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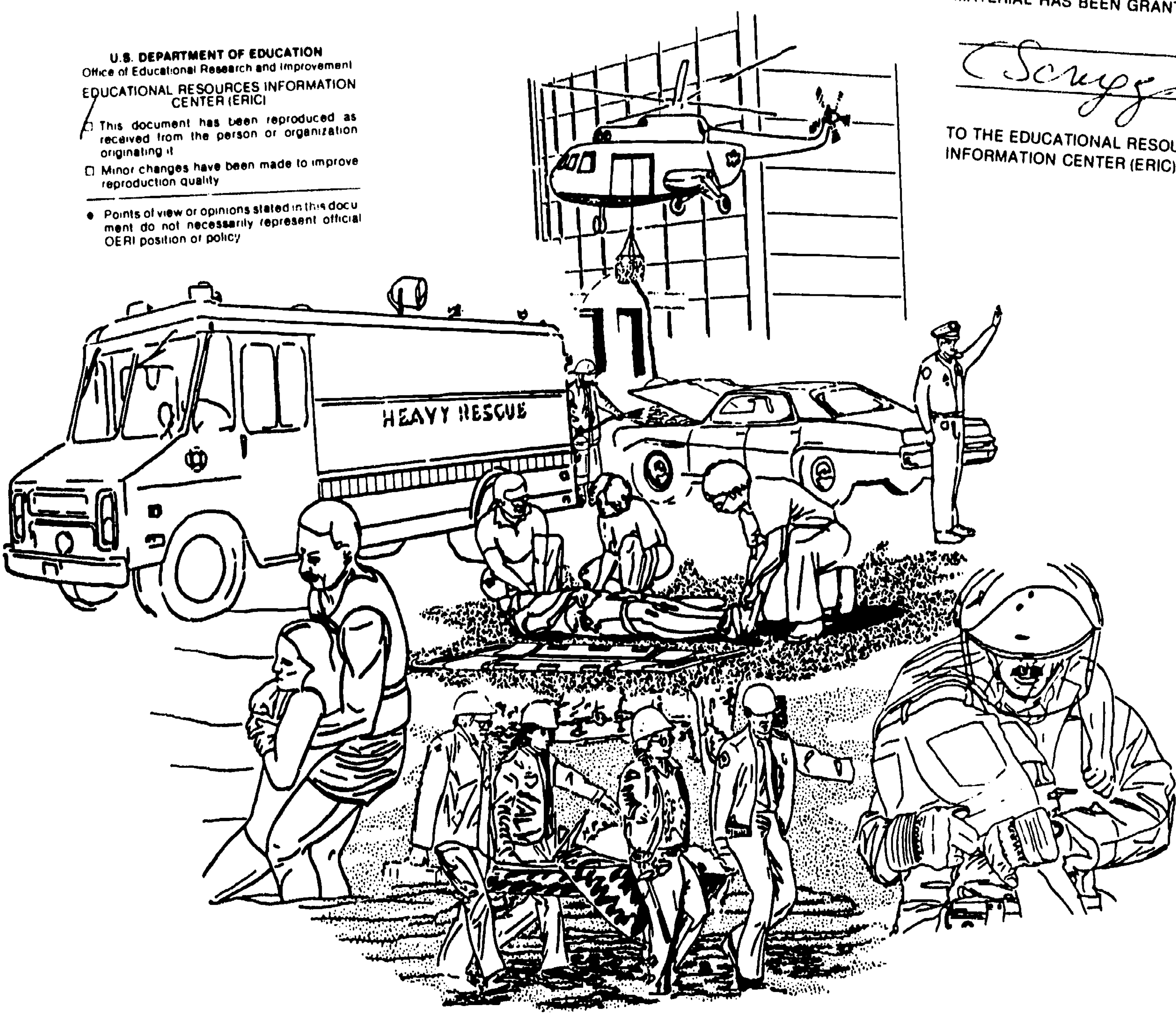
ABSTRACT

This learner manual for rescuers covers the current techniques or practices required in the rescue service. The ninth of 10 modules contains 7 chapters: (1) ice characteristics; (2) river characteristics and tactics for rescue; (3) water rescue techniques; (4) water rescue/recovery operations; (5) dive operations; (6) water rescue equipment; and (7) water rescue safety tips. Key points, an introduction, and conclusion accompany substantive material in each chapter. (NLA)

RESCUE MANUAL



MODULE 9

Ice Characteristics
River Characteristics and Tactics for Rescue
Water Rescue Techniques
Water Rescue/Recovery Operations
Dive operations
Water Rescue Equipment
Water Rescue Safety Tips

INSTRUCTIONAL MATERIALS LABORATORY
THE OHIO STATE UNIVERSITY
COLUMBUS, OHIO 43210

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The Ohio State University
College of Education
Columbus, Ohio 43210

Rescue operations may subject both rescuer and victim to the possibility of injury or death. Rescuers must understand the nature and effect of each rescue technique, and practice techniques regularly, using this text to enhance their learning. The materials and information presented here are intended only as a learning aid, and are no substitute for training. Expert opinions, recommendations, and guidelines change as research and experience refine procedures. This text includes the most up-to-date information from rescuers working in the field.

Specialized procedures require demonstration and training by subject-matter experts. It is not likely that a rescuer will become proficient in all rescue operations. Most rescuers develop proficiency in only a few areas but may be familiar with several others.

This text suggests procedures and explains how to do them. The techniques given are guidelines only. Each department should incorporate its own procedures and address local needs.

RESCUE MANUAL

INSTRUCTIONAL MATERIALS LABORATORY
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WATER EMERGENCIES

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FOREWORD

The intent of this manual for rescuers is to provide the latest instructional content and serve as an up-to-date, comprehensive source of information covering the current techniques or practices required in the rescue service. To help in this endeavor, an instructor's manual has been developed to be used in conjunction with this learner's manual. The manual has been produced in a series of modules to facilitate future revisions more rapidly and cost effectively.

The instructor's manual follows the key points identified in the text. Chapters have been included in the text which exceed those printed in any other resource. These include managing and operating the emergency vehicle, rope rescue techniques, industrial rescue, farm accident rescue, and various water emergency procedures, among others.

That the rescue profession is a dangerous and challenging career is a recognized fact. It is our hope that this text will help the rescuer meet the challenges of the rescue service in a safe and professional manner.

Tom Hindes
Director
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PREFACE

The Ohio State University Instructional Materials Laboratory has played a major role in the training of public safety personnel through the development of text materials for many years. Due to the advances in the rescue techniques, it became apparent that the existing text was obsolete. Upon the advice of many knowlegeable people in the rescue service, the Instructional Materials Laboratory initiated the development of a new text that would be easily updated, and address the needs of the rescuer. To this end, an editorial review board representing a broad spectrum of individuals in the various phases of the research profession was convened to determine what topics this text should address. The culmination of this effort is the Rescue Manual. It is hoped that this text will be useful to not only the new rescuer but will serve as a reference source for the experienced rescuer.

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MODULE 9

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ICE CHARACTERISTICS

KEY POINTS

- **Conditions that affect ice formation**
- **Factors that influence ice strength**
- **Traveling on frozen bodies of water**

INTRODUCTION

Curious children and many winter sports enthusiasts such as ice skaters, ice anglers, and cross-country skiers are attracted to frozen lakes and ponds. The number of people pursuing outdoor winter activities is increasing, which increases the need to provide ice-safety education. Outdoor park personnel, rescue workers, and fire fighters must know and be aware of the deadly hazards associated with the ice that forms on bodies of water.

Year after year, tragedies occur when would-be rescuers die during attempted ice rescues. When rescuers are called to the scene of an ice emergency, they are expected to perform rescue operations. Unfortunately, rescuers can become victims due to poor or inadequate training. Rescuers must understand the hazards of ice emergencies and the techniques used to execute safe ice-rescue procedures.

The following information will provide an introduction to ice rescue procedures. It will address ice formation, ice hazards, ice-rescue equipment and basic ice-rescue techniques; however, simply reading information does not qualify rescuers for emergencies involving ice rescue. Ice-rescue techniques must be practiced, equipment must be kept up to date, and a constant effort must be made to obtain new information on ice-rescue techniques by any person attempting such rescue operations.

Ice Reporting

Many bodies of water in the United States that provide an area with commercial or recreational winter activities have a local agency to monitor ice conditions. For example, the U.S. Coast Guard monitors the weather and water on the Great Lakes to inform commercial boating traffic of the current status of the lakes' condition. Smaller bodies of water are often monitored by city, county, and state park personnel, or the U.S. Army Corp of Engineers. Information is always available for rescue personnel. A check can be made with the local U.S. Coast Guard station or a local park authority for current lake conditions.

Most people are not aware of the dangers of ice. They often ignore or are unaware of the warning signs about the dangers near ice, and place themselves in dangerous situations. Rescuers must be able to identify the hazards and potential dangers of ice. The more a person knows about ice, the better he or she can judge its strengths and weaknesses. With this knowledge, the rescuer can evaluate the situation quickly and act appropriately.

ICE CHARACTERISTICS

Ice Formation

A typical scenario follows: it is a cold, windy, fall evening, and the weather service is forecasting the winter's first hard freeze; by morning, ice will cover the area lakes and rivers. How does this transformation take place?

The windy cold winter air cools the water on the surface of the lake, causing the heavier cold water to sink. Warm water from the bottom rises to replace it. This is called vertical circulation (see Figure 1). When the water throughout the lake reaches the same temperature, this process stops. At this point, the water is referred to as **isothermic. Isothermic** means that all the water at every depth is exactly 39.2°F. Water becoming colder than 39.2°F stays at the surface and freezes; thus, ice begins to form.

Ice expands 9% when freezing; thus, it becomes lighter than the water. As ice forms at the surface, a thermocline develops. The ice's surface temperature is 32°F or colder. The **thermocline** is the water directly under the ice sheet, where the tem-

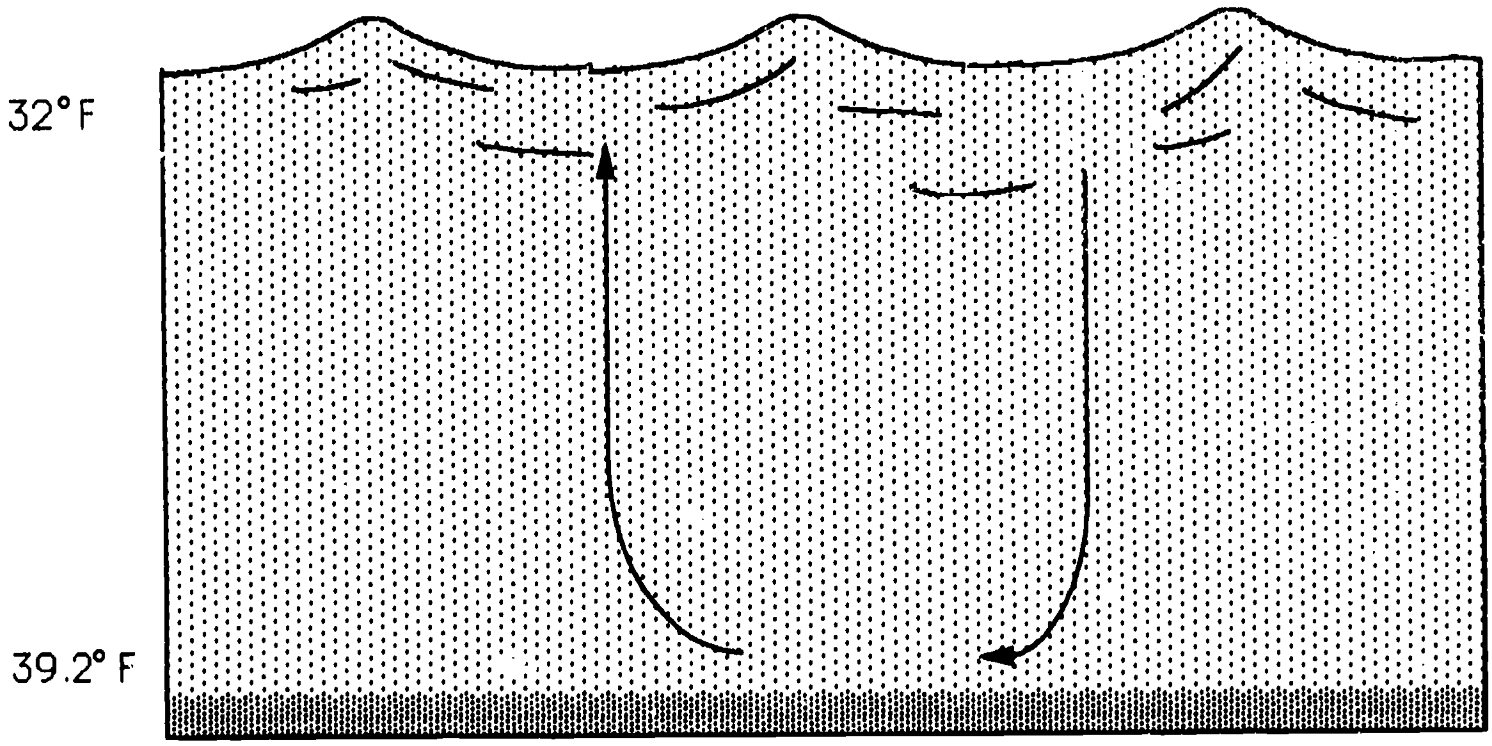


Figure 1. Vertical Circulation

perature ranges from 32°F - 39.2°F. Water depth and weather determine the depth of the thermocline. The water temperature within the thermocline increases with depth. The area below the thermocline remains isothermic at 39.2°F.

Types of Ice

A rescuer must be familiar with many different types of ice. The following information briefly describes the various types of ice.

- *Frazil ice* is the first type of ice to form. It is composed of disk-shaped crystals suspended in the water. The crystals form a thin, oily, or opaque-looking film that floats to the surface. As the temperature drops, crystals clump together to form a solid sheet of ice.
- *Clear ice* is new ice formed during a long hard freeze. It can be blue, green, or black, due to the color of the water seen through the ice. This is the strongest ice formed.
- *Snow ice* is an opaque or milky-looking, weak ice formed from the freezing of water-soaked snow. It has a low density and is porous.
- *Layered ice* is formed from many layers of frozen and refrozen snow. It has a striped appearance.
- *Frazil slush* is soft and forms in moving water where the water current prevents a solid freeze.
- *Anchor ice* is formed when a river bottom cools to 32°F and ice forms on solid objects. As sun-warmed objects release anchor ice, an ice jam can occur.
- *Pack ice* is ice driven against ice by wind, current, or waves. Layers of pack ice can pile up and freeze together leaving weak holes.
- *Drift ice* or *floating ice* is free-floating ice that is not attached to the shore.
- *Fast ice* or *shore ice* refers to an unbroken sheet of ice that is attached to the shore of a lake or river.
- *Pancake ice* is a circular piece of newly formed free-floating ice. It is usually approximately ten feet in diameter and up to 4″ thick. It is relatively flat with raised edges caused by pieces of ice striking against one another.
- *Floe ice* is any relatively flat piece of ice 10′ in diameter or larger. A floe may consist of a single, unbroken piece of ice or many combined fragments.
- *Candle ice* refers to the ice fingers in a rotting or disintegrating surface. It appears honeycombed or resembles many candles bundled together. It is commonly found in late winter or early spring.
- *Ridged ice* is ice haphazardly piled up by pressure in the form of ridges or walls.
- *Rotten ice* is old honeycombed ice in an advanced stage of disintegration. It may appear black be-

cause it is saturated with water.

- *Refrozen ice* is ice that has frozen after it has melted.
- *Ice rind* is a brittle, shiny crust of ice formed on a quiet surface. It is easily broken by wind or waves.

Openings in Ice

1. An *ice crack* is a fracture in ice that has not separated.
2. A *lead* is a fracture in ice that makes it navigable by surface vessels.
3. A *polyna* is any sizeable, nonlinear opening in ice that is found in the same region every year.
4. A *puddle* is an accumulation of melted water on ice. It may be caused by melting snow.
5. A *thaw hole* is a vertical hole formed when surface holes melt through to the underlying water. It may be caused by a warm spring, or similar phenomena, present in the water.
6. A *pool* is any small area of water that is surrounded by ice other than a crack, polyna, lead, or thaw hole.

Ice Strength

Ice strength and thickness may vary considerably, even on the same body of water, since ice seldom freezes or thaws at a uniform rate. A variety of factors affect ice strength. Although identifying these factors may be difficult, emergency situations require immediate decisions. Whenever an ice rescue is needed, time cannot be taken to cut a hole in the ice to measure its thickness. A few general guidelines can assist in performing a safe rescue.

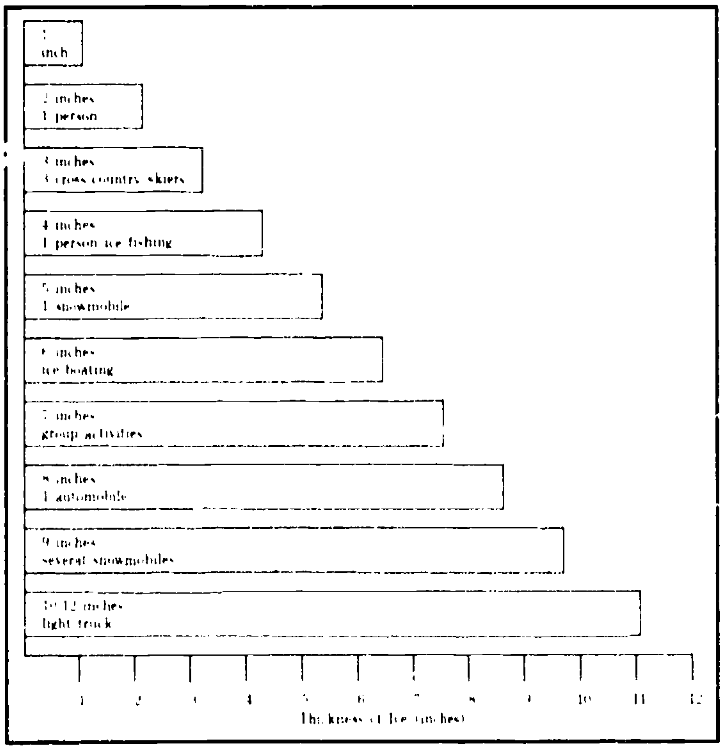


Figure 2. Maximum Safe Load for Ice According to Its Thickness

Ice thickness is only one factor used to determine ice strength. Charts are available to give a general idea of the safe load for ice according to its thickness (see Figure 2). Remember, ice is not uniformly thick from one location to another. It can be 1′ thick in one location and only 1″ thick, ten feet away.

New ice is usually stronger than old ice. Ice normally grows stronger and thicker during formation. As ice decays, it can maintain its thickness but still become unsafe. Decaying ice does not melt into a thin sheet. The bond between the ice crystals decays or "candles" into a dangerous porous condition. Decaying ice often takes on a black appearance.

Factors That Influence Ice Strength

Most factors that influence ice formation and its strength also cause it to deteriorate. Weather conditions are a key factor.

A light wind speeds up ice formation, while a heavy wind slows it down. Heavy winds keep holes open on frozen lakes. Winds force water beneath the edge of the ice, causing the ice to decay from below.

Snow on top of ice acts in different ways. It insulates strong ice and prevents it from melting, but, snow can also insulate the surface of the ice against further freezing. It can cause ice to form or to slowly deteriorate. The weight of the snow can depress the ice sheet and reduce its weight-bearing capacity. Snow also covers danger spots in the ice.

Slush is caused by rain, warming temperatures, or by water rising through cracks in the ice. Beware of slush! It is a sign that the ice is no longer freezing from below and is unsafe for weight bearing. Slush normally freezes from the top down.

Water sitting on top of the ice causes it to erode. The resulting dangerous vertical fractures in the ice allow water to percolate through it.

Daily temperatures affect ice strength. When air temperatures stay below 0°C, ice is much stronger. Warm temperatures weaken the ice because melting, shifting, and contraction occur. Sunlight even deteriorates ice from below by reflecting off rocks or a sandy bottom.

Changing air temperatures cause thermal expansion, creating cracks throughout the ice. Small dry cracks refreeze to a strength similar to that of the original ice; however, the wet cracks reach through to the water below. These cracks become very hazardous if they meet at 90° angles. Thermal expansion causes pressure ridges, with soft ice or open water areas often occurring near these ridges. The booming sound that can be heard on cold days occurs when the ice sheet is expanding and changing shape.

The depth and size of a body of water affects the ice's strength. Large deep lakes take longer to freeze, but the ice formed on them is stronger and usually decays at a slower rate. Very large lakes, such as the Great Lakes, may remain open in the winter because of the wind, waves, and water currents.

The ice found close to shore is weaker because of the shifting and expanding processes, and the sunlight reflecting off the bottom of the lake. Buckling shore ice continually thaws and refreezes.

Water currents and water velocity affect the strength of ice that forms on moving streams. River ice is usually 15% weaker than lake ice. Ice found on straight stretches of a river is generally stronger than ice on a river bend due to the slower current. The ice found at the river mouth is usually dangerous because the underlying currents often cause air pockets in the ice.

Water chemistry is an important factor in determining ice strength. Pure water freezes faster and thicker than water containing chemicals or pollutants. Pollutants concentrate along the boundaries of ice crystals as they form. This causes melting along the crystal boundaries resulting in porous, vertical streaks called "candling".

Fluctuating water levels caused by rain, seepage from wet cracks, or additional water from dam releases can weaken ice. Lower water levels weaken ice because it lacks the support of the water underneath it. Ice on shallow water areas will stress and crack.

Obstructions in waterways such as rocks, logs, vegetation, or pilings can also affect the strength of ice. Heat from these obstructions slows the formation of ice (see Figure 3). Ice shifting and expanding will create pressure cracks and ridges around such obstructions. For example, decomposing vegetation generates heat which hinders the ice formation.

Underground springs weaken ice formation. This upwelling, relatively warm water degrades the ice's undersurface and prevents ice formation. Ice weakened by springs is often camouflaged by snow. Be aware of springs in an area.

