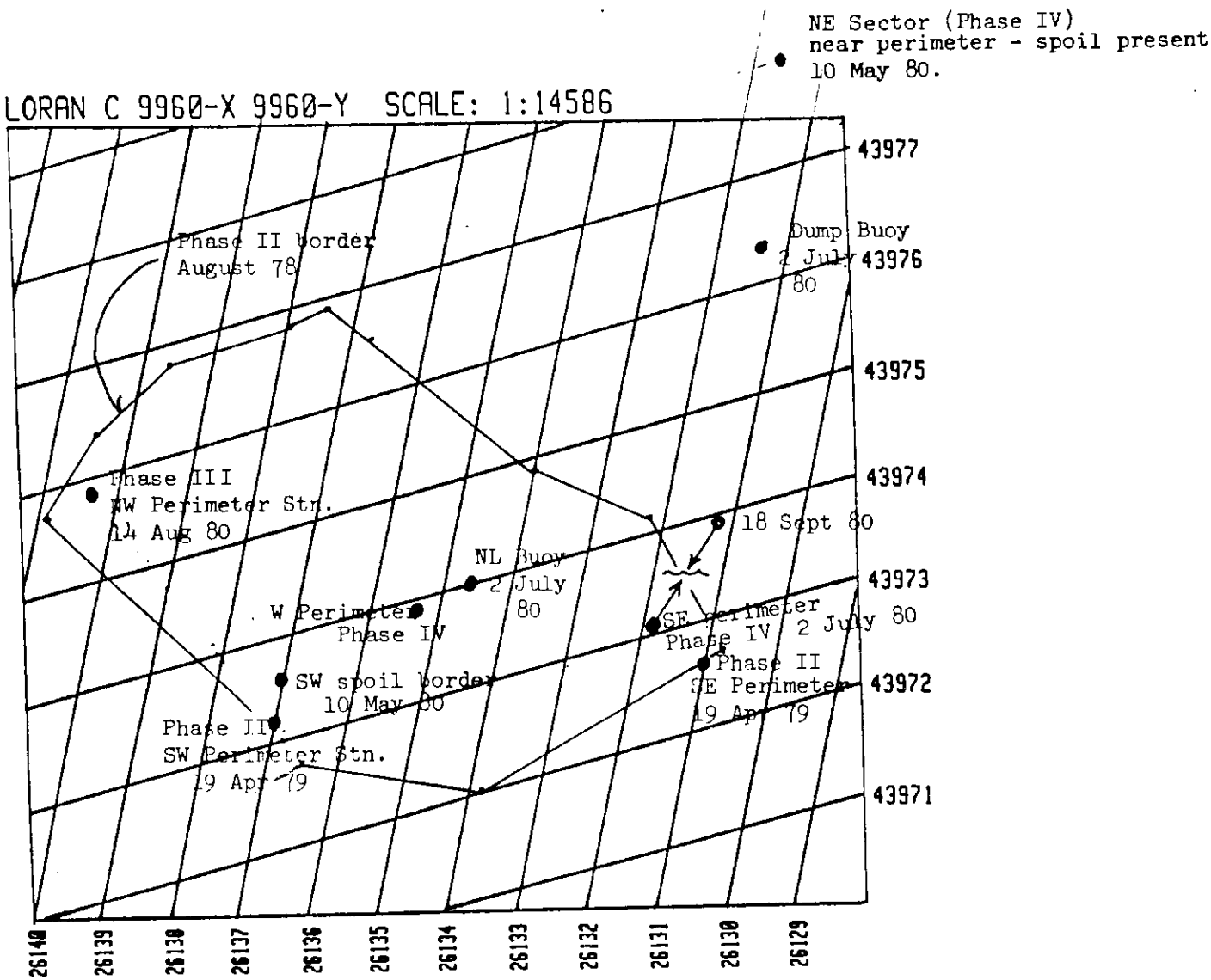


Figure 8.3-2 Loran-C grid indicating perimeter limits and permanent benthic border stations established on the New London Disposal Site.

Monitoring of the established perimeter stations showed change in the sediment horizon, relative to the elevation stakes, at the NW and SE border stations through 1980, and no evidence of sediment border advance or elevation change was found at the SW station for a 10 month period (September 1978 - June 1979). However,inspection of the SW border station in September, 1979, indicated recent burial by Phase IV sediment precluding further long-term monitoring at this location. The dredged material cover extended in a SW direction for approximately 100 m to a depth of .5-1.0 m over natural bottom. Results of elevation stake readings and penetrometer tests are presented in Tables 8.3-2 and 8.3-3. Transects across the disposal mound showed that the center of the area was characterized by scattered clay mounds overlaying various sediment matrix material ranging from fine silt and clay to a coarse shell hash. The margins of the mound in th NW area consisted of three E-W oriented ridges colonized by various species of epibenthic crustaceans (e.g. Pagurus, Homarus, Cancer, Crangon).

When the New London disposal site marker bouy was lost in February, 1980, less controlled disposal of Phase IV dredged material took place in the northeast sector of the disposal site.

A dive survey with a battery-powered diver propulsion vehicle (DPV) to determine the extent of coverage indicated extension of the mound border a considerable distance to the north and east of the designated target area. Circumnavigation of the perimeter was not possible in the NE sector and final position of the diver track indicated a .5-1

TABLE 8.3-2 Periodic elevation stake reading at the SW, NW and SE permanent border stations at the New London Disposal site. September 1978 - August 1980.

Station	Date Stakes Deployed	# Stakes	Observation Date	Level
SW border station	6 Sept. 78	3		0 cm
			10 Jan 79	no change
			19 Apr 79	no change
			13 June 79	no change
NW border station	6 Sept. 78	3		0 cm - stn. lost
	10 June 80	2 NW 1		0 cm
	14 Aug 80	NW 10		no change
SE border station	18 May 79	3 SE 1, SE 5 SE 10		0 cm
			17 Oct 79	no change
			25 Mar 80	no change SE 5 disturbed reset "0'
			10 May 80	no change
			10 June 80	no change SE 1, SE5 SE 10 disturbed.
			14 Aug 80	no change.

TABLE 8.3-3 Penetrometer Measurements at central and border locations. New London Disposal Site.

Date	Station	lb.pressure	Measurements
10 May 80	N.L. Buoy	10	SW of chain 2, 1, 5, 1, 2.5 cm spoil
			NE of chain 1, 2 cm spoil.
10 June 80	SE Perimeter	10	SE 10 .2, .4, .5 cm off spoil
			SE 5 .3, .4, .2 cm off spoil
			SE 1 .5, .6, .6 cm on spoil apron

meter thickness of dredged material over natural bottom (Figure 8.3-2).

A diver survey on 25 March, 1980, at the temporary disposal buoy deployed to control disposal during refit of the original buoy, provided unique observations on dredged material behavior following storm conditions (1-1.5 meter swell; 50 m wave length). "Fissure lines" (4-5 m long) were observed in three separate areas on the surface (Plate 8.3-10). The effect of the swells, at the 15 meter depth, was to produce a .5 - 1 cm movement of material along the fissure line. Masses of sediment were observed to separate, creating a 1 cm wide, 30-50 cm deep fissure line, which merged together repeatedly on a 7-10 second cycle. No extreme resuspension was noted due to current transport, however, a 10 - 20 cm vertical extrusion of turbid silt was emitted from the fissure on each closure.

Another type of sediment mass oscillation was observed which can be described as a "slip line", with one density of dredged material rising and resettling on a 30 - 45^{o} plane over adjacent material. No turbidity resulted from this sediment movement since the material resettled as a cohesive unit. The net effect of this spoil "slippage" appeared to be compaction of the pile.

The site was revisited by divers the following day (26 March) to determine whether any large scale changes in topography had occurred. The pulsing and fracturing of the spoil surface, observed on the previous day, had ceased, coinciding with abatement of surface swells. Densely concentrated, large (20-70 cm diameter) clay mounds were found directly around the disposal

buoy. Approximately 20 m east along a 90 meter transect from the buoy, clay mounds were more scattered and smaller. Approximately 70 meters along the same transect, very large (70 - 120 cm diameter), clay mounds were found, indicative of individual dumps.

The perimeter of the disposal pile was often difficult to distinguish from surrounding natural bottom over the entire survey period (through August 1980). Occasionally, gross differences in sediment texture, the occurrence of Corymorpha pendula, the obvious burial of mussel (Mylilus edulis) clusters, or the presence of amphipod communities allowed the delineation of spoil boundaries.

There was considerable evidence of biological recovery during the 1979-80 survey period at the New London disposal site. From the period when Phase III disposal operations ended until May 1979, a pattern had persisted of low species diversity and abundance at the center of the pile. After May 1979, increasing, and similar, numbers of species and individuals were found on the mound apron and adjacent natural bottom (DAMOS 1979, Vol.II, Biological Observations). Species composition differed between these two regions which is possibly attributable to differences in substrate (grain size).

On the June 1979 survey, tubiculous amphipod communities (Ampelisca spp.) were noted on Phase III apron regions. In the Fall of 1979, numerous amphipod clusters were found along transects heading toward active Phase IV disposal sites in the NW and SE sectors. Photographic estimates of amphipod density on the spoil margin indicated densities approaching 9000 per m^2. The numbers of amphipod parchment tubes

resembled those first observed during the predisposal reconnaissance of the NE sector in June 1974, indicating successful recolonization. Through the 1979 surveys, recolonization was observed principally on old disposal surfaces, margins of the new dredged material, and on the adjacent natural bottom. During the 24 July, 1980 survey, active amphipod repopulation was observed directly on the new sediment surface. The reappearance of Ampelisca communities is significant since ampeliscids, and other tubiculous organisms, stabilize the substrate, their tubes acting as a securing system as well as providing habitat and food for other organisms.

Further evidence of the repopulation of the New London disposal site was the widespread spawning of large, carniverous snails (Lunatia, Polinicies, Busycon) observed during the June 1979 survey. The presence of these snails coincided with the reappearance of the dense populations of amphipods. The mussel (Mytilus edulis), which was found to be an abundant organism at the New London reference site in previous survey years (1977-79), was generally absent from the disposal site itself. A population of juvenile mussels was found in the SW sector on old phase II spoil in July 1977 and monitored through maturity in September 1979.

