INDEX TO RHODE ISLAND COASTAL RESOURCE MAPS

SHORELINE TYPES

Shoreline types are color-coded in a ranked order to indicate increasing oil spill damage and long-term persistence. Response measures should primarily protect environments ESI - 8, 9, and 10.

Sensitivity

1. Exposed, rocky shores
2. Exposed rocky ledges
3. Fine-grained sand beaches
4. Coarse-grained sand beaches
5. Mixed sand and gravel beaches
6. Gravel beaches
7. Exposed tidal flats
8. Sheltered rocky shores
9. Sheltered tidal flats
10. Marshes

(unranked) Man-made structures (seawalls, piers, etc.)

BIOLOGICAL FEATURES
WILDLIFE SYMBOLS AND OCCURRENCES

RESIDENT MARINE MAMMALS
- Seals — Haulout ground or pupping areas

MARINE BIRDS
- Wading Birds — Heron, egret, rail and related bird nesting and feeding areas
- Waterfowl — Migratory waterfowl overwintering areas
- Gulls or Terns — Rookeries or feeding areas

SHELLFISH
- Lobsters — Generalized lobster area
- Clams — Clam, scallop or mussel areas
- Oysters — Oyster beds

FINFISH
- Fish — Anadromous or nearshore fish concentrations

SOCIOECONOMIC FEATURES

The following sites are indicated as deserving special attention during a spill depending on season and other factors. Field survey sites are also included.

- Marinas and yacht clubs
- Parks
- Aquaculture sites
- Recreational beaches
- Seawater intakes
- Field survey sites

SPILL—RESPONSE DATA

Places for locating key spill response equipment are designated on these maps. Equipment locations were designed as a primary defense against a large, offshore (as opposed to an in-harbor) oil spill. Secondary and tertiary defense plans, such as placing absorbent boom along interior marsh areas, are not indicated as they would be too numerous to be meaningful. During actual spill conditions, however, they should be considered on a case-by-case basis. The following methods of spill control are indicated on these maps:

- Open-water boom (large, durable, and able to handle rough seas).
- Harbor boom for calmer or interior environments.
- Open-water skimmer with paravanes for use in channels and embayments.
- Inlet closure for small inlets which have interior marshes and/or tidal flats. Water quality should be carefully monitored during closure to avoid high salinity/low oxygen conditions. These inlets should be reopened after the oil threat has passed.
- Boat ramps for launching boats and equipment.

SEAWATER INTAKES*

1. Market By the Sea
   Atlantic Avenue, Weekapaug
   322-7020
2. Skip's Dock
   Succotash Road, Jerusalem
   783-5031
3. DEM Fish Lab
   Jerusalem 783-2304
4. Snug Harbor Fish Market
   Gooseberry Road 783-7766
5. Global Seafood
   Galilee 789-1055
6. J & L Shellfish
   State Pier Galilee 783-7979
7. Pt. Judith Fisherman's Coop
   Galilee 783-6201
8. Dave Handrigan Seafoods
   Galilee 789-6201
9. Champlin's Market
   Galilee 783-3152
10. Wickford Shellfish
    67 Esmond Street 885-1100
11. DEM Fish Lab 294-4524
12. Custy's Wholesale Lobster
    Quonset Point 885-1166
13. Wharf Tavern
    Water Street 245-5043
14. Quito's Shellfish Co.
    411 Thames Street 253-9042
15. Gilbert's Seafood
    Corner of State and Thames Sts.
    253-6097
16. Stone Bridge Seafood
    17 Point Road 683-1011
17. Bridgeport Seafood
    2117 Main Road 624-4411
18. Manchester Seafood
    2139 Main Road 624-8000
19. Aquidneck Lobster
    Bowen's Wharf 846-0106
20. Anthony Seafood
    Waites Wharf 846-9622

* Numbers refer to those indicated on ESI maps: (from Haring, 1982)

AQUACULTURE OPERATIONS*

1. Ninigret Pond - Charlestown (Quonchontaug)
   James Ryley: 595-4351, Native Fish Market, Westerly: 596-0470, 14 acres; bottom culture of oysters
2. Ninigret Pond - Charlestown (Quonchontaug)
   (3 plots together between Sportsman Cove Marina and Mud Cove)
   a) John Crandall: 322-2032, 2 acres; bottom culture of oysters, b) Joseph T. Saunders: 322-7666, 2 acres; bottom culture of oysters, c) William Sieczkiewicz: 322-7574, 322-8890, 2 acres; bottom culture of oysters
3. Potter Pond - South Kingstown (Kingston)
   Bruce Rogers (Blue Flag Farms): 539-2858, ½ acre; raft culture of oysters
4. Allen Harbor - North Kingstown (Wickford)
   (permitted, but not yet established), Richard Colagiovanni: 942-4464, 15 rafts (12 x 16 ft); poly-culture of oysters, mussels, and quahogs
5. Warren River - Warren (Bristol)
   Luther Blount: 245-4444, 3 acres; bottom culture of oysters
6. Jenny Creek - Prudence (Bristol)
   Luther Blount: 245-4444, Blount Marine, Warren: 245-8300, Raft culture of oysters
7. East Passage - Portsmouth (Prudence Island)
   Link Murray or Bill Silkes: 847-6278, 6 plots, 10 acres each (40 x 1090 ft each); long-line culture of mussels
8. Quicksand Pond - Little Compton (Tiverton)
   James Quinn: 789-3148 (temporary), 4 rafts (12 x 14 ft) experimental; raft culture of oysters