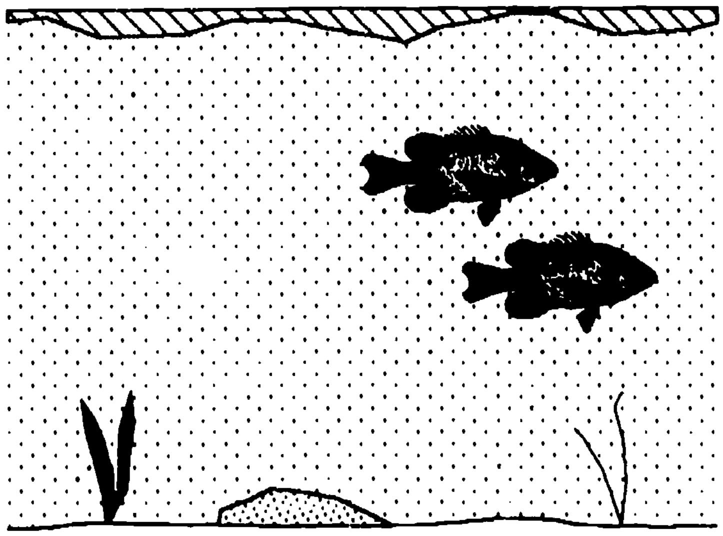


Figure 3. Ice Characteristics

Finally, waterfowl and schools of fish can prevent ice formation. The water activity where fish gather is a form of vertical circulation that creates thin spots in the ice. Waterfowl often gather in one location to keep an area of water open. If the fowl leave the open area, allowing it to freeze, the ice will be weaker in this area than the surrounding ice.

Traveling on Ice

Anyone traveling on a frozen body of water should be aware of its inherent danger. When using a vehicle on ice, keep the following information in mind: a light truck parked on a 12″ thickness of ice depresses that ice 2″ to 2 1/2″ for approximately 200′ around it. Moving a vehicle across the ice causes the ice to bend up and down. This movement will form long waves that roll out and away from the vehicle, similar to the wave a boat creates when traveling on surface water. Movement also creates another wave in front of the vehicle, which may create a pressure ridge crack if the vehicle is moving at the applicable critical speed (see Figure 4).

Critical Velocity of Moving Loads on Ice

	(Feet)						
WATER DEPTH	4	6	8	10	15	20	30
	(mph)						
CRITICAL VELOCITY	9	11	12	14	17	19	22

Figure 4. Critical Velocity of Moving Loads on Ice

Following closely behind another vehicle will interrupt the wave actions described in Figure 4, causing similar cracks in the ice. Two vehicles traveling on ice should each take different routes, allowing plenty of room between vehicles. Repeated use of the same path will weaken the ice. Extra caution is advised when traveling at night or during heavy snowfall, since either of these can obscure thin ice or open holes.

Several safety precautions should be followed if it is necessary to drive on ice. Drive with the windows open, the seat belts unbuckled, and each passenger wearing a personal flotation device. All clothing should be zipped to provide added warmth and insulation in case the vehicle becomes submerged. Preplan a route of escape in case the vehicle breaks through ice. Preplanning, assessing ice conditions, and knowing self-rescue techniques will greatly increase chances of survival when traveling on the ice.

If a vehicle plunges through the ice, all passengers must act quickly. The ideal time to escape is when the car is still afloat. The floating time may vary from a few seconds to a few minutes depending on the vehicle. The best escape route is through the open windows.

Once the vehicle starts to sink, it will be impossible to open the doors until water fills the vehicle. When full, the water pressure outside the vehicle will equal that on the inside, making it possible to open the doors. If no other escape route is possible, it may be necessary to force the front or rear window out of its frame by pressing against the corner of the window with the feet or shoulders. It is important to remember that the amount of air remaining is greatly diminished at this point. A vehicle will normally descend engine first coming to rest with the engine buried upside down.

CONCLUSION

Only with preplanning for ice rescue, a knowledge of how ice is formed, the types of ice, factors affecting ice strength, and training in water-rescue techniques can a person be qualified to judge the most effective way to perform an ice rescue. Thickness is only one of the many determining factors in ice safety.

RIVER CHARACTERISTICS AND TACTICS FOR RESCUE

KEY POINTS

- **Characteristics of a river**
- **River running**
- **River hazards**

INTRODUCTION

The factors of moving water and current add a new dimension to water rescue procedures. Water current can be the most dangerous, overlooked hazard in a river rescue situation. Moving water can fold a boat, trap a person under a fallen tree, or hold boats, people, and debris in the recirculating hydraulic at the base of a dam.

While river currents may cause problems, they are also predictable. With practice, a rescuer can safely navigate many areas that might otherwise have been inaccessible simply by being able to predict currents and river features. This is referred to as *river reading*. Use of this technique will enable the rescuer to recognize and avoid the dangers found in rivers and increase the likelihood of successful rescue operations.

Understanding river current alone will not ensure a successful rescue. Rescuers must also use techniques that stress minimum risk to prevent the rescue personnel from becoming accident victims and further complicating a rescue operation.

RIVER CHARACTERISTICS

A river changes as the surface of the riverbed and the bottom changes. Water moves downhill, and its velocity or speed is effected by many things: the friction on the bottom and sides; the depth, width, and slope of the channel; and the amount of water in the channel, which is referred to in cubic feet per second (CFS). All of these factors interrelate to affect the characteristics of the river.

For example, if the amount of water in a river remains the same between point A and point B, and the river narrows, then the depth or velocity of the water must change.

$$\text{Velocity} = \frac{\text{CFS}}{\text{Width} \times \text{Depth}}$$

When the depth, width, and velocity of a river are known for a given location the CFS can be calculated for that location (see Figure 5).

Example:

Depth × width × velocity = CFS
4 ft. × 200 ft. × 2 ft./sec. = 1600 CFS

This information indicates the force of the river. Knowing the cubic feet per second (CFS) allows a rescuer to make a decision as to whether the current is too strong to use a boat-based rescue operation. If the water has risen 2 feet, the river has a dam

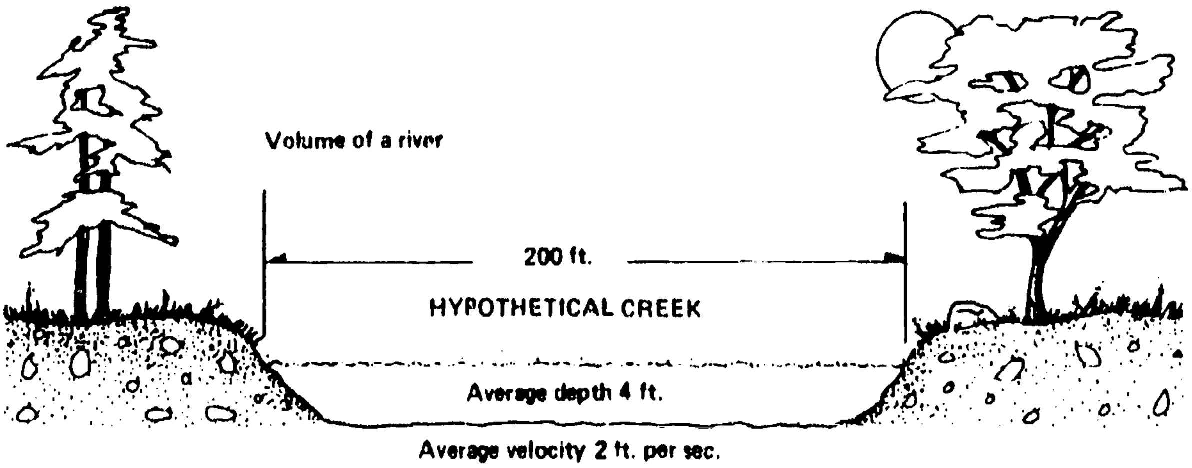


Figure 5. Calculating CFS.

on it, and the CFS at the dam outflow is known, the velocity can be calculated.

Example:

Depth × width × velocity = CFS
6 ft × 200 ft × ? = 4800 CFS
The velocity is equal to 4 ft./sec.

Water current traveling four feet per second may be too fast for a rescuer to rely on a hand-powered canoe or a rowboat.

Many people do not understand the force of moving water until they have an experience that puts their body against a river current. The force of water can pin boats to a bridge or pier. Water force does not increase linearly as the water increases. For example, if the water current doubles from 3 to 6 mph, the force does not double. Water force obeys a square law. This means that if the speed of the water doubles, then the force increases by the square, or four times.

The chart shown in Figure 6 indicates that it would be difficult to stand in hip-deep water with a current as slow as 3 mph.

CURRENT VELOCITY	AVERAGE FORCE OF THE WATER		
(MPH)	LEGS	BODY	SWAMPED BOAT
3	16.8	33.6	168
6	67.2	134.0	672
9	151.0	302.0	1512
12	269.0	539.0	2699

Figure 6. Water Current Velocity

Gravity pulls water downhill. As it moves it encounters obstacles that tend to slow the progress of the water by creating resistance to the flow. Submerged rocks, trees, cars, the banks, and the river bottom and sides all offer resistance to moving water.

Current differentials result when there are currents of different speeds and/or direction existing side by side in a river. Typical differentials are caused by obstructions like boulders and resistance to the flow like the riverbed itself. Differentials also occur at the confluence of two or more moving bodies of water. Many times the differences are visible on the surface of the water. Experienced canoeists and water enthusiasts classify these patterns and their causes as river reading. It is important not only to recognize these differentials, but to be able to use them.

The riverbed and the river load (obstacles in the water and the slope of the river bed) creates obstructions and resistance throughout the path of the water. This is referred to as the *river structure.* To illustrate the different characteristics of a river, the text will discuss a stream 3 feet deep, traveling at approximately 5 miles per hour.

When the river encounters an object (i.e. a rock) less than three feet in height, a *pillow* is created. Just down stream of the object, a swell is noticed on the surface of the water. The bigger the swell, the closer to the water surface the rock is located (see Figure 7).

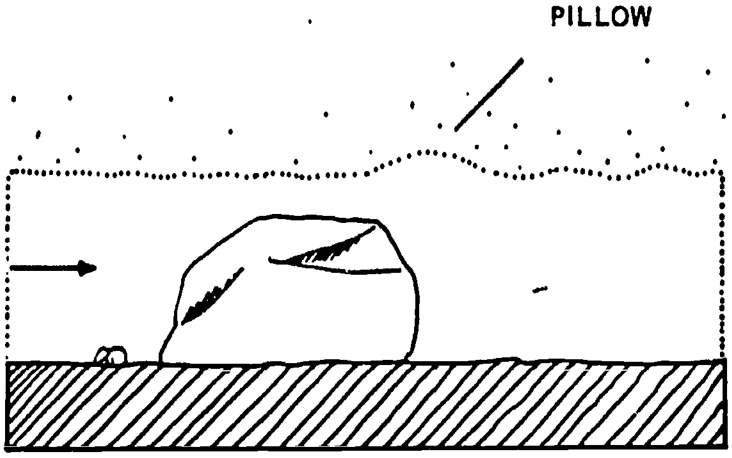


Figure 7. Pillow in a River

If the rock is large enough to break the surface or it just touches the surface, a *hole* will be created (see Figure 8). As the water passes over the rock

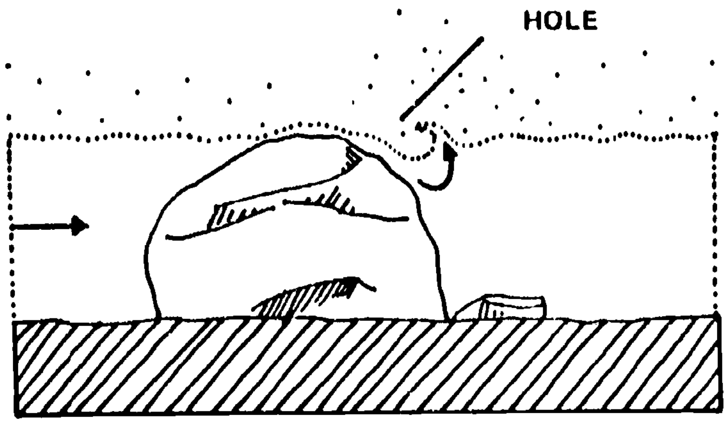


Figure 8. Hole in a River

(rising slightly), it will drop over the downstream side and form a small depression on the surface. A hole will usually form downstream of a ledge or long continuous obstruction. The greater the drop over the downstream side of the obstruction, the larger the hole will be. Holes are also affected by volume and/or velocity. An hydraulic is a recirculating hole and the water downstream is flowing back upstream to fill the hole.

If the rock or obstruction is large enough to rise well above the water, an *eddy* is formed (see Figure 9). Because water does not flow over the rock, water flowing around the rock from each side fills the void behind the rock. Thus an area of water flowing upstream, or *current*, is formed. This water does not flow downstream at the same velocity as the rest of the river, so a current differential is created. This differential can be very useful in river running, but it can also be hazardous to cross (i.e. eddy turns and peel outs).

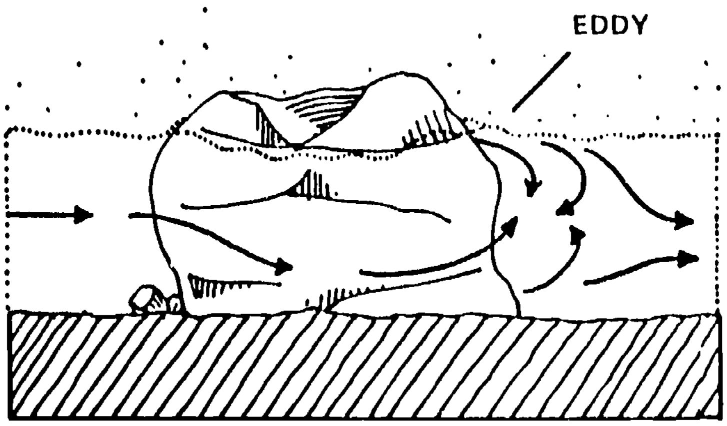


Figure 9. Eddy in a River

As water moves past rocks and other obstructions, regardless of their size, ripples are formed. These ripples appear on the surface as **upstream "V's"**. The tip of the "V" points upstream, while the edges spread out toward the shores moving away from the obstruction. If two rocks are six feet apart in the river, the **two upstream "V's"** will meet in mid-channel creating a downstream "V".

Nature has scattered rocks throughout a river's course. As a result, a river runner must read the river constantly to find a safe passage. The safest and easiest path is often shown by looking for the **upstream "V's"** to indicate where rocks are located and **downstream "V's"** to indicate the deepest, safest, channels.

Standing waves are formed in a similar manner (see Figure 10). When a channel is restricted by rocks, the water will back up behind the rocks. As the water passes between the rocks, the velocity will increase due to water pushing from behind. Once the water is through the drop, it encounters slow water in the pool below. When the fast water hits the slow water below, the energy is released by water piling up or by creating standing waves.

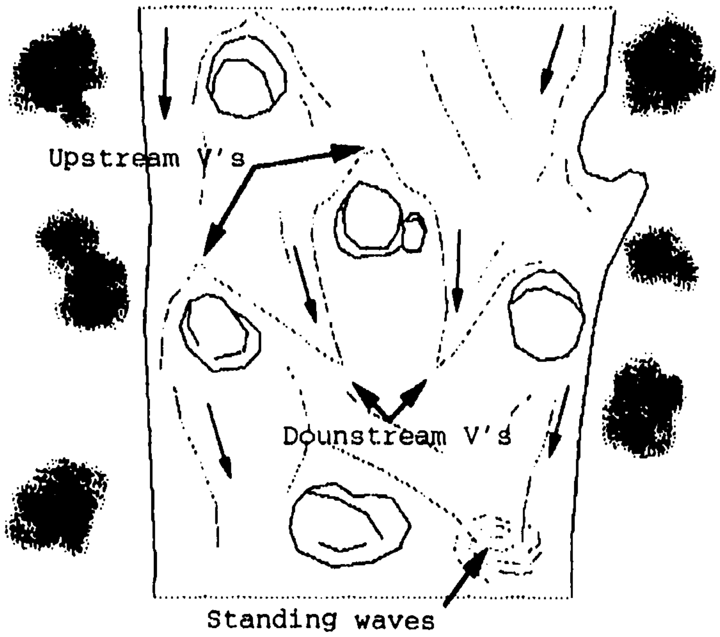


Figure 10. Upstream and Downstream Vs with Standing Waves

When seen from shore, standing waves appear stationary. Each downstream wave becomes a little smaller than the wave upstream until all the energy is released and the current flow approaches normal again.

Due to the interaction of the river sides, bottom, and the air with the water, current differentials are found in a straight river channel. The water on the bottom and sides will move the slowest. The water just below the surface and in the middle of the channel will move the fastest (see Figure 11).

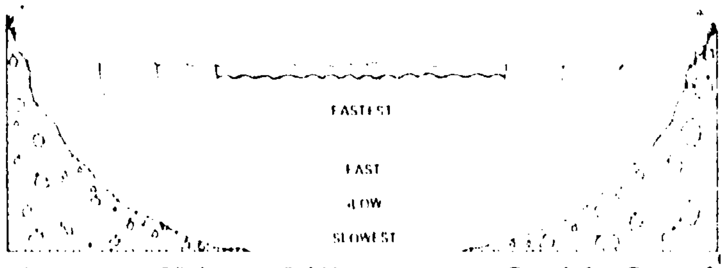


Figure 11. Velocity Differences in a Straight Stretch of River

Water also reacts to centrifugal force. As moving water rounds a curved section of channel, the water will pile up on the outside of the bend. There will be a corresponding shift in the current differentials(see Figure 12).

Holes, pillows, eddies, standing waves, and currents are all found in a river. A realistic river may

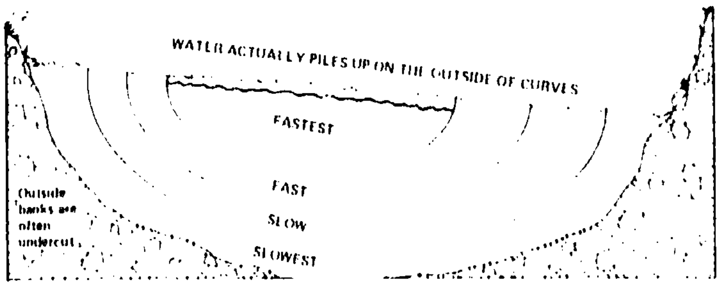


Figure 12. Velocity Differences in a River Bend

look like Figure 13. Rescuers must be able to recognize and use these characteristics.

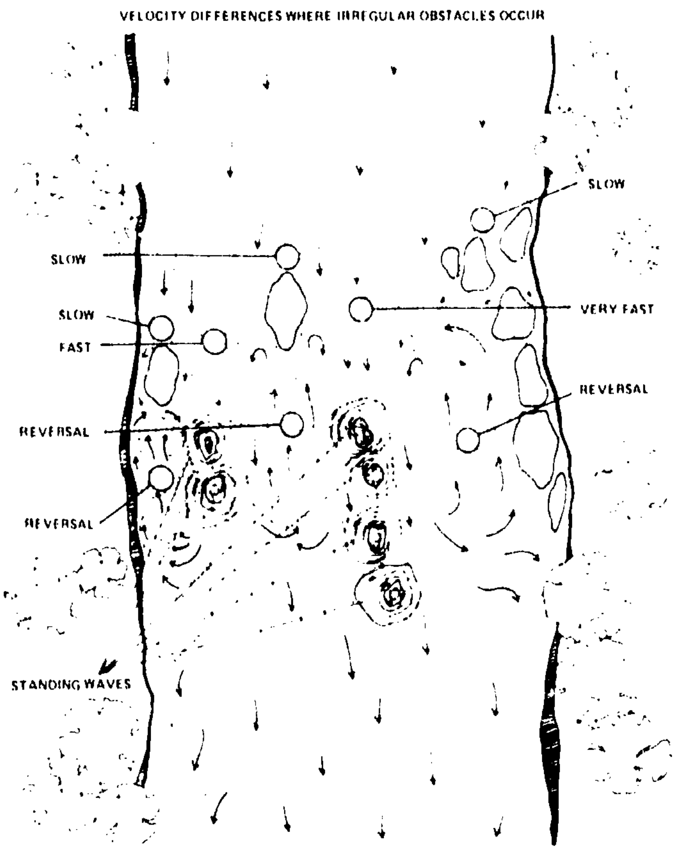


Figure 13. Velocity Differences where Irregular Obstacles Occur

BOATING ON RIVERS

As experience is gained in river reading, new skills will be learned. Many times a powerboater is experienced in boat handling on lakes or ponds, where he or she knows how a craft will behave in situations involving wind, waves, obstacles, and other crafts. This basic knowledge is very important, but, the same boater on a river with standing waves, rocks, hydraulics, eddies, pillows, or fast chutes may be overwhelmed. The motion and force can quickly eliminate the inexperienced river runner.

The river runner must consider current differentials with every move. This is especially true when cutting across differentials. When cutting across a differential, the boat will act in one of two ways:

Rotational Capsizing Force. A rotational capsizing force acts against the keel and the side of the boat. A strong current differential can very quickly capsize even the most stable boat (see Figure 14).

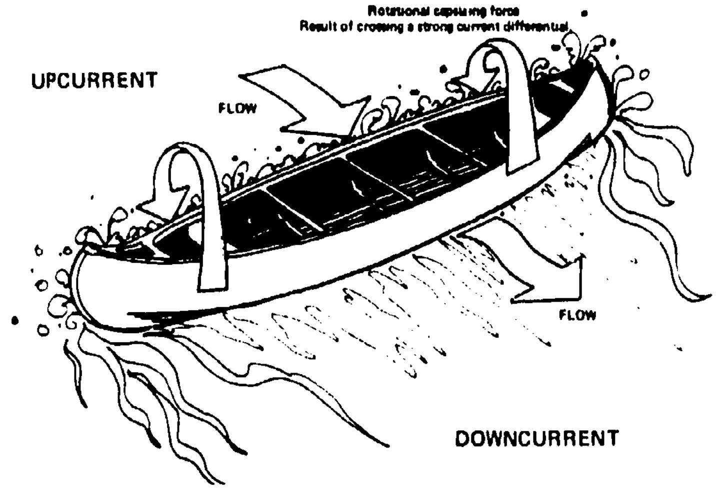


Figure 14. Rotational Capsizing Force

This force can be seen in action when a boat enters or leaves an eddy. The operator must be prepared for this force and compensate by leaning down-current. Adding weight to the down-current side of the boat should balance with the strength of the rotational capsizing force (see Figure 15).

