Municipal Mooring Area Management

Module IV

Harbormaster Reference Series

Source: Unit One - State of Maine, Department of Economic & Community Development, Office of Comprehensive Planning and John Ferland, President, Coastal Zone Strategies, Inc., Portland, Maine

Unit Two - Chris Myers, Mooring Specialist, Newport, Rhode Island

COASTAL RESOURCES CENTER

RHODE ISLAND SEA GRANT

Additional copies of this publication are available from: Rhode Island Sea Grant Information Office, University of Rhode Island Bay Campus, Narragansett, RI 02882-1197. Order P1288.

National Sea Grant Depository publication #RIU-E-92-004. Loan copies available from the National Sea Grant Depository, Pell Library Building, University of Rhode Island Bay Campus, Narragansett, RI 02882-1197.

This work was partially supported by NOAA Office of Sea Grant, U.S. Department of Commerce, under Grant #NA89 AA-D-SG-082. The views expressed herein are those of the author(s) and do not necessarily reflect the views of NOAA or any of its sub-agencies.

Sea Grant is a national program dedicated to promoting the wise use and development of marine resources for the public benefit.

Module IV

MUNICIPAL MOORING AREA MANAGEMENT

Harbormaster Reference Series

URI Coastal Resources Center Education Series: ES3040
Rhode Island Sea Grant Publication: P1288

PREFACE

Throughout the country, coastal municipalities are under increasing pressure to effectively manage shoreline resources and a wide range of water-related activities. The ability to accomplish this improves with the presence of a qualified harbormaster. He or she is primarily responsible for ensuring that the rules and regulations are properly enforced, that information and assistance is provided to all waterway users, and that waterfront safety is achieved. These public servants often find themselves at the center of complex management decisions, involving difficult issues and active special interest groups.

In order to assist harbormasters in meeting their expanding roles, the University of Rhode Island's Coastal Resources Center and Rhode Island Sea Grant, in conjunction with the Rhode Island Harbormaster Association, developed an educational program specifically for municipal harbormasters. This program consists of forty hours of basic training in a wide array of topics including first aid, law enforcement, boating safety, seamanship, mooring management, harbor planning, environmental awareness and liability mitigation. Individual reference materials were developed for each topic. Combined, they create a comprehensive reference guide for harbormasters. The complete reference series consists of six modules, which are intended to be used as reference material to assist harbormasters in carrying out their official responsibilities. It can be used to provide answers to questions from the users of local waters and waterfronts; it can help harbormasters make better informed management decisions for the activities within their jurisdiction; and it can give harbormasters a better understanding of their role in implementing coastal management polices.

A brief summary of each module follows.

MODULE I
Public Rights to Coastal Waters: Applying the Public Trust Doctrine

Part of the expanding role of today's harbormaster is to balance private use of shoreline areas with public demands for greater coastal access. Private control or riparian ownership takes many forms ranging from filling submerged land to the placement of moorings. Public interest extends from getting to the shoreline to the harvesting of the fishery resources. This module is the Executive Summary of a national report on the Public Trust Doctrine by David Slade et al. It provides an overview of the legal status of tidelands held in trust by each state for public use and is intended to provide guidance to coastal managers on the application of the Public Trust Doctrine to trust lands, waters and living resources.

MODULE II
Federal Regulations: Coastal Structures, Environmental Protection and Boating Safety

Harbormasters are required to perform work in the coastal zone and on coastal waters which are subject to a wide assortment of federal rules, regulations and policies. Federal regulations which are most pertinent for harbormasters are presented in this module. The first section presents the federal guidelines for the placement of objects or structures in navigable waters as regulated by the Army Corps of Engineers. The second section presents elements of the Federal Code of Regulations, which are administered by the Coast Guard, pertaining to boating safety and water quality impacted by boating.

MODULE III
Rhode Island State Regulations: Environmental Protection and Boating Safety

Harbormasters are the primary front line enforcement people for water dependent uses. Although the authority to enforce conservation laws varies from state to state, harbormasters, at the very least, have

the ability to monitor the taking of shell and finfish and report any illegal activity to the proper authorities. In addition to protecting the aquatic resources of a state, harbormasters are responsible for enforcing boating safety regulations. The need for active on-the-water patrols and enforcement of boating rules and regulations has increased proportionally to the number of boaters operating on local rivers, harbors, and embayments. This module presents those Rhode Island state laws governing fisheries, water quality and boating safety. It is applicable only to Rhode Island and is intended to be substituted with appropriate laws for other states.

MODULE IV
Municipal Mooring Area Management
Pressures to use surface waters for moorings and docks has increased as the boating population swells. In order to meet this demand, harbormasters are looking for safe techniques for increasing mooring density. The first section of this module presents suggestions for efficient management of harbor surface areas.

The second section, through diagrams, reviews the standard mooring assembly for a single point mooring as used throughout the United States. Proper mooring sets, winterization and inspection processes are also discussed.

MODULE V
Harbormaster Liability: Reducing Risk
Each time a harbormaster goes out on patrol or makes a mooring placement decision, the municipality for which he or she works incurs some liability. This module provides the harbormaster and the city or town with basic information on how to limit liability by reducing risks which occur during routine harbor patrols including medical response, mooring management, towing, hazard mitigation.

MODULE VI
Multi-use Harbor Management: A Case Study for Local Harbormasters
Local harbor management has become a key element in state coastal planning, allowing home-rule decision making and management. In many instances the harbormaster is quickly becoming the person responsible for local coastal management. This module presents a case study which explains the expanding role of harbormasters and examples of effective interaction with local decision makers and harbor users.

Mark Amaral and Virginia Lee
July 1992

ACKNOWLEDGEMENTS

This undertaking could not have been achieved without the efforts of the many people who dedicated so much of their time in creating, reviewing and finalizing this Reference Guide: Chris Myers, Interstate Navigation; John Codega and Richard Vovosko, Franklin Environmental Services; Michael Scanlon, Scott McNamee, Joseph Migliore, Rhode Island Department of Environmental Management, Jake Farrell, President, Rhode Island Harbormaster Association; Rhode Island Marine Trade Association; Malcolm Spaulding, Professor, Ocean Engineering, University of Rhode Island; Rodrego Bourgetta, Edward King and Christina Beal, Newport Harbormaster Department; Charles Bourret, Coventry Police Department; Thomas Clark, Providence Police Department; Theodore Dyer, Education Committee, Rhode Island Harbormaster Association; Bernard Ennis, South Kingstown Police Department; B. James Glista, Charlestown Harbormaster Department; Edward Hughes, Rhode Island Long Shoreman's Union; Douglas McLaughlin, East Providence Police Department; Sharon McNamee, Jamestown Harbormaster Department; Karl McNulty, North Kingstown Harbormaster Department; Paul Watters, New Shoreham Harbormaster Department.

Additional thanks are extended to those who participated with us in harbormaster training courses: Chief Warrant Officer Alan Beal, United States Coast Guard; Richard Roach and Robert Desista, Army Corps of Engineers; Dennis Nixon, University of Rhode Island; Edward Lavallee, Newport Police Department; Jeffrey Willis, Rhode Island Coastal Resources Management Council; Rick Coons and Sergeant Jaques, Rhode Island Department of Environmental Management; John Ferland, Coastal Strategies; Maine Department of Environmental Protection; and Thomas Brillat, Rhode Island Department of Economic Development.

Module IV was created using information provided by two leading mooring experts in New England. The first section "Mooring Layout Alternatives" was written by Mr. John Ferland, President, Coastal Strategies, Inc., Portland, ME for the State of Maine's Office of Comprehensive Planning. The second section "Mooring Gear Management" was written by Mr. Chris Myers of Interstate Navigation, Point Judith, RI specifically for the RI Sea Grant Harbormaster Training Program.

The contribution of Malcolm Spaulding, Professor of Ocean Engineering at the University of Rhode Island, who reviewed an earlier draft and provided valuable comments, is greatly appreciated.

We are grateful for the care with which Annette Burgess, of the URI Coastal Resources Center, painstakingly reproduced government regulations and worked on layout and cover design.

Mark Amaral and Virginia Lee
July 1992

TABLE OF CONTENTS

INTRODUCTION

Mooring density has been a continuing problem for all harbor managers. Pressures for the use of surface waters on which to place moorings has increased as the boating population swells. In order to meet this demand harbor managers are looking for safe techniques for increasing mooring density. Single point moorings, although in the majority, are gradually being replaced by other systems such as double point or star cluster moorings.

The first part of the module was originally created by John Ferland in conjunction with the State of Maine's Office of Comprehensive Planning. It provides a short narrative on possible and innovative mooring techniques which harbor managers may consider for use to maximize mooring density and minimize damage to vessels.

Reference: Maine Department of Economic and Community Development. 1989. Mooring Planning Handbook. Augusta, Maine.