* Numbers refer to those indicated on ESI maps (from Haring, 1982).

SPECIES LIST

MAMMALS		
	2. Harbor Seal	*Phoca vitulina*
BIRDS		
	B. Various shorebirds	
	C. Various waterfowl	
	E. Various wading birds	
	F. Various seabirds	
	38. Herring gull	*Larus argentatus*
	45. Common tern	*Sterna hirundo*
	54. Great blue heron	*Ardea herodias*
	86. Least tern	*Sterna albifrons*
	87. Little blue heron	*Egretta caerulea*
	89. Snowy egret	*Egretta thula*
	90. Black-crowned night heron	*Nycticorax nycticorax*
	92. Great black-backed gull	*Larus marinus*
	95. Roseate tern	*Sterna dougallii*
	97. Green heron	*Butorides striatus*
FISHES		
	65. Bluefish	*Pomatomus saltatrix*
	84. Rainbow smelt	*Osmerus mordax*
	85. Alewife	*Alosa pseudoharengus*
	86. Blueback herring	*Alosa aestivalis*
	87. American shad	*Alosa sapidissima*
	88. Winter flounder	*Pseudopleuronectes americanus*
	89. Cunner	*Tautoglaburus adspersus*
	97. Tautog	*Tautoga onitis*
	99. Atlantic tomcod	*Microgadus tomcod*
	●101. Shortnose sturgeon	*Acipenser brevirostrum*
	102. Atlantic sturgeon	*Acipenser sturio*
	104. Striped bass	*Morone saxatilis*
	108. Summer flounder	*Paralichthys dentatus*
	138. Sea trout	*Salmo trutta*
	142. Crevalle jack	*Caranx hippos*
	144. Atlantic salmon	*Salmo salar*
	145. White perch	*Morone americana*
	146. Atlantic herring	*Clupea harengus harengus*
SHELLFISH		
	19. Blue mussel	*Mytilus edulis*
	25. Soft shell clam	*Mya arenaria*
	34. Atlantic deep-sea scallop	*Placopecten magellanicus*
	42. Quahog (hard clam)	*Mercenaria mercenaria*
	43. American oyster	*Crassostrea virginica*
	45. Lobster	*Homarus americanus*
	49. Blue crab	*Callinectes sapidus*
	52. Bean clam	*Donax gouldii*

ENDANGERED

PRINCIPAL REFERENCES

Coastal Resources Center, 1982, State of Rhode Island oil spill contingency guide; protection strategies for vulnerable coastal features: Prepared for Rhode Island Department of Environmental Management, Univ. of Rhode Island, Kingston, 185 pp.

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Pilson, M.E.Q. and E. Goldstein, 1973, Ch. 7, marine mammals: In Coastal and Offshore Environmental Inventory, Cape Hatteras to Nantucket Shoals: Marine Publ. Series No. 2, Univ. of Rhode Island, Kingston.

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Description of Shoreline Types

EXPOSED ROCKY SHORES — ESI = 1

- Present along the outer coast of Rhode Island and near Branford, Connecticut
- Composed of steeply-dipping to vertical bedrock
- Exposed to the high waves or tidal currents
- Commonly contain barnacles along the upper intertidal zone; rockweed and mussels along the middle intertidal zone; and red and brown algae in the lower intertidal zone

Predicted Oil Impact

- Most commonly, oil will be held offshore by waves reflecting off the steep cliffs
- On less steep shores, oil may come onshore
- Oil persistence is related to the incoming wave energy; during high-wave conditions, oil persistence is limited to days
- Oil trapped in tidal pools will kill resident organisms
- The damage to the intertidal community is expected to be relatively light with fairly rapid recovery
- Diving birds utilizing these rocky sites may be killed if oiled

Recommended Response Activity

- On most shores, no cleanup is necessary (and may be dangerous)
- Access is usually difficult
- Cleanup of recreational areas may be necessary; high-pressure water spraying is effective while oil is still fresh