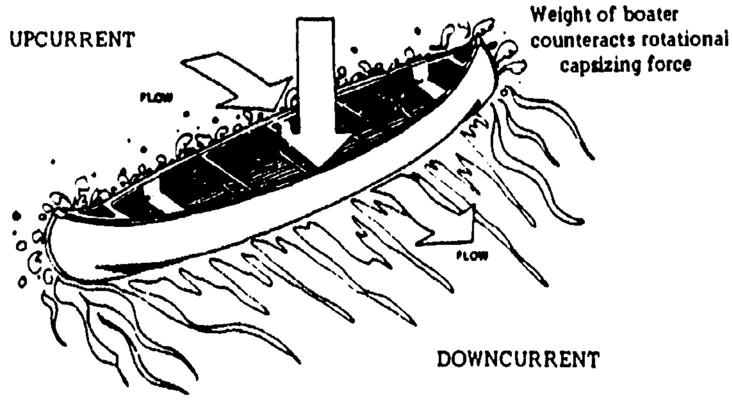


Figure 15. Leaning Down Current

Rotational Turning Force. A rotational turning force occurs when a boat crosses from one current to another. This differential acts against the bow and stern in opposite directions. This throws the boat completely off course unless the boater intends to go that way or is counting on the current to change the direction of the boat (see Figure 16).

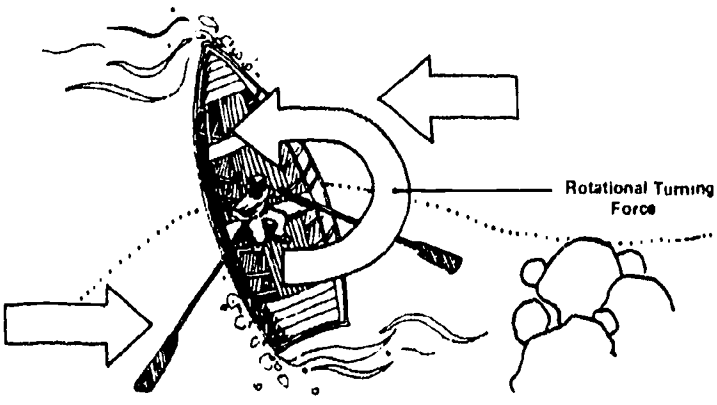


Figure 16. Rotational Turning Force

Offensive Versus Defensive River Running

If a boat reacts to the river's current like a milk jug floating downstream wherever the river takes it, the boat operator is not in control. The chances of having the current take a rescue boat safely to the victim and safely back to shore are very slim. To maneuver in the water current, the operator must give the boat positive or negative momentum in relation to the current.

When a boat is handled offensively, positive momentum is used to steer the boat. In this situation, the boat is moving faster than the river current. If the boat is moving at 5 mph on a river that is moving 3 mph, the actual speed that the boat is traveling is 8 mph. Moving faster than the current, lessens the amount of time the boat operator has to react to the water, the current, and obstructions.

Boating defensively means the boat is moving slower than the water current. This increases the amount of time the operator has to react to danger or river characteristics. If the river is moving at 3 mph and the boat is moving against the current at 2 mph, the boat would actually be moving downstream at 1 mph. As a rescuer, it is easier and safer to be a defensive boater.

RIVER TACTICS

Whenever possible, do not fight the river current, use it. Eddies are very useful on a river. They provide a place to launch the boat, or to stop and pause when traveling to see what is ahead downstream. Getting out of an eddy is called a *peel-out;* getting into an eddy is referred to as an *eddy turn.*

Peel Out

If a boat is at point A (see Figure 17), slowly move up to the eddy and point the bow just down

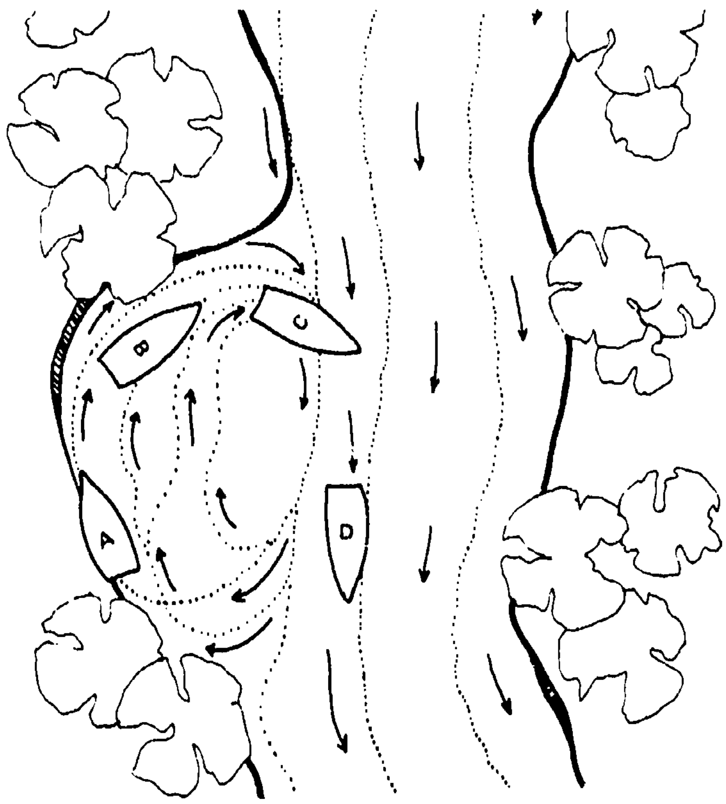


Figure 17. Peel Out of an Eddy

stream (point B) of the obstruction that creates the eddy to peel out. As the bow of the boat begins to cross the differential line or eddy line, increase the speed a little, turn the boat downstream, and lean as if riding a bicycle. Between points C and D, the rotational turning force will quickly spin the boat, assisting the turn; however, if the operator does not lean, the rotational capsizing force will turn the boat over and the operator will end up in the water.

Eddy Turn

Getting from the current back into an eddy is called an eddy turn (see Figure 18). It is similar to a peel-out in that the lean is the key. It is also important to stay as high in the eddy or as close to the obstruction that created the eddy as possible. As shown in Figure 18, a peel-out is completed from an eddy behind the island and the boat is headed downstream as shown in points A, B, and C. At point C, the bow is pointed toward the eddy. Use forward momentum to move the boat to the eddy, or differential line. At point D, the bow of the boat should begin to cross the eddy line. A forward speed is maintained until the boat is halfway across the eddy line. At this point, the operator and any passengers should be leaning down-current (lean the same way as in a bicycle turn). When point E has been reached, the boat will have spun around due to the rotational turning force and the operator must cut the throttle to avoid hitting the shore. Points F and G show the boat moving to shore.

Figure 18. Eddy Turn

Eddy turns and peel-outs are not difficult to master. Remember, it is important to **lean** as if riding a bicycle to complete an eddy turn or peel-out.

Ferrying

Many times it is important to cross a river and not go downstream. This may be necessary to put backup rescuers on the other shore or to avoid traveling over a falls. In either case, this can be done by forward ferrying.

In the days of the horse-drawn carriage and the early years of the automobile, there were many rivers that were too deep to ford, too wide to bridge, and too swift to pole a ferry boat across. As a result, the ingenious idea of a static line ferry was implemented (see Figure 19).

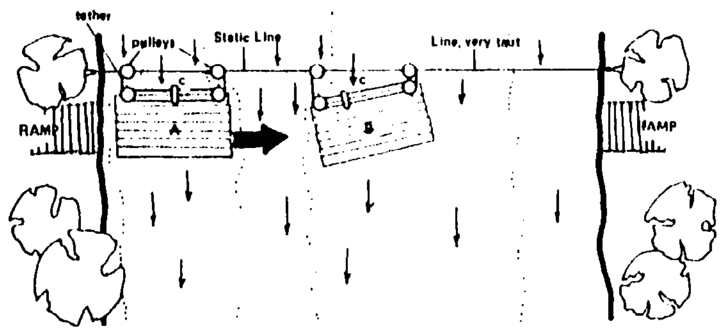


Figure 19. Static Line Ferry

To make a static line ferry, stretch a strong cable or static line across the river and anchor it at each shore. Make sure the line is perpendicular to the current (perpendicular to the current does not always mean perpendicular to the river's banks). Stretch the line taut and attach a ferry boat with a line and pulley system. Load the ferry at point A and the control lever C is moved to shorten the riverside tether and lengthen the shoreside tether. The current will then push against the side of the boat and move it across the river. The boat may return by reversing the tether links.

A ferry crossing can also be performed without a static line. This requires that the boat angle upstream at approximately a 45° angle and have enough power to counteract the river's current (see Figure 20).

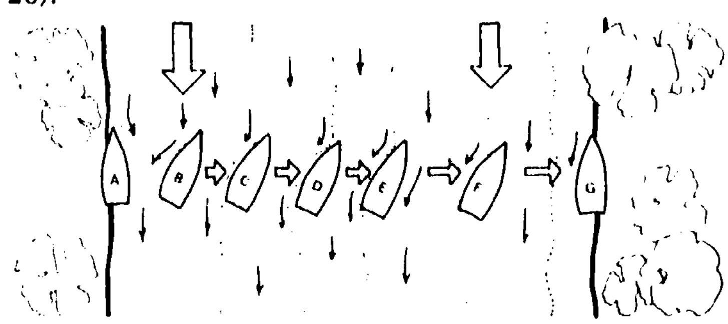


Figure 20. Ferrying a Boat

Launch the boat at point A and leave the shore by applying power and nosing out into the current at point B from points B through F. Keep the boat angled to the oncoming current, applying only enough power to neutralize the current so that the boat follows a course across the current, without moving upstream or downstream.

The angle at which a river should be crossed may change with the situation (see Figure 21). Factors include the strength of the current and the amount of power available. White-water canoeists frequently paddle across fast current without the advantage of an outboard motor. If the angle is increased, then the power must also be increased, which will cause the boat to cross the river quicker. If more power is not available, then the boater must use a smaller angle and the crossing will be much slower.

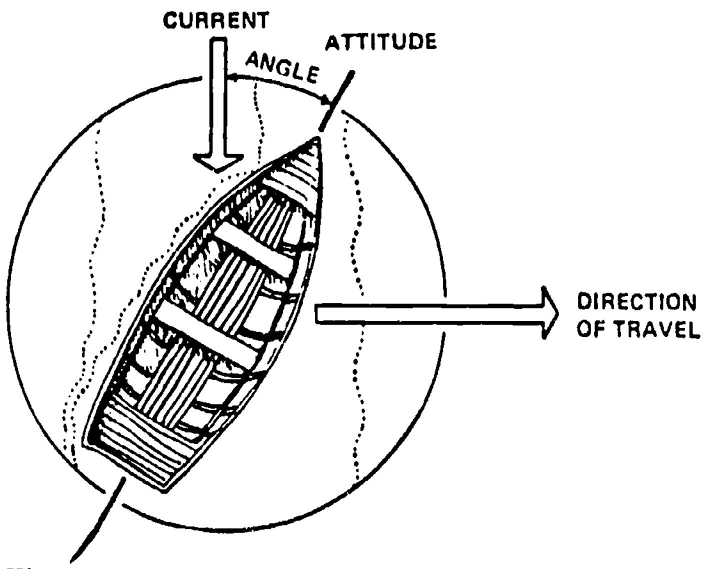


Figure 21. Ferry Angle

Good judgement and practice are required to cross the varying currents in a river. Controlling the power and the angle traveled is essential. Remember, while crossing it is important to **lean down current** to compensate for the rotational capsizing force.

Use of Gravity in Crossing a River

Where waves form, gravity can be used as an aid in crossing a river, preferrably from an eddy on one side of the river to an eddy on the other side of the river (see Figure 22).

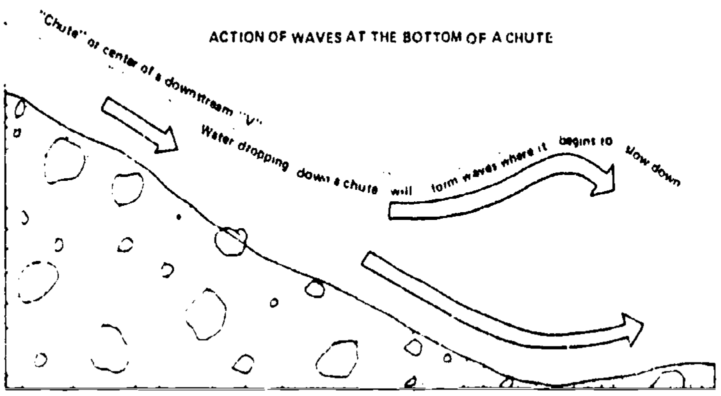


Figure 22. Wave formation in a chute.

When a boat is in the trough of the wave, the push of the water downstream is balanced with the pull of gravity downhill. By *surfing* the waves while crossing the chute, less power will be used in the ferry and the power of the river can be used to the boater's advantage (see Figure 23).

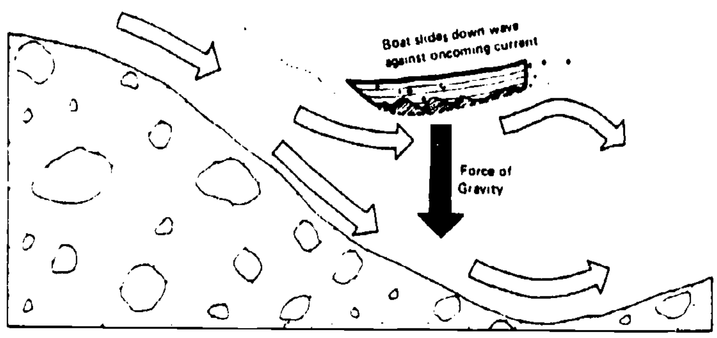


Figure 23. Surfing.

Whenever a boat is on the upstream side of an obstruction, the current will push the boat into the obstruction and possibly overturn the boat. Even a mild current can swamp and pin a boat when it is pressed against a rock, bridge, pier, or other obstruction.

If a boat should get pressed against an obstruction, **occupants must immediately lean toward the obstruction** to avoid capsizing. Leaning into the obstruction raises the up-current side of the boat so that water can go underneath the keel and the hull. If the object is solid, like a rock, the boat might ride the pillow around the rock and avoid the pinning if occupants lean immediately (see Figure 24).

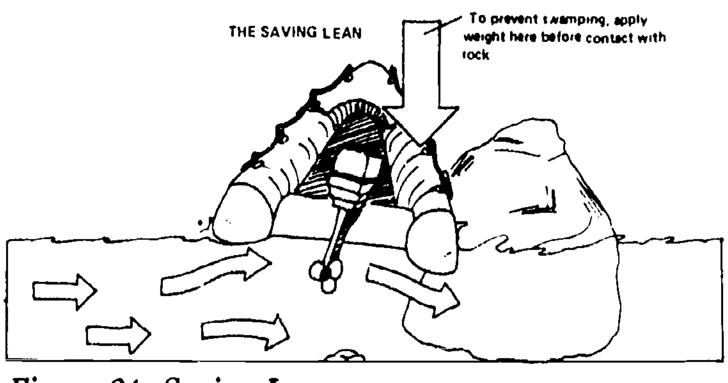
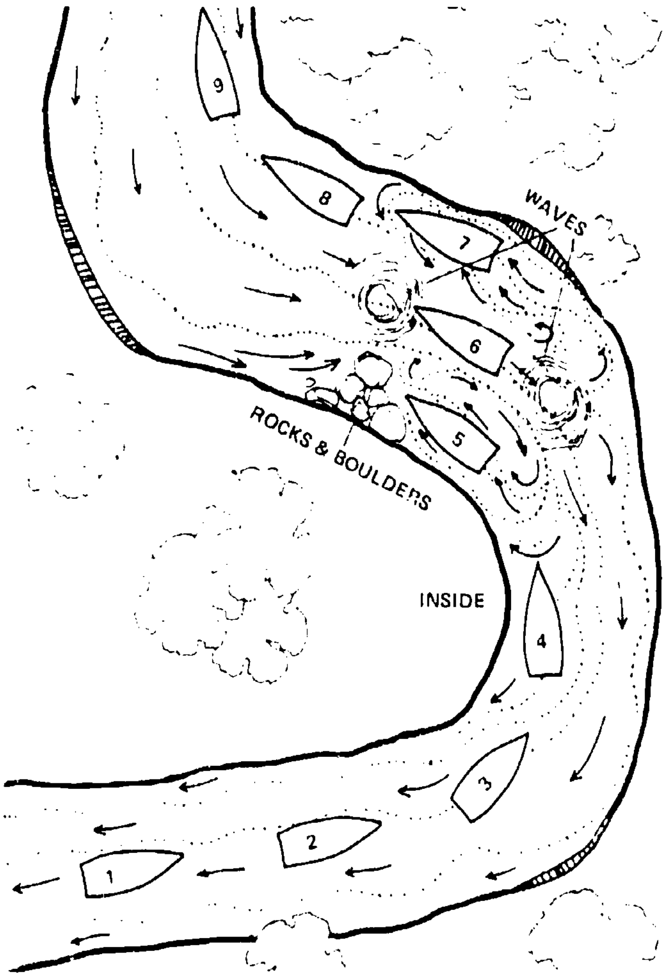


Figure 24. Saving Lean

Ascending and Descending a River

Use special caution when ascending and descending a current under power. Boat as defensively as the water allows by slowing the speed of the boat in relation to the current. Usually, the safest way to descend a river is to point the bow upstream and have a person at the oars rowing gently to give negative momentum (see Figures 25 and 26).



Read from bottom to top

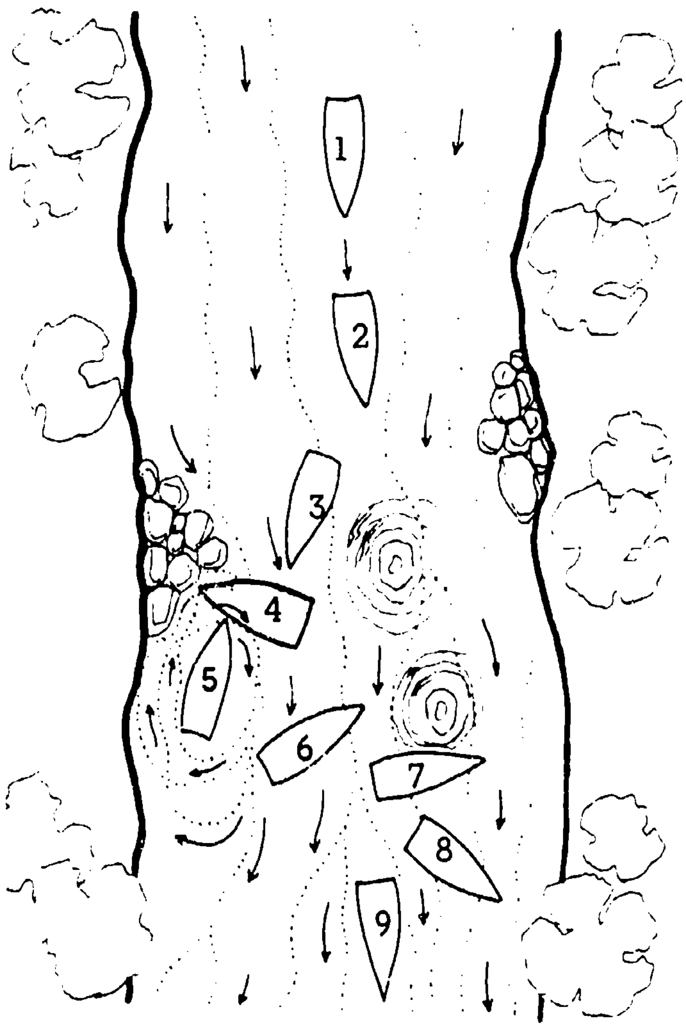
7-8-9 continue upstream keeping to the shore with slower current.

6-7 Ferrying across between waves the boater enters slower water along opposite shore.

4-5 Entering the eddy, the boater selects course between waves

1-2-3 Boater maneuvers across to be on the inside as he or she approaches the bend.

Figure 25. Ascending a Current



(1) Descend with slow reverse (50% neutralizing of current).
(2) Maintain slow reverse letting current move boat as current speed increases.
(3) Shift to forward with one short burst of power as boat crosses differential.
(4) Steer right to finish turn.
(5) Cut power and stop in in the eddy.
(6) Apply low forward power and cross eddy line.
(7) With low forward power, let the boat turn downstream.
(8) Back off on forward power.
(9) Return to slow reverse and proceed cautiously downstream.

Figure 26. Descending a Current

RIVER HAZARDS

As a person gains experience in river running, it is important to learn to recognize the many hazards of a river. Special consideration must be given to unusual situations where the water is extremely wild, or where obstacles such as dams and piers interfere with the normal behavior of the river.

Dams

Of all the hazards on a river, the lowhead dam is the most dangerous. Engineers construct these dams river-wide with a perfect hydraulic which is virtually escape-proof. The hydraulic is symmetrical with no breaks in water flow where victims can escape. The high cement walls that are built on both sides of the river prevent victims from being flushed out from either side. This effect gives the lowhead its name: the drowning machine.

Size is not a significant factor; all lowhead dams are dangerous. They range from 6 inches to 25 feet tall depending upon their purpose. Large dams were built for pools of water for irrigation, water supplies, and water wheels. However, dams encasing power lines, phone lines, TV cables, and water and sewage pipes are the most numerous and usually unmarked. These dams are usually less than 10 feet high. From upstream the only warning that this type of dam exists is a horizon line and the roar of the hydraulic.

High dams do not pose as great a threat as lowhead dams. High dams are over 25 feet tall and are typically used to create lakes with the resulting impoundment used for recreational purposes. These dams are usually well-marked and their locations are well known.

Lowhead dams are commonly found on rivers and streams throughout the United States. They are usually located in pleasant places and provide a fresh oxygen supply for fish and other aquatic life. Anglers and children tend to congregate in these areas. Small dams do not look very dangerous; however, they are extremely dangerous (see Figure 27).