Traditionally, harbormasters have worked closely and often extensively with mooring gear and ground tackle. The second part of the module is dedicated to that aspect of the job. It has been compiled and written by Chris Myers of Interstate Navigation, Point Judith, Rhode Island. Chris has spent over a decade of building, setting, inspecting and replacing mooring gear in Newport, Rhode Island and surrounding coastal communities. His knowledge and experience provides many useful and valuable insights. Mr. Myers, through diagrams, reviews the standard mooring assembly for a single point as used throughout the coastal United States. He then details each section of the assembly including the anchor, chain, shackles, buoys, and pendants. Mr. Myers then discusses proper mooring sets, mooring gear winterization and inspection processes. Although this is not the only reference material available regarding the subject, it combines existing information with years of experience, providing a good foundation for all harbormasters.

MOORING LAYOUT ALTERNATIVES

Single Point Moorings

Single point moorings where boats swing about an anchor or mooring block are the most common type of mooring in New England. Space has not been much of a problem in the past; typically a boat has been allowed to swing in a circle ("circle of influence") that varies from about 100 feet across to 240 feet in diameter, depending upon the length of the boat and the depth of the water. This type of mooring has the advantage that unless there is a very strong current, the bow of the boat faces into the wind and presents the lease exposure to storm winds and waves.

In the past, single point moorings have been laid out in a harbor so that the circle of influence described by one boat does not infringe upon the circle of influence of another boat (see Figure I).

As mooring areas become more crowded, the circles of influence overlap each other as boats are moored closer to each other. In many instances, this crowding together with overlapping circles is acceptable as long as all of the boats at the moorings behave in the same manner (see Figure II).

Problems occur, however, when different types of boats are moored near each other, e.g., when a 30-foot lobster boat is moored next to a 45-foot sport fishing boat (which may be moored next to an 18-foot outboard, etc.). Different types of boats do not react to wind and current in the same manner. Consequently, mooring locations must be assigned by the type of boat, as well as its size. A yacht club with a fleet of similarly designed sailboats can moor boats much more efficiently than a mixed use public mooring area that includes everything from outboards and small centerboard cat boats to commercial trawlers and deep draft sailing yachts. (See Figures III and IV for sample mooring radii and overlapping moorings for three types of boats grouped to provide maximum usage.)

Two Point Moorings

In narrow constrained areas, it is possible to set a second mooring so that the boat is held fore and aft. The boat no longer swings in a circle and takes much less mooring space. However, since storm winds do not always come from the same direction, this type of mooring is not practical if there is any possibility that large waves can build and strike the side of the moored vessel. Frequently, such moorings are set in narrow rivers with considerable wind protection provided by the river banks.

Two or More Anchors

In an effort to reduce mooring space requirements, some communities in southern New England are now requiring moorings with two or more anchors or mooring blocks. In its simplest form, there are two mooring blocks with a heavy chain from each block which meet at a swivel that can be reached at low tide; a lighter chain is connected to the swivel and leads to the mooring buoy. (See Figure V.) In some instances, heavy nylon rope is used in place of the upper chain. The resulting area of influence is an ellipse of less area than the circle of influence described by a single point mooring. (See Figure VI.)

The size of the ellipse will vary depending upon the length of boat, depth of water, tide, distance between blocks, and scope. The spacing may be set at twice the water depth, or greater. The illustration in Figure VI, using the same boat, same depth of water, same tidal range and same pennant as in the single point calculations above, shows that the mooring area can be reduced to 40 percent of that required for the single point mooring. Here the blocks are placed apart almost 2 1/2 times the water depth and the heavy chains are twice the water depth. The light chain is twice the tidal range. (This provides the same scope as the single point mooring when the boat is held by one mooring block and in a position parallel to the line described by the two blocks on the bottom.) Under these conditions, the boat theoretically occupies an area which is in the form of an ellipse about 120 feet along its primary

axis and 110 feet along its secondary axis. In actual practice, single point mooring circles of influence and ellipses described by boats on two-point moorings are slightly smaller than the calculations indicate. This is because the chains sag and form a catenary curve instead of straight lines. However, this is an appropriate safety allowance and should not be deducted from the area allowed for each boat.

A slightly more complex mooring can be constructed with three blocks or anchors set 120 degrees apart. With additional chain and block(s), the moorings are, of course, more expensive, but in selected areas, may be very appropriate.

Because there are so many variables, it is not practical to devise an all inclusive formula which will meet all conditions. However, if the following conditions are set, the major and minor axis of the mooring area for a two-block system can be calculated using the following formula:

1. Heavy mooring chains twice the high water depth (2H).
2. Mooring blocks set so that angle between heavy chains at the swivel is 90 degrees.
3. Light mooring chain 2 times Tidal range.
4. Pennant 2.3 times height of boat at the bow.

Major axis = 2.8H+4T+4.6h+2(LOA)
Minor axis = 1.2H+4T+4.6h+2(LOA)
(See Figure VI for the ellipse.)

Definitions:

H = Depth of water at high tide
T = Tidal range
h = Height of bow above water
LOA = Length overall of boat

Mooring circles or a mooring grid can be plotted on a chart of the mooring area. Similar to Figure IV, except using symbols to denote mooring type instead of vessel type.

At present, just being able to plot circles of influence for existing moorings may be enough to enable a harbormaster to find room for additional boats. However, it probably will be necessary to either set shorelines for the layout of moorings or to set up a grid system of moorings if a harbor is to be fully utilized. Permanent marking of mooring lines or grids on shore is to be recommended, but it is understood that private ownership of tidal lands may prevent establishing such markers.

Other Mooring Systems

MOORING FLOATS

In very protected areas mooring floats are commonly used (See Figure VII). These floats are actually narrow floating docks which are long enough so that a boat can tie up to each side of the float. Each boat, as well as the float, ride on the mooring assembly. The mooring must be heavy enough for both boats plus the float and can use one or more anchors or blocks. The two boat owners who use the mooring float are sometimes the owners of the float. At other locations, the community may own the float and lease it to the users. Mooring floats can also serve as useful storage areas for lobster bait or gear away from the general shoreside public. The floats also ease boarding to and debarkation from the vessel.

MOORING CHAINS (GROUND LINES)

When harbor bottom conditions are such that conventional moorings are not practical (e.g., steeply sloping rock bottom where mooring blocks are not stable and anchors cannot dig into the bottom) heavy chains have been stretched from shore to shore and lighter mooring chains have been attached at intervals along the heavy chain. Because there is no possibility of dragging this type of mooring, it is theoretically possible to set closer tolerances and place moorings closer to each other. This type of mooring system has not been a widely accepted method of increasing the number of moorings in a particular area. However, it has been reported that in Europe, the system has been used

to increase mooring efficiency for boats up to 30 feet in length. Therefore, we may see a time when a submerged chain mooring system will be an appropriate alternative to increase the mooring capacity of a harbor in New England. (See Figure IX.)

With this system comes the responsibility of maintenance and replacement of the submerged chain as well as any liability if it should fail. Matinicus Harbor, Maine uses this system, which is described in part in a leading coastal cruising guide:

> "You will notice that the lobster boats lie in orderly lines. Instead of each boat's having a mooring of its own, each is moored to a heavy nylon line running across the harbor from shore to shore. The ends are chain to resist chafe on the rocks. Each boat is attached to this line with a heavy nylon painter. Nylon has lots of stretch, every bit of which is needed in a heavy northeasterly. One fisherman observed, 'Don't they ride easy!'" (From Duncan, Roger F. and Ware, John P., "A Cruising Guide to the New England Coast," New York: Dodd, Mead & Co., 1987.)

FLOATING STAR DOCKS

Floating star docks with slips radiating from a single point have been used in some areas of the United States, such as the Great Lakes. The docks are relatively expensive and usually are anchored to the bottom with pilings. However there are major drawbacks during storm activity. No matter which way a storm wind blows, more than one-quarter of the boats will be nearly broadside to the storm and almost one-half of the boats will have their off quarter exposed to the storm. This can lead to some potentially destructive situations. (See Figure VIII.)

