

ENVIRONMENTAL SENSITIVITY INDEX—LAKE ERIE SYSTEM










SHORELINE TYPES

The shoreline of the Lake Erie system was classified during low-altitude, fixed-wing aerial surveys and ground station surveys. The list below, presented in order of increasing sensitivity to spilled oil, provides a summary of all shoreline types common to the Great Lakes region. All shoreline types are found within the study area. Wetland environments (ESI = 10) are the most sensitive and deserve priority protection.

- Sensitivity ↓
- 1. Exposed bedrock bluffs
 - 2. Exposed unconsolidated sediment bluffs
 - 3. Shelving bedrock shores
 - 4. Sand beaches
 - 5. Mixed sand and gravel beaches
 - 6. Gravel beaches
 - 7. Riprap and harbor structures
 - 8. Sheltered bluffs
 - 9. Low banks
 - 10. Coastal wetlands
 - (Unranked) Man-made structures

BIOLOGICAL RESOURCES

The biological resources found within the Lake Erie system are compiled from the literature and from direct contact with scientists knowledgeable about local species occurrence. Areas having resources should receive consideration when planning all spill-response activities. The symbols to indicate these resources are given below.

- MAMMALS
 -  Coastal species
- BIRDS
 -  Shorebirds
 -  Wading birds
 -  Diving birds
 -  Waterfowl
 -  Raptors
 -  Gulls
- FISHES
 -  Salmonids
 -  Other gamefish

KEY TO SPECIES

BIRDS

4.	Great blue heron	<i>Ardea herodias</i>
5.	Green heron	<i>Butorides striatus</i>
6.	Virginia rail	<i>Rallus limicola</i>
7.	Sora rail	<i>Porzana carolina</i>
9.	Black-crowned night heron	<i>Nycticorax nycticorax</i>
10.	American bittern	<i>Botaurus lentiginosus</i>
11.	Belted kingfisher	<i>Megaceryle alcyon</i>
12.	Black tern	<i>Chlidonias niger</i>
17.	Canada goose	<i>Branta canadensis</i>
18.	Mallard	<i>Anas platyrhynchos</i>
19.	Black duck	<i>Anas rubripes</i>
20.	Green-winged teal	<i>Anas crecca</i>
24.	Redhead	<i>Aythya americana</i>
25.	Greater scaup	<i>Aythya marila</i>
26.	Common goldeneye	<i>Bucephala clangula</i>
27.	Bufflehead	<i>Bucephala albeola</i>
30.	Marsh hawk	<i>Circus cyaneus</i>
32.	Peregrine falcon	<i>Falco peregrinus</i>
40.	American coot	<i>Fulica americana</i>
41.	Pied-billed grebe	<i>Podilymbus podiceps</i>
43.	Whistling swan	<i>Olor columbianus</i>
45.	Lesser scaup	<i>Aythya affinis</i>
50.	Great egret	<i>Casmerodius albus</i>
54.	Yellow rail	<i>Coturnicops noveboracensis</i>
55.	Killdeer	<i>Charadrius vociferans</i>
56.	Spotted sandpiper	<i>Actitis macularia</i>
57.	Greater yellowlegs	<i>Tringa melanaleuca</i>
58.	Lesser yellowlegs	<i>Tringa flavipes</i>
61.	Dunlin	<i>Calidris alpina</i>
65.	Semipalmated sandpiper	<i>Calidris pusilla</i>
66.	Herring gull	<i>Larus argentatus</i>
67.	Ring-billed gull	<i>Larus delawarensis</i>
68.	Common tern	<i>Sterna hirundo</i>
71.	Least bittern	<i>Ixobrychus exilis</i>
72.	Bonapartes gull	<i>Larus philadelphia</i>
74.	Southern bald eagle	<i>Haliaeetus leucocephalus</i>
75.	Forsters tern	<i>Sterna forsteri</i>
76.	King rail	<i>Rallus elegans</i>
82.	Upland sandpiper	<i>Bartramia longicauda</i>