A person or boat caught in the backwash of a hydraulic will be carried to the face of the dam. Water pouring over the top will push the victim under the water. The victim will struggle to the surface and be carried by the backwash to the dam again. The cycle repeats itself over and over. A good swimmer who is able to control his or her breath and is strong enough to survive the repeated cycles may work over to one side or the other where a

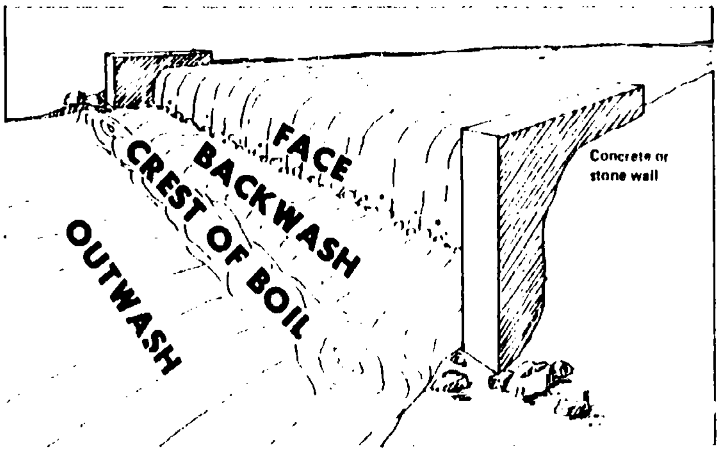


Figure 27. Dam Face

rescuer or bystander may be able to help the victim climb the retaining wall.

If no rescuer is immediately at hand, the victim caught in the hydraulic must go down with the current coming over the face of the dam, get pushed under the water, staying as close to the river bottom as possible, and try to swim along the bottom to get past the boil and into the downstream water. This self-rescue is very difficult and very few people have been successful (see Figure 28).

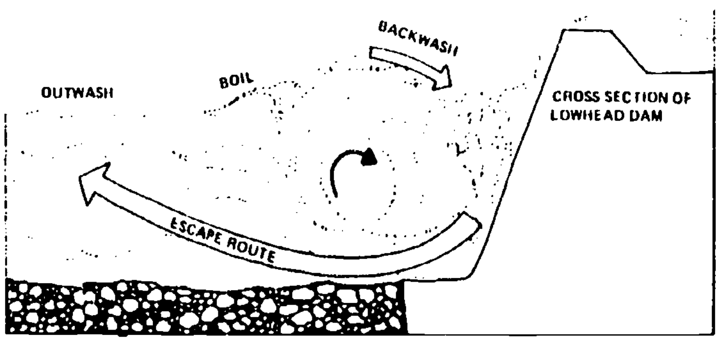


Figure 28. Dam Escape Routed

Strainers

Strainers are usually downed trees; however, a strainer can be any obstruction in the water that allows water to pass through but would restrict the passage of boats, people, and other objects. Avoid all obstruction, including water intakes, fences, and submerged objects such as automobiles.

Downed trees can be found anywhere on a river, but usually occur on the outside of a bend where water has eroded the bank. Once the bank becomes eroded, trees fall into the water creating strainers. This is particularly hazardous because the current moves faster on the outside of a bend, taking victims and boats into the strainer quickly with no chance for escape. The water can hold the victim against the strainer or push him or her under the water completely.

Bridge Piers

Bridge piers often appear in midstream where the stream is too wide for a single span to cross. Piers are easy to see and to avoid in a maneuverable boat, but a disabled or swamped boat may be swept by the current onto the upstream end of the pier and become pinned against the pier. The force of water can destroy the strongest boat. Debris caught on a pier creates piles of flotsam and a strainer that can cause damage to a boat.

CONCLUSION

Many hazards exist on a river. Properly marked hazards help prevent problems found in a river; however, it is not common for hazards to be identified. Large holes, waterfalls, natural hydraulics, and rock gardens can all be formed on rivers; however, they are not often found in streams located in the midwest section of the United States.

If an accident occurs the rescuers must follow a logical rescue sequence at each scene. **Never risk turbulent waters, jeopardizing a life, if there is an easier and safer way to execute the rescue.**

WATER RESCUE TECHNIQUES

KEY POINTS

- **Assessing the scene**
- **Guidelines for choosing and performing a rescue technique**
- **Self-rescue techniques**
- **Shore-based rescue techniques**
- **Boat-assisted rescue techniques**
- **Boat-based rescue techniques**
- **Go-rescue techniques**
- **Rescuing victims with cervical-spine injuries**
- **Techniques for extricating victims from the water**

INTRODUCTION

Water-related activities rank at the top of recreational pursuits. As the number of people swimming, fishing, and boating increases, the number of water accidents is steadily rising. Currently, the second leading cause of accidental deaths for persons 1-44 years of age is accidental drowning. It is also one of the leading causes of accidental deaths among emergency and rescue personnel.

The following information addresses basic rescue techniques for water-related accidents. The information has been used for several rescue-oriented programs.

To successfully perform water rescue operations, the rescuer must be a good swimmer and be completely comfortable wearing a personal flotation device (PFD) while in the water.

Rescuers are not expected to become lifeguards, since this would involve a separate training course; however, all rescuers are urged to seek further training in swimming skills and water-related rescue techniques from local organizations such as the American Red Cross, the YMCA, the YWCA, or a local adult education program.

ASSESSING THE SCENE

To effect a safe rescue, the rescuer must first be trained in self-preservation. The rescuer is subject to the same hazards as the victim. Although the rescuer's situation is more controlled through the use of a lifeline and other precautions, it is imperative to exercise caution and safety measures to ensure that the rescuer does not become another victim.

The best method of self-preservation is to avoid dangerous situations whenever possible. By the nature of the conditions involved in a water accident, rescue personnel are subject to danger. No matter what precautions are taken, the rescuer must be prepared to deal with an emergency. The danger in a rescue can be minimized by following the basic procedures listed below before proceeding with operations.

1. Assess the victim's condition.
2. Assess the environmental conditions.
3. Assess the equipment available.
4. Assess the workforce available.
5. Follow the rescue sequence:
   a. Self-rescue
   b. Shore-based techniques
   c. Boat-assisted techniques
   d. Boat-based techniques
   e. Go (swimming and wading) techniques—Proceed, but only with the proper equipment and following safety precautions

Assessing the Victim

In all water rescue situations, first try to communicate with the victim. Ask questions such as: "Are you injured?" and "Are there any more victims?" It may be possible to talk the victim through a self-rescue. However, if the victim is injured and does not have a personal flotation device and water conditions are hazardous, self-rescue is impossible, and another rescue technique will need to be used.

Assessing Environmental Conditions

Environmental conditions make each rescue site unique. Rain, storms, lightning, ice, cold air and water temperatures, and wave conditions are environmental conditions that must be considered. Another consideration is approaching weather conditions, which can turn a calm body of water into one with 8-10 foot waves in less than an hour.

A more deceptive point to consider is the water's geography. Preplanning for water rescue may include becoming familiar with using marine, fishing, or other available charts. Another source of information may be local user groups, such as anglers, boaters, lifeguards, or people who live in the area.

A depth sounder with a graph recorder can be used to verify the information obtained from resources. This information may pertain to drop-offs near shore, pot holes, stumps, weed-beds, and the formation and composition of the bottom. It is important to remember that bottom formations often change due to currents that cause erosion near the shore.

Environmental conditions will cause problems (refer to the chapters on ice characteristics and river characteristics), but often can be seen and taken into consideration. Unfortunately, the most dangerous condition, cold water, cannot be seen and can disable unsuspecting victims and rescuers. Cold water is identified as water below 70°F. This includes most waters during the spring and fall months, and year-round for many northern areas of the United States. Victims in cold water may not be able to assist in the rescue.

Choosing the Proper Rescue Procedure

When choosing a rescue procedure there is not one correct technique, but there can be wrong choices. The decision as to which rescue procedure to choose will depend on site conditions, the victim, equipment available, workforce available, and the rescuer's ability, experience, and knowledge. The rescuer's safety is the ultimate concern. If the rescuer is safe, a successful rescue will most likely be performed. The following rescue techniques are prioritized in the order that rescuers should proceed:

1. Self-rescue
2. Shore-based rescue
3. Boat-assisted rescue
4. Boat-based rescue
5. Go (swimming and wading) rescue

SELF-RESCUE

Self-rescue has two important components that must be considered; the ability of the victim to self-rescue and the ability of a rescuer to do the same.

When a rescue scene is first established, initiate immediate contact with the victim and maintain it for the entire rescue. Often victims have lost their lives because of the feeling that no one was going to rescue them. In many situations, a rescuer can talk the victim into self-rescue; however, hypothermia, environmental conditions, and other factors may make self-rescue impossible.

The first effort is to get some sort of flotation device, preferably a wearable PFD, to the victim. The rescuer must be ready to assist with safety backup equipment, such as ropes or extension devices needed to aid the victim.

During training in the self-rescue techniques, emphasis should be placed not only on skill development, but also on mental development to ensure that rescuers will not panic should they find themselves in need of assistance. Even a weak swimmer can become an excellent rescuer. Wear a PFD while learning and practicing all of the rescue skills.

Self-Rescue in Open Water

If a rescue boat capsizes and rescuers find themselves dealing with self-rescue, hypothermia is a concern. Persons immersed in cold water begin to lose body heat immediately. Close-fitting garments made of wool or pile prevent water from moving across the skin and washing away body heat, thus creating some delay in chilling. No matter what type of clothing is worn, the key to survival is to leave it zipped and fastened. This will provide buoyancy and help fight hypothermia. A person should spend as little time as possible in cold water.

If the rescuer spills in very cold water, severe pain in the lower abdomen will be experienced. It may not be possible to breathe for several seconds. It is common to gasp for air. When entering cold water, cover the mouth and nose to prevent the aspiration of water. The immersed person, faced with self-rescue, must remain calm and think clearly, and decide whether to swim to shore or stay with the boat.

Factors to be taken into account include water conditions, air and water temperatures, and the distance from the shore. In most situations, the decision is to stay with the boat because it floats. The average good swimmer is not able to swim very far in water that is 50°F before being overcome by hypothermia.

A swamped boat or anything else that will float can help a victim remain afloat, and can save human life. If the decision is made to stay with the boat, get as much of the body as possible out of the water as soon as possible. Remember, water is a heat conductor—it moves heat away from the body.

Occasionally, a victim is unable to grasp a flotation device in the water. It is important to remain as still as possible in this situation. Treading water or swimming cools the body at a rate about 35% faster than remaining still. To improve even that percentage, the victim should assume the fetal position, known as the Heat Escape Lessening Posture (HELP). This position will protect the body's major areas of heat loss, which include the head, neck, sides, and groin (see Figure 29).

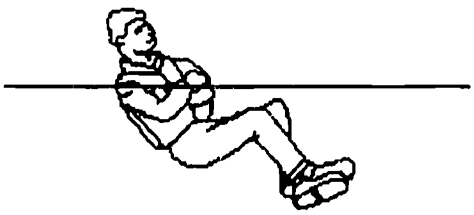


Figure 29. Heat Escape Lessening Posture (HELP)

The HELP can only be done while wearing a PFD. Some types of PFDs make this a difficult position to maintain; however, even a partial HELP position will increase survival time.

When three or more victims are in the water, a second option to increase survival time is to assume the "huddle" position (see Figure 30). As the name

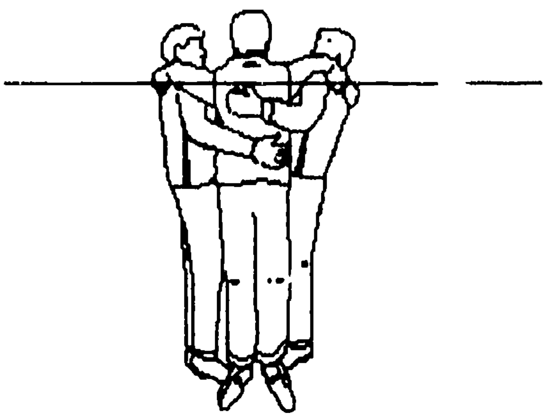


Figure 30. Huddle Position

implies, the victims "huddle" close together, side-to-side, in a circle. They protect their heads and sides by keeping their heads out of the water and their arms to the sides, and they protect their groins by crossing their legs. Young children or persons without PFDs can be placed in the center of the huddle to receive added heat from others in the huddle.

Self-Rescue on Rivers (Moving Water)

If a boat capsizes in fast-moving water on a river or stream, self-rescue requires the victim to move immediately to the upstream side of the boat. Then the victim should proceed with self-rescue, moving to shore by floating on the back, with the feet at the surface, angling the body at a 45° angle toward the shore (with the feet pointing toward the shore opposite the destination), and backstroking against the current (see Figure 31). The victim should always

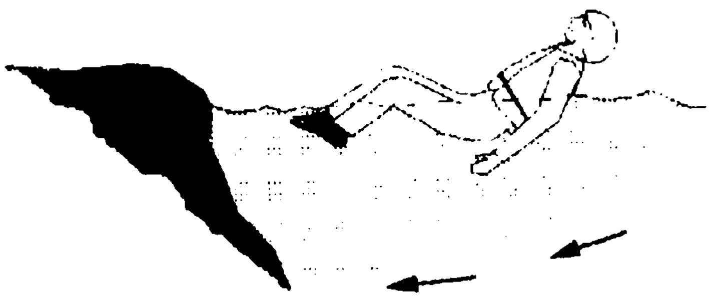


Figure 31. Self-Rescue Position in River

look downstream and avoid being carried into strainers or other hazards. The feet **SHOULD BE USED** to fend around rocks (see Figure 32). **Victims should never stand up in rivers or fast-moving water!**

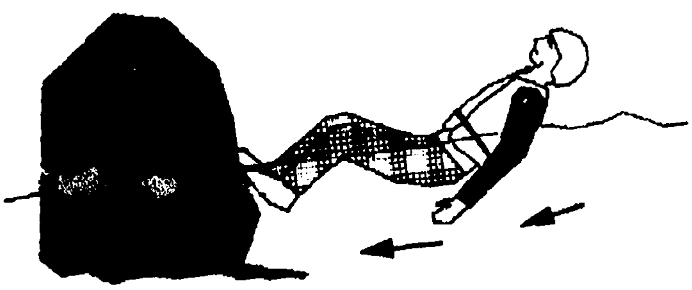


Figure 32. Rescuer Fending Off a Rock

Self-Rescue on Ice

Self-rescue from ice requires equipment such as ice awls, ice staff, car keys, nails, pens, or some other sharp object to help get a grip in the ice. Use a strong kicking action and alternately jabbing with the gripping device to ease out of the hole. Do not immediately stand up once out of the water! Slowly roll away from the hole to safety (see Figure 33).

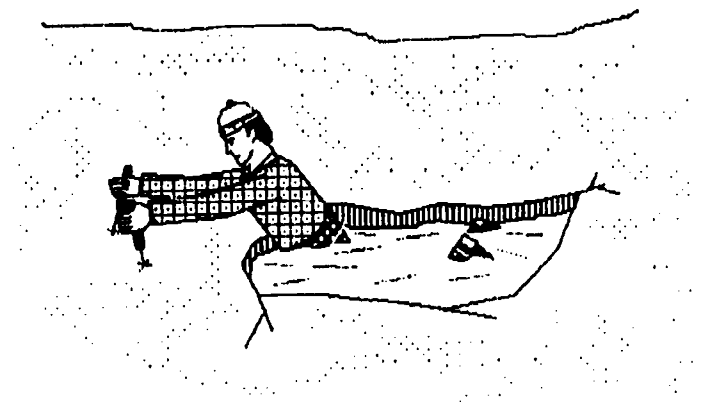


Figure 33. Self-Rescue With Ice Awls

If a rescue technique requires walking on ice, an ice staff can be used to test the quality of the ice. Walk on ice slowly and carefully. Use sliding steps to lesson the impact of each footstep. Never run on ice. Use the ice staff to identify the hard, resonant sound of good ice as opposed to the dead "thud" of bad ice.

Move forward slowly, tapping the ice with the staff in a semicircular pattern to test the ice thoroughly. When the ice sounds bad, turn the staff over and jab the ice with the spike. If the ice is slushy or breaks away easily, retreat to another route.

An ice staff can save a rescuer who is in danger of breaking through the ice. Hold the staff on a horizontal plane at chest level and lie down on the ice to distribute the weight evenly. This may prevent the ice from breaking. If the rescuer should plunge into the water, it is important to remain calm and use the staff horizontally to lift yourself out of the water or use the spike vertically to stab the ice to pull yourself onto the ice. Slowly roll away from the hole to safety (see Figure 34).

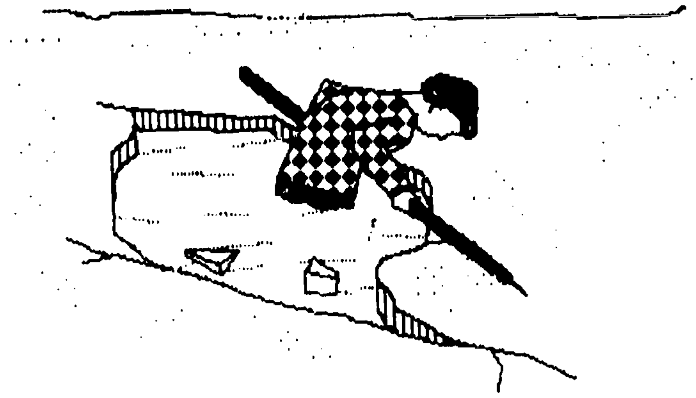


Figure 34. Self-Rescue with Ice Staff

SHORE-BASED RESCUE

Shore-based rescue techniques are commonly referred to as "reaching" and "throwing" rescues. The idea is to assist the victim without putting the rescuers in any danger. The techniques can be accomplished easily and quickly by one or two rescuers. Basic pieces of rescue gear or items that can be made inexpensively from materials on hand can be used.

REACHING RESCUES

Reaching rescues are accomplished by extending an item such as a pair of jumper cables, a branch, an ice staff, an ice cross, a ladder, a pole, a fire hose, or some other device to the victim. The rescuer's body position should be low or prone with a wide base on a stable platform. The rescuer's body position is important; the rescuer must not over-extend and end up in the water, or be pulled into the water by the victim.

Fire Hose Rescue. A fire hose and a pressurized air cylinder, which are standard pieces of fire-fighting equipment, can be used to make a water-rescue device. A fire-hose rescue tool can be easily transported and placed into service quickly, and requires a minimum number of rescuers for control. It requires approximately six seconds to fill a fifty-foot section of fire hose. Experiments have proven that a fifty-foot section of hose can support eight to ten people.

Fill the hose with air to make it rigid and buoyant. Any number of sections may be coupled together and pushed out into the river or lake, or onto an ice-covered body of water. The inflated hose can also be used to affect a rescue at a hydraulic created by a low-head dam. For more detail on fire hose rescue, see the section on water rescue equipment.

THROWING RESCUE

The throwing rescue technique is the most common and most frequently used of all the water-rescue techniques. Throwable flotation devices, throwing lines, and throw-bags are commonly used. Throwable flotation devices are usually considered U.S. Coast Guard approved Type-IV Personal Flotation Devices (PFDs), such as a ring-buoy or a throwable cushion. However, in an emergency, anything that floats may be thrown!

Throwing Line. A throwing line can be left as a coil of line or attached to a ring-buoy or throwing jug. The line must have inherent flotation properties so it does not sink away from the victim.

NOTE: In the following descriptions, reference will be made to *throwing hand* and *non-throwing hand* rather than to the "right hand" and "left hand".

All line-throwing techniques begin with the rescuer laying a coil of line in the palm of the non-throwing hand. When using a coiled line-throw, divide the coil equally, placing half of the coil in each hand. Remember to hold on to the opposite end. One other way to quickly secure the end is to stand on it. Never tie the end to yourself or any stationary object. Use an underhand motion for throwing. Keep the palm of the nonthrowing hand open to allow line to travel its full distance. With practice, coiled line throws are accurate and extremely quick, especially if a second throw is necessary.

Flotation Device. A ring-buoy or a jug (filled with water for weight) with a line attached can be used as a flotation device. Begin by placing the coil of the line in the palm of the non-throwing hand and the flotation device in the other hand. The line should land over the victim's shoulder with the device landing just beyond so the rescuer can pull it back to the victim.

Throw Bag. The throw bag is an excellent device for throwing rescue. The bag is made of nylon and holds approximately 70' of polypropylene rope (which floats) and an ethafoam flotation disc. When the rope is properly stuffed into the bag, a rescuer can make an exact throw to the victim.

The advantage of this bag is that it will feed out perfectly even if left in storage for a year. The bag can be thrown underhanded, overhanded, or sidearm, but the underhand throw is the most effective. If the first throw is not successful, use a second throw similar to the coiled line throw. Remember to always hold on to the line or stand on it. **Never** wrap the line around the hand, fasten it to the body or a stationary object. The throw bag is one of the most versatile devices used in rescue operations.

TAG LINE RESCUE

A tag line rescue is performed with a large flotation device connected by two lines and worked by rescuers holding on to the lines across a river, inlet, small pond, or quarry. The flotation device consists of a large ring buoy, Jim-buoy, inner tube, or other type of flotation device.

Connect the rescue device with the two lines. Take one of the lines and walk it or shoot it across the body or water to the other side to rescuers. Work the rescue device to the victim. Once the device reaches the victim, the victim should grab it to be pulled to shore by the rescuers (see Figure 35).

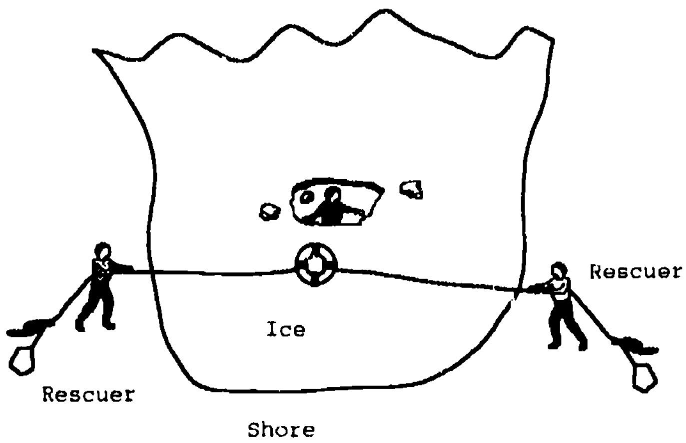


Figure 35. Tag Line Rescue

STABILIZATION LINE RESCUE

The snag-line rescue and stabilization-line rescue are both similar to the tag-line rescue. They are set up by getting a line stretched across a river, inlet, small pond, or quarry down-current from the victim. Both rescues are worked by rescuers handling the stretched line across the body of water.

The stabilization-line technique is used to help the victim keep his or her head out of the water until another rescue technique can be set up. It is commonly used if a victim has a foot trapped or is pinned vertically in the river (see Figure 36). Work

Figure 36. Stabilization-Line

the line from downstream and support the victim across the chest or back. Be careful that the line is not in a position to strangle the victim. Remember, the river current is powerful. Do not try to pull the victim out of the water with this technique. However, a victim can sometimes free himself or herself with the assistance of this line.