EXPOSED ROCKY LEDGES — ESI = 2

- Present near Newport and New York border as low lying bedrock
- On Block Island, present as wave-cut till platform
- Commonly contain narrow, mixed-sediment beaches along the high-tide swash zone
- The lower intertidal zone contains extensive algal growth
- Tide pools and associated organisms are common in the lower-to-middle intertidal zone

Predicted Oil Impact

- Incoming oil will commonly form a band along the high-tide swash line
- Tide-pool organisms may be killed
- Lower intertidal algae may escape damage depending on tidal stage and oil type and quantity
- Oil persistence is limited (days to weeks) in most high-energy areas

Recommended Response Activity

- In most wave-exposed areas, cleanup is not necessary
- High recreational-use areas may be effectively cleaned using high-pressure water spraying if oil is still fresh
- Removal of organisms should be avoided

FINE-GRAINED SAND BEACHES — ESI = 3

- Present along the Atlantic Coast as long, recreational beaches
- Usually contain a broad, gently sloping profile
- Commonly backed by dunes or seawalls
- May be mixed with shells or shell fragments
- Upper beach fauna are scarce
- Amphipods and crabs are dominant intertidal organisms

Predicted Oil Impact

- Heavy oil accumulations will cover the entire beach face
- Light oil accumulations will be deposited as oily swashes along the upper intertidal zone
- Oil penetration into the beach will be approximately 15 cm
- Organisms living in the beach sands may be killed either by smothering or by lethal oil concentrations in the water
- Shorebirds may be killed if oiled

Recommended Response Activity

- Fine-grained sand beaches are among the easiest beach types to clean
- Cleanup should concentrate on the removal of oil from the upper swash zone after all oil has come ashore
- Removal of sand from the beach should be minimal to avoid erosion problems; special caution is necessary in areas backed by seawalls
- Activity through both oiled and dune areas should be severely limited
- Manual cleanup rather than use of road graders and front-end loaders is advised

COARSE-GRAINED SAND BEACHES — ESI = 4

- Common in western Rhode Island and Connecticut along the open Sound
- Scattered within Narragansett Bay
- Usually have a moderate slope and may be mixed with shell fragments
- May be present as pocket beaches or on top of bedrock platforms
- Contain low species density and diversity

Predicted Oil Impact

- Commonly, oil will be deposited on and become mixed into the sand along the high-tide swash zone
- Oil may become deeply buried (30-50 cm) into the beach sands
- Oil may also penetrate (or seep) deeply into the beach
- Organisms resident in the beach are likely to be killed under moderate oil concentrations

Recommended Response Activity

- Cleanup may be difficult because of relatively soft sediments
- Cleanup should concentrate on oil removal from the upper swash zone
- Sand removal should be mimimal to avoid erosion problems
- Activity through the oiled sand should be limited to prevent grinding oil deeper into the beach
- Use of heavy equipment for oil/sand removal may result in the removal of excessive amounts of sand; manual cleanup may be more efficient

MIXED SAND AND GRAVEL BEACHES — ESI = 5

- Very common throughout the study site
- Present in both sheltered and exposed areas
- Common as a narrow beach or stringer on top of bedrock platforms (ESI = 2)
- Composed of coarse-grained sand, gravels of varying sizes, and possibly shell fragments
- In active beaches, organisms are scarce due to the harshness of the environment
- In stable habitats, algae may be attached to the larger gravel or boulder components
- The larger rocks may also provide habitat for mussels, crabs, and snails

Predicted Oil Impact

- Oil will be deposited primarily along the high-tide swash zone
- Under very heavy accumulations, oil may spread across the entire beach face
- Oil percolation into the beach may be up to 60 cm in well-sorted material
- Burial may be very deep along the berm
- Biota present may be killed by the oil, either by smothering or by lethal concentrations in the water column

Recommended Response Activity

- Remove oil primarily from the upper swash lines
- Removal of sediment should be limited
- Mechanical reworking of the sediment into the wave zone, and/or high pressure water spraying can effectively remove the oil; sorbent boom may be necessary to capture oil outflow

GRAVEL BEACHES — ESI = 6

- Common throughout the study site
- Composed of gravels and cobbles of varying sizes
- Shell fragments and woody debris are also common beach components
- Biomass is generally very low in high-wave areas; at calmer sites, the population of fauna and attached algae may be fairly great; crabs, snails, mussels, barnacles, and attached algae are most common

Predicted Oil Impact

- Under light-to-moderate concentrations, oil will be deposited primarily along the last high-tide swash zone
- With heavy oil quantities, the entire beach face may be covered
- Oil may percolate rapidly and deeply (up to 1 m) into the beach face
- If oil is left to harden, an asphalt/gravel pavement may result
- Resident fauna and flora may be killed by the oil