This population displayed a continuous increase in the mean shell length over the 1.5 year sampling period to a length of 55.9 mm. Furthermore, this population persisted although subject to intense predation. Mussel clusters occur in an interconnected net pattern over 50% of the entire 200-300 m SW region. Phase IV material was deposited on the SW sector in

September 1979 which prevented further observation of this population. However, diver surveys of the SW, SE, and NW sectors between February and September 1980 revealed populations of 0 (zero) year class (5-10 mm shell length) mussels on Phase III sediment extending onto recent Phase IV material. Assuming these populations of Mytilus survive to maturity on the dredged material, they serve to stabilize the unconsolidated sediment with their byssus threads and provide microhabitat for other organisms.

In contrast to organisms which stabilize the surface sediment, another biological mechanism of substrate modification is burrow excavation. The most conspicuous, large burrowing organisms are hake (Urophysis spp.), various crustaceans (Homarus, Cancer, Axius, Squilla, Crangon), winter flounder (Pseudopleuronectes) and mollusks which conceal themselves in shallow depressions. Burrowing activity promotes and accelerates aeration of the underlying sediment which, consequently, makes the substrate availabe for recolonization by infaunal organisms.

The June and July 1979 surveys provided evidence of extensive burrow formation by Homarus, Cancer and Urophysis at the NW, SW, and SE perimeter stations. The winter flounder (Pseudopleuronectes americanus) and the squirrel hake (Urophysis chus) were the most abundantly seen fish species on the disposal mound, probably attracted by the irregular topography affording concealment, and the availability and abundance of prey species (epi- and infaunal invertebrates). Passive fishing gear (fyke nets, wire fish traps) was deployed at the SE perimeter station between September and November 1979 in order to gauge the abundance and distribution of nocturnal fish species (Table

8.3-4). The smooth dogfish (Mustelus canis), conger eel (Conger oceanicus), and sea raven (Hemitripterus americanus) were the only species captured which were not observed at the disposal site during the day.

Epibenthic net samples have been obtained by divers at the New London site since the initiation of the program in 1977. A record of collections which have been preserved, sorted and archived through August, 1980, is presented in Table 8.3-5. A summary of the species identified in each sample is complete through May, 1979, and presented in Table 8.3-6. The data show a trend of increasing species diversity moving away from the pile center with peripheral areas colonized by numbers of organisms approximating that of natural bottom. Future epibenthic sampling reports will include a contrast of species present on dredged material versus natural sediment.

Table 8.3-4 Distribution of nocturnal species collected with stationery passive fishing gear at New London Disposal Site (SE station). September - November 1979

	9/10	9/24 fyke	9/24 wire	10/31	11/5 fyke
Busycon sp. (whelk)			2		1
Callinectes sapidus (Blue Crab)					1
Cancer borealis (Rock crab)					5
Homarus americanus (Lobster)					3
Libinia emarginata (Spider Crab)					12
Pagurus pollicaris (Hermit Crab)					1
Mustelus canis (Sm. Dogfish)		4		8	
Conger oceanicus (Conger eel)			1		
Hemitripterus americanus (Sea Raven)					3
Prionotus carolinus (C. Sea Robin)		11			1
Pseudopleuronectes americanus (Wtr. Flounder)		2			1
Scophthalmus aquosus		1			
Stenotomus chrysops (N. Scup)		16	4		1
Tautoga onitis (Tautog)	1				
Tautogolabrus adspersus (cunner)					1
Urophysis sp. (hake)					3

TABLE 8.3-5 Date and location of epibenthic net dive collections, New London Disposal Site September 1977 - May 1979

	Date	Location
1.	30 Sept. 77	Station #1 75'
2.	28 Oct. 77	Station #3 60'
3.	16 Dec. 77	N.L. Buoy Chain - mid-depth - 40'
4.	29 Mar. 78	200 meters W of N.L. Buoy - 70'
5.	29 Mar. 78	½ mi NNE of N.L. Buoy - 55'
6.	30 Mar. 78	Station #3 - 60'
7.	18 April 78	½ mi S of N.L. Buoy (Mussel bed) - 75'
8.	25 April 78	100 yds. N of Station #1 - 78'
9.	25 April 78	½ mi NNE of N.L. Buoy - 60'
10.	25 April 78	100 yds. NE of N.L. Buoy (New spoil material) 62'
11.	1 June 78	.5 mi E of N.L. Buoy (New spoil material).
12.	1 June 78	.5 mi NW of N.L. Buoy
13.	21 June 78	.5 mi SSW of N.L. Buoy
14.	23 Aug. 78	NW corner of spoil pile at marker buoy (45 sec.) - 70'
15.	23 Aug. 78	SW corner of spoil pile at marker buoy (45 sec.) - 80'
16.	1 Sept. 78	Station #1 (45 sec.)
17.	1 Sept. 78	Station #2 - 78' (45 sec.)
18.	15 Nov. 78	½ mi SE of N.L. Buoy near perimeter station on mussel bed
19.	15 Nov. 78	NW perimeter station on spoil
20.	1 March 79	Station #2
21.	9 March 79	SW section of NL Dumpsite on Mussel Bed
22.	9 March 79	SW perimeter
23.	19 April 79	SE 10 to SE 8 at perimeter station (on pile)
24.	19 April 79	SE 1 to SE 3 at perimeter station (off pile)
25.	19 April 79	SW 4 to SW 3 at perimeter station (off pile)
26.	19 April 79	SW 7 to SW 10 at perimeter station (on pile)
27.	18 May 79	25 m W of N.L. Buoy (15 m tow)
28.	18 May 79	50 m N of SE 10 on pile (15 m tow)
29.	18 May 79	SE 7 to SE 10 on pile periphery (15 m tow)
30.	18 May 79	SE 1 to SE 3 periphery off pile (15 m tow)
31.	18 May 79	50 m S of SE 1 off pile (15 m tow)

TABLE 8.3-5 (Cont.)

Date	
13 June 79	NW corner - on spoil NW corner - off spoil N.L. buoy to SW SW perimeter station SW 10 - SW 7 SW perimeter station SW 8 - SW 5
20 Sept 79	SE perimeter station SE 1 - SE 4 SE perimeter station SE 10 - SE 7 NW perimeter station - off spoil NW perimeter station - on spoil
25 March 80	20 yards east of temporary disposal buoy.
26 March 80	SE 10 to N - on spoil SE 1 to S - off spoil
10 May 80	SE 1 - off spoil SE 10 NW - on spoil
10 June 80	SE 1 to W 45 sec - small net - off spoil SE 10 to SE 30 sec -on spoil
11 June 80	NW perimeter spoil side to S - 30 sec. NW perimeter off spoil to N - 30 sec. At west periphery of new spoil - on old spoil.
14 Aug 80	NW perimeter NW 10 to S - 30 sec. on spoil. SE perimeter SE 10 to N - 30 sec. on spoil.

TABLE 8.3-6 Species distribution from epibenthic net (diver) collections at the New London Disposal Site.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
PHYLUM PROTISTA																															
Foraminifera sp.						1						1																			
PHYLUM PORIFERA																															
Porifera sp.		+																													
PHYLUM CNIDARIA																															
Cl. Hyrozoa																															
Campanularia sp.									+			+													+			+		+	
Corymorpha pendula								1	2			2																			
Eudendrium sp.																											+		+		+
Halecium sp.																			+												
Hydrozoan sp.																		+	+												
Thuiaria sp.		+							3														+						+	+	
Tubularia sp.																										+					
PHYLUM NEMATODA																															
NEMATODE sp.		+													1												A	C	A	B	C
PHYLUM RHYNCHOCOELA																															
RHYNCHOCOEL sp.		2							1			2														1					
PHYLUM MOLLUSCA																															
Cl. Polyplacophora																															
Chiton sp.										1																					
Cl. Gastropoda																															
Anachis translirata	+													2																	
Anachis sp.													4								1			1			2			1	
Crepidula sp.														1						1	1										
Eupleura caudatus																															
Lunatia heros									2			1																	1		
Lunatia triseriata																													1		
Nassarius trivittatus	1	1		5		10		4	3		1	4	23	14	12			1		1	14	12	9	10	12	5	8		5	11	4
Nudibranch sp.								1	6				1																1		
Cl. Pelecypoda																															
Astarte sp.	+	4						+	4			4								1	2		3				2		1	1	
Cerastoderma pinnulatum															1								1						1		
Crassostrea virginica													1																		
Cyclocardia borealis		2						6	3			1									1		3	4					1	1	
Macoma tenta														2										1							
Mercenaria mercenaria																										+					
Mytilus edulis							1						+		1			+			12										
Nucula proxima				2				7	2					1																	
Pandora gouldiana																										3					
Pitar morrhuana				1						1								1				1				1					
Tellina agilis																			+												
Tellina sp.																				1											
Yoldia limatula																		1	1												
PHYLUM ANNELIDA																															
Cl. Polychaeta																															
Ampharete sp.												1																			
Amphitrite cirrata														1																	
Amphitrite sp.					2																										
Clymenella torquata						2	4																								

TABLE 8.3-6 (Cont.)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Clymenella sp.					1	1																									
Glycera sp.					1																										
Glycerid sp.							2																								
Hesionid sp.							1																								
Hispaniola grayi													1						2			1				+					
Lepidonotus squamatus		+												+							12									
Lepidonotus sp.													1					3													
Lumbrineris sp.							1						1																		
Maldane sars					1		1						1																		
Maldane sp.						1																									
Maldanopsis elongata																															
Maldanid sp.											1																				
Nephtys incisa													1																		
Nephtys sp.							1	+	1	5	5								+	1		1									
Nereis sp.							3					1	6	4	3		1	2				1	1			3					
Opheliid sp.											2												1								
Orbiniid sp.	+																														
Owenia sp.						1																									
Phyllodoce sp.		2																													
Potamilla reniformis		2												1																	
Sabella sp.												3																			
Sabellaria vulgaris		1																													
Sabellariid sp.									1					1																	
Spirorboris sp.													1																		
Hermathoe sp.																															1
Terbellid sp.							1																								
Tharyx sp.							2																								
Polychaete sp.					9	2		2								2															
PHYLUM BRYOZOA																															
Bicellariella sp.												+																			
BRYOZOAN sp.														+			+			+				+	+	+	+				
Bugula harmsworthi	+													+	+		+	+	+												
Bugula sp.													+																		
Crisia sp.									+																	+					
Microporella sp.		+		+					+			+	+		+												+				+
Schizoporella sp.	+												+	+						+		+									+
PHYLUM ARTHROPODA																															
S.C. Copepoda																															
Copepod sp.																											3		1		
S.C. Cirripedia																															
Balanus sp.											1																				
S.C. Malacostraca																															
O. Amphipoda	5	25	6+	2+	46		27		9	6		12	4	2		1	1	6	38	1		15	7	4		4		9		+	+
Aeginina longicornis		1																													
Ampelisca vadorum					+																										
Ampelisca sp.												3	1		1											3	3				
Amphipod sp.																															
Caprella sp.																										+					
Gammarus annulatus			+																												
Gammariid sp.				+	+																										
Ischyrocerus anguipes			5											1				2		1											
Leptocheirus pinguis				+																											
Photis dentata					+																										
Unicola irrorata					+																										
					+																										