SNAG-LINE RESCUE

The snag-line is usually used in conjunction with t. tag line or stabilization line. The snag-line rescue is the technique used to free victims caught in foot ent apments and in vertical pinning situations. The line must be weighted in the center with rocks or diver's weights so it can be worked underneath the water and to the trapped victim.

When the line is underneath the victim and against the trapped body part, using a line from both sides of the river moving upstream, pull slowly and steadily. This should free the victim; however, if the current is too strong, or there are too many hazards downstream, or the victim cannot get free, another technique must be initiated (see Figure 37).

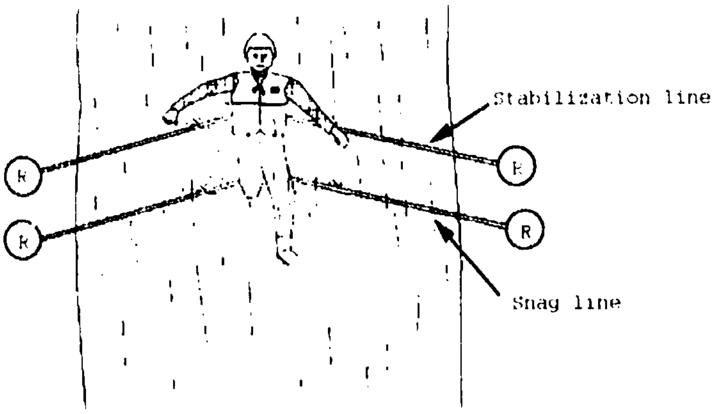


Figure 37. Snag-Line With a Stabilization Line

BOAT-ASSISTED RESCUE

It may seem logical when shore-based techniques fail to move directly to a boat-based rescue; however, first consider a boat-assisted rescue. Boat-assisted rescues are used on rivers, lakes, ice, and lowhead dams where access to the victim cannot be made from shore or by boat. In a boat-assisted rescue, use the boat to position lines, gear, and the rescuers. Once gear, lines, and personnel are in place, initiate a shore-assisted rescue technique for the actual rescue.

Boat-Assisted Tag Line Rescue

An example of a boat-assisted rescue is the tag line rescue at the hydraulic of a lowhead dam. In this situation, use the boat to transport rescuers and gear across the channel, but not for the rescue. On a small channel, the line can be thrown or shot across the water.

The tag line works well if the dam is less than three hundred feet long and there is access to both ends.

When using the tag line in a boat-assisted rescue, keep the boat downstream out of the danger zone of the boil (see Figure 38). Launch the boat and

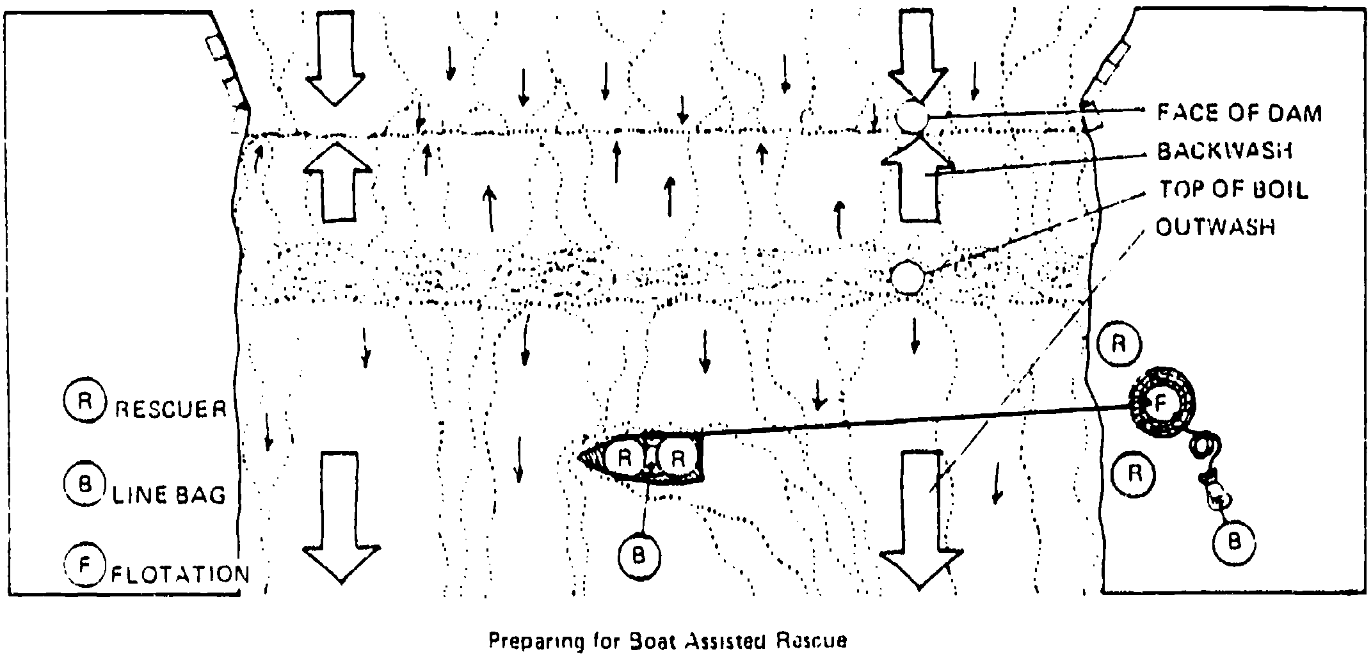


Figure 38. Boat-Assisted Tag Line

clip two lines to the rescue device. The boat operator and one rescuer should take the boat and one long-line bag (300 ft.) across the water to a clear landing spot. Do this as quickly as possible because the line in the water will create a tremendous load.

Once the boat reaches the shore, get a line on shore and out of the water quickly. A considerable effort will be required to pull the rope out of the water and upstream to the boil. Once the line is aligned with the top of the boil, pull the flotation device into the water and into the hydraulic. Work the device back and forth across the face of the dam until contact with the victim can be made. Preferably pull the victim to safety on the nearest shore.

Boat-Based Rescues

Boat-based rescues are fourth in the rescue sequence, which includes, boat-assisted rescues. In a boat-based rescue, the boat must go directly to the victim. Approach the victim slowly, and if he or she is conscious, make verbal contact explaining how help will be provided.

The next step is to extend a paddle or throw a Type IV PFD to the victim. Continue to talk the victim into self-rescue over to the rescue boat. In most cases, the victim will calm down when the rescuer establishes contact and gives him or her a flotation device.

If the rescue boat is a powercraft, turn off the engine before the victim approaches the boat. Putting the engine in neutral is not sufficient, because the propeller may still spin fast enough to severely cut the victim.

Have the victim approach the stern of smaller craft instead of the sides or gunwale. Small rescue boats can capsize if a panicked victim tries to enter on the side. If the victim is large, have him or her hold on to the stern. Other extrication techniques will be discussed in the water rescue techniques section.

NOTE: Remember, use other rescue techniques in conjunction with a boat-based rescue.

Rescue From Midstream Obstruction

When a boat rescue involves a midstream obstruction on a river, approach the obstruction from downstream or the side to avoid becoming pinned on its upstream side.

In the situation shown in Figure 39, the proper approach is from a diagonal ferry to the eddy formed alongside and behind the bridge pier. A careful extrication can be made from the logs if the logs are secure enough to hold the rescuer's weight. A line extended from above to the rescuer will provide a backup.

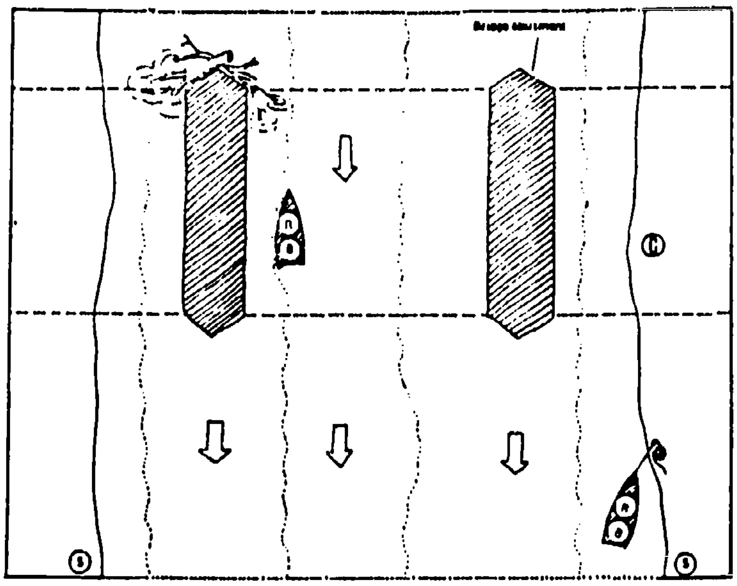


Figure 39. Rescue from a Strainer

Boat Belay Rescue

A river rescue situation might require the lowering of a boat to the victim because an approach from the side or downstream is impossible. Consider lowering a boat from a tree (a solid belay point) to the trapped victim (see Figure 40).

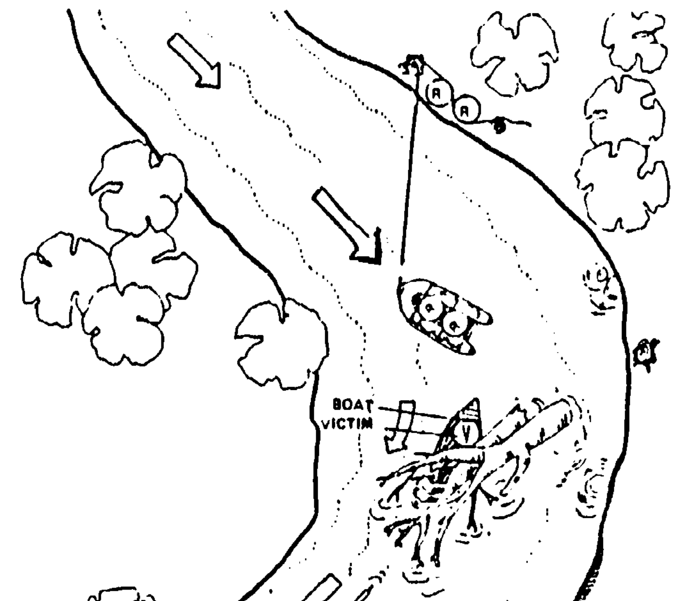


Figure 40. Boat Belay Rescue

A similar procedure might work on a straight channel if the boat is tethered to a static line across the water. By carefully controlling the lines and using oars or paddles, position the boat just upstream of the victim. After the victim has been extricated, pull the boat back toward the static line, and then ferry to shore (see Figure 41).

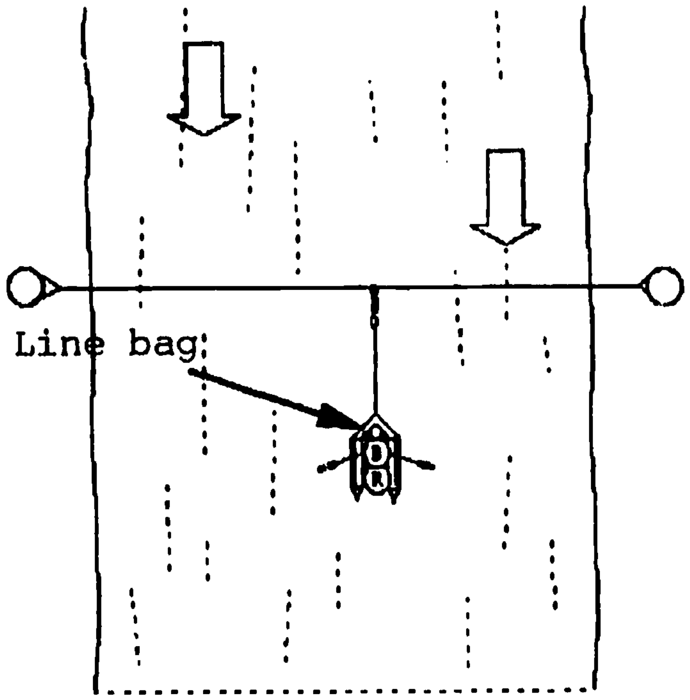


Figure 41. Static Line Lower Rescue

Moveable Control Point Rescue

In extreme cases, such as on the outside bend of a river, dropping a boat straight downstream may be impossible. As a boat drops down in the current, the water changes direction; thus the control point on the static line must also change. The rigging of the **moveable control point** then becomes necessary.

Place a static line across the river above the victim. Run line "A" through a fixed point, (which is usually a carabiner attached to a Prusik or Gibbs) on the other side of the river as close to shore as needed. Line A is then attached to the moveable control point (which is a pulley attached onto the static line with a carabiner and a steel ring). Then line "B" is attached to the moveable control point. Next, pass line "C" through the moveable control point and attach it to the bow of the rescue boat. By having a person or two on each line, rescuers can maneuver the rescue boat river right, river left, or up or downstream. A lot of teamwork is required to make this rescue procedure work (see Figure 42).

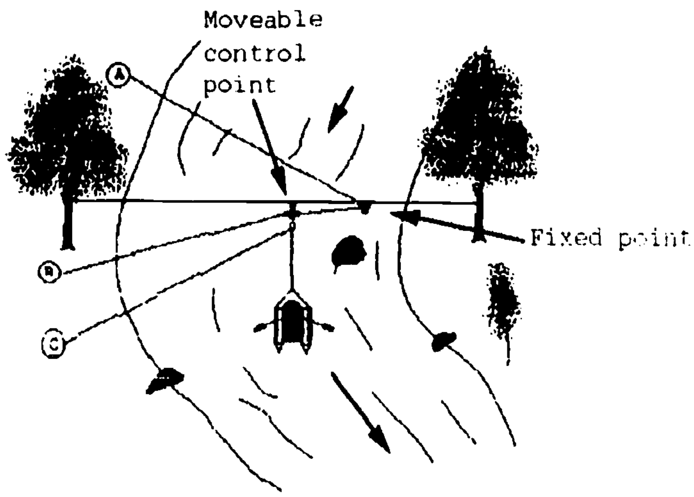


Figure 42. Moveable Control Point Rescue

The terms *river right* and *river left* used in this description refer to the left bank or right bank when facing downstream. All references to right or left are river right or river left.

When a dam is more than 300' wide, or when access to both sides is not possible, or it is impossible to stretch a line from one side to the other, the two-boat tether technique is an alternative rescue method. This method requires a crew to approach the boil from downstream with the primary rescue boat tethered to a second boat. The second boat should keep the first boat from being pulled into the boil and into the hydraulic while rescuers in the first boat attempt to throw a flotation device to the victim trapped in the dam's hydraulic. Both boats can maneuver left or right in the current as long as they move together, keeping the boats and line parallel to the current.

When performing a two-boat tether, it is important for each member of the team to know his or her job. The incident commander should stand at the boil line to signal both boat operators as to how far the primary boat is from the boil. **The primary boat should never cross the boil line.** Once the primary boat has reached the boil line, the primary rescuer should throw a flotation device to the victim. Backup rescuers should also be placed downstream of the dam (see Figure 43).

At this time, the tether line is belayed by a rescuer in the secondary boat. It should not be fastened because the rescuer will always be adjusting the line.

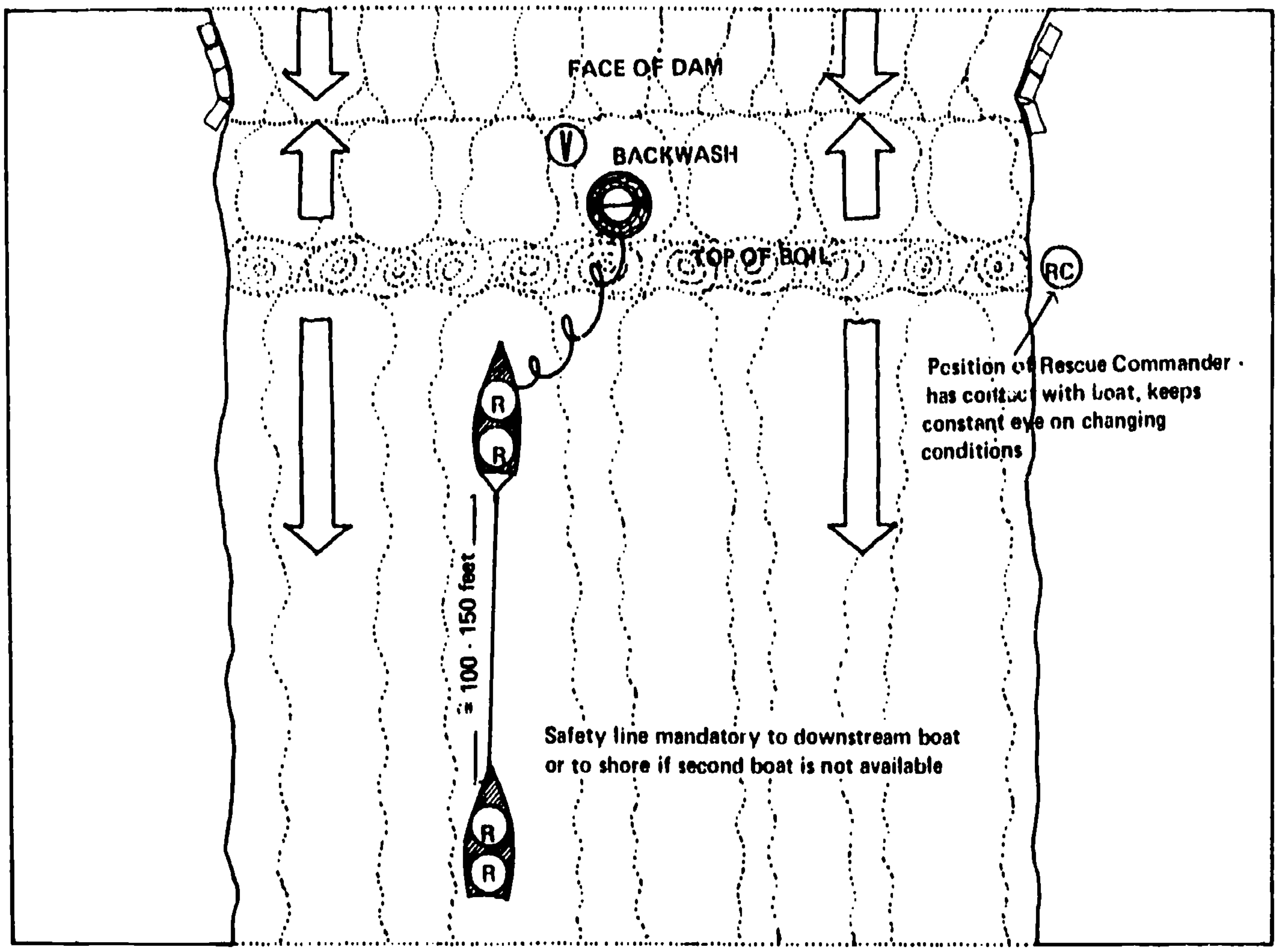


Figure 43. Two-Boat Tether

NOTE: In case an accident occurs, it is critical that the secondary boat be prepared to "peel out" (turn downstream, angling toward the shore) and cut across the current to pull the primary boat out of the boil. This maneuver uses the power of the motor and the power of the river on the side of the boat and on the drag of the line to help pull the primary boat. If peeling out does not work, fasten the tether line to the secondary boat and swamp it. The secondary boat can then act like a sea anchor and pull the primary boat downstream.

Ice Rescue by Boat

In an ice rescue, an inflatable boat, a rescue sled, and a small flat-bottom boat can be a great asset in performing a direct-contact with the victim. Two or three rescuers can slide the boat or sled over the ice to the victim. If the ice begins to break, jump into the boat and row, paddle, or push the boat toward the victim. The boat and the shore must always be connected by a safety line.

When approaching the victim with a boat, slide the transom to the edge of the hole. At this point, enter the boat and pull the victim aboard. Always use the transom as the point of entry for the victim since it provides maximum stability. Once the victim is aboard, the rescuers can either get out and slide the boat back to the shore or signal the safety backup personnel to pull the boat back to shore using the safety line (see Figure 44).

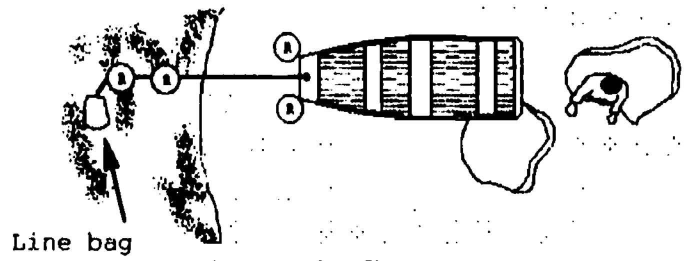


Figure 44. Ice Rescue by Boat

Airboats and hovercrafts are also utilized to perform water, river, and ice rescues. Do not forget to use proper safety precautions and follow the rescue sequence when incorporating these devices into the rescue operation. Know the equipment and its limitations.

GO (SWIMMING AND WADING) RESCUES

Swimming and wading rescues place the rescuer in direct contact with the victim and in a dangerous environment. The dangers of a go rescue make this technique the most hazardous of all rescues; therefore, a rescuer must realize that a go rescue should be attempted only when there is no alternative. In a go rescue, the rescuer must wear adequate cold-water protective gear and a PFD. The ultimate concern when performing this type of rescue is the rescuer's safety.

CONSCIOUS-VICTIM RESCUE

When a conscious-victim tow is performed the rescuer should be wearing a PFD, in addition to carrying another PFD (Type IV) or a lightweight, buoyant piece of equipment attached to a safety line. A backup rescuer should work the safety line from a boat or the shore. As the rescuer swims toward the victim, it is important to always watch the victim and talk to the victim.

When nearing the victim, stop swimming and reverse the body motions in case it is necessary to make a quick getaway. Shove the rescue equipment toward the victim and let him or her grab hold of it. During the process, back away from the victim. The victim may try to grab the rescuer because he or she appears larger and safer. Once the victim is calm and securely holding the rescue equipment, the rescuer should signal to the backup rescuer to slowly pull them to safety (see Figure 45).