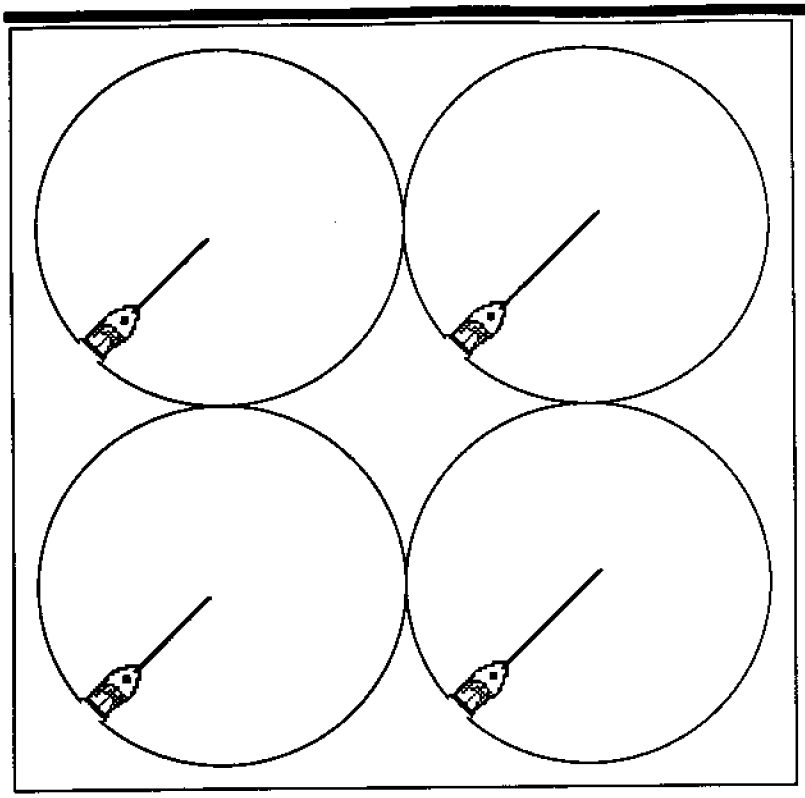


Figure I Non-Overlapping Moorings

Four 30' boats moored with non-overlapping circles of influence 93.6' radius
4 boats per 3.2 acres

Low tide	20'
Tidal range	9'
Height of boat at bow	4'

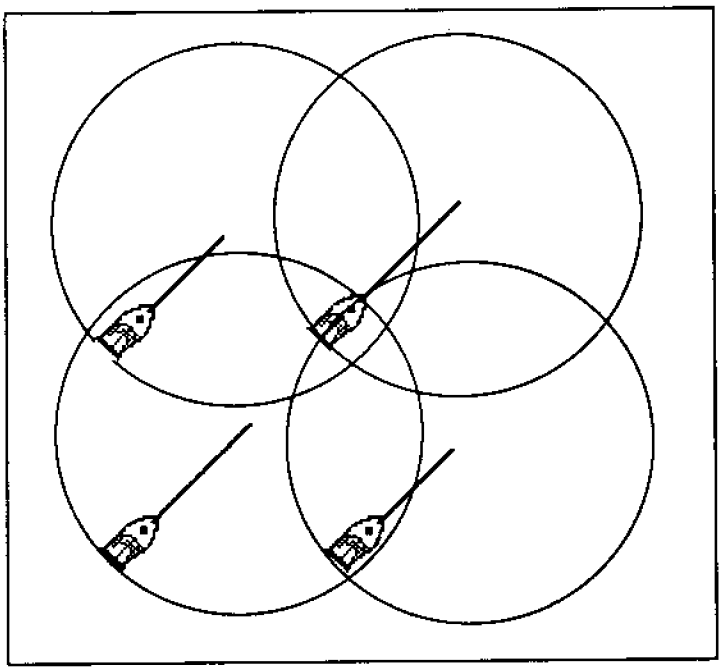
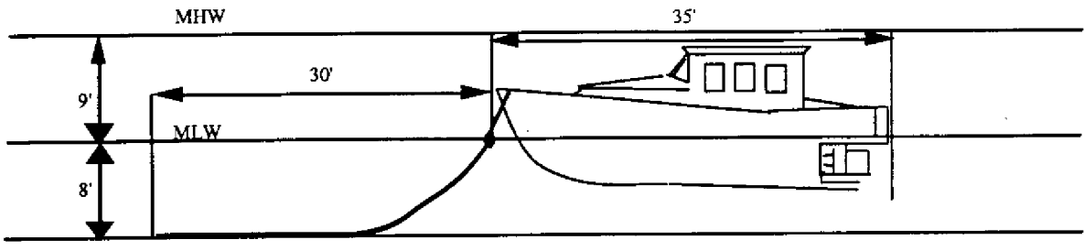


Figure II Overlapping Moorings

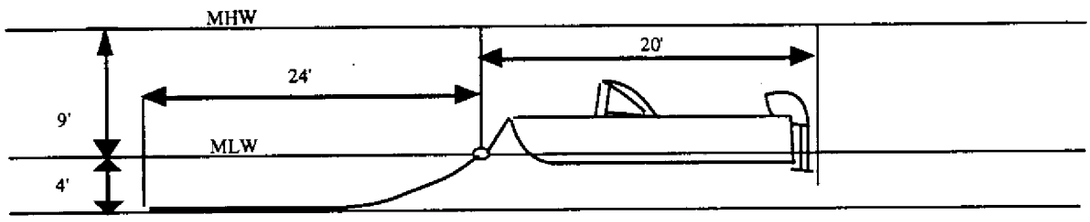
Four 30' boats moored with over-lapping circles of influence at 93.6' radius
4 boats per 1.94 acres

Low tide	20'
Tidal range	9'
Height of boat at bow	4'

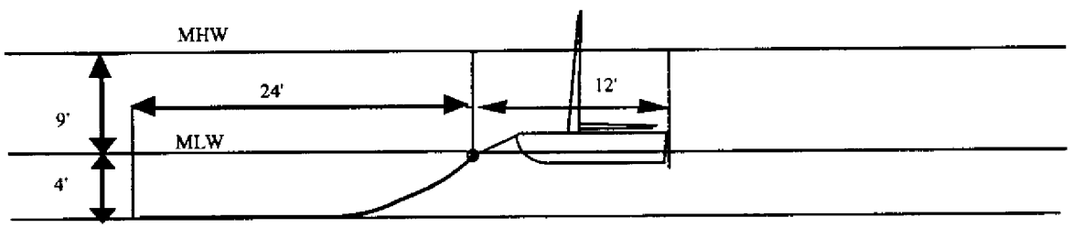
Figure III Shallow Harbor with Minimum Radii Moorings