TABLE 8.3-6 (Cont.)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
O. Mysidacea																															
Heteromysis sp.	+																	+													
Mysid sp.							1	2		1				5	2	10		3													
Neomysis americana																				1							3		1	1	2
O. Decapoda																															
Cancer irroratus		4		+								+			4			1	1		2					1				
Crangon septemspinosa	4	39					+	4	2	2		15	3	13	7		16	3	13	2		3	8	15	12	10	45	20	6	20	37
Dichelopandalus sp.	1		+																						3	+					
Pagurus longicarpus		8					2	2	3			14	9	7	+		7	11	+	12	11	3	3	8	5	2	14	2	1	17	
Pagurus pollicarus		1											3																	2
PHYLUM ECHINODERMATA																															
Cl. Echinoidea																					+										
Asterias forbesii																															
Asteroid sp.													2	1				1													1
Henricia sanguinolenta		+													1																
Ophiopholis sp.												2																			1
Ophiuroid sp.							1																								
Pedicellaster typicus													1																		
														1																	
PHYLUM CHORDATA																															
Cl. Pisces																															
Pseudopleuronectes sp.													2													+					
juvenile flounder																												+			
Raja sp.																															1

NOTE: + - indicates the occurrance of a species at a particular site, number of individuals present not determined

A - 750 individuals
B - 730 individuals
C - 7100 individuals

TABLE 8.3-1. List of captions corresponding to Plates 8.3-1 to 14 at the New London Disposal site - Underwater Photography June 1979 - July 1980

PLATE #	Date	
8.3-1	June 79	Diver collecting SW mussel bed sample.
8.3-2	June 79	Sonic beacon placement at permanent benthic station.
8.3-3	18 May 79	75 m N of Station SE 10. HFVP - 6". Sediment profile photograph of phase III spoil north of permanent SE border station; a relatively homogeneous sediment type with a 2 cm "conditioned" surface layer.
8.3-4	13 June 79	Spoil border Station SE 1. HFVP - 6". Sediment profile photograph illustrating layer strata of natural substrate.
8.3-5	9 Aug. 79	50 m east of NL buoy. HFVP - 15". Typical "shell hash" deposits on spoil surface occur shortly (1 - 2 months) after disposal.
8.3-6	31 Oct. 79	SE transect from NW border station. HFVP - 14". Adjacent burrows (Homarus and Cancer) excavated in clay banks on the spoil surface demonstrate substrate cohesiveness. Extensive amphipod communities (tubes protruding from sediment) have repopulated the SE and NW spoil sectors.
8.3-7	5 Nov. 79	SE border station SE 5. HFVP - 6". At the transition from natural to spoil sediment, densities of amphipod tubes approach 250 individuals per 15 x 15 cm square area, as illustrated. Their occurrence in similar concentrations was noted throughout the SE sector.
8.3-8	31 Oct. 79	NW border station SE transect. HFVP - 10". Turbidity cloud is produced by Cancer irroratus excavation beneath Mytilus growth on a 5 month old spoil surface.
8.3-9	5 Nov. 79	SE transect from NW border station. HFVP - 15". Patch areas (10-15 m) exhibit coarse gravel/sand mixtures on spoil surface. Exposed sediment of this type is rarely observed (5 - 10%) in contrast to the silt-clay clump spoil type.

TABLE 8.3-0 (Cont.)

Plate #	Date	
8.3-10	26 Mar. 80	Temporary disposal buoy (East transect). HFVP - 12". A "fissure line" and .5 m deep chasm observed on recent (~ 1 week old) soft spoil surface. The open-closure cycle associated with overhead storm swell conditons, appeared to function as a spoil mass consolidation mechanism.
8.3-11	26 Mar. 80	Temporary buoy east transect. HFVP - 20". The sharp angular faceted surface of new spoil (~ 2 days) can be distinguished from the weathered smoothed surfaces of older spoil.
8.3-12	26 Mar. 80	Temporary buoy. HFVP - 4". Immediate physical fracturing and particle formation of clay mounds was evident on two day old spoil surfaces.
8.3-13	26 Mar. 80	SE border station SE 4. HFVP - 6". Cluster concentrations of the hermit crab, Pagurus longicarpus displayed constant grazing and surface substrate manipulation.
8.3-14	2 July 80	Eastern transect from NL buoy. HFVP - 20". The four month old spoil materials shows a smoothed surface, elaborate burrow structure, and extremely dense colonization by amphipod communities.