FISH

1.	Alewife	<i>Alosa pseudoharengus</i>
2.	Rainbow smelt	<i>Osmerus mordax</i>
6.	Brown trout	<i>Salmo trutta</i>
9.	Chinook salmon	<i>Oncorhynchus tshawytscha</i>
10.	Coho salmon	<i>Oncorhynchus kisutch</i>
13.	Northern pike	<i>Esox lucius</i>
14.	Bluegill	<i>Lepomis macrochirus</i>
15.	White crappie	<i>Pomoxis annularis</i>
16.	Black crappie	<i>Pomoxis nigromaculatus</i>
17.	Yellow perch	<i>Perca flavescens</i>
18.	Largemouth bass	<i>Micropterus salmoides</i>
19.	Smallmouth bass	<i>Micropterus dolomieu</i>
20.	Rock bass	<i>Ambloplites rupestris</i>
21.	Pumpkinseed	<i>Lepomis gibbosus</i>
22.	Walleye	<i>Stizostedion vitreum vitreum</i>
23.	White bass	<i>Morone chrysops</i>
26.	Channel catfish	<i>Ictalurus punctatus</i>
27.	Carp	<i>Cyprinus carpio</i>
28.	Gizzard shad	<i>Dorosoma cepedianum</i>
29.	Cisco	<i>Coregonus artedii</i>
30.	Brook trout	<i>Salvelinus fontinalis</i>
33.	Fathead minnow	<i>Pimephales promelas</i>
34.	Banded killifish	<i>Fundulus diaphanus</i>
35.	Shorthead redhorse	<i>Moxostoma macrolepidotum</i>
37.	White sucker	<i>Catostomus commersoni</i>
39.	Brown bullhead	<i>Ictalurus nebulosus</i>
40.	Green sunfish	<i>Lepomis cyanellus</i>
41.	Grass pickerel	<i>Esox americanus vermiculatus</i>
42.	Sauger	<i>Stizostedion canadense</i>
45.	Freshwater drum	<i>Aplodinotus grunniens</i>
46.	Lake sturgeon	<i>Acipenser fulvescens</i>

MAMMALS

3.	Muskrat	<i>Ondatra zibethicus</i>
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SOCIOECONOMIC FEATURES

The following information is provided to highlight those areas having socio-economic importance in order to assist or direct the spill-response effort.




-  Preserves and wildlife refuges
-  Parks
-  Recreational beaches
-  Power plants
-  Water intakes
-  Marinas
-  Submerged vegetation

PARKS AND PRESERVES

1.	Sterling State Park	9. Evangola State Park
2.	South Bass Island State Park	10. Beaver Island State Park
3.	Crane Creek State Park	11. Buckhorn Island State Park
4.	East Harbor State Park	12. Joseph Davis State Park
5.	Kelley's Island State Park	13. Point Mouillee State Game Area
6.	Headlands Beach State Park	14. Erie State Game Area
7.	Geneva State Park	15. American Lotust Plant Preserve
8.	Presque Isle State Park	

SPILL-RESPONSE INFORMATION

The symbols below are used to indicate primary locations for the positioning of booms and open-water skimmers. Boat ramps to enable equipment access to the river are also indicated.

-  Boat Ramps
-  Hoists
-  Airports

SOCIOECONOMIC FEATURES (continued)

AQUACULTURE SITES [(from Card and Aho (1983); and Card, pers. commun. (1985)]