△ Typical Power Boat 65' Radius



□ Typical Outboard Motorboat 44' Radius



○ Typical Small Sailboat 36' Radius

Figure IV Mooring Plan, Maximum Usage Small, Shallow Harbor

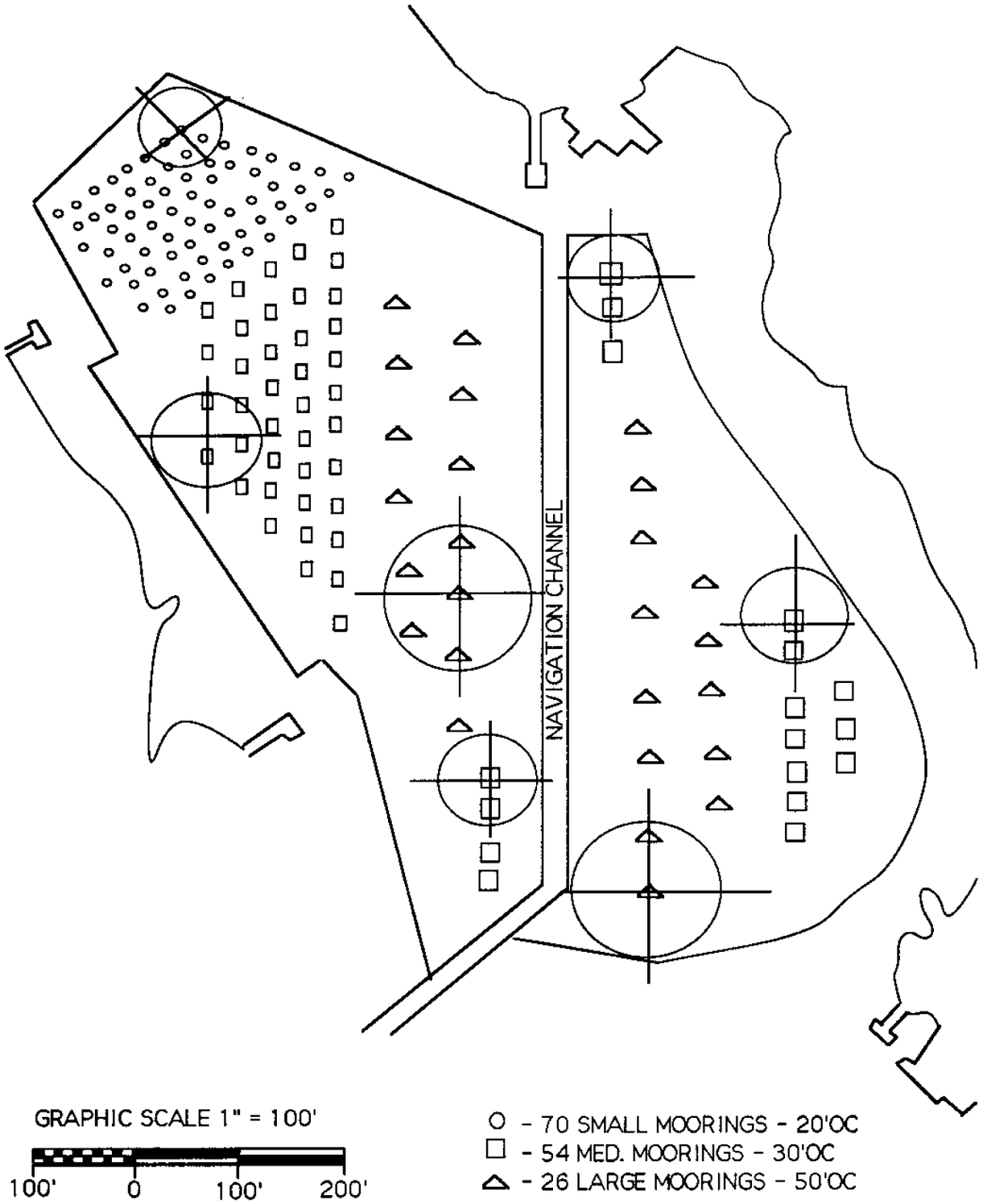


Figure V Single Point Mooring with Dual Mooring Blocks

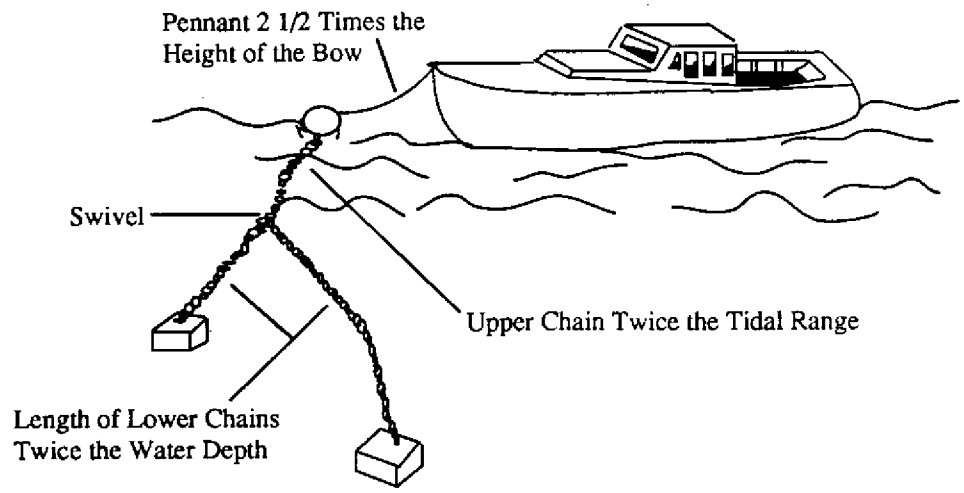
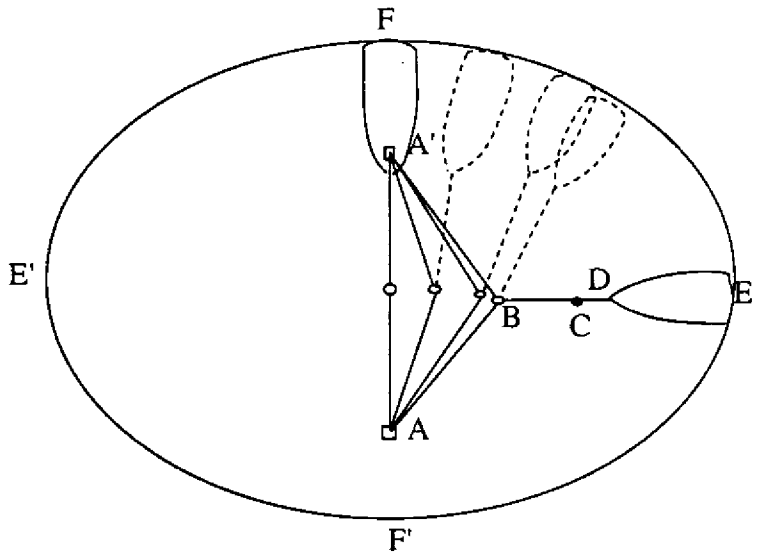


Figure VI Ellipse Described by Stern of Boat on 2 point. Mooring at Low Tide



E' - E = Major Axis = 2.8H + 4T + 4.6h + 2LOA
F - F' = Minor Axis = 1.2H + 4T + 4.6h + 2LOA
When
H = Depth of water at mean high tide
T = Mean tidal range
h = Height of bow above water
LOA = Length overall of boat
AB = A'B = 2H = Length of lower chains
BC = 2T = Horizontal projection of upper chain length
CD = 2.3h - Horizontal projection of pennant
$\measuredangle$ ABA' = 90°
NOTE - Ellipse will vary in size and shape as mooring scope, tidal range, depth of water, and distance between blocks varies.

Figure VII Typical Mooring Float and Boats

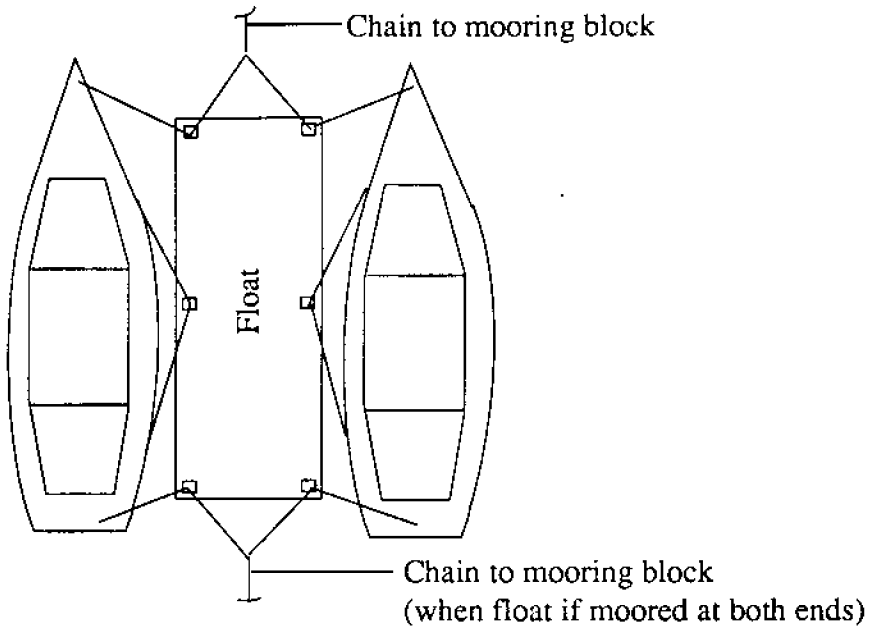


Figure VIII Floating Star Docks

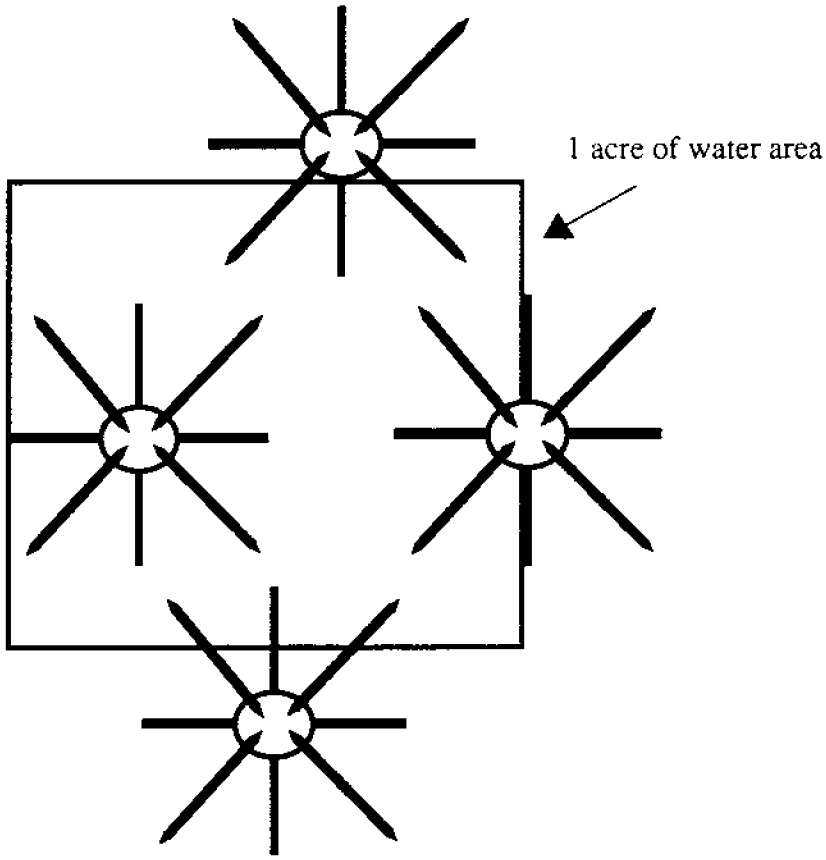
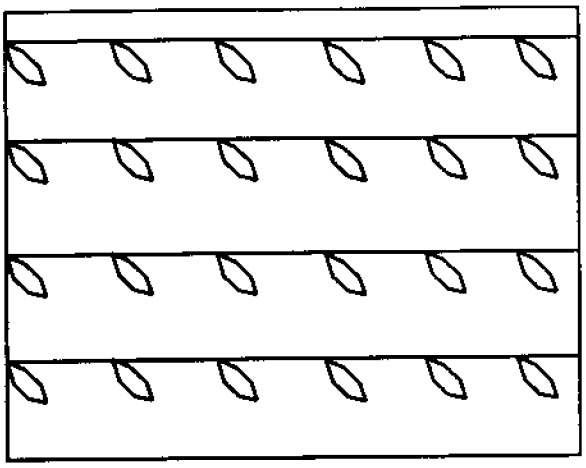