PLATE 8.3-1

PLATE 8.3-2

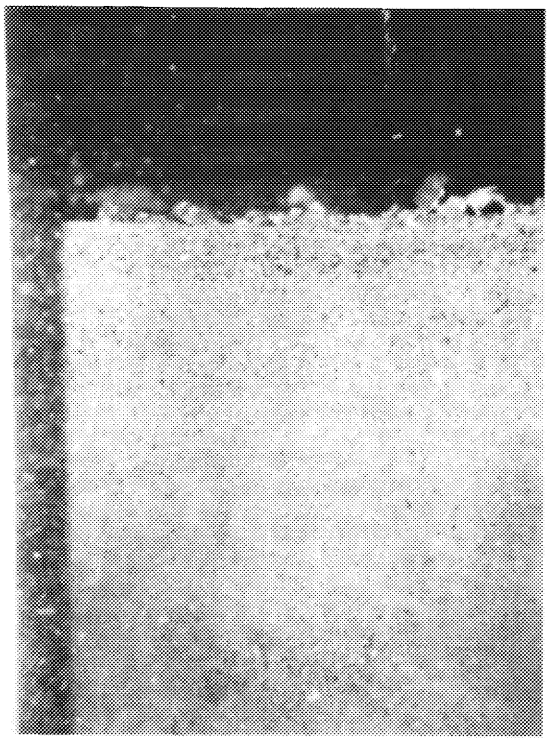


PLATE 8.3-3

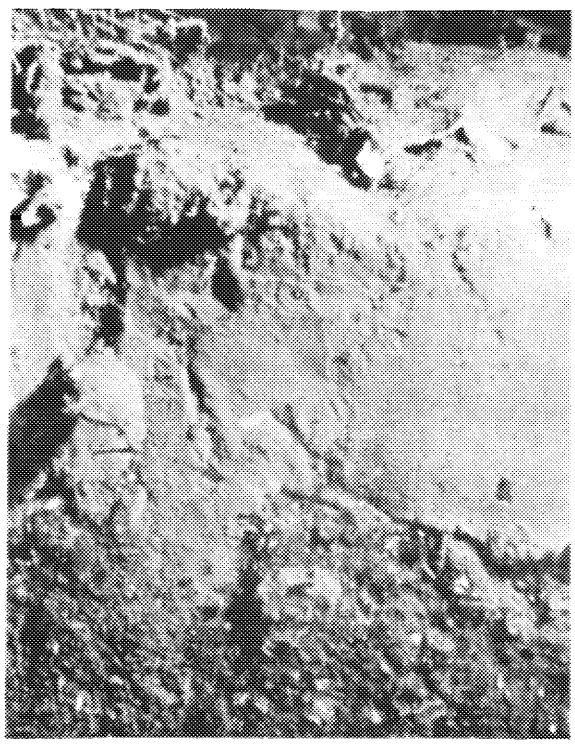


PLATE 8.3-4

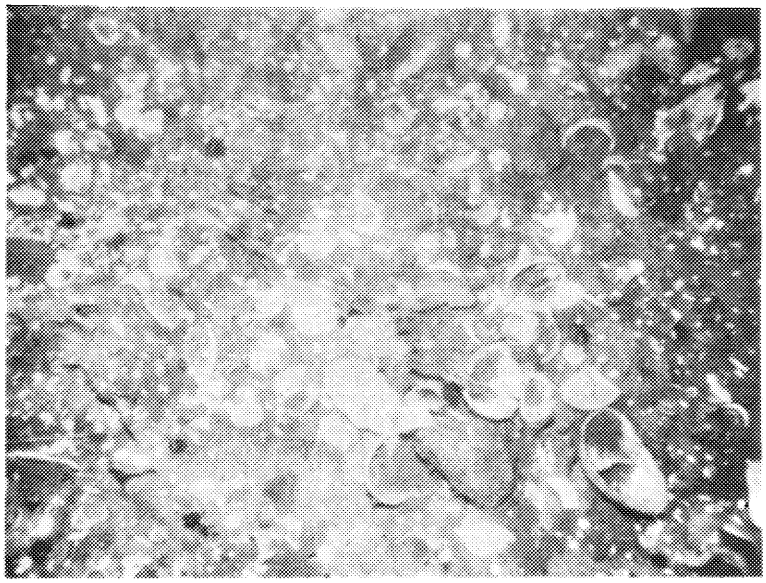


PLATE 8.3-5

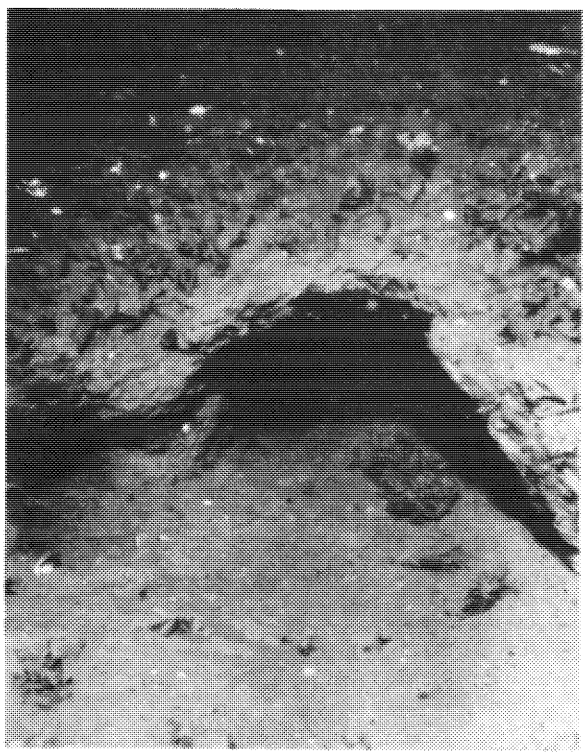


PLATE 8.3-6

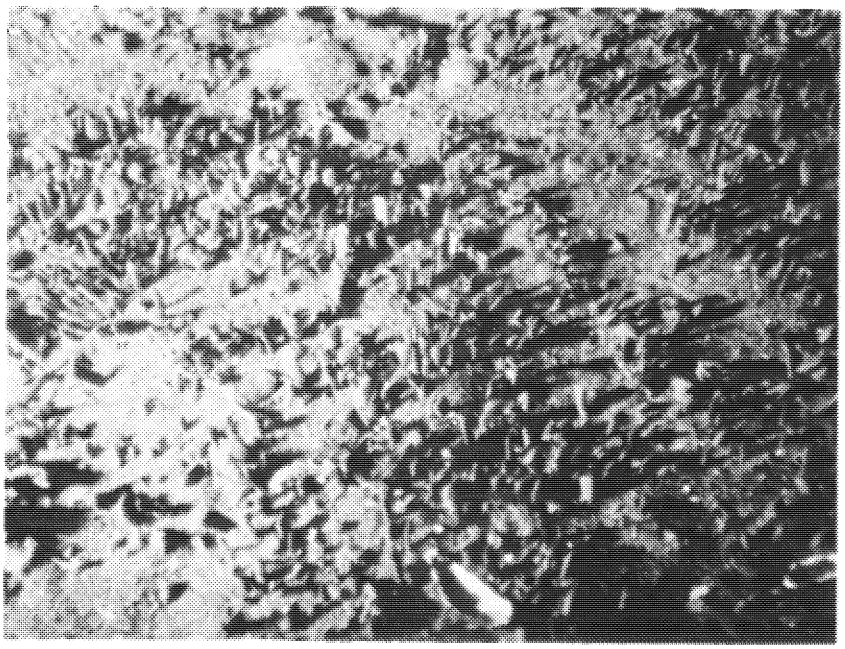


PLATE 3.0-7

PLATE 8.3-8

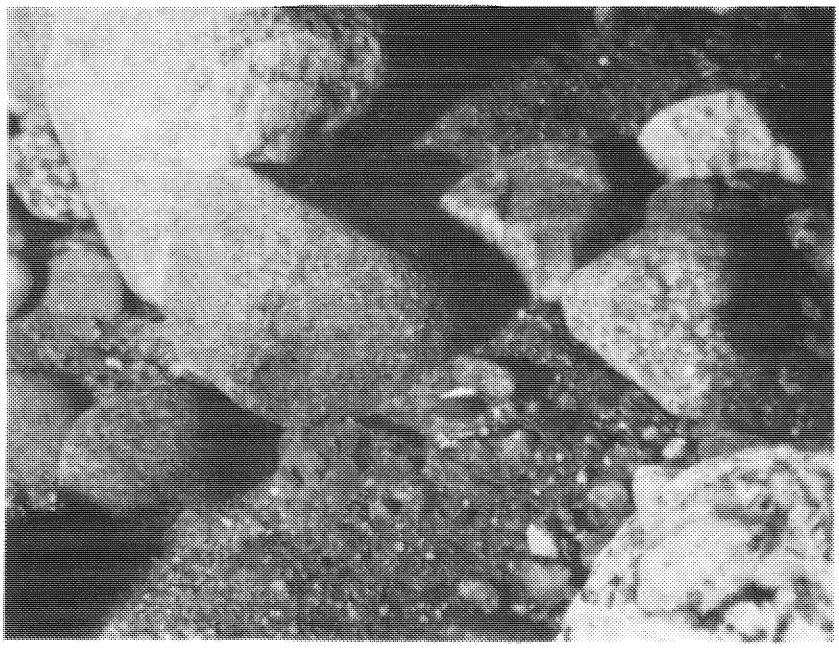


PLATE 8.3-9

PLATE 8.3-10

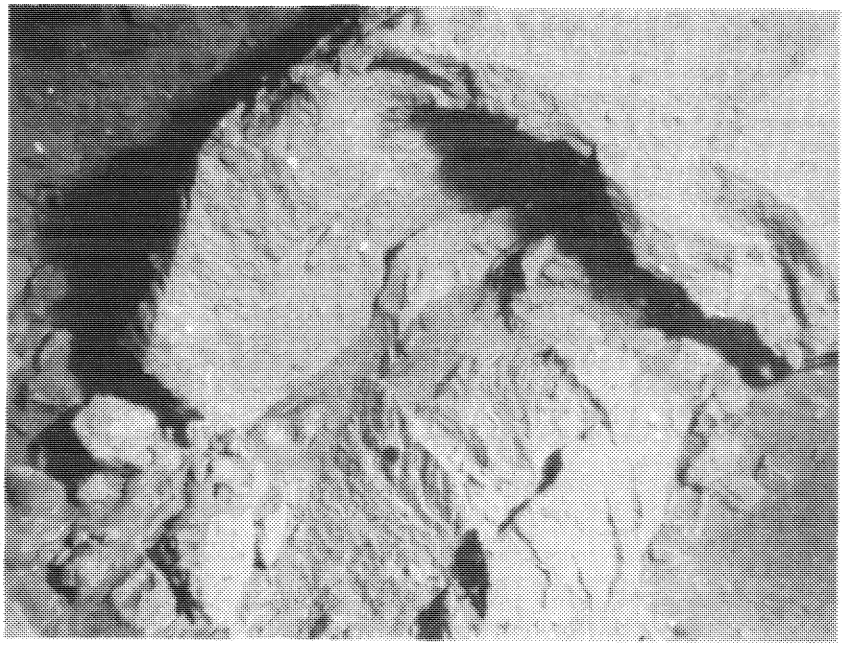


PLATE 8.3-11

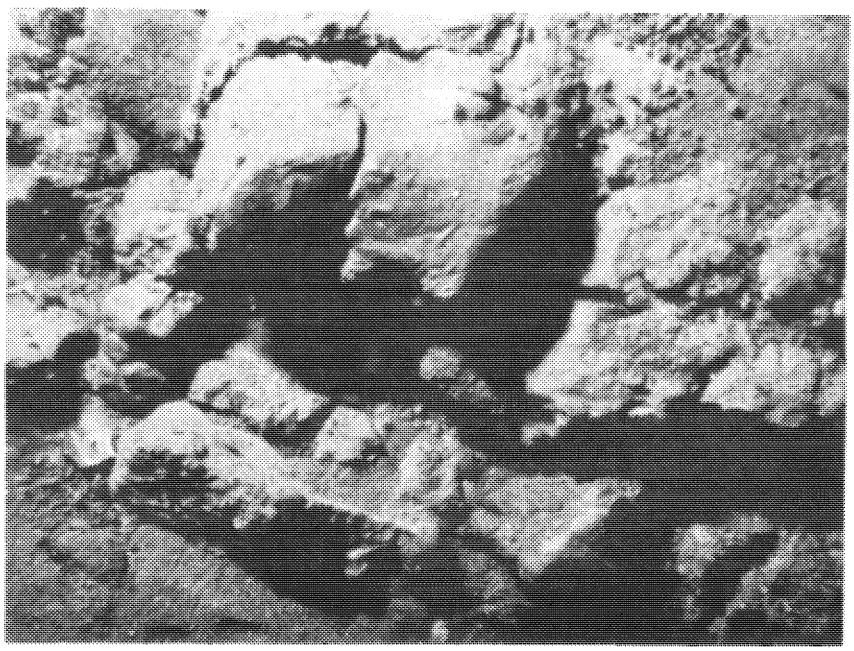


PLATE 8.3-12

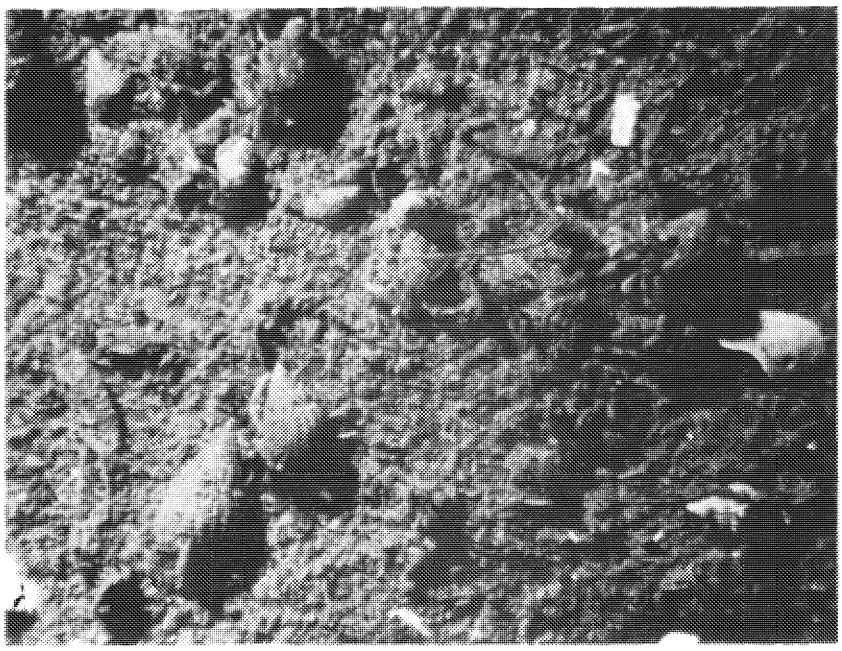


PLATE 8.3-13

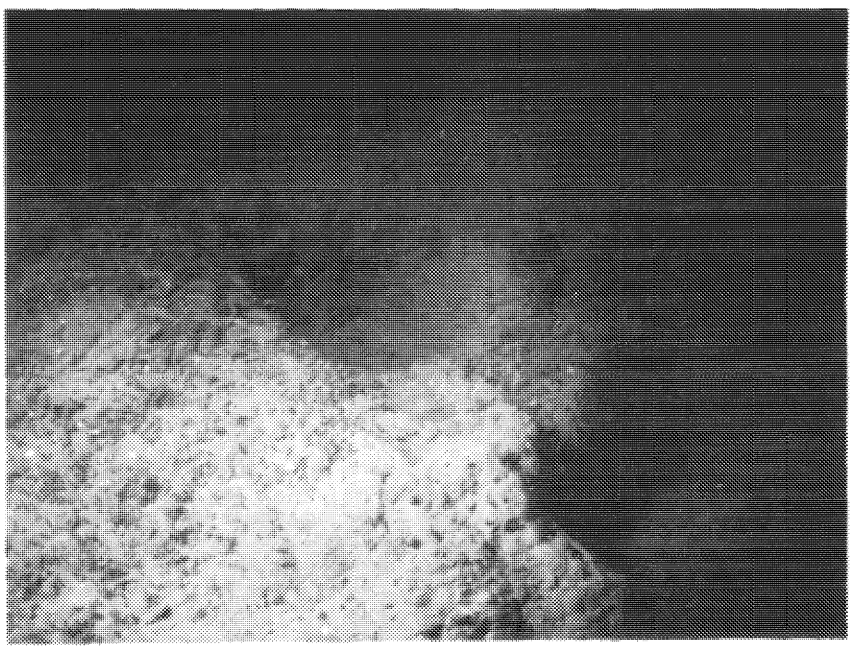


PLATE 8.3-14

8.4 Portland, Maine Disposal Site (April - August, 1980)

Visual observations were made in the vicinity of the Portland disposal site during the period from April-August, 1980, to document both geological and biological features of the dredged material and the surrounding area. Observations were made by remote camera systems (Table 8.4-1) and by diver surveys (Table 8.4-2) over the sites defined in Figure 8.4-1. Representative photographs obtained by remote and diver held cameras are presented in Plates 8.4-1 to 26. Tables 8.4-3 contains the list of captions which correspond to Plates 8.4-1 to 26.