1. Gem Farms (Map 2) 563-3670/633-3127
Newcastle, blue mussels
2. Dodge Cove (Map 4) 644-8624/563-8168
Newcastle, oysters
- 2A. Meadow Cover Sea Farm (Map 4) 633-5102
Boothbay, European oysters
3. Maine Mariculture (Map 5) 644-8427
Newcastle, oysters
4. Harry's Sea Farm (Map 5) 563-5938
Newcastle, European oysters and blue mussels
5. Dodge Cove Marine Farm (Map 5) 644-8624/563-8168
Newcastle, South Bristol, European oysters
6. Gulf of Maine Oyster Growers (Map 5) 882-3445
Damariscotta, European oysters
7. Maine Mooring Oyster Co., Inc. (Map 5) 644-8164
Walpole, European oysters
8. MARITEC (Map 5) 644-8180
Walpole, blue mussels and European oysters
9. Culture Fisheries Corp. (Map 5) 563-3226
Newcastle, oysters
10. Abandoned Farms, Inc. (Map 5) 563-3935
Damariscotta, blue mussels, European oysters, and American oysters
11. Paul Durgin (Map 5) 563-5026
Walpole, European oysters
12. Mary Parmley (Map 6) 563-5872
Newcastle, American oyster
13. Bristol Shellfish Farms (Map 8) 529-5634/5210
Bristol, quahogs, European oysters, and American oysters
14. John Stotz Site (Map 8) 529-5566
Bremen, bottom culture (30 acres)
15. Donald E. Davey Site (Map 11) 832-5080
Friendship, European oysters
16. Friendship Trap Co. (Map 11) 354-2545
Friendship, mussels (experimental)
17. W. S. Foster Site 1 (Map 11) 289-2291
Friendship, bottom culture (pilot scale)
18. Agmar Blue Mussel Farms (Map 11) 372-6507
St. George, mussels
19. Great Eastern Mussel Farms (Map 13) 372-6317
St. George, mussel tanks (with intakes)
20. Mike and Joe's Seafarm (Map 21)
Crockett Cove, Vinalhaven, mussel bottom culture
21. Northport area (Map 24)
Oysters, but mostly inoperative
22. R. Burgess, J. Hamblen, and Great Eastern Mussel (Map 33)
Camp Island, mussel bottom culture
23. G. Blastow, R. Larrabee, Sr., and Great Eastern Mussel (Map 33)
Webb Cove, mussel bottom culture
24. D. Hutchinson (Map 33)
Buckman Neck, mussel bottom culture
25. M. Haskell (Map 34)
Eatons Island, mussel long line
26. Little Dear Island (Map 34)
Marine farm mussels

LOBSTER-HOLDING FACILITIES [(from Card and Aho (1982, 1983); and Card, pers. commun. (1985)]

1. Five Island Seafood (Map 1) 371-2145/443-9064
Georgetown
2. Lusty Lobster (Map 1) 529-5184/882-7781
Southport
3. Mill Cove Lobster Pound (Map 1) (202) 633-3340
Boothbay
4. Francis Lobster Pound (Map 1) 633-3307/4258
Boothbay
5. Robinson's Wharf, Division of Fisheries (Map 2) 633-3803/3033
Southport
6. Bristol Lobster Sales (Map 2) 633-2204
Boothbay Harbor
7. Farrins Lobster Pound (Map 4) 644-8500
South Bristol
8. South Bristol Fisherman's Co-op (Map 4) 644-8224
South Bristol
9. Little River Lobster Co. (Map 4) 633-2648
Boothbay
10. New Harbor Co-op (Map 8) 677-2791
New Harbor
11. Small Brothers Wharf, Inc. (Map 8) 677-2200
New Harbor
12. Midcoast Lobster (Map 8) 529-5622
Round Pond
13. Muscongus Bay Lobster Co. (Map 8) 529-5528/5584
Round Pond
14. Bernard Zahn, Inc. (Map 8) 529-5543
Bremen
15. Lusty Lobster (Map 8) 529-5184
Bremen
16. W. A. Reed and Sons (Map 11) 832-4053
Friendship
17. Simmons Lobster Co. (Map 11) 832-4936
Friendship
18. Bramhalls Lobster Wharf (Map 11) 832-5153
Friendship