Figure IX Submerged Chain Mooring Systems

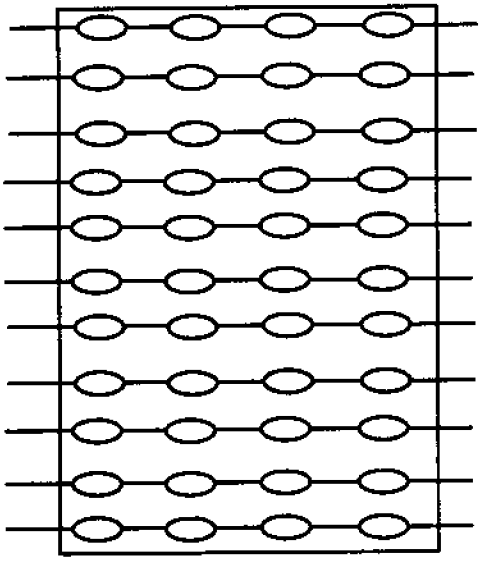
Example: 18 foot water depth, 30 foot boat maximum length

Single point moorings
(24 boats/acre)

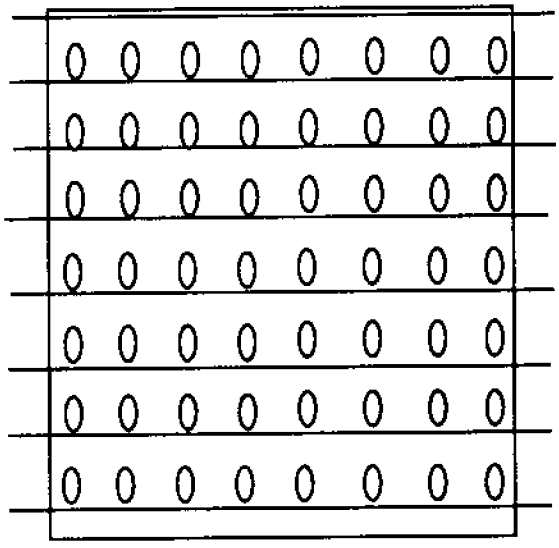


1 acre of water area

Parallel to chain
(44 boats/acre)



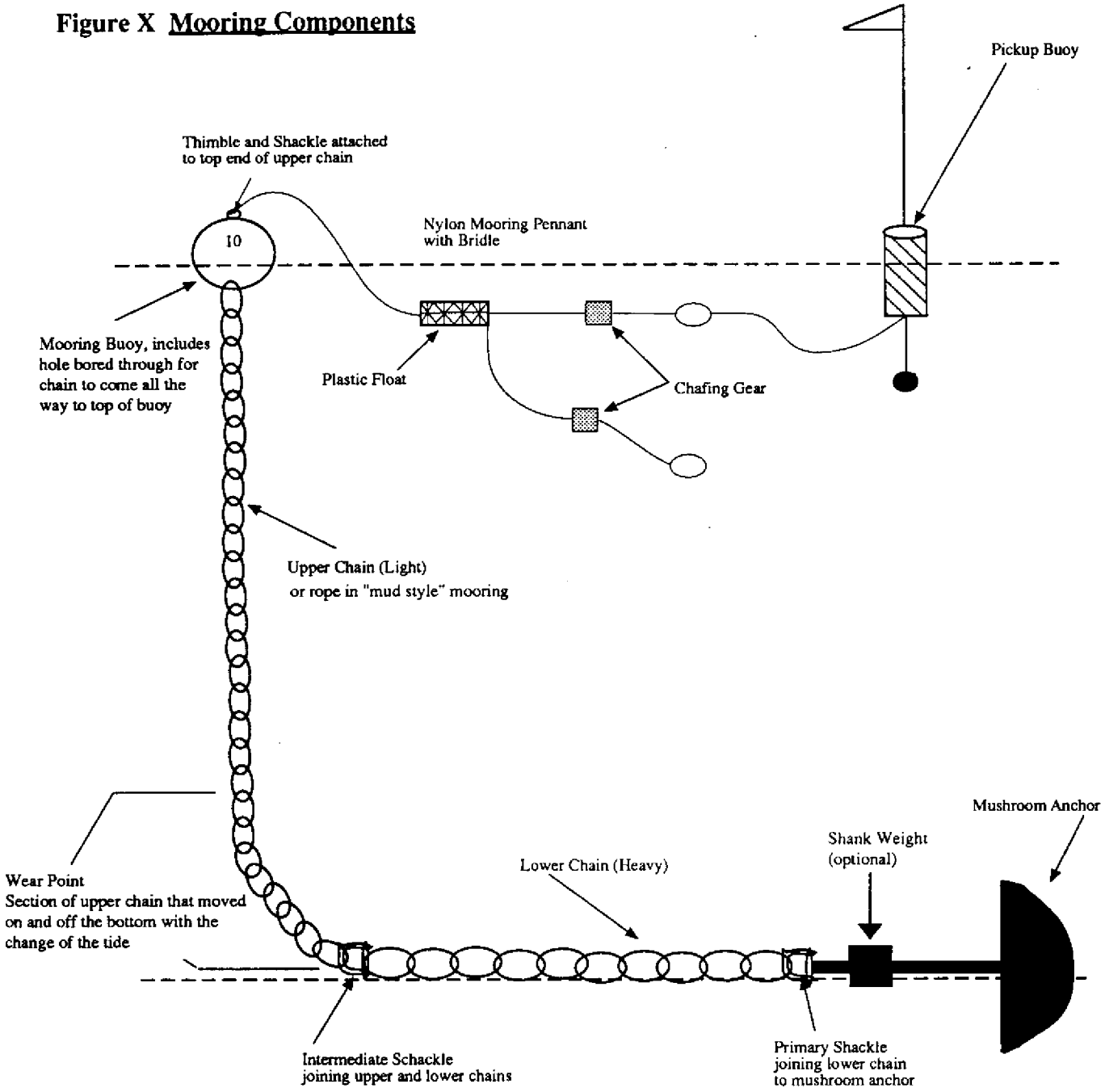
Perpendicular to chain
(50+ boats per acre)



MOORING GEAR MANAGEMENT

Standard Mooring Assembly The typical single point mooring is made up of four major components: anchor (FigureXI); chain and shackles (Figure XII): buoy (Figure XIII); and the pendant (Figure XIV). When these components are properly assembled, set and inspected the boater is provided an economic and safe means for vessel mooring (Figure X). A "mud style" mooring is widely used in New England, in which a 3/4-inch diameter nylon rope is used instead of the light upper chain and fitted with chafing gear.

Figure X Mooring Components



This diagram shows a mooring properly assembled and properly set, laying on its side, in the mud or sand.

Figure XI. Mushroom Anchor (cast iron)