In addition to the visual observations, dives were made to locate and sample populations of the horse mussel, Modiolus sp., for use in the heavy metal uptake monitoring program. These dives were made in April, 1980, at the Bulwark Shoal reference station at which time photographs were taken of representative hard surface fauna (ascidians, asteroids and brachiopods) for comparison with biota observed on ledges NW and SW of the disposal site.

These ledges were surveyed in August, 1980, and revealed evidence of the disposal operation particularly at the SW site where clay mounds were scattered over the granite outcroppings (Plates 8.4-13&14). These mounds probably represent spillage from the disposal scows during transit to and from the site as no significant concentration of sediment, indicative of a disposal operation, was observed. The SW and NW sites were biologically similar, supporting a combination of rocky and fine-grained fauna. Modiolus was conspicuously absent at these

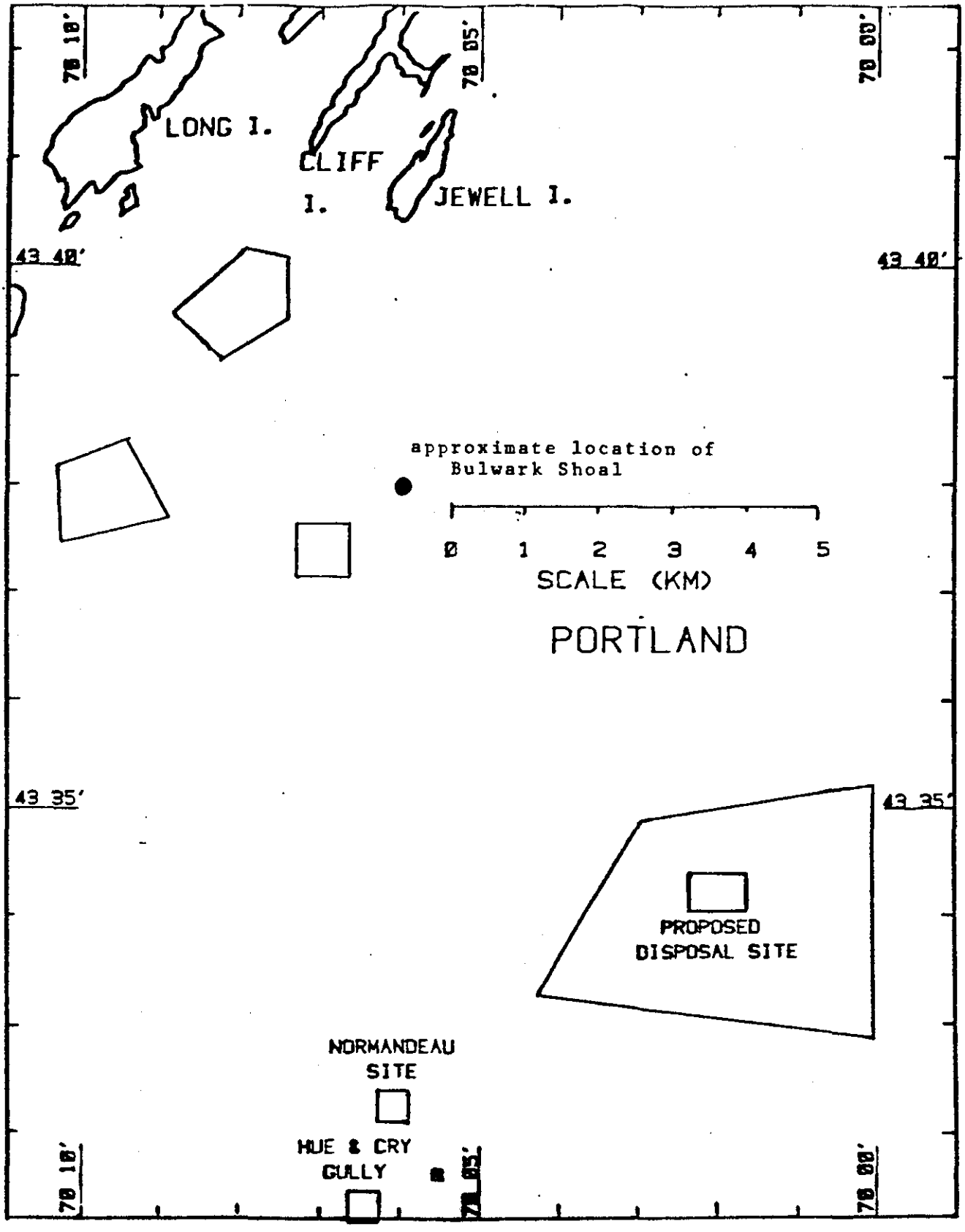


Figure 8.4-1. Location of Bulwark Shoal Reference and Portland Disposal sites.

TABLE 8.4-2. Summary of diver observations at mussel source area and shallow water regions adjacent to the Portland Disposal site. April - August 1980.

Date	Station	Time	Transect Location and Distance	Physical Condition (Depth, Temp. Vis. Tide Bottom Type)	Biological Observations
11 April 80	Bulwark Shoal	PM	West of buoy	Granite with fractures and ridges. Thin to silt veneer depth 40 ft. vis. 30 ft.	70% cover of Modiolus; Ophiophlis Boltenia, Buccinum undatum, Hyas, Strongylocentrotus. Encrusting calcareous algae. Poor lobster habitat.
3 June 80	Bulwark Shoal	PM	West of buoy	No silt veneer.	Agarum dominant macro algae. Callithamnion extensive - attached to Modiolus. Ophiophlis Boltenia, Buccinum undatum, Strongylocentrotus, Modiolus - extensive coverage. Encrusting calcereous algae and poriferans. Cyclopterus with eggs. Whelk eggs.
26 Aug 80	SW Rise	0940-0955	110-120 ft.	Granite outcrop - major fractures and troughs present. Angular steps to peak. Thin silt veneer 3 small areas of spoil clumps. 15-20 cm dia. clumps .5-.75 m^2 coverage of eroded material.	Polymastia spp. Iophon on Terebratulina, V - vase like sponge sp., Globose sponge sp., Haliclona oculata. Metridium senile - 1, Tealia - 1, Terebratulina - dense 12-20/m^2, Modiolus - 1 - prey to Asterias. Ophiopholis - 15, Ctenodiscus - 12.
				Vis 20 ft. 9.6°C	Asterias tanneri - 2, Boltenia 2-4/m^2 in patches, otherwise 1/1-4m^2. Stalked bryozoan, Pagurus sp. - 1, Tautogolabrus adspersus 12-15 along wall edges. Myoxocephalus octodecem-spinosus - 1 Thigmotactic to clay clump.

TABLE 8.4-2 (Cont.)

Date	Station	Time	Transect Location and Distance	Physical Condition (Depth, Temp. Vis. Tide Bottom Type)	Biological Observations
26 Aug 80	NW Rise	1500-1515	100-110 ft.	Vis. 25 ft. 9.6°C. Granite outcrop with thin silt veneer. Fractures and troughs with angular steps to peak. No spoil clumps present.	Calcareous algae. Polymastia spp. Globose sponge spp - 2 sp. V-vase-like sponge sp. Haliclona oculata. Barnacle sp. - dead - on east side of rise - Ophiopholis inside. Ophiopholis - 5, Ctenodiscus - 8, Henricia - 1, Solaster - 2, Asterias - most abundant. Modiolus - sparse. Boltenia - denser on West side 1-4/m^2 east side 1/m^2. Terebratulina 12-20/m^2 west side. sparse and many dead on east side. Strongylocentrotus - 2 Myoxocephalus octodecemspinosus - 1 Pagurus pollicarus - 1.

sites, probably as a function of depth ($\sim$ 30 m).

As a result of the work accomplished here, and the expected utilization of other deep-water disposal sites, an underwater video tape system combined with the 35 mm EG&G camera is being developed. This system will provide a continuous scan of the disposal site while maintaining a capability for hard copy photographs of pertinent features. Utilization of this instrumentation should make visual surveys of deep water disposal sites (up to 100 m) nearly as comprehensive and informative as those made by divers in shallow areas.

TABLE 8.4-1 Inventory of photographic surveys at the Portland Disposal Site. April - August 1980.

Date	Method	Location	Other
10 April 80	Remote TV/35 mm ENDECO System	EPA Stations 1,2,4,5,6,7, 8,9,11.	Cooperative DAMOS/EPA survey. 84 frames. (Data with EPA).
3 June 80	Diver - 35 mm	Bulwark Shoal Reference Station	Photographs of hard rock faunal assembleges. 38 frames.
26 Aug 80	Diver - 35 mm	SW Rise	Photographs of hard rock faunal assembleges. 38 frames.
	Diver - 35 mm	NW Rise	Photographs of hard rock faunal assembleges. 17 frames.
	Remote EG & G 35 mm	SW to NE transect towards dump buoy.	L/C coordinates 21505.7/14297.2 to 22323/14723. 4 frames.
		N of dump buoy to N	L/C coordinates 13241.2/25956.7 to 13240.0/25957.0 5 frames.

TABLE 8.4-3 List of captions corresponding to Plates 8.4-1 to 26 at Portland Disposal Site. Underwater Photography. April - August 1980.