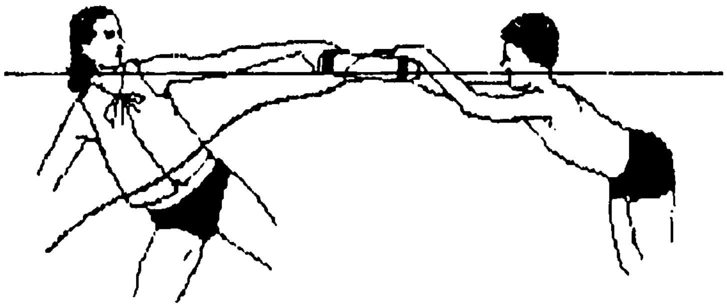


Figure 45. Conscious-Victim Tow

If the victim is conscious but cannot hold the rescue equipment, the rescuer can use a cross-chest carry, or secure the victim by the rescuer swimming up behind the victim and wrapping the arms around the victim and then to the rescue device. Even if the victim starts to struggle, the victim will not be able to harm the rescuer or get loose. The backup rescuer should then pull both the primary rescuer and the victim to safety.

DEFENSE TACTIC

Anytime a rescuer gets too close and is grabbed by the victim, escape can be accomplished by swimming underwater, taking the victim under as well. This action forces the victim to release the rescuer to return to the surface for air.

HAIR, COLLAR, OR PFD RESCUE

Hair, collar, and PFD tows can easily be performed on unconscious victims. In performing any of these tows, using the stiff-arm technique prevents the victim from grasping the rescuer. Remember to keep checking on the victim to be sure the head is out of the water and the victim is breathing (see Figure 46).

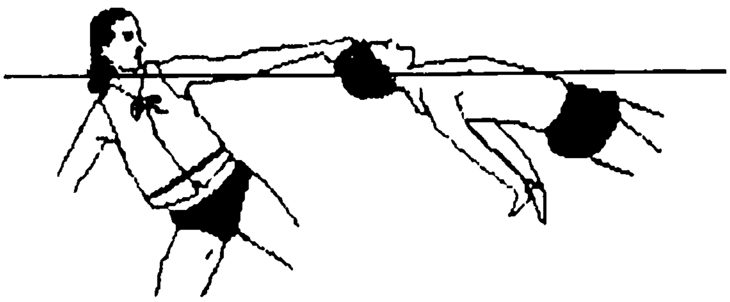


Figure 46. Hair Tow

MOUTH-TO-MOUTH RESCUE

The best rescue technique for an unconscious victim is the mouth-to-mouth victim tow. The rescuer must wear a PFD and carry a Type IV ring buoy with a safety line attached. Slide the ring buoy down the victim's arm to the shoulder. Then move to the victim's other side and the rescuer's arm closest to the victim's feet positioned over the victim's arm near the armpit and grab the ring buoy behind the victim's back.

This position frees the rescuer's other arm to pinch the victim's nostrils for mouth-to-mouth. The ring buoy also supports the victim's head. Now the primary rescuer can signal a backup rescuer to pull them slowly to safety! During the pull to safety, the primary rescuer can give the victim mouth-to-mouth resuscitation (see Figure 47)

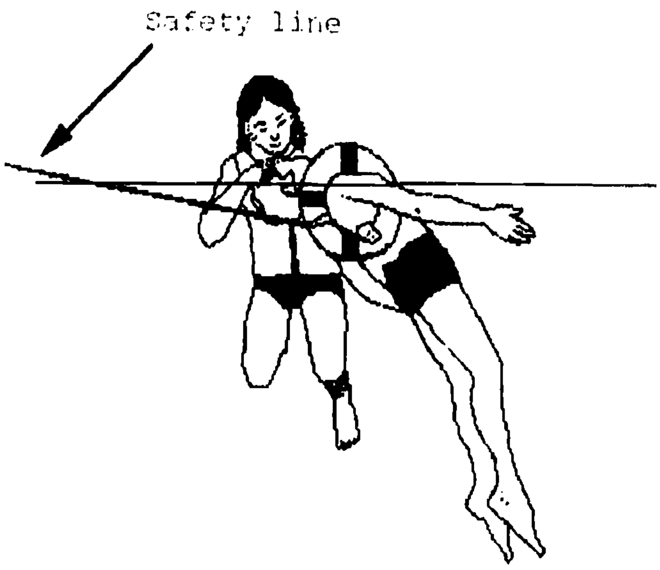


Figure 47. Mouth-To-Mouth Tow

ICE-GO RESCUE

The ice-go rescue technique is performed in a slightly different way than any other techniques. Wear a dry suit with a PFD or a U.S.C.G.-approved exposure suit. Wear a harness and a safety line with two figure-eight loops approximately 4' apart at one end. The rescuer should be fastened into the second knot (not the end knot) with a carabiner. A second carabiner should also be attached to the end knot so the rescuer can hold onto it (see Figure 48).

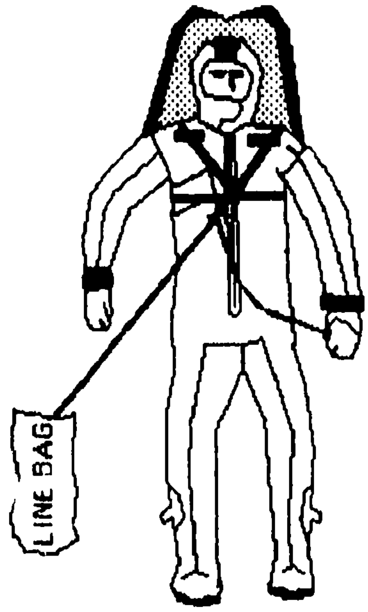


Figure 48. Setup for Ice-Go Rescue

Approach the victim from behind and run the carabiner and line around the victim's chest and under the arms. Clip the carabiner onto the line above the rescuer's knot. With this setup, the line will not constrict the victim's chest while being pulled to safety. When ready for tow, the primary rescuer should signal to the backup rescuer to pull them to safety. While being pulled to safety, the rescuer and victim should both float on their backs.

NOTE: Do not perform this rescue on rivers or water with a fast-moving current of any type during any season. A current can hold a rescuer under water even when he or she is attached to a line.

WADING RESCUE

A wading rescue can be used effectively in a shallow water situation or for an emergency river crossing when there is no alternative. The river current makes this technique very dangerous for the rescuer. Attempt this rescue only when wearing a PFD and cold-water protective gear, and carrying a bracing device.

Use a sturdy tree limb, pole, oar, or paddle as a bracing device. Use the bracing device to feel the bottom structure and also as the third point for triangular stability. This is important when working in moving water and when the bottom cannot be seen.

In wading into the water, use a sliding movement with each foot, and use the bracing device. Move slowly, moving only one triangular point at a time so as not to lose balance. Test each step for stability and security before transferring weight to that point. Always lean and push down on the bracing device, and face upstream or into the waves or current (see Figure 49).

Figure 49. Wading Rescue

If the victim is uninjured, place a PFD on the victim and have him or her wade to safety. To do this, have the victim stand directly behind the rescuer, holding onto the rescuer's PFD at the shoulder area, pushing down and leaning on the rescuer's body.

If the victim is unable to stand, a sling can be used to carry the victim on the rescuer's back (see Figure 50). However, to prevent further injury of the victim and for the safety of the rescuer, it is better to wait for boat assistance before moving the victim.

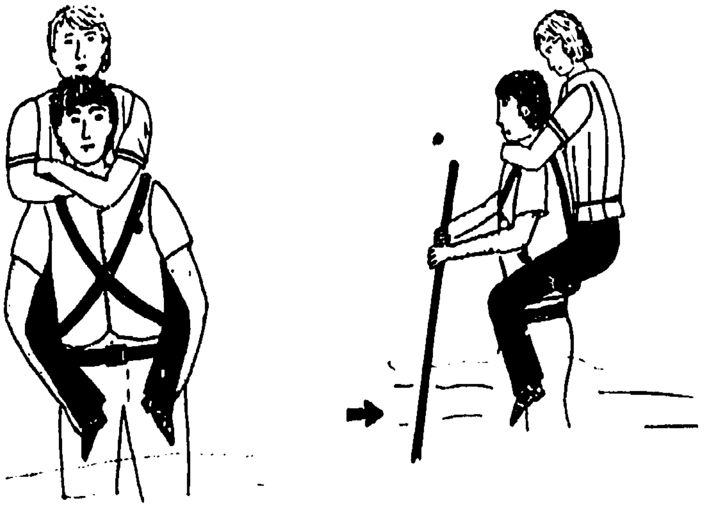


Figure 50. Carrying a Victim in a Web Sling

NOTE: If the rescuer or victim gets swept off their feet or falls into the water, they should immediately assume a self-rescue position.

RESCUING A VICTIM WITH A CERVICAL-SPINE INJURY

One of the most delicate water rescue situations is the victim who has suffered a cervical-spine injury. This victim may have fallen in shallow water or from a diving board, or may have been in a water accident involving a high-speed spill, such as water-skiing. The signs and symptoms of a victim with a cervical-spine injury from this type of accident include the following:

- Pain in the area of the fracture
- Loss of movement or feeling in the extremities
- Tingling in the extremities
- Deformity of the back or neck
- Absence of respiration

It is important to handle a victim with a possible cervical-spine injury, carefully and not induce further injuries. Such injuries can be caused by excessive movement in the water if rescuers jump into the water too near the victim, by fast swim strokes, or by the boat wakes upon approach to the victim. Clear the area of all swimmers and boat traffic as quietly and quickly as possible.

HEAD AND CHIN SUPPORT AND VISE-GRIP TECHNIQUE

The head-and-chin-support method taught by the American Red Cross, and the vise-grip technique are the only techniques recommended for use with a face-up, face-down, or submerged victim suspected of having a cervical spine injury. A rescuer must have practical training before performing these techniques. The only difference between these two techniques is the placement of the victim's arm. The head-and-chin support is done with the arm alongside the victim's body and the vise-grip technique is performed with the arm up and out of the way. The rescuer must wear a PFD while performing these procedures (see Figure 51).

Approach a victim lying face-up from the side. Place one forearm on the victim's sternum and the other arm on the victim's spine. Support the head by cupping the victim's chin and the back of the skull. It is important that the pressure is placed on the chest and spine, not on the head!

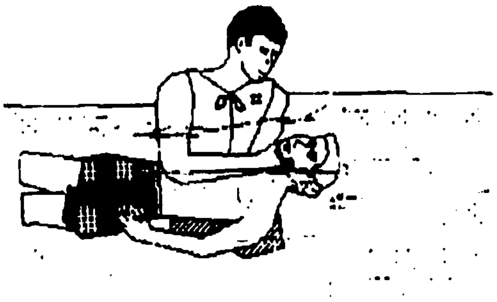


Figure 51. Rescuing a Victim Face up, C-spine Injury

A cervical-spine-injury victim lying facedown in the water will have to be turned faceup. Approach the victim from the side, and position the victim's arms up and out of the way or beside the body. Submerge underneath the victim and rotate the victim from below toward the rescuer. Be careful not to lift the victim's head out of the water while performing this technique (see Figure 52).

NOTE: This technique is difficult to perform while wearing a PFD, but the PFD is important for the rescuer's safety, especially when supporting the victim in deep water. This technique must be practiced regularly.

The cervical-spinal handling techniques described are to be used only while the victim is in the water. Before removing the victim from the water, secure him or her to a backboard (see the chapter on patient care and handling). It is important to follow the local protocol when performing this procedure.

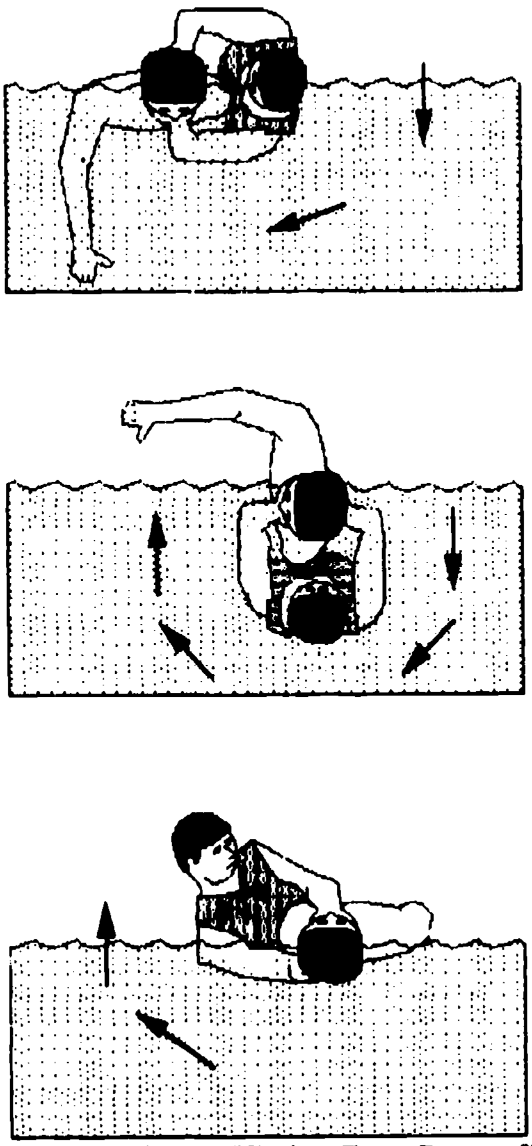


Figure 52. Rescuing a Victim Face Down, With a C-Spine Injury

EXTRICATING THE VICTIM FROM THE WATER

Rescue operations performed in shallow water are usually the simplest. This is also true when removing a victim from the water. Occasionally rescue and extrication procedures must be done in deep water. These conditions include areas of heavy surf, or areas far from shore, or when shallow water areas are not available. If possible, to simplify the rescue and reduce further injury, move the water-emergency victim to shallow water, especially if cervical-spine injury is suspected.

When using a small rescue boat such as a jon boat or a rowboat, with or without an engine, caution is necessary. Rescuers and victims should always enter the craft from the stern (back of the boat) since such crafts are easily capsized, especially if a panicked victim tries to enter from the side of the boat. Also, if the boat has an engine, the motor must be shut off before anyone approaches the boat.

Double-Bounce Technique

The double-bounce technique can be used to get an unconscious person into a small boat. Working from the transom, grab the victim's wrists or armpits and bounce the victim two times in the water. On the second bounce, pull the victim to waist high and into the boat. The buoyancy and displacement of the victim in the water will help propel him or her up into the boat. Once the victim is at least waist high on the transom, continue pulling and rotating the victim sideways and onto the back, allowing the victim's body to slide into the boat (see Figure 53). **NOTE:** Do not bounce the victim so hard that the victim's head goes under water.

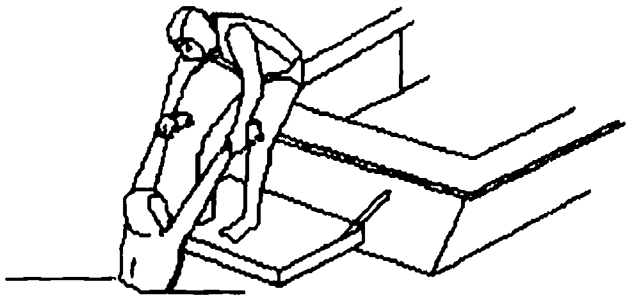


Figure 53. Double-Bounce Technique

Stirrup Technique

A stirrup can be used to help a conscious victim get aboard a boat. The stirrup is a line fastened to the top of a gunwale or transom with several loop stirrups tied down the line. The length of the line with loops should correspond with the height of the transom or gunwale. A victim can climb the stirrups just like a rope ladder (see Figure 54).

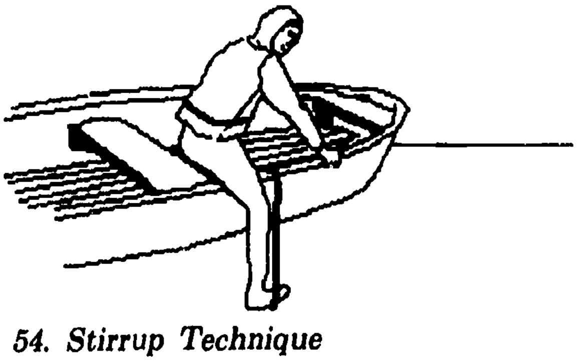


Figure 54. Stirrup Technique

Rope-Step Assist

Another type of conscious victim entry is the rope-step assist. String a line across the transom, draping it down to the surface of the water. A victim can step on the line and into the boat (see Figure 55). NOTE: The line may also be draped from bow to stern; however, caution must be taken to be sure the boat will not capsize while the victim is stepping into it.

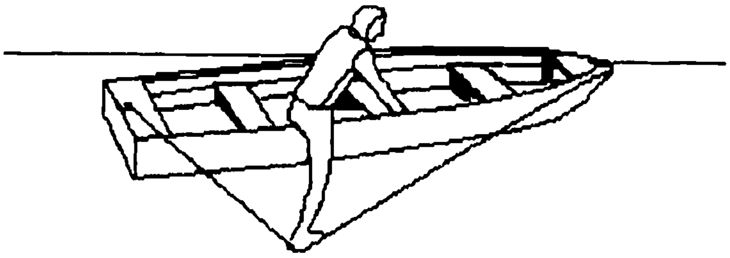


Figure 55. Rope-Step Assist

Unique problems are present when trying to move a victim from the water into a large boat with high sides. There may be a problem whether the victim is unconscious or conscious. A qunwale cutout or a sturdy swim platform on the boat at the water level can overcome this obstacle. Unfortunately, this apparatus is not always available on a rescue craft.

A ladder will also work in most situations, except when dealing with an unconscious or an extremely overweight victim.

NOTE: In all situations, the engine must be turned off so the person approaching the boat is not cut by the propeller. **(Putting the engine in neutral is not acceptable!)**

Blanket-Roll Technique

The blanket-roll technique is simple and uses equipment that is readily available. A pulley arrangement shown in Figure 56 gives a mechanical advantage of two-to-one, meaning the force required to lift a weight is only one-half that of the object being lifted (see Figure 56).

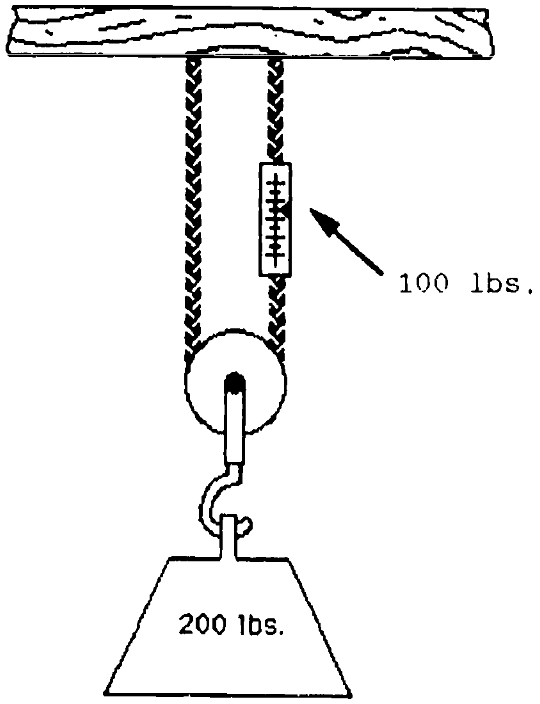


Figure 56. Pulley Diagram (Weight Outside Pulley)

The same mechanical advantage applies if the weight is concentrated in the pulley itself in the manner shown in Figure 57. If a 200-pound victim is placed into a rescue net or blanket, and two people are used to roll the victim upward, the result is that 100 pounds will be divided between rescuers, requiring each to pull only 50 pounds (see Figure 57).

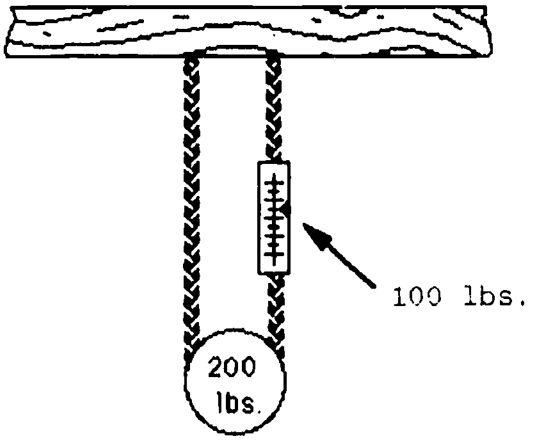


Figure 57. Pulley Diagram (Weight Inside Pulley)

Position the victim in the blanket or net while it is in a slack position. Secure the top of the blanket or net to the gunwale. This can be done by tying it or standing on it. If the victim is unconscious, tilt the head slightly upward while the victim is being rolled upward onto the boat. This allows the water to drain away from the face.

This technique will work using almost any boat, no matter what size, and from a dock or bulkhead. In an emergency situation, lines can be adapted and used for this technique (see Figure 58).

Even though the blanket roll is an effective rescue technique, it should not be used when handling a victim with a suspected cervical-spine injury. Research in handling techniques is being continued. Two other techniques can be used that can simplify removing victims with suspected cervical-spine injuries.

The first technique involves using a 12′ - 14′ ladder

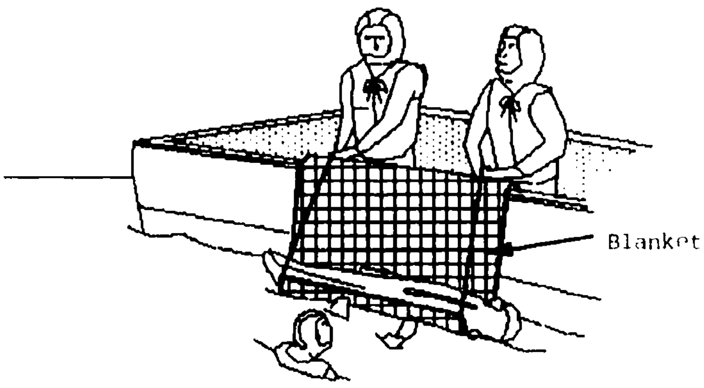


Figure 58. Blanket Roll

placed next to a pool deck or dock. Once the victim is secured to the backboard, move the board onto the ladder and position it on an incline. Ropes may be needed at the top of the board for guidance from shore. When the victim is on the ladder, pull it closer to the fulcrum point of the ladder and the edge of the deck. This will make it easier to tilt the ladder into a flat position. Care must be taken to keep the ladder from falling (see Figure 59).