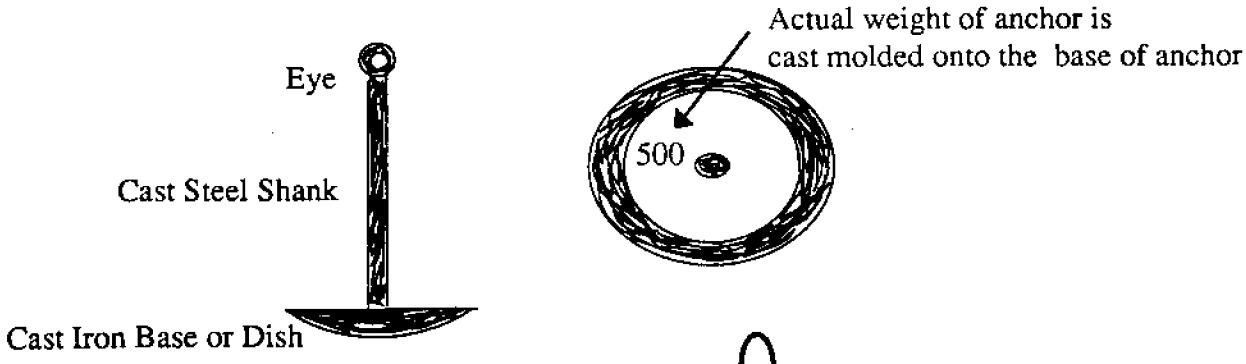
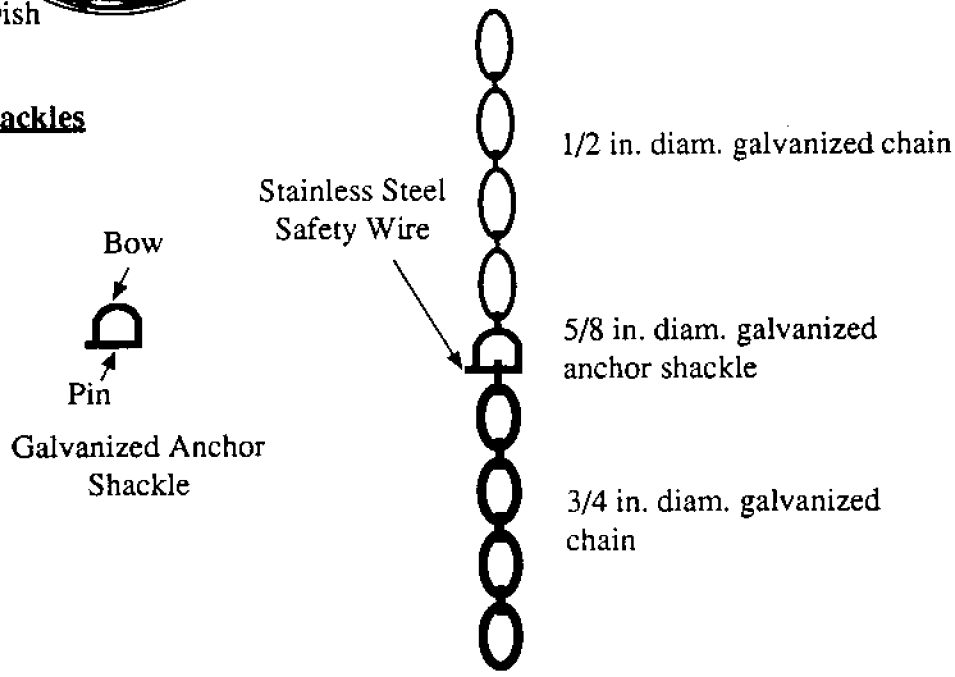


Figure XII. Chain and Shackles



MORE ABOUT CHAIN

A. When selecting chains, stud-link chain is the best choice. However, stud-link chain is often not available in this country except as surplus. Galvanized proof-coil chain is the next best choice.

Proof-Coil Chain Link

Stud-Link Chain

B. How Much Scope?
Minimum Safe Ratio - 2:1 Total length of mooring chain: mean high water depth
Recommended Ratio - 2.5:1 Total length of mooring chain: mean high water depth

Remember! Total length of chain in scope is combined lengths of upper and lower chains. For your 200 lb. mooring in 15 ft. of water you will have 15 ft. of 1/2 in. diam. lower chain and 15 ft. of 3/8 in. diam. upper chain, a total of 30 feet of chain, for a minimum safe standard.

Shackle Sizes for Properly Joining Chains

Shackle Size (diam. in inches)	Joins	Upper Chain Size (diam. in inches)	To	Lower Chain Size (diam. in inches)
3/8		5/16		3/8
7/16		3/8		1/2
1/2		1/2		5/8
5/8		1/2		3/4
3/4[1]		3/4		1
1[2]		1		1 1/4

*Diameter of shackle in inches refers to the diam. of the shackle pin!
[1,2] Also most commonly used in joining lower chain to mushroom anchor

Specifications of Mooring Tackle

Mushroom Anchor (Pounds)	Lower Chain (diam. in inches)	Upper Chain (Diam. in inches)	Mooring Pendant (Diam. in inches of rope)
75	1/2	5/16	1/2
150	1/2	3/8	1/2
200	1/2	3/8	1/2
250	5/8	3/8	5/8
300	5/8	3/8	5/8
400	3/4	3/8	3/4
500	3/4	1/2	3/4
600	3/4	1/2	7/8
750	1	1/2	1
800	1	1/2	1
1000	1-1 1/2	1/2 - 5/8	1 1/4
2000 and Up	2	5/8 - 3/4	1 1/2

Figure XIII. Mooring Buoys

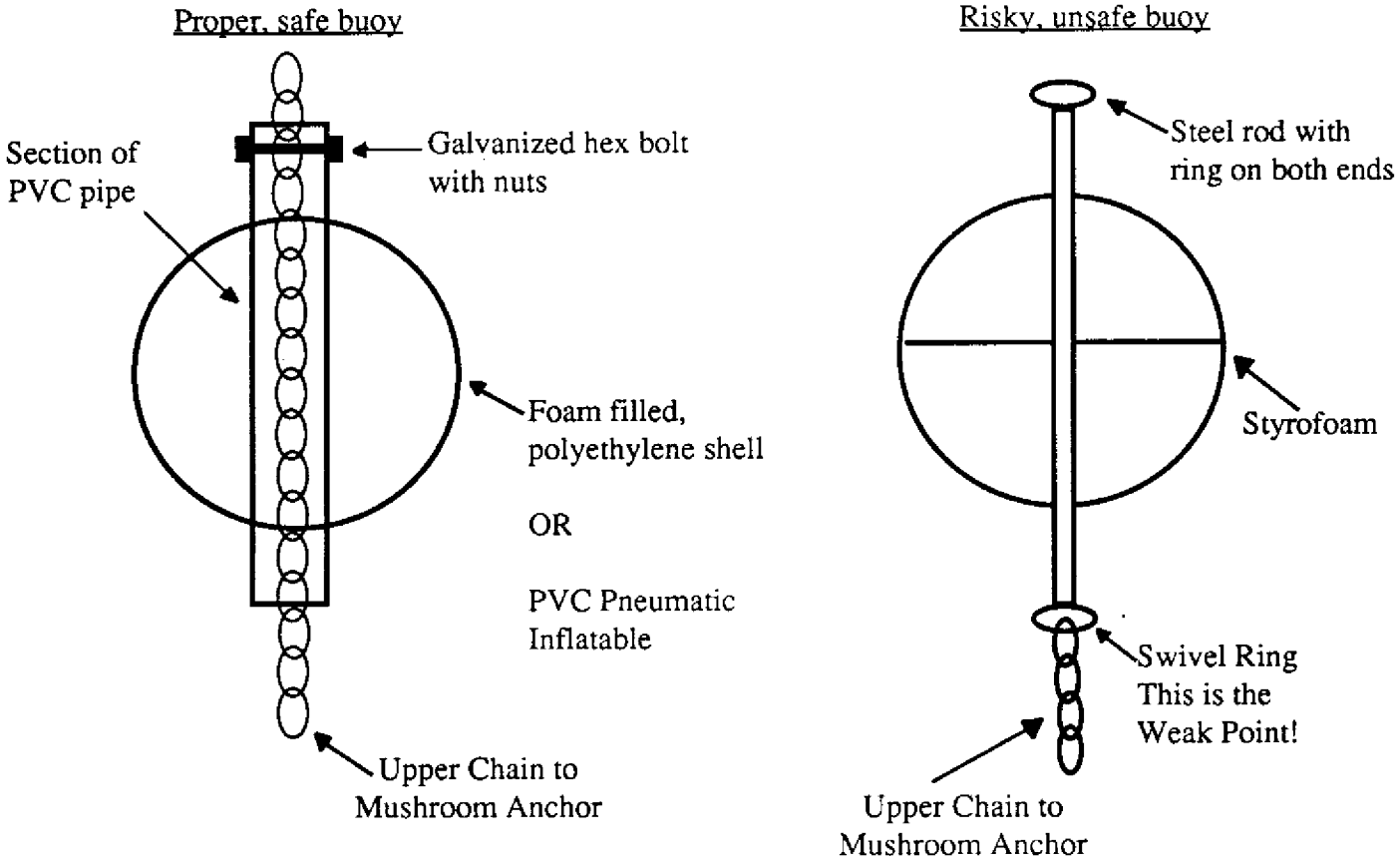
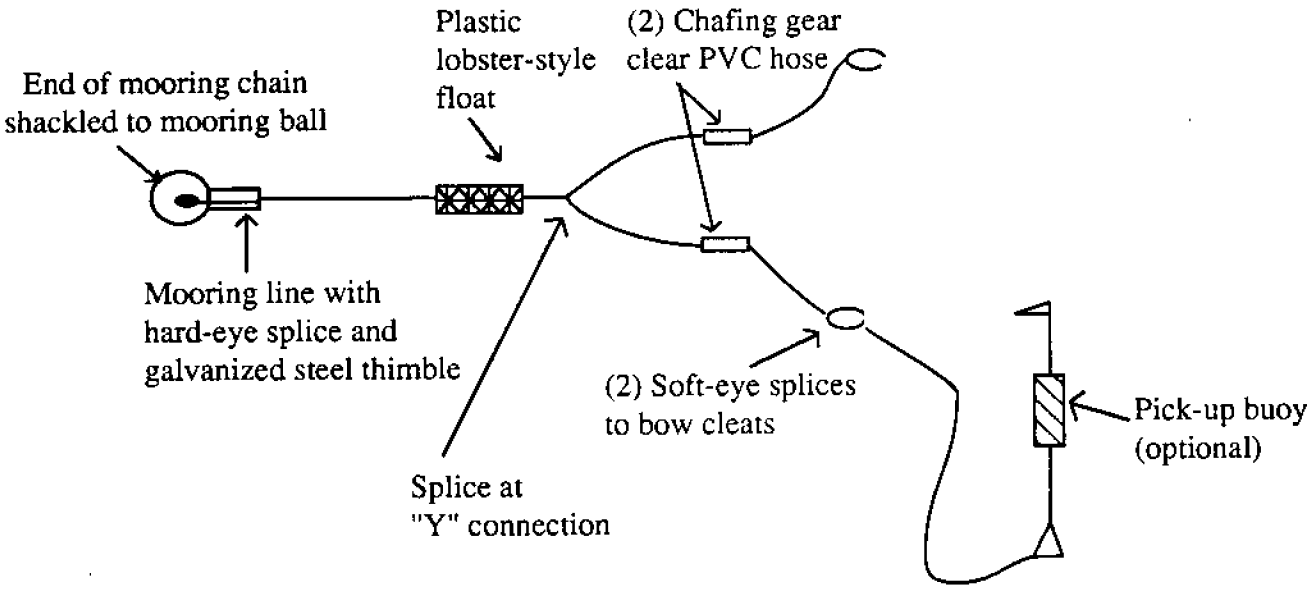