19. Friendship Harbor Marine, Division of Nelson Marine (Map 11) 832-5056
Friendship
20. Coastal Fisheries (Map 11) 832-5517
Friendship
21. Wallace's Shellfish, Inc. (Map 11) 832-4435
Friendship
22. Young's Lobster (Map 11) 354-2313
Cushing
23. The Lobster Factory (Map 11) 354-6020
Cushing
24. Port Clyde Fishermen's Co-op (Map 11) 372-8922
Port Clyde
25. Atwood Brothers, Inc. (Map 11) 372-8922
Port Clyde
26. Johnny's Wharf (Map 11) 372-6717
Port Clyde
27. Gary Davis (Map 11) 372-8140/8992
Port Clyde
28. Edward L. Black (Map 11) 372-8116/6211
Port Clyde
29. Cod End Market (Map 13) 372-6782
Tenants Harbor
30. Art's Lobster Co., Inc. (Map 13) 372-6265
Tenants Harbor
31. Seacoast Lobster Co. (Map 13) 372-6252
St. George
32. Atwood Brothers Inc. (Map 13) 372-6331
St. George
33. Miller Lobster (Map 14) 594-7406
S. Thomaston
34. Spruce Head Fishermen's Co-op (Map 15) 594-7980
S. Thomaston
35. Wm. Atwood Lobster Co. (Map 15) 594-2317
S. Thomaston
36. McLoon Lobster Co. (Map 28) 594-4231
S. Thomaston
37. Maine Coast Seafoods (Map 16) 596-6481
S. Thomaston
38. Reeds Wharf - Atwood Bros., Inc. (Map 16)
Owls Head Harbor
39. Owls Head Lobster Co. (Map 16)
Owls Head Harbor
40. Ash Point (Map 16)
Rockland
41. Black Pearl (Map 16)
Rockland
42. Maine Way Lobster
Rockland
43. Jordan's Market (Map 16)
Rockland
44. Sailoft Restaurant (Map 17)
Rockport
45. Grayfarm Brothers (Map 17)
Rockport
46. Waterfront Restaurant (Map 17)
Camden
47. Ayres Market (Map 17)
Camden
49. Lobster Pound Restaurant (Map 18)
Lincolnton
50. Beach Inn (Map 18)
Lincolnton
51. City Lobster Co. (Map 19)
Belfast
52. Young's Lobster Pound (Map 19)
Belfast Bay
53. B. O. Radley (Map 20)
Matinicus
54. Art's Lobster (Map 20)
Matinicus
55. Superior Shellfish Co. (Map 24)
Searsport Harbor
56. C. L. Bickford Lobster Co. (Map 25)
4 pounds; in Dog Point, Norton Point, Vinalhaven, and Greens Island
57. Vinalhaven Fisherman's Co-op (Map 25)
Vinalhaven
58. Island Lobster Corp. (Map 25)
Vinalhaven
59. J. E. Brown, Inc. (Map 26)
Vinalhaven
60. Dennet's Wharf (Map 28)
Castine
61. Eatons Shipyard (Map 28)
Castine
62. Fifield Lobster Co. (Map 33)
Fifield Point
63. Clyde Cannery (Map 33)
Stonington
64. Colwell Brothers Lobster Co. (Map 33)
Stonington
65. Lobster Transport Co. (Map 33)
Stonington
66. Stonington Lobster Co-op (Map 33)
Stonington

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Description of Shoreline Types

EXPOSED BEDROCK BLUFFS

ESI=1

- Exposed bedrock bluffs are fairly common along the shoreline and vary from 10 to 200 feet in height
- These exposed rocky bluffs experience waves and strong currents
- Landside access to the base of these bluffs is difficult at most locations

Predicted Oil Impact

- An oil band will form at the rocky-shore/water interface, and if conditions are favorable, the entire lower portion of the bluff may be oiled
- The persistence of oil would vary to the incoming wave energy; oil persistence would be short-lived during high-wave conditions
- Birds that use the lower portion of the bluffs may be killed if oiled

Recommended Response Activity

- Cleanup will be a low priority on most shorelines
- Cleanup is very difficult because of poor access
- If cleanup is warranted, the use of high-pressure water spraying is effective if the oil is still fresh



EXPOSED UNCONSOLIDATED SEDIMENT BLUFFS

ESI=2

- The shoreline of the central basin from Cleveland to Erie is dominated by this shoreline type
- These bluffs are vertical to steeply sloping and composed of unconsolidated material 10 to 150 feet high (glacial or lacustrine)
- Beaches in front of the bluffs are narrow or absent
- Biological activity is low

Predicted Oil Impact

- Incoming oil will form a band along the swash line
- Oil persistence will be limited to days or weeks, because of wave activity