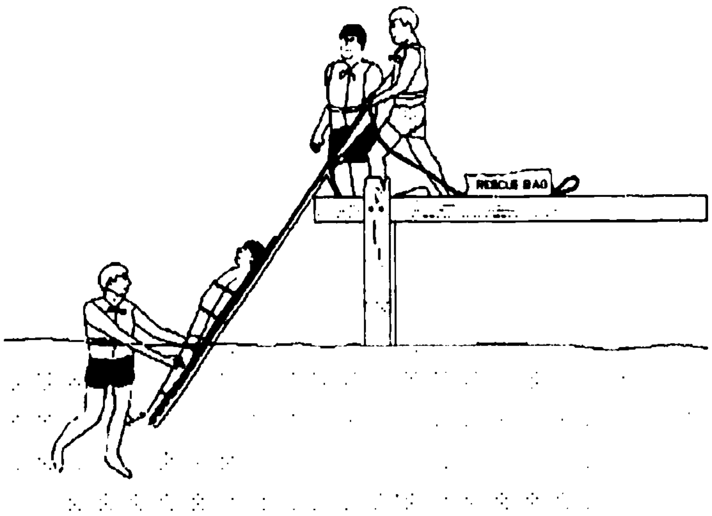


Figure 59. Removing a Victim With a Suspected C-spine Injury From the Water

Dealing with a victim in the water with suspected cervical-spine injuries can be extremely difficult. Backboarding and extrication techniques must be practiced to gain adequate skills, especially in rescuing from deep water.

The second technique that can be used for extricating victims with suspected cervical-spine injuries involves a slanted ramp. Once the victim is secured to the backboard, pull the backboard up the ramp onto the boat (see Figure 60).

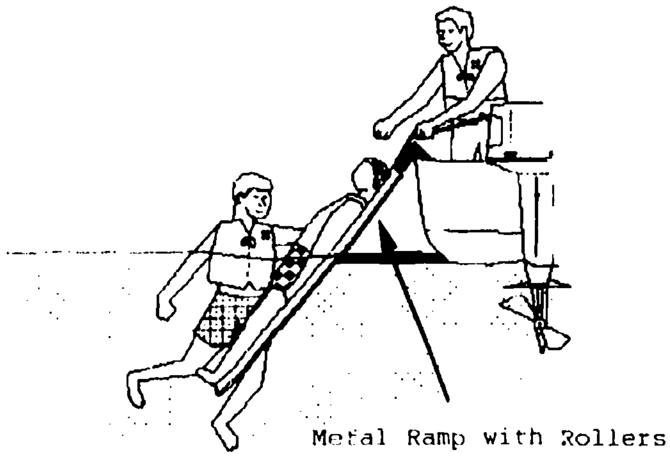


Figure 60. Moving a Victim With a Suspected C-spine Injury into a Boat

This technique has been successfully used to rescue victims injured at high-speed hydroplane races; however, carrying this bulky piece of equipment can present a problem.

CONCLUSION

The water rescue procedures presented in this text are designed to be simple, safe, and effective. Even though some of these techniques may appear simple, continuous training and practice is strongly encouraged. The techniques presented are not for the novice. As with all rescue procedures, improvisation is often required. To ensure the safety of rescuers and victims, careful thought must be given in all rescue operations and the rescue sequence must be followed.

WATER RESCUE/RECOVERY OPERATIONS

INTRODUCTION

The key to success in any water rescue/recovery is to act quickly and in an organized manner. An organized search must have a strong incident commander who is capable of making a safe and correct decision while under pressure and when time is a critical factor.

A drowning victim can survive a 60-minute submersion and still make a full recovery. When a victim is submerged more than 60 minutes, a rescue usually becomes a recovery operation. If submersion time is unknown, the operation should be treated as a rescue operation until 60 minutes have passed, at which time the search becomes a recovery operation.

If a body search proceeds for several days, more than one incident commander may be needed. It may be necessary for search personnel to work in shifts, with an incident commander present at the scene throughout the entire search. The commander should remain mobile and be capable of directing the search from either land or water. Too many boats or too many people acting as leaders can hinder a rescue or recovery mission.

A determination needs to be made as to which agency is responsible for the rescue or the body recovery. It may be the sheriff's office, the rescue squad, the fire department, or park district personnel. NOTE: One solution is to let the first agency to arrive take charge, unless that agency opts to turn the responsibility over to another agency.

BODY LOCATION

For rescuers involved in water-rescue operations, it is advantageous to know what happens to the body when a person drowns. Medical experts agree that most victims' lungs fill with water when a drowning death occurs. Once there is little air left in the lungs, the body sinks to the bottom. This sinking can occur quickly or be a slow process, depending on such factors as air and water temperature, the clarity of the water, the season of the year, the water current, the wind velocity, the clothing worn by the victim, and the victim's physical condition. Various combinations of these factors, can cause the body to take minutes or hours to reach the bottom. Heavy victims, small victims, and victims wearing several layers of clothing may tend to float on the surface for a long period of time.

A body will rise to the surface when enough gas is formed in the intestinal tract to make it buoyant. The length of time this takes depends on the water temperature and the stomach contents. In the summer, the average rising time ranges from eighteen to seventy-two hours. If the water is very cold (38°F year round), a body will become suspended indefinitely. A body will rise gradually as more gas is formed in the intestinal tract, thus making it more buoyant. If the victim's stomach is full at the time of the drowning and the water is warm, gases will start to form within hours. If the victim consumed alcohol, excessive gas formation will occur in a short period of time.

A drowning victim will remain in the vicinity where the drowning occurred. Experts agree that a drowning victim will be found in a circular area with a radius equal to one-and-one-half times the water's depth. Once a body has surfaced, the current and wind velocity can affect its location. In a river, a body is usually carried to the first eddy or strainer downstream (see Figure 61).

STAGING WATER RESCUE/ RECOVERY OPERATIONS

To make a successful water rescue or recovery, an evaluation of the scene must be done at the drowning

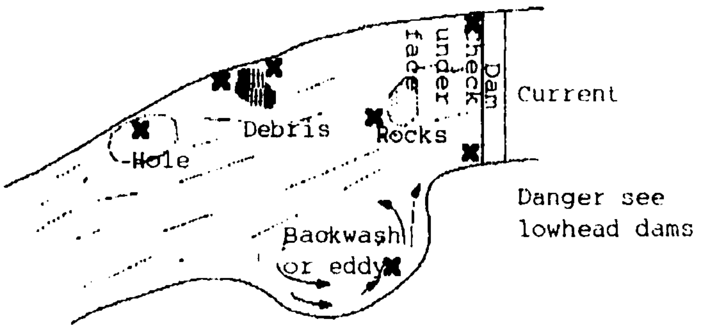


Figure 61. Search Locations for Victims

site. The incident commander must consider the following factors:

- How long the victim has been submerged.
- Where the victim was last seen.
- How the victim was dressed.
- Knowledge of the lake or river bottom and the
  - Current
  - Snags and obstructions
  - Depth and width of water
  - Terrain (flat, hilly)
- Details from people who witnessed the drowning, such as time, location, when and what the victim ate or drank, and other pertinent details.

When this information has been gathered and assessed, the incident commander should have a rescue or recovery team ready. This team should include law enforcement personnel to keep bystanders away from the scene, divers, water patrol personnel, park or wildlife authorities, and competent boat crews who are familiar with the area. Mark the area that is to be searched with buoys to protect the search team and the victim.

SEARCH METHODS

Searching the water for a drowning victim is hard work. Dragging and probing with grappling hooks or pike poles are the most common methods used to locate a body. Sonar graphs are also becoming popular with rescue personnel.

Before beginning the search, mark the probable location of the drowning victim, using large, brightly-colored buoys at each corner of the search area. Search boats should cover an area no greater than 100 yards long and 50 yards wide at one time. Whenever the body is thought to be located, immediately mark the spot with a buoy, and put divers in the water to investigate the location. If no body is found, continue searching the area.

There are many different search patterns used for rescue and recovery operations. It is important that rescuers use the technique with which they are most familiar.

Human Chain

A shallow-water search can be done by using a human chain (see Figure 62). The human chain should not be used on ice, in deep water, or in rivers or other fast-moving water. This search method is usually used at beach areas. Rescuers should link arms or hold hands and wade across an area in a line formation. Rescuers should sweep the bottom with their feet while moving through the water. The human chain line should not go beyond chest-deep water.

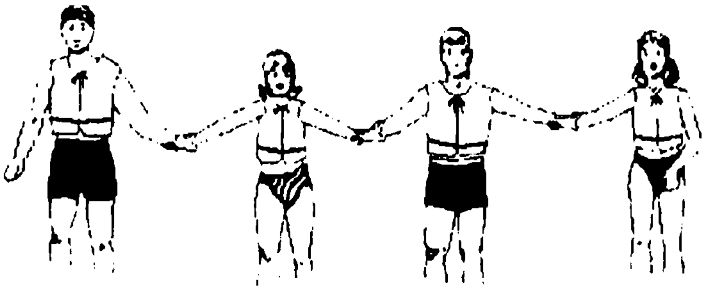


Figure 62. The Human Chain

When water is over chest-deep, rescuers will need to conduct the search operation from boats, using sonar graphs, grappling hooks, or divers. Several factors need to be taken into consideration when performing a search from a boat.

- Try to search with or against the current. Crosswinds make it difficult to search in a straight line.
- Always overlap the search pattern. Overlap is needed to search the drop-offs, ledges, debris, and other places that may be difficult. If a search is centered in an area with drop-offs, establish several cross-search patterns.
- The boat operator should motor or row the boat at the slowest speed that allows rescuers to graph the bottom or to keep the drag hooks on the bottom of the lake or river. The rescuer using the drag hooks should kneel on the stern seat of the boat and operate the hooks. Gloves should be worn by the rescuer handling the lines. Handhold the lines at all times so it can be noted if an object has been hooked.

The procedure for grappling for a body with a pike pole (see equipment section) is different than when using the dragging method. Hold the pole in a vertical position and probe the bottom using up and down strokes. This probing allows the rescuer to feel what is being struck on the lake bottom. This procedure is used in a water area with a stumpy or debris-filled bottom.

The Circular Search. One search method that can be used in deep water is the circular search pattern (see Figures 63 and 64). Establish an anchor point on land or water to secure a line. As each circular search is made, let out more line and do another circular search. Make knots or marks in the rope to mark locations and avoid losing position. Remember to overlap between sweeps, using buoys to mark the area being searched.

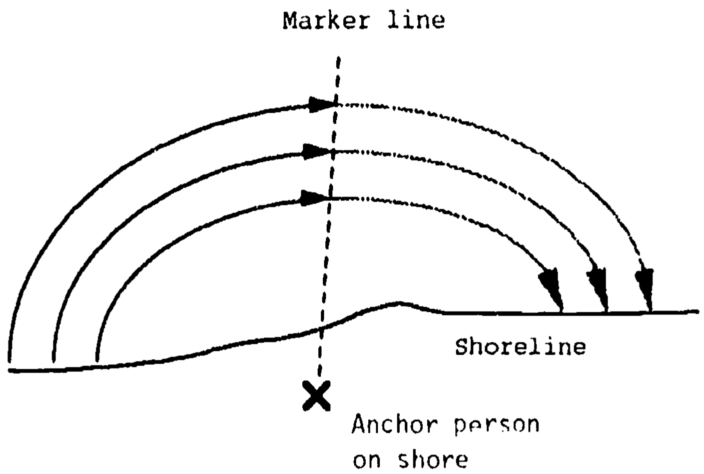


Figure 63. Semi-circular Search Pattern

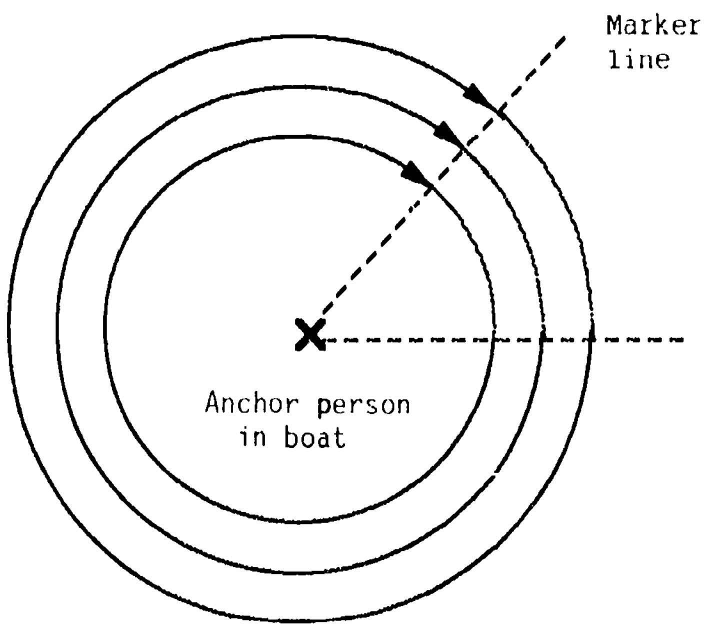


Figure 64. Circular Search Pattern

The Line Search. Line searches are used when the approximate location of the victim's body is known. Run the search legs parallel to the long side of the search area (see Figures 65 and 66). Each search leg should be one over from the other one.

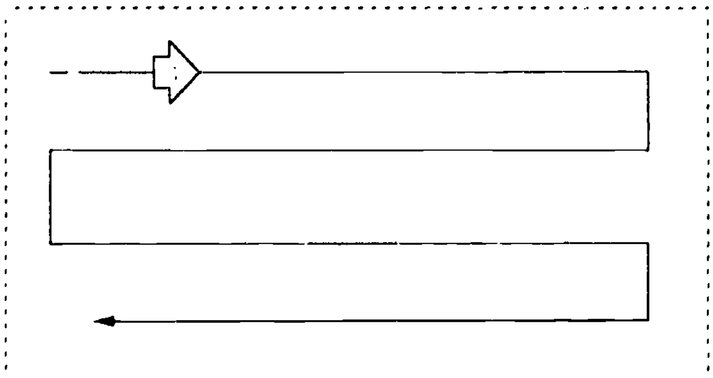


Figure 65. Parallel Track-Line Search (single boat)

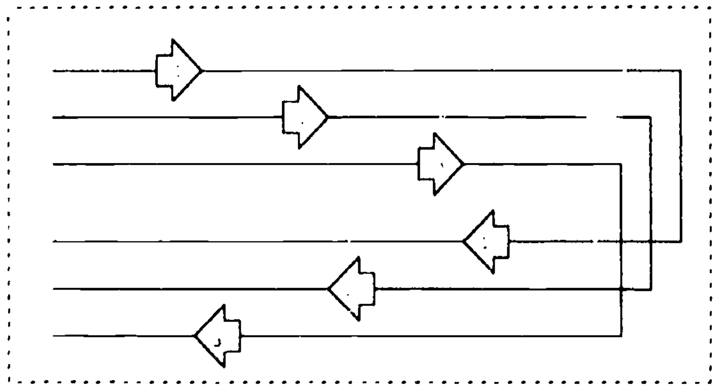


Figure 66. Parallel Track-Line Search (several boats)

The Expanding Search Pattern. Use the expanding-square search pattern (see Figure 67) when the last-known position of the victim's body has been identified with a high degree of accuracy. Conduct the first search leg in the direction of the water current's drift. All course changes should be 90° to the right.

The Sector Search Pattern. Use the sector search pattern (see Figure 68) when the exact location of the victim's body is known. This pattern resembles the spokes of a wheel and covers a circular search area. The location of the victim's body should be at the center of the wheel. Mark this spot with a buoy. The search boat should pass through the center of the area several times, each time increasing the chances of finding the victim.

Searching for victims in a river is more difficult than searching a lake, quarry, or pond. Always conduct shoreline searches first. Often the body is lo-

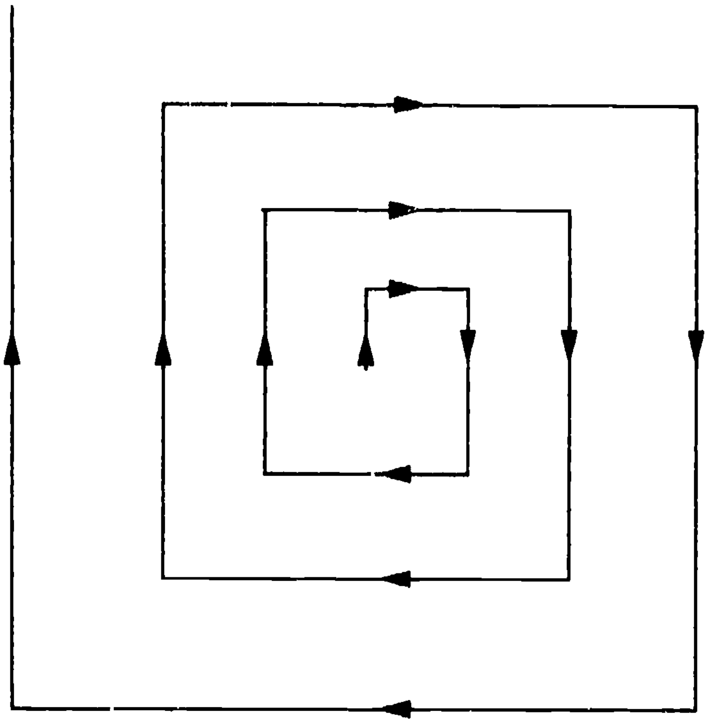


Figure 67. Expanding Square Search Pattern

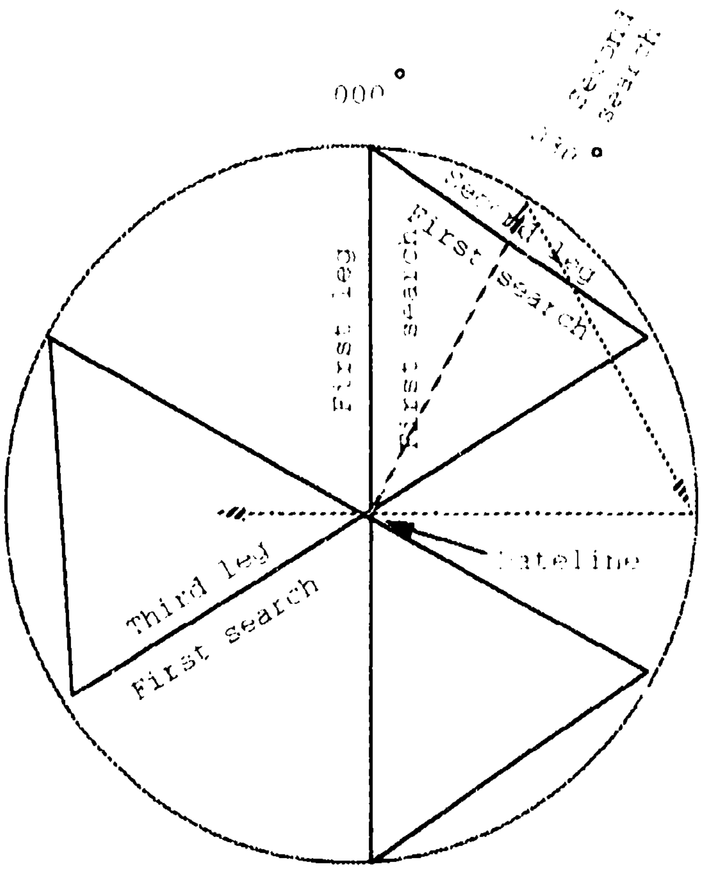


Figure 68. Sector Search Pattern (single boat)

cated in the first strainer (debris) or eddy (slackwater) downstream. Use a pike pole to search the strainers.

The easiest river dragging method is to put a safety line across the river (see Figure 69), attach the rescue boat to the safety line, and move the boat slowly across the river. The rescuer should be positioned in the rear of the boat while dragging. The boat can then be moved upstream or downstream depending on the victim's location.

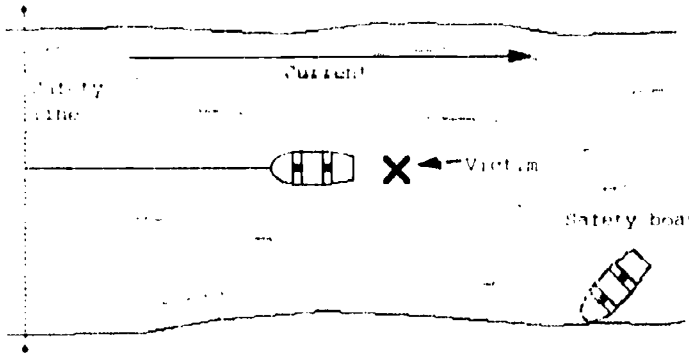


Figure 69. Dragging a River

SAFETY GUIDELINES FOR WATER RESCUERS

Water rescue personnel must wear personal flotation devices at all times. There are no exceptions.

Boats used in recovery operations should be large enough to hold at least three people: two rescuers and the victim. Each boat should be operated by a competent, knowledgeable rescuer. The operator should be in constant two-way radio communication with the incident commander. The operator should also be familiar with the water area. Qualified divers should be on standby in case diving services are needed.

Keep all other boats out of the search area. Recreational boaters can cause hazardous conditions, especially if there are divers in the water. Boaters can also cause distracting wakes that can alter the course of the search.

The safety of the rescuers is the number one priority. Each team member should recognize and acknowledge his or her limits. NO ONE should enter the water unless trained in lifesaving procedures. Even then, rescuers should go into the water only if the victim can be seen alive.

If a drowning victim is recovered within one hour, start uninterrupted, aggressive CPR immediately. Transport the victim to a medical facility as soon as possible.

DIVE OPERATIONS

KEY POINTS

- **Importance of being prepared for dive operations**
- **Importance of dive-operations training**
- **Interviewing witnesses after an accident**
- **Search patterns**
- **Caring for the recovered victim**

INTRODUCTION

In any geographic area where bodies of water are found it is important to preplan for dive rescue in possible drownings. Organized training in water rescue is important not only to the safety of the general public, but also to the safety of the rescue personnel.

Rescue divers can be an asset to any public safety service department, even when its own members have been trained in rescue operations using Self-contained Underwater Breathing Apparatus (SCUBA). The time to preplan for dive rescue is in advance of a problem, not when a possible drowning is reported. Rapid deployment, underwater search, and rescue dive training require very specialized training.

When SCUBA diving first became popular, many divers died due to inadequate training, making it difficult for divers to obtain life insurance. In an effort to increase the safety of dive rescuers and decrease the number of deaths, the diving industry implemented a policy that in order to buy dive gear, a person must show proof of certification. Most dive shops will not sell SCUBA regulators to or fill air tanks for a diver who is not certified.