Figure XIV. Mooring Pendant

A Mooring Pendant with a bridle in a "Y" configuration is better than a single pendant (pronounced "pennant"). Safety of your vessel is to be considered in heavy or foul weather, so that your vessel could part one-half of its bridle and still remain safely moored. It may be impossible to use a bridle configuration on some smaller boats, usually under 26 feet, because they have only a single bow cleat.



Nylon rope is the best choice for all mooring pendants, as it has a good stretch capability, while still maintaining its strength. Other varieties of cordage available for moorings:

Polypropylene
Dacron
Poly-Dacron combination
Poly-Nylon combination
Manilla
Hemp

PROPER MOORING WEIGHT FOR TYPICAL RECREATIONAL VESSELS

Length of Vessel (in feet)	Anchor Weight (in lbs.)
under 16	75
16-19	150
20-22	200
23-25	250
26-30	300
21-35	400
36-40	500
41-49	600
50-54	750
55-59	800
60-65	1000
66-80	2000
over 80*	5000+
	Not a standard anchor

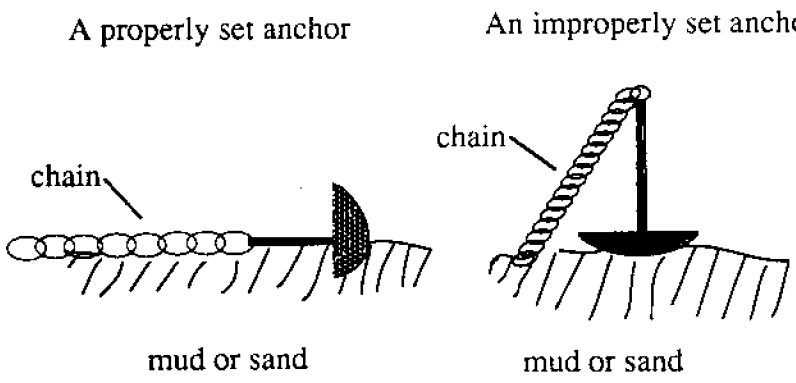
*Special circumstances must apply in regard to scope of chain, length of chain, availability of large anchors and swing room of moored vessels.

Remember! In this instance bigger is always better! A heavy anchor is cheap insurance and provides a more secure anchorage for your vessel and other nearby vessels.

Setting A Mushroom Anchor

A mushroom must be 'set' on its side to achieve its ultimate safe holding power, allowing for the anchor to dig.

Figure XV. Mooring Sets



*Note: An improperly set anchor, standing (straight up) is exceptionally hazardous. As the wind shifts, and moored vessels move around with the wind, there is a tendency for the chain to become fouled around the shank of the mushroom. As the chain fouls, mooring scope is reduced and the possibility of a vessel dragging its mooring in a heavy blow is increased.

Mooring Inspection Criteria And Standards

MUSHROOMS. Anchors need only to be hauled (pulled out of the mud and water) for a visual inspection every 3 years. An anchor will maintain better holding power if left buried in the mud for as long as possible. For large anchors, (800 lbs.+) an inspection by a diver is sufficient.

Items to check:

A. Condition of eye - if worn by more than one-half its original diameter, replace anchor.

B. Straightness of shank - shank must be perpendicular to base or dash. If bent, replace anchor.

*Note: Worn out mushroom eyes can be "doubled" with a ring welded next to the old eye. Also, a bent shank may be straightened with an axyacetylene torch by a competent welder.

LOWER CHAIN. Lower chain need only be inspected every 3 years as well. Pay close attention to end links for wear, if worn more than one-third of its original diameter, replace section of chain. When installing lower chain, remember that its length should be sufficient to leave the anchor buried in the mud, yet the top link should break the waters surface.

UPPER CHAIN. Upper chain and intermediate shackle (joining both sections of chain) must be inspected annually. If worn more than one-third of its original diameter--replace.

ALL SHACKLES. Replace shackles if worn more than one-third of their original diameter. All shackles must have safety wire to prevent shackle pins from working loose. DO NOT use anything other than stainless steel seizing wire. Other types of wire (i.e., copper electrical wire) contribute to the electriclytic corrosion of your hardware.

MOORING BUOYS. Inspect annually mooring buoys for cracks, breakage deterioration or other damage. Maintain mooring number and owner's name in large black lettering on buoy for easy identification. Mooring buoys should have adequate reserve buoyancy to float chain and maintain a visible profile above the surface of the water. The best color choice for buoys is white with a blue stripe.

MOORING PENNANTS. Inspect annually. Pay close attention to chafing of the rope, resulting in broken strands.

SWIVELS. Do not use swivels. Swivels are the weakest possible link in any good mooring system. They have a tendency to wear out in a year's time, and corrode rapidly in salt water.

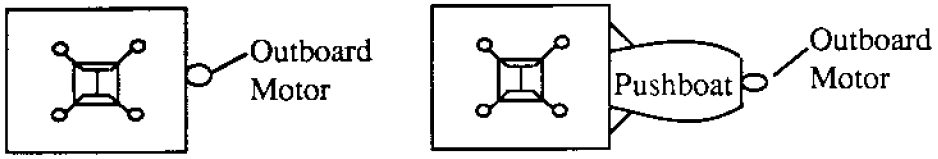
CONCRETE BLOCKS. Although the first choice of many, concrete blocks are a bad choice. The holding power of a good mushroom anchor is far superior to that of a concrete block in soft bottom conditions. However, if a concrete block is chosen, weight standard for mushrooms at a minimum should be doubled.

OTHER TYPES OF MOORINGS. Old engine blocks, radiators, oil drums filled with concrete and other steel junk, are not acceptable. However, these are options that are widely in use among New Englanders. The use of these should be discouraged.

Vessels For Mooring Inspection

In order to provide the best means of mooring inspection, a properly rigged platform is necessary.

Figure XVI. **Flat Square Barge 12' x 12' Wooden Construction** - The traditional and least expensive means of inspection moorings.