PLATE #		
8.4-1	3 June 80	Bulwark Shoal. HFVP - 8". Modiolus modiolus clusters on ledge outcropping (45' depth) were collected and installed on PVC platforms for heavy metal analysis.
8.4-2	3 June 80	Bulwark Shoal. HFVP - 8". Associated hard surface invertebrate communities include: Boltenia ovifera Halocynthia pyriformis, Didemnum, Buccinum undatum (egg cases).
8.4-3	26 August 80	EG & G remote camera. North sector Depth 135 feet. Loran C coordinates 13241.2 25956.7 Scattered brachiopoda Terebratulina septentrionalis attached to a hard ledge surface with thin sediment veneer overlay.
8.4-4	26 August 80	EG & G remote camera. North sector. Depth 138 feet. Loran C coordinates. 13241.0 25956.8 Dense concentration of Terebratulina septentrionalis with blood star Henricia evident near crevices.
8.4-5	26 August 80	EG & G remote camera. North sector. Depth 127 feet. Loran C coordinates 13240.9 25957.1 Although poorly focused, the photo illustrates a saturation of all exposed hard surfaces by invertebrate epifauna.
8.4-6	26 August 80	EG & G remote camera. SW to NE transect. Depth 120 feet. Loran C coordinates. 21505.7 14297.2 The cunner Totagalabrus adspersus over soft bottom with the sponge Polymastia and spiny star, Crossaster papposus, in lower left.

TABLE 8.4-3 (Cont.)

PLATE #		
8.4-7	26 August 80	SW ledge - Depth 120 feet. HFVP - 30". Loran C 13257.7 25956.6 Cobble-boulder glacial till deposits occur atop a granite outcrop knoll (110-130' depth). Fouling organisms are diverse and percentage coverage ranges from 80-90%.
8.4-8	26 August 80	SW ledge - HFVP - 30". Small clay spoil patch (.5 m diam) observed from accidental barge wash in transport to disposal site. The long horned sculpin, Myoxocephalus octodeimspinosur; stalked accidan Boltenia ovifera; brachipods Terebratulina, and large globose sponge are evident in lower left.
8.4-9	26 August 80	SW ledge. HFVP - 15". Boulder-crevice with interspace shell hash habitat illustrating degree of attached fauna with Modiolus, Balanus, and Amaroucium, dominant.
8.4-10	26 August 80	SW ledge. HFVP - 30". The flat horizontal ledge surface demonstrates high diversity and dense concentration of sessile and encrusting epifauna.
8.4-11	26 August 80	SW ledge. HFVP - 24". The large northern anemone Talia felina is evident in foreground with numerous Terebratulina, Boltenia and hydroid clusters in background.
8.4-12	26 August 80	SW ledge. HFVP - 16". The common anemone Metridium senile was encountered occasionally in colonial aggregations on hard ledge surfaces.
8.4-13&14	26 August 80	SW ledge. HFVP - 16". Obvious recent spoil from barge wash atop SW ledge outcropping. Three small areas (.5 m diam.) were only evidence of spoil in a ~ 100 m diameter survey of ledge vicinity.

TABLE 8.4-3 (Cont.)

PLATE #		
8.4-15	26 August 80	SW ledge. HFVP - 16". A granite rock ridge demonstrates dense invertebrate fouling in uniform distribution.
8.4-16	26 August 80	NW ledge. Loran C coordinates 13240.0 25957.8 Dense brachiopod Terebratulina assemblage with brittle stars (Ophiuroidea) intertwined. The encrusting coralline algae Lithothamnium coats ledge patch areas.
8,4-17	26 August 80	NW ledge. The long horned sculpin Myoxocephalus octodecemspinosus was the most common finfish (4-6) observed in 20 min. diver survey.
8.4-18	26 August 80	NW ledge Crevice shelter regions of ledge outcrop provides niche space for brittle stars, Ophiopholis oculeata and barnacles Balanus evident in right foreground.
8.4-19	26 August 80	NW ledge. HFVP - 24". The representative epifauna of the hard rock Portland Disposal region are illustrated: Leptasterias tenera, Terebratulina, Boltenia.
8.4-20	26 August 80	NW ledge. HFVP - 6". Red sea star, Hippasteria phrygiana was also frequently (6-8) observed.
8.4-21	26 August 80	NW ledge. HFVP - 6:. The sponge Polymastia surrounded by a rich fouling community; polychaet tube worms, Sea pork Amaroucium, brachiopods Terebratulina, and hydroid stalks.
8.4-22	26 August 80	NW ledge. HFVP - 3". Barnacle, Balanus balanus, walls provide shelter for brittle stars and basal stalk attachments for Boltenia.
8.4-23	26 August 80	NW ledge - HFVP - 6". The blood star rests within several brachiopods Terebratulina. Note the associate sponge Iophon nigricans on shells.

TABLE 8.4-3 (Cont.)

PLATE #		
8.4-24	26 August 80	NW ledge. HFVP - 6". A dense group of Terebratulina on a vertical rock face at the southeastern slope of the 120' ledge.
8.4-25	April 80	Remote video and 35 mm camera survey of peripheral regions around the Portland Disposal site.
8.4-26	April 80	Deployment of the video and 35 mm camera system from the stern of R/V Edgerton.

PLATE 8.4-1

PLATE 8.4-2

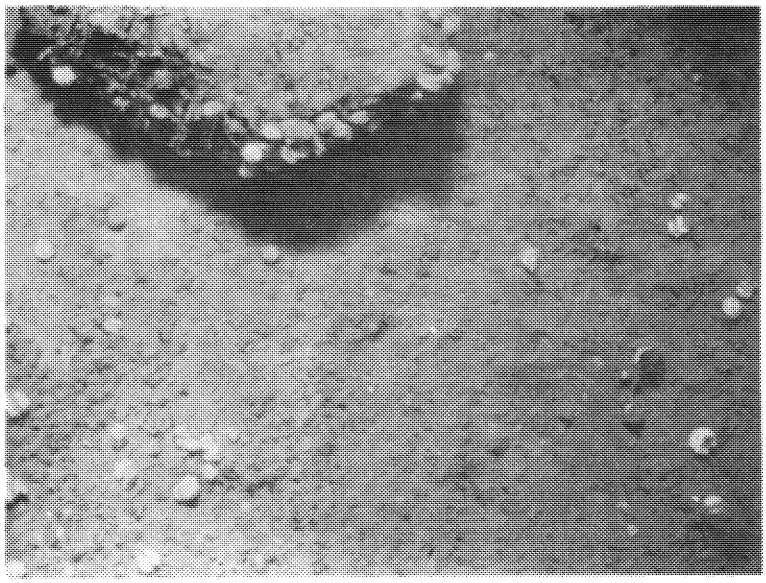
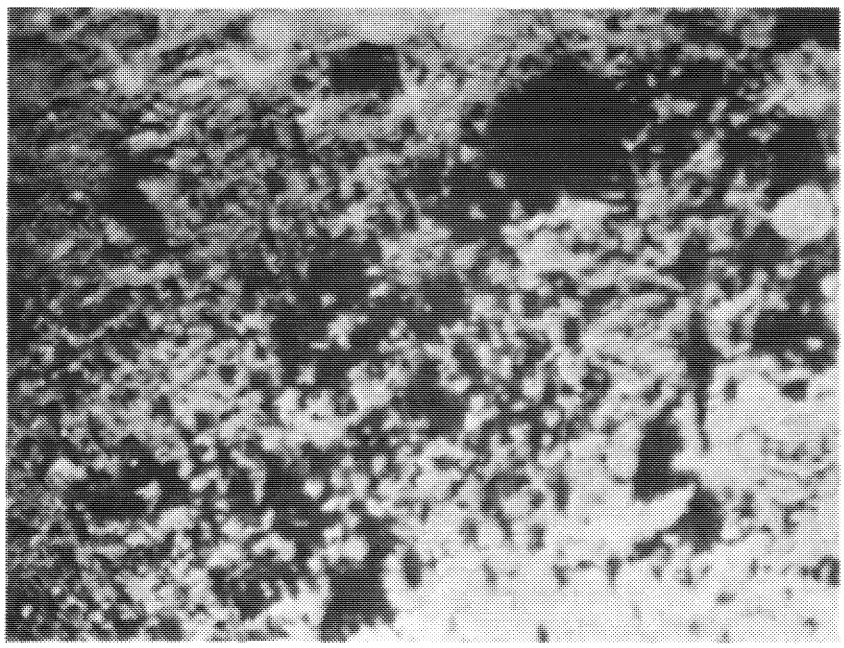


PLATE 8.4-3

PLATE 8.4-4



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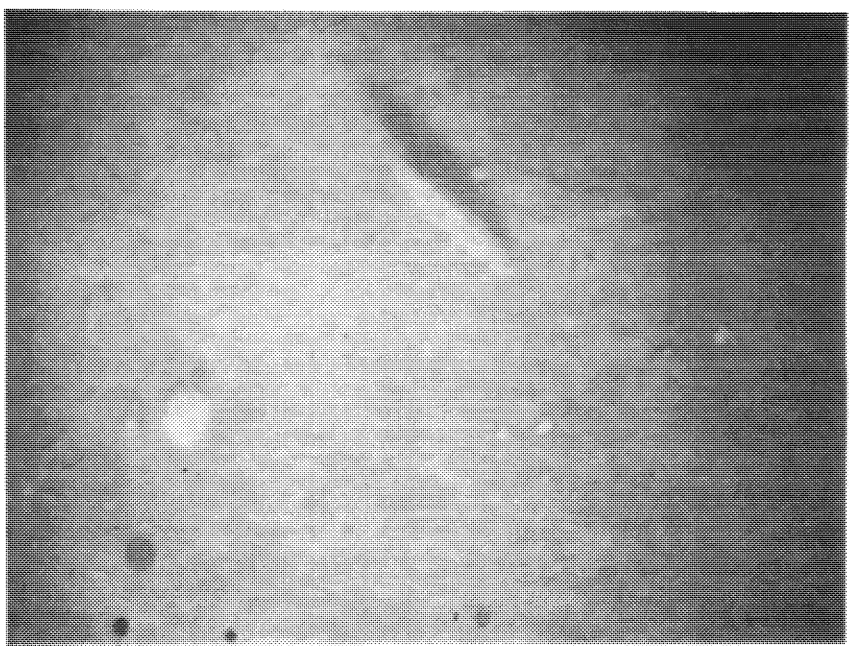
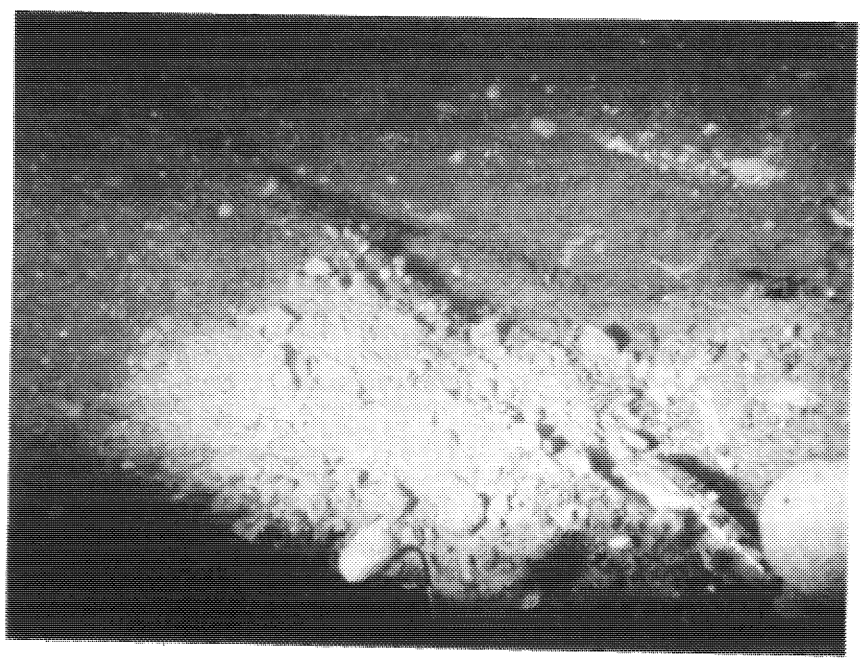