Recommended Response Activity

- Removal of sediment should be restricted
- Pushing gravel into the active surf zone and use of high-pressure water spraying is effective at removing oil while it is still fresh
- Sorbent booms should be used to capture oil outflowing during the above cleansing process

EXPOSED TIDAL FLATS (MOD. TO HIGH BIOMASS) ESI = 7

- Not common in study site
- Found in the ponds and fronting Atlantic and Sound beaches
- Visible only at low tide
- Exposed to low-to-moderate wave energy and/or tidal currents
- Composition is most commonly sand or mixed sand and gravel
- Species density and diversity may be high; soft-shelled clams and worms are most important

Predicted Oil Impact

- Most oil will be pushed across the flat as the tide rises
- Deposition of oil on the flat may occur on a falling tide if oil concentrations are heavy
- Biological damage may be severe

Recommended Response Activity

- Cleanup is very difficult (and possible only during low tides)
- The use of heavy machinery should be restricted to prevent mixing oil into the sediments
- On sand flats, oil will be removed naturally from the flat and deposited on the adjacent beaches where cleanup is more feasible. In gravelly areas, oil may bind with the sediment; high-pressure water spraying may be necessary

SHELTERED ROCKY SHORES ESI = 8

- Not common in the study site
- Composed of bedrock outcrops, ledges, or boulders
- Located in calm, interior environments
- Species density and diversity vary greatly, but barnacles, mussels, crabs, snails, and rockweed are often very abundant

Predicted Oil Impact

- Oil will persist for several years especially between rocks
- Upper intertidal biota and algae will be most severely affected
- Algae present in the lower intertidal zone are most resistant to damage

Recommended Response Activity

- These are areas needing priority protection using deflection booms, sorbent booms, and offshore skimmers
- High- and low-pressure water spraying is effective while oil is still fresh
- Cutting of oiled algae is generally not recommended

SHELTERED TIDAL FLATS ESI = 9

- More common the Connecticut, associated with large marsh areas
- Present in calm-water habitats, sheltered from major wave activity
- Composed of muds, commonly fronting marshes
- Usually contain large populations of clams, worms, and snails; many of these flats are commercially harvested
- Bird life is seasonally abundant

Predicted Oil Impact

- Oil may persist for many years
- Long-term oil incorporation into tidal-flat sediments is common
- Oil deposition will commonly occur along the upper fringes of the flat
- Very heavy oil accumulations will cover much of the flat surface
- Biological damage may be severe

Recommended Response Activity

- This is a high-priority area necessitating the use of spill protection devices to prevent or limit oil spill impact; open-water, deflection, and sorbent booms and open-water skimmers should be used
- Cleanup of the flat surface after oiling is very difficult because of the soft substrate
- Manual operations from shallow-draft boats may be helpful

MARSHES — ESI = 10

- Very common as narrow, fringing marshes in most areas, or as broad marshes within the upper estuaries
- Very sheltered from waves and tidal activity
- Composed primarily of *Spartina* grasses on an organic-rich mud base
- Crabs are common and bird life may be abundant
- Marshes provide a nursery ground for numerous fish species

Predicted Oil Impact

- Oil in heavy accumulations may persist for decades
- Small quantities of oil will be deposited primarily along the outer marsh fringe or along the upper wrack (debris) swash line
- Resident biota, including bird life, are likely to be oiled and possibly killed

Recommended Response Activity

- Under light oiling, the best practice is to let the marsh recover naturally
- During winter months, surface ice commonly offers shoreline protection
- Cutting of oiled grasses and low-pressure water spraying are effective, especially during the early part of the spring growing season
- Heavy oil accumulations on the marsh surface should be removed manually; access across the marsh should be greatly restricted
- Cleanup activities should be carefully supervised to avoid excessive damage to the marsh

MAN-MADE STRUCTURES — (Not Ranked)

- Very common throughout the study area
- Composed of rip-rap, concrete and stone, wooden or metal bulkheads, and wooden pilings
- Concrete and stone are most common along the outer coast (behind the beach) and along the sheltered residential areas
- Organisms and algae may be common in rip-rap structures and on pilings
- Biota on concrete structures along the upper intertidal or supratidal zones is sparse

Predicted Oil Impact

- Oil would percolate easily between the gravel and boulders of rip-rap structures
- Oil would coat the intertidal areas of solid structures
- Biota would be damaged or killed under heavy accumulations

Recommended Cleanup Activity

- May require high-pressure spraying:
  - — to remove oil
  - — to prepare substrate for recolonization of barnacle and oyster communities
  - — for aesthetic reasons
- Since rip-rap is often associated with developed, recreational beaches cleanup would be advisable to minimize chronic leaching of oil trapped in the rocks