Recommended Response Activity

- In most cases, cleanup is not necessary because of the short residence time of the oil
- Oil can usually be scraped off the surface of the sediment using manual labor
- Removal of sediment should be avoided
- The mechanical cleanup of the oil may be very difficult because of the steep slopes of the bluffs

SHELVING BEDROCK SHORES

ESI=3

- Shelving bedrock shores are scattered throughout the area
- They are gently sloping bedrock surfaces composed of carbonates or shale that extend to heights of up to 10 feet above normal lake level
- The shelving bedrock shore ranges from less than 10 feet to over 100 feet

Predicted Oil Impact

- Incoming oil will form a band along the swash line
- The oil persistence is limited to days or weeks varying with the shore's exposure to wave action

Recommended Response Activity

- In most wave-exposed areas, cleanup is not necessary
- Other areas, having lower energy and high recreational use, may be cleaned effectively using high-pressure water spraying if oil is still fresh



SAND BEACHES

ESI=4

- Sand beaches are widespread throughout the area, often occurring in the vicinity of small delta and spits
- Sediments range from very fine- to coarse-grained sand with narrow to moderate width beaches (50-100 feet)
- Birds such as plovers, sandpipers, and gulls are common along the beaches

Predicted Oil Impact

- Commonly, oil will be deposited on and become mixed into the sand along the swash line
- Oil may become deeply buried into the beach sands; up to 12 inches in coarser-grained beaches
- 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 minimal to avoid erosion problems
- Activity through the oiled sand should be limited to prevent grinding oil deeper into the beach sediments
- 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

- These beaches are not widespread but often occur in high wave-energy settings
- Generally, beach access is good
- Beach slopes are greater than the sand beaches but less than gravel beaches

Predicted Oil Impact

- Oil will be deposited along the swash zone
- Oil may spread across the entire beach face under very heavy accumulations
- The percolation of oil into the beach may be deep in well-sorted sediments
- Biota present may be killed by the oil, either by smothering or by lethal concentration in the water column

Recommended Response Activity

- Remove oil primarily from the upper swash lines
- Removal of sediments should be kept to a minimum
- 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

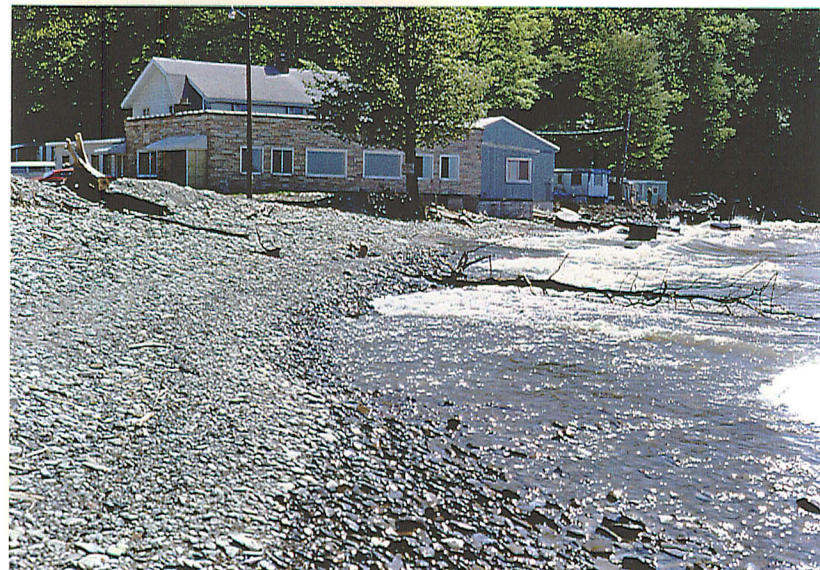
- Gravel beaches are not common within the study site
- These beaches are composed of pebbles and boulders with narrow beaches (< 50 feet) and are usually associated with bedrock exposures
- Beach access is highly variable

Predicted Oil Impact

- The primary problem with oil pollution in this environment is related to the deep penetration of oil into the gravel beach
- If oil is left uncleaned, it may become asphalt-like
- Resident fauna and flora may be killed by the oil