PLATE 8.4-6

PLATE 8.4-7



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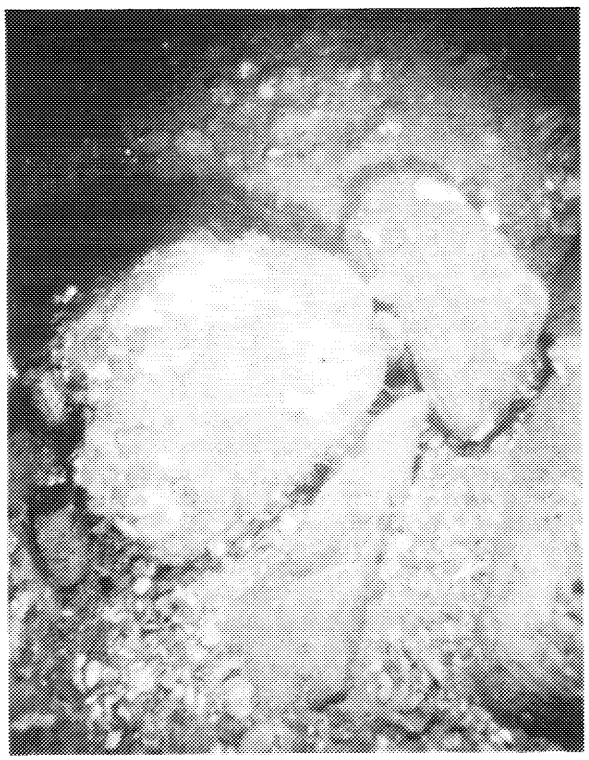

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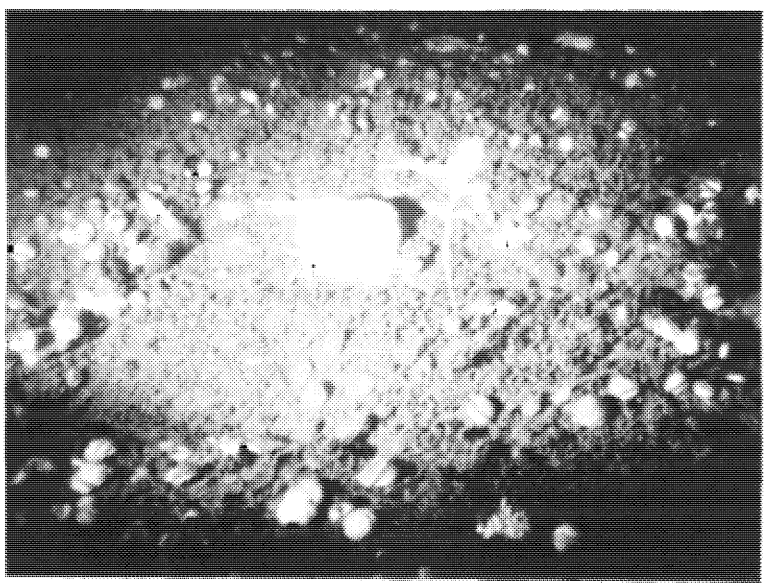


PLATE 8.4-10

PLATE 8.4-11

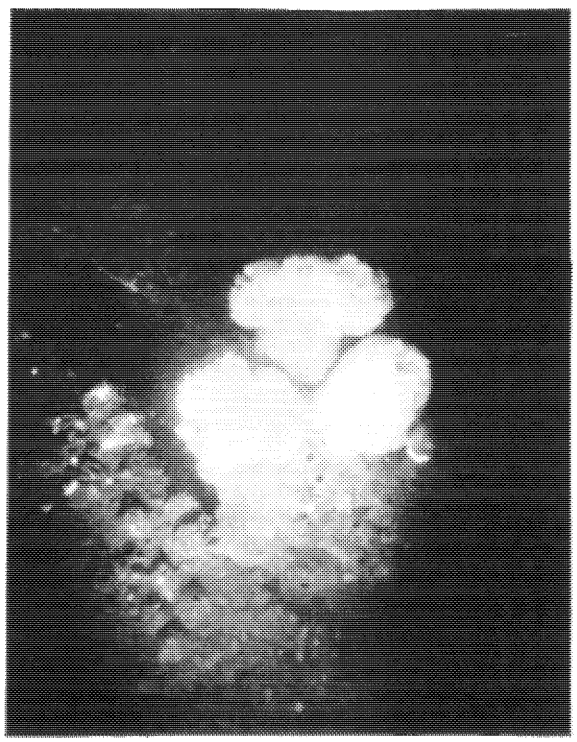
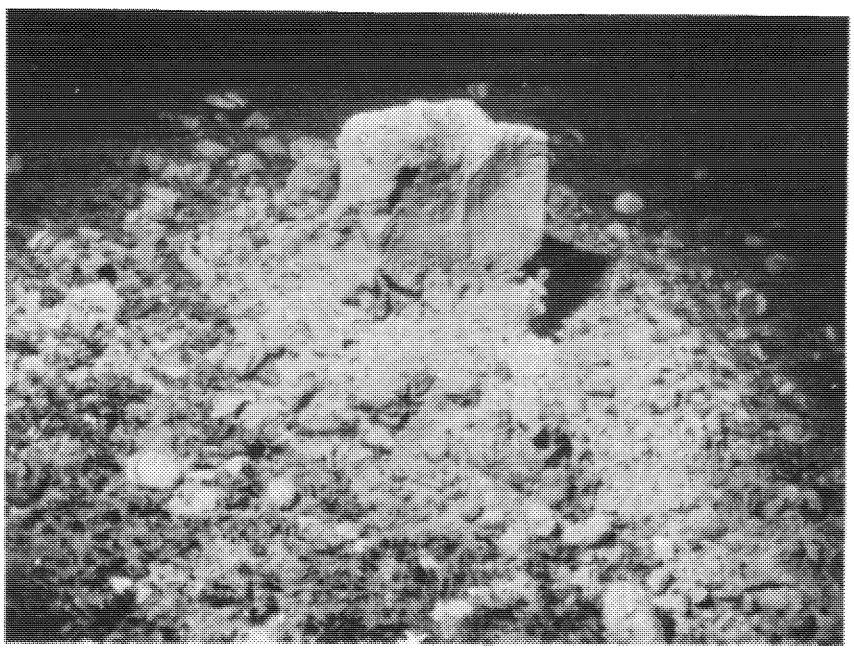


PLATE 8.4-12

PLATE 8.4-13



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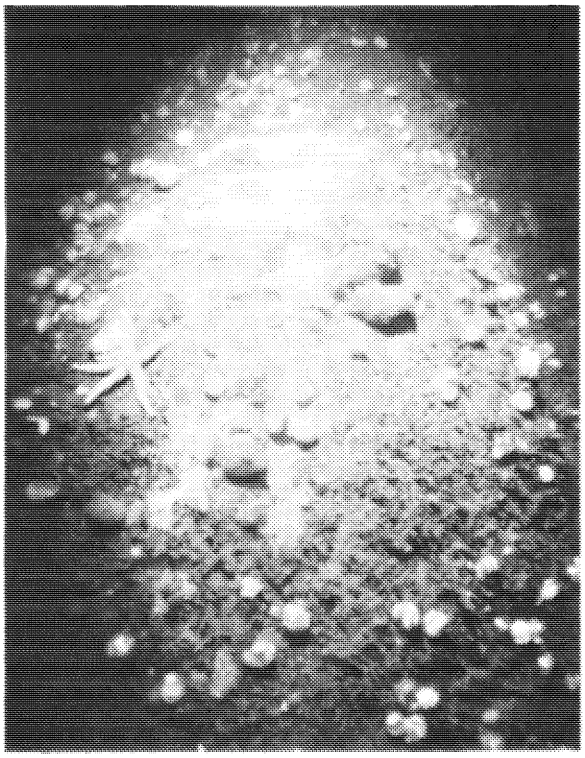

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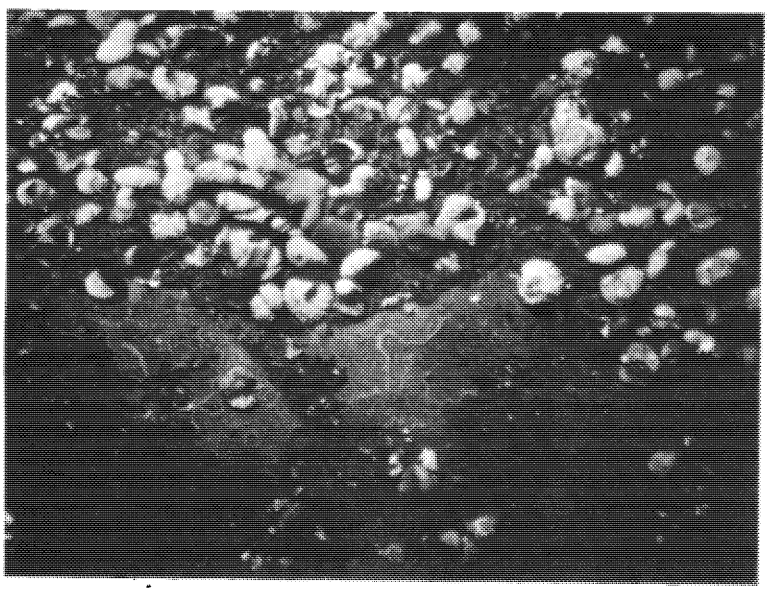