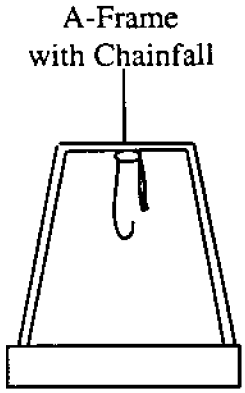
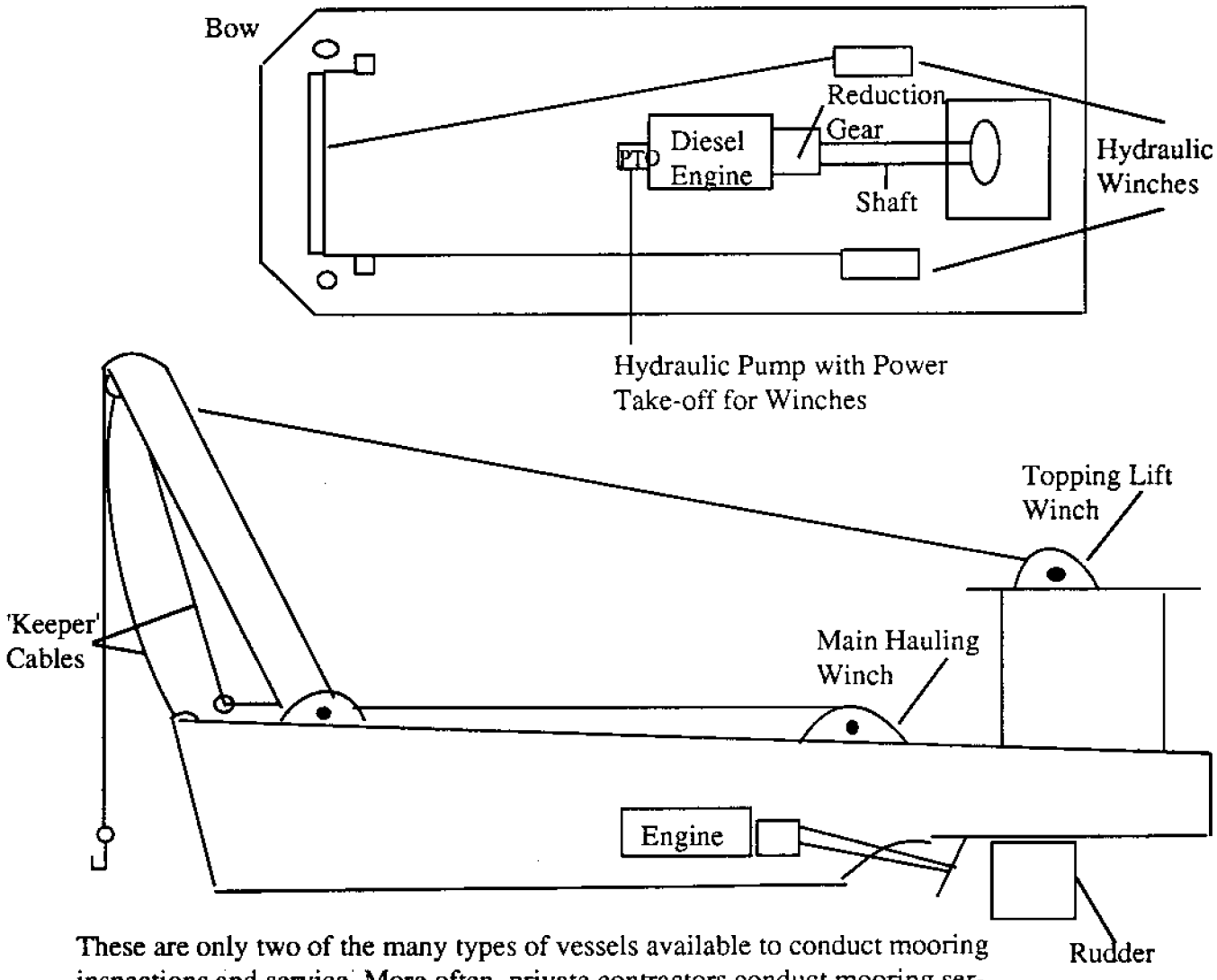
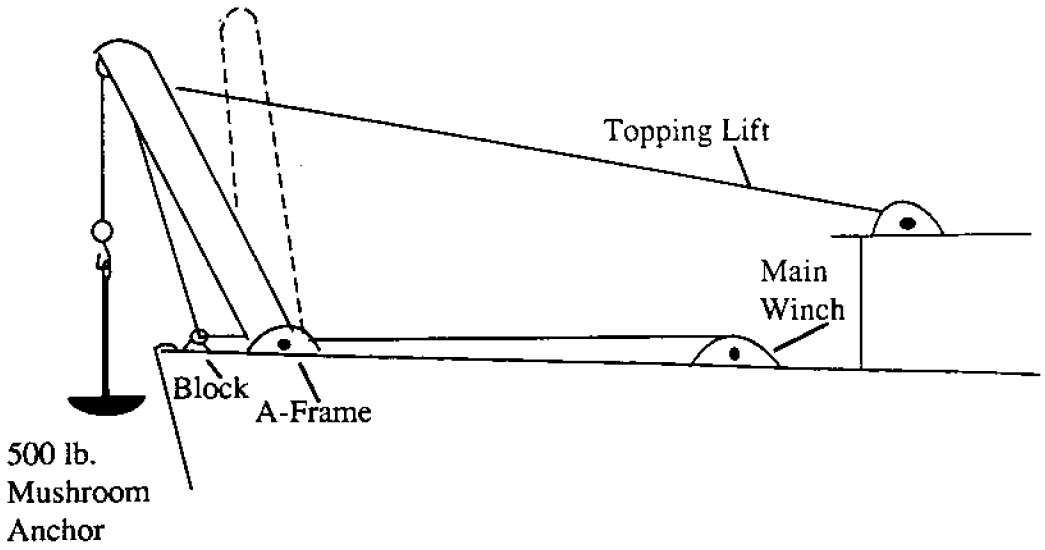


Figure XVII. **Self-Propelled Flat Bottom Barge 16' x 30' Aluminum Construction**
Diesel Reduction with Hydraulic Power - Expensive, but extremely efficient.



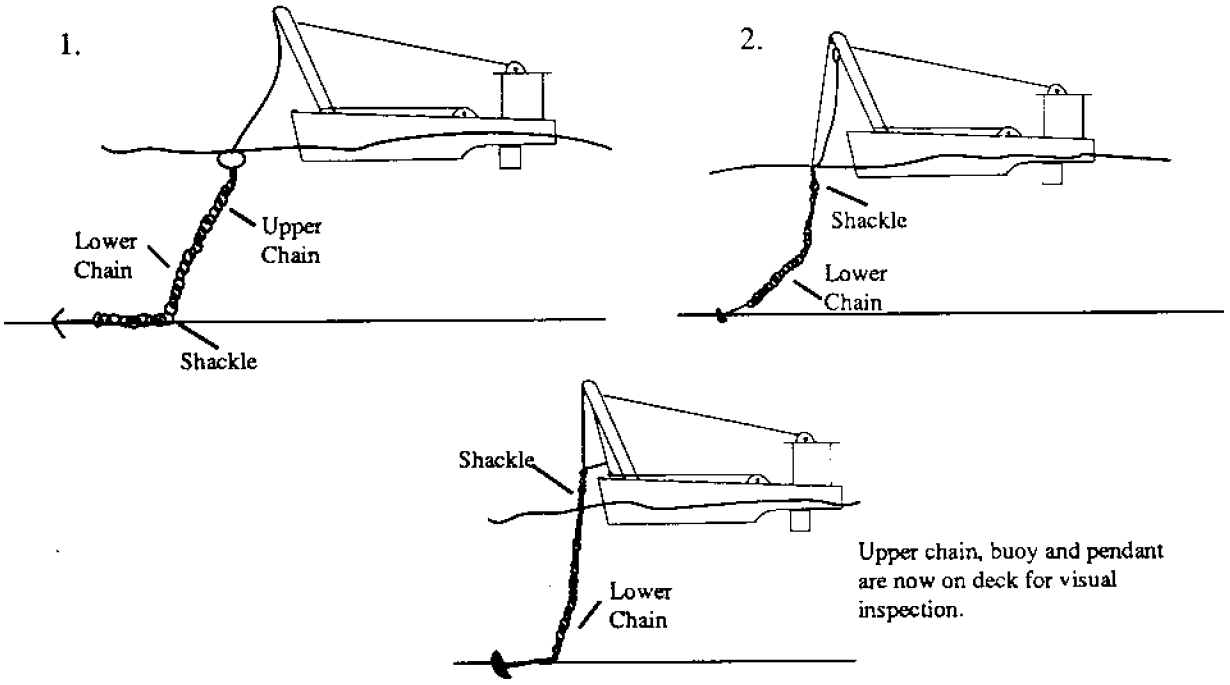
These are only two of the many types of vessels available to conduct mooring inspections and service. More often, private contractors conduct mooring services in New England, but local harbormasters should be familiar with their equipment and procedures.



A 500 lb. Mushroom Anchor may be easily brought aboard a vessel like this, and set on deck. If the winches and A-frame are rigged as above, this operation may be done easily, quickly and safely.

OR

A simple upper chain inspection may be accomplished in several minutes.



It is important to note that water surface areas and submerged land which mooring gear occupy are regulated by state and federal agencies. This is done to ensure protection of public rights in the coastal zone. Module II, Federal Regulations, of this series refers to the setting of structures in the Coastal Zone and should be consulted prior to placing moorings into local waterways. Also check with state officials regarding local ability to place and manage mooring fields. By being familiar with and adhering to federal and state policies, mooring areas will be properly controlled and managed.

Winter Mooring Stakes

It is a very good idea to winterize moorings in the off-season. Why?

A. Mooring chain wear is reduced by one-half if your mooring is staked, allowing all chain to lay in the mud. This eliminates rising and falling of the upper chain with the tidal cycle and thus wear.

B. Allows mooring owners a chance to clean and paint surface tackle (i.e., buoy, pendant, etc.), and prepare it for the following season.

C. Can prevent mooring damage by ice in winter. A mooring in a cove can become iced in, dragged off station and lost. Mooring scope is increased, and a winter stake is designed to pull through the ice.

Figure XVIII. Winter Mooring Stake