Recommended Response Activity

- Removal of sediment should be restricted
- The use of high-pressure water spraying may be effective at removing oil while it is still fresh
- Sorbent booms or pads should be used to capture oil outflowing during the cleaning process



RIPRAP AND HARBOR STRUCTURES

ESI=7

- Riprap and harbor structures are scattered throughout the area but common on the St. Clair, Detroit, and Niagara Rivers
- The bluff areas between Cleveland and Erie are covered by riprap (cobble- to boulder-sized material)
- A variety of material is used including steel sheet piles, concrete, wood, and old tires
- Biota along the upper structure are sparse, although gulls may be common
- Some fish, including yellow perch, darters, and sculpins, occupy portions of riprap structures
- Riprap is an important substrate for fish-food organisms and for the spawning of several species of fish

Predicted Oil Impact

- Oil would percolate easily between the gravel and boulders of riprap structures
- Biota would be damaged or killed under heavy accumulations
- Sheltered areas along harbor structures would enhance oil accumulation

Recommended Response Activity

- Along exposed structures, cleanup may not be necessary
- Since riprap is often associated with developed, recreational beaches, cleanup would be advisable; sorbent materials should be used to capture the oil as it is cleaned
- Structures may require high-pressure spraying:
 - To remove oil
 - To prepare substrate for recolonization of barnacle and oyster communities
 - For aesthetic reasons



SHELTERED BLUFFS

ESI=8

- Sheltered bluffs are found most often associated with rivers or bays in the Lake Erie system
- The bluffs range in height from 5 to 150 feet and are composed of mixed bedrock and unconsolidated deposits
- Narrow sand and/or gravel beaches and wetlands are often associated with the edges of these bluffs
- Beach access is normally good except in lesser developed areas

Predicted Oil Impact

- Incoming oil will form a band along the swash line
- Oil sediment interactions will vary with bluff composition with possible burial in sand and percolation down in the gravel
- Biota present may be killed by the oil, either by smothering or by lethal concentrations in the water column

Recommended Response Activity

- Removal of sediment should be limited
- Cleanup should concentrate on oil removal from the upper swash zone
- Since beach sediments are highly variable, refer to specific sediment beach type (ESI number) for more detailed response activity

LOW BANKS

ESI=9

- Low banks are common on the western and eastern extremities of the lake and the lower reaches of tributaries
- These banks are less than 5 feet high and composed of unconsolidated sediments; glacial till, lacustrine, or stream deposits
- Land access is normally good
- Shore erosion can be extreme during high-water storms

Predicted Oil Impact

- During low lake levels, oil will coat only the edge of the bank or the narrow beach at the toe of the bank
- During high lake levels, oil can overtop the bank and cover the grasses or trees on the bank
- Oil may kill the grasses and other vegetation present
- Trees may become oiled but probably will not be killed unless oil concentrations within the base sediments are very high

Recommended Response Activity

- Where possible, these areas should be boomed to prevent oil from entering
- Raking oiled grasses may effectively remove light-to-moderate oil accumulations
- High- and low-pressure spraying, with cutting only if necessary, will aid oil removal from exposed tree roots
- Sorbent booms should be placed on the waterside of the cleanup operation to collect outflowing oil



COASTAL WETLANDS

ESI=10

- Wetlands are most commonly associated with river mouths (St. Clair River, delta) and fringing wetlands in sheltered settings like tributary heads; Mentor Marsh and Arcola Creek
- Sheltered embayments or lagoonal wetlands such as Woodtick Peninsula and Presque Isle contain broad wetlands
- Wetlands are relatively sheltered from wave action
- Commonly composed of emergent to floating aquatic vegetation
- Wetlands are the most important wildlife habitat in the area, providing a nesting area for ducks, geese, herons, rails, kingfishers, some shorebirds, muskrats, and turtles; as well as a major nursery and spawning ground for many species of sport and forage fish

Predicted Oil Impact

- Oil in heavy accumulations may persist for decades
- Small quantities of oil will be deposited primarily along the wetland 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 wetland 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 wetland surface should be removed manually; access across the wetland should be greatly restricted
- Cleanup activities should be carefully supervised to avoid excessive damage to the area