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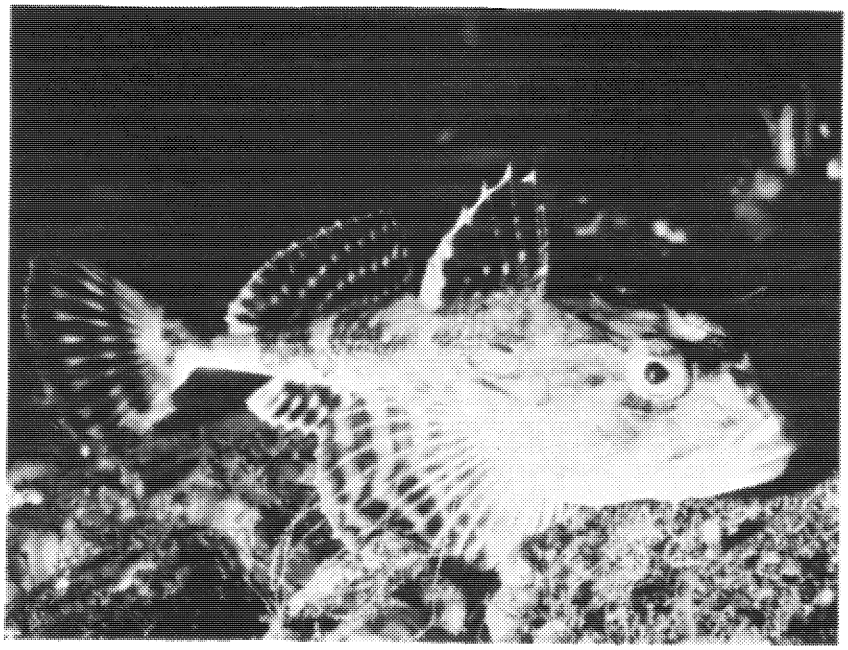

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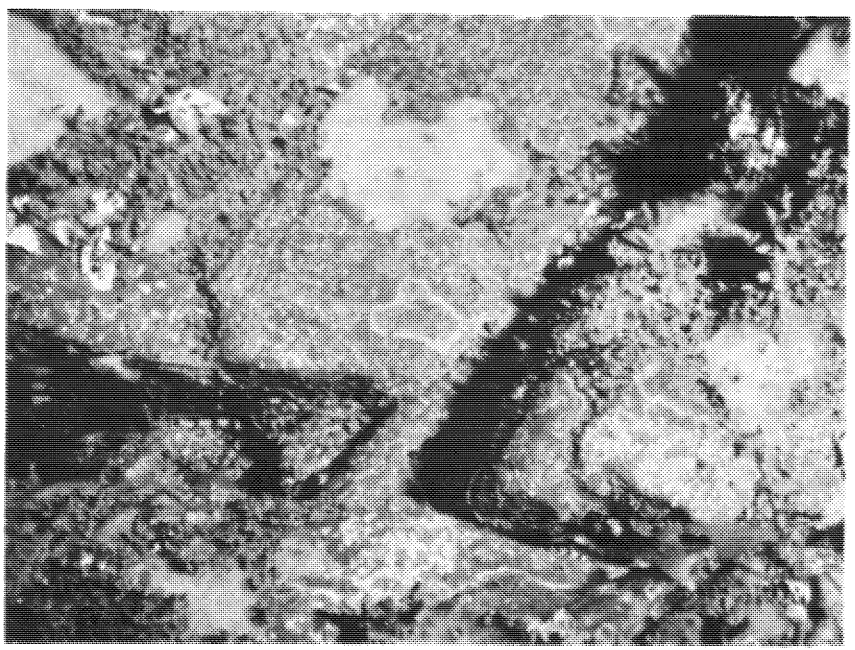

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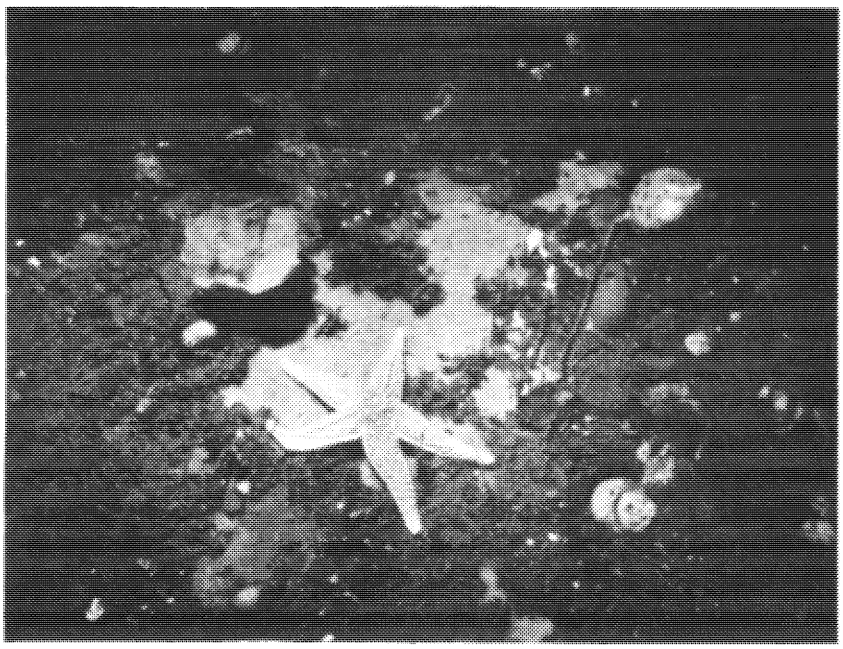

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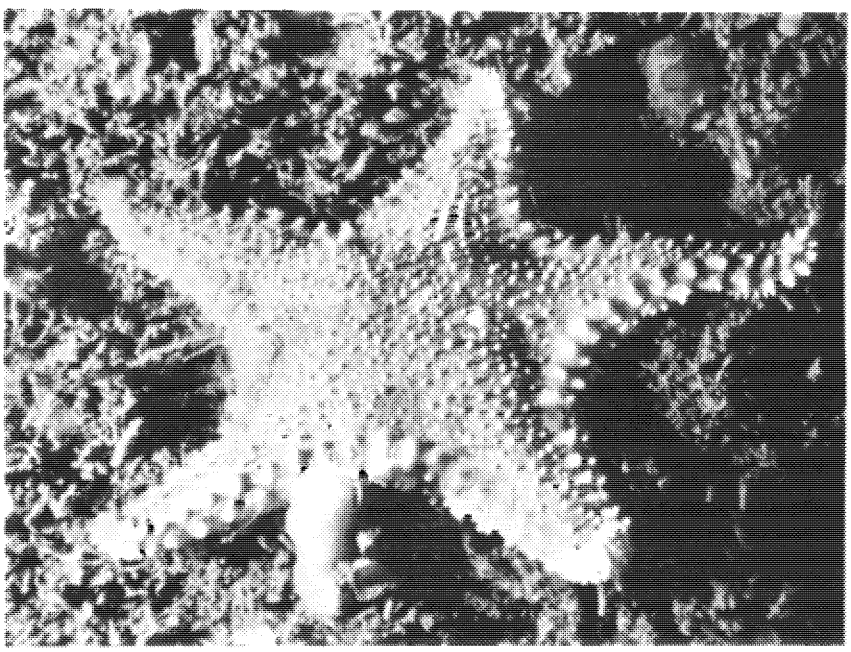


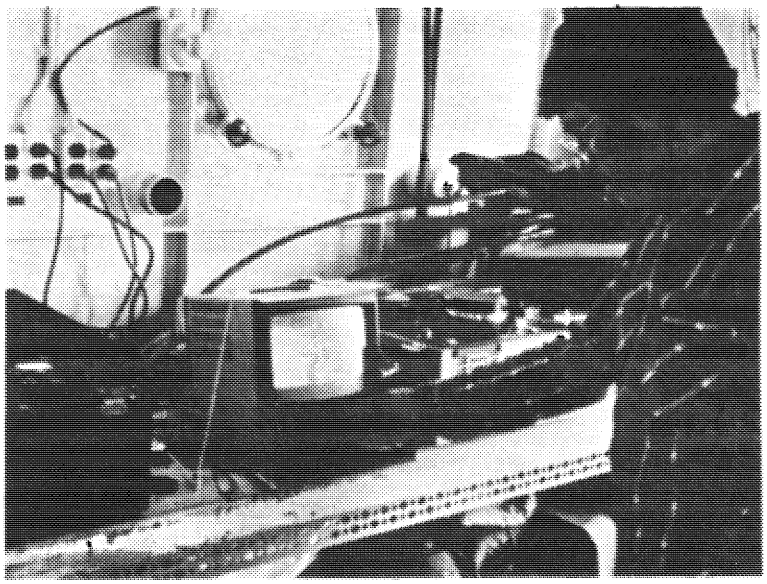
PLATE 8.4-20

PLATE 8.4-21

PLATE 8.4-22

PLATE 8.4-23

PLATE 8.4-24



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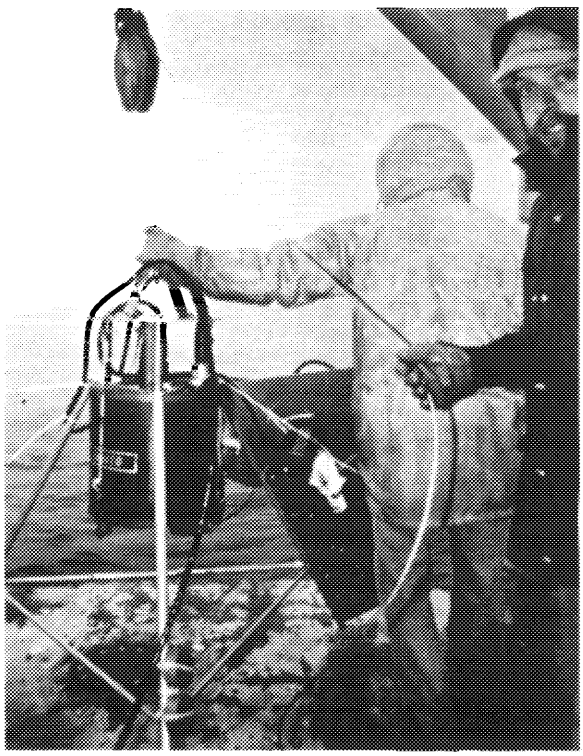

PLATE 8.4-26