DIVE OPERATIONS TRAINING

Training is available from many sources, including the United States Navy, Professional Association of Diving Instructors (PADI), National Association of Scuba Diving Schools (NASDS), National Speleological Society (NSS), YMCA, and Dive-Rescue Specialists, Inc. To obtain information about training, check with the nearest dive shop or dive team.

The effectiveness of any diver is dependent on training and previous experience. Diving proficiency requires more than a basic SCUBA certification card ("C card"). Obtaining the "C card" is just the starting point.

For example, the PADI certification levels are as follows: basic SCUBA diver, open-water diver, and advanced open-water diver. After completing advanced training, divers should take specialty courses such as Search and Recovery, Rescue Diver, Night Diver, Ice Diver, Underwater Investigation, Wreck Diver, Underwater Photography, Cavern Diver, Dive Master, Medic First Aid, Deep Diver, Master Diver, and Dive Instruction. Some dive-rescue teams require a diver to have training in advanced open-water diving with a search and recovery, or to have a rescue-diver rating before they issue a pager or place him or her on the ready-to-go list. Most diving teams will not use a diver at night or under ice until he or she has a "C card" and diving experience.

Before a diver enters a submerged aircraft, bus, truck, boat, ship, or auto, he or she must have training in ice diving, wreck diving, and cavern diving. All divers should participate in practice dives at least once a month. During diving practice it is important to study the water areas in all seasons, and under varying weather and water conditions, including high water, low water, and ice. Divers should be able to recognize conditions that are unsafe for diving, such as moving ice jams and fast current. Training and experience give a diver the knowledge to judge whether the water and weather conditions are acceptable for dive operations.

RESPONDING TO THE SCENE

If divers can respond to a drowning scene quickly, do not attempt drag operations. Drag hooks will ruin whatever visibility of the bottom may be present. Without rescuers realizing it, drag hooks can hook a victim and drag a body completely out of the search area.

A more productive rescue attempt will initiate the following sequence: interview witnesses, set up a command post, alert a standby medic helicopter, and call divers. Time is a critical factor in water rescue operations. Once a victim slips beneath the surface, the rescue requires diving operations. Do not wait until a victim disappears completely before dispatching divers. A call can always be cancelled.

Surrounding boaters may be used to assist a water rescue on a heavily used waterway; however, too many boaters can become a problem. A victim may survive the water immersion; however, he or she may not survive being chewed up by a propeller. Boat traffic must be maintained by cordoning off the search area with buoys and lines.

INTERVIEWING WITNESSES

Bystanders often want to contribute information as to where the search should be conducted. Such information can be helpful. A few minutes spent interviewing witnesses may save hours. It is possible for a person to come forth who witnessed the disappearance and had left the scene to call for help, or who did not realize anyone was missing until later, and has returned to the scene. Often, efforts are made to keep bystanders back or send them home. Remember, these people might be valuable witnesses. When they leave, the information needed goes with them. It is better to ask them to tell rescuers what happened.

Public safety personnel should conduct the witness interviews. Keep in mind that an interview is a conversation with a purpose. Do not begin an interview without checking to see if the person has already been interviewed. It is also important to interview people as soon as possible, before they leave the scene.

Remove the witness from any distractions (noisy equipment or a crowd). It may be necessary to move to a car or someplace free of interruptions.

Identify yourself, explaining who you are and what rescue attempts are being made. Be friendly; do not act bored or arrogant. Courtesy is a must. Act in a professional manner. When interviewing a child, consider the age of the witness and talk to the child on his or her level.

Interview one witness at a time. Take any information to the command post or directly to the divers as soon as possible. Witnesses must have been present when the event occurred. For the witness's accounting to be accurate, the witness has to have been alert (not asleep) and paying attention to what happened. Check to see if the witness wears glasses, and whether he or she was wearing them at the time of the incident.

Typical questions include the following: "Where were you located when the event occurred?" "What drew your attention to that area?" and "Where did you see the victim disappear?" Avoid asking questions that can be answered with a yes or a no.

Let the witness tell the story uninterrupted. Take notes recording exactly what is said; if possible, use a tape recorder. Listen carefully for changes in the witness's story. Be sure to check if anyone else was around when the accident occurred.

A check can be made to see how attentive the witness was by asking, "What was the victim wearing?" "What color clothing?" "What color was the victim's hair?" Ask the witness to indicate where the victim was last seen, aligning the location with reference points on land. If possible, have the witness estimate distances; however, remember that witnesses commonly estimate distances incorrectly. Check the distances stated.

Witnesses may have been anchored at a given point near a swimming buoy and remember seeing a person dive into the water and not surface. It can be helpful to draw a map noting landmarks and have the witness identify on the map where the victim was last seen. Map references may be useful to other witnesses to identify a specific location.

Be polite and thank the person for cooperating. Be sure to record the witness's name, phone number, and where he or she can be reached. After the interview, if there are any questions, refer to the notes or the tape.

SEARCH PATTERNS

It is important that the water scene not be changed by moving "no wake" buoys or other reference points on the surface of the water. If buoys are moved in an effort to slow boat traffic, the location will be difficult to identify.

The most important aspect of any water search is to be able to identify what areas have already been searched. A search involves the process of elimination and it is extremely important to be able to positively say where the victim is **not located**. Once an area has been thoroughly searched, it must be **marked**. This will help identify the area where the victim may be. Random dives are considered a hit-or-miss process and offer little chance for success in locating the victim.

Experienced divers know which search patterns to use, depending on the size of the area to be searched, the water's bottom terrain, and the size of the object they are searching for (car, boat, body, handgun, etc.). See the section on water rescue/recovery operations search patterns for further information.

Compass patterns such as the U pattern have been omitted from this text because divers often dive in zero visibility unable to see a compass, an air pressure gauge, a depth gauge, or a buddy.

SAFETY PRECAUTIONS

A pony bottle should be used for an air reserve, so that when a main air supply runs out the rescuer does not need to rush to the surface. A standby diver and tender should be suited, ready to go, on the surface with a tender, should a diver get stuck or pinned. All divers should know line signals to tell the standby diver when there is a problem. U.S. Navy line signals should be used between the diver and the tender. The following signals are commonly used.

1 tug – "I am okay or on bottom."
2 tugs – "Give me some line."
3 tugs – "Take up the slack."
4 tugs – "Emergency – pull me up."
2 - 2 - 2 tugs – "I am fouled; send down a backup diver."

Training as a fire fighter, police officer, sheriff's deputy, or paramedic does not qualify a person as a diver. It is important to get training from a competent instructor, and follow safe diving rules. Rescuers should not be pressured into attempting a rescue that they are not ready to handle.

CARING FOR THE RECOVERED VICTIM

Standard care for any victim who has been removed from water 70°F or below, and was under one hour or less, is to treat the victim as a potential rescue, even if he or she is not breathing, has no pulse, has blue skin, is cold to the touch, has rigid muscles, and has fixed, dilated pupils. Start aggressive CPR immediately and transport the victim to a hospital as soon as possible.

Do not rewarm the victim in the field. Adding external heat to the severely hypothermic victim can cause stale acidic blood from the extremities to enter the heart, thus making the victim very unstable. A severely hypothermic heart is susceptible to external stimuli and likely to go into ventricular fibrilation if the victim is not handled properly.

Remove wet clothing and protect the victim from further heat loss. Administer heated humidified oxygen. If rescuers are not equipped to administer heated humidified oxygen, administer mouth-to-mouth or mouth-to-mask ventilation. The rescuer's breath is warm, and will help to warm the victim's lungs and heart.

WATER RESCUE EQUIPMENT

KEY POINTS

- **Specialized water rescue equipment**
- **Guidelines for purchasing water rescue equipment**
- **Advantages and disadvantages of the various types of equipment used in water rescue operations**

INTRODUCTION

Rescue techniques used for river, open water, and ice rescue operations are changing rapidly since new equipment and procedures are continually being developed. However, the bottom line still remains the same: to prevent taking unnecessary risks when rescuing a victim. With training, practice, and proper equipment, rescue teams can approach water rescue operations with confidence that a safe, effective rescue can be executed.

A wide variety of equipment is available for water rescue. The key is to choose the equipment that is right for the job and the rescuer, whether it has a specific use or is a versatile tool. Whatever the choice, the rescue equipment must be durable and provide maximum protection for the rescue personnel.

PERSONAL EQUIPMENT

Personal Flotation Device

It is critical that all rescuers wear a *personal flotation device* (PFD) and protective clothing to guard against the hazards of hypothermia and drowning. Various manufacturers have developed different types of dry suits; some are buoyant and some are not. The cost of outfitting each rescue team member with this apparel may be prohibitive; however, alternative methods of outfitting rescuers can be used to provide effective rescue operations.

When a rescuer is near water, he or she must always wear a personal flotation device approved by the U.S. Coast Guard. There are five different types of PFD's: either type III or V is the best to wear when involved in water rescue situations. A rescue PFD should be made of foam, have torso and/or crotch straps, be a bright color, be the correct size, have a nylon zipper, and have a whistle attached.

The type I PFD provides the maximum required buoyancy, is high in color visibility, and is the most effective type to use in rough water. It is designed to turn the unconscious victim to a face-up position. However, the type I PFD is available only in two sizes—adult (90 lbs. or more) and child (less than 90 lbs.), and tends to be large and cumbersome. A type I PFD is required for each person on board a commercial vessel (see Figure 70).

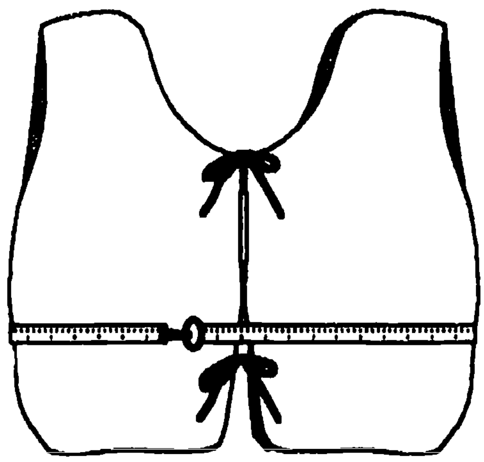


Figure 70. Type I Personal Flotation Device

The type II PFD is a buoyancy vest devised for ease of emergency donning. This "horse-collar" style PFD is designed to turn an unconscious person face-up but not as effectively as a type I PFD. These features and minimal cost make it best suited for general boating and quick rescue activities (see Figure 71).

A type III PFD is designed to maintain a conscious person in an upright position, but will not necessarily float an unconscious person, faceup. Flexibility of design provides type III PFD's which match general and specialized boating activities such as skiing, canoeing, kayaking, and fishing. Many Type III devices are comfortable, pliable, have a combination of nylon zipper and torso straps, are easy to swim

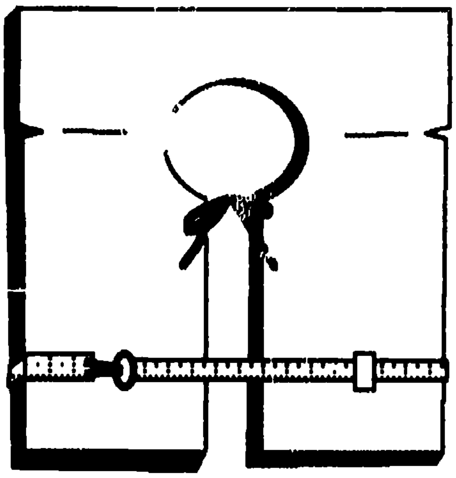


Figure 71. Type II Personal Flotation Device

in, provide some hypothermia protection, are brightly colored, are available in various sizes, and are a good choice for water rescue activities (see Figure 72).

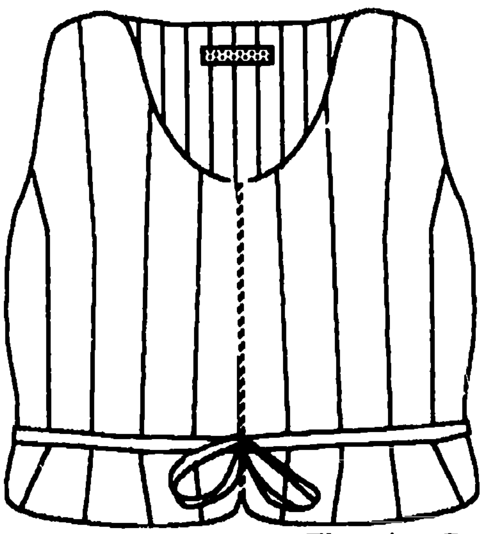


Figure 72. Type III Personal Flotation Device

A type IV PFD is a throwable device with a minimum of 16 lbs. buoyancy. These are in the shape of rings, cushions, and horseshoes. They are not designed to be worn; just grasped and held until a rescue is completed (see Figures 73 and 74).

There are two classes of type V PFD's; specific and hybrid. Type V PFD's for specific activities are designed for and restricted to the specific applications indicated on the label. Some of the specific activities approved for type V PFD's are waterskiing, board sailing, and commercial white-water rafting. These PFD's can also be used as a vest when working around the water (see Figure 75).

The hybrid type V PFD contains a minimum of 7.5 lbs. of buoyancy when deflated and expands to 22 lbs. of buoyancy when inflated. For acceptability, these devices must be worn except when the boat is not underway or when the user is in an enclosed space. All hybrid flotation devices are equipped with oral inflation devices. When inflated, the vest will

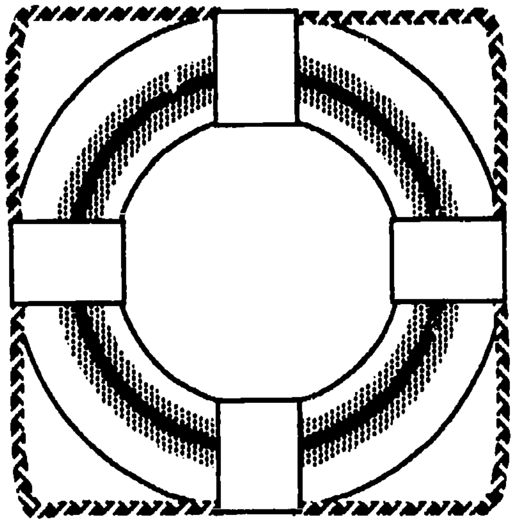


Figure 73. Type IV Personal Flotation Device (Ring Buoy)

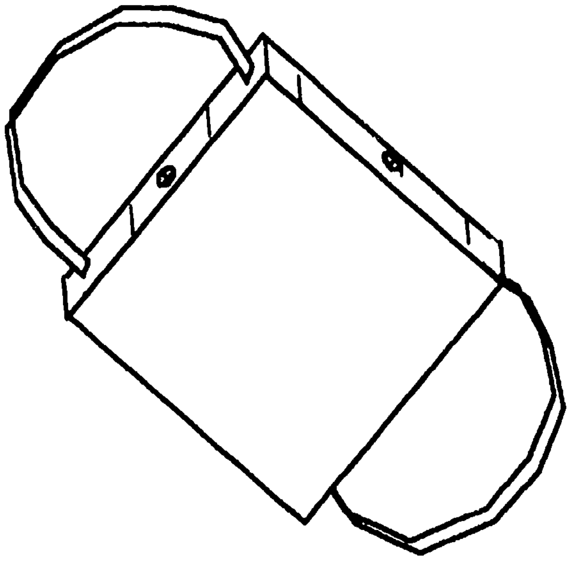


Figure 74. Type IV Personal Flotation Device (Seat Cushion)

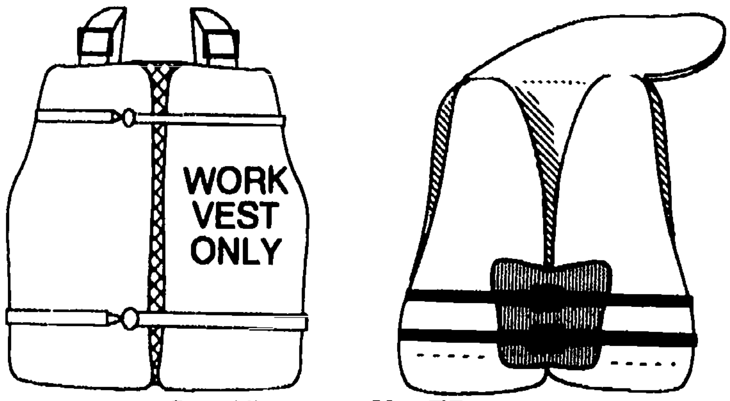


Figure 75. Specific Type V PFD

turn a person to a position equivalent to the position a person assumes wearing a type I or II PFD (see Figure 76).

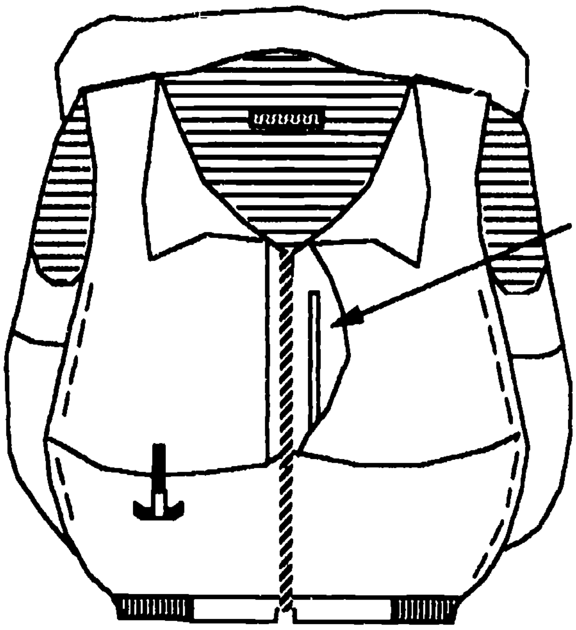


Figure 76. Type V Personal Flotation Device (Hybird)

Exposure Suits and Dry Suits

Cold water protection is a must when performing an ice rescue. Primary and secondary rescuers must have the ultimate in protection if they are to venture onto the ice. An exposure suit or a dry suit with a PFD will provide flotation and keep the rescuers dry even when performing the "go" rescues.

Exposure suits are designed in accordance with U.S. Coast Guard and Underwriter's Laboratory standards. They provide more than 40 lbs. of buoyancy and can easily support the rescuer wearing the suit plus one or two victims. If the suit becomes torn or cut, it will still float the person wearing it. The suit is designed to be quickly donned over normal everyday work clothing (see Figure 77).

Dry suits for divers have been around a long time. However, technology and new manufacturing techniques are creating suits that apply to more water activities. They are more comfortable, durable, reliable, and flexible, and less expensive. When choosing a dry suit, check the type of materials, seams, zippers, and cuffs. Most dry suits will not provide insulation or buoyancy; therefore, a PFD and the layering of clothing is required.

Wet suits usually do not provide the cold water protection needed when performing an ice rescue. The thicker the neoprene, the less mobility the rescuer has. A wilderness cut wet suit with long legs (a Farmer John) allows greater flexibility than a scuba cut. A 1/4" thick gas-blown neoprene material is a good thickness for ice rescue procedures during the winter, but the 1/8" to 3/16" thickness is better the rest of the year. Cement and cross-stitching at the seams, nylon linings, and rolled edges are desirable characteristics.

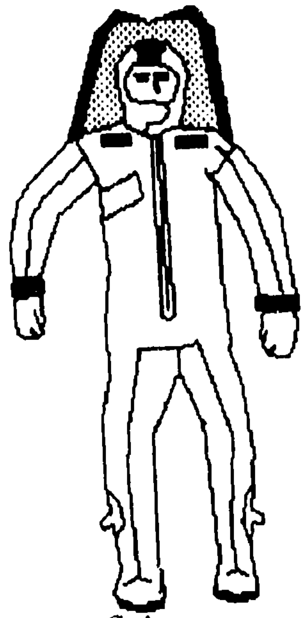


Figure 77. Exposure Suit

Layered Clothing

If it is not possible to outfit all rescue team members with exposure suits or dry suits, the land-based backup can be dressed in layered clothing and wear a PFD. There are three important layers when layering clothing for warmth:

- The *inner vapor transmission layer*'s function is to transport perspiration away from the skin to the outer layers of clothing. This prevents evaporation and the cooling of the skin. Materials like silk and polypropylene are excellent choices. Cotton is a poor choice for this layer because it absorbs moisture, loses its insulating value, and hastens heat loss.
- The *middle insulating layer*'s function is to insulate and absorb perspiration passed through the underwear. It can be comprised of several clothing articles. Wool, pile, fleece, or bunting are the best choice due to their absorption and insulation abilities. Cotton and down fibers are not recommended. Down, the underfeathers of geese and ducks, offers the best warmth-to-weight ratio of any material when dry; however, when

it gets wet, the feathers absorb water, collapse, become heavy and lose all insulating value.

- The *outer protective layer*'s function is to protect against wind and water. Rain gear and synthetic fabrics that are breathable and waterproof are excellent choices for this layer.

Hand, Foot, and Head Protection

Hand, foot, and head protection must not be forgotten. Boots with an injection-molded rubber sole and combination leather and rubber upper offer waterproofing and insulation. Wear polypropylene and wool socks inside the boots. The boots must fit properly or circulation may be constricted, resulting in cold feet. Do not wear hip-style fire boots.

Hand protection is a must to allow finger dexterity and protection from rope burns, hypothermia, or frostbite. Liner gloves made of silk, polypropylene, wool, or a reflective "space-type" material are available. Insulated overmitts can also be worn over gloves or mittens during ice rescue operations. Gloves designed for waterskiing or sailing provide good protection against rope abrasions.

The head must be covered; it is estimated that a human being loses 40% to 70% of the body heat through the head. A wool stocking cap plus a parka or rainsuit hood makes a good combination to insulate and protect a person against wind and water. A balaclava or face mask offers added protection from extreme cold and wind.

Wear a helmet as protection against head injuries. Motorcycle helmets are too heavy, and hard hats are too light. Suitable helmets are available from white-water outfitters or stores that specialize in sports equipment. Desirable features of a helmet include a foam inner liner to cushion the head, a chin strap to fasten the helmet securely, drain holes to allow water to drain away, and styling that offers low forehead protection.

Knife

A knife carried in a protective sheath is recommended for all rescue personnel. It is easy to get tangled in a rope and need to cut the rope free. The knife should be sharp, have a stainless steel blade, and be operable with one hand. A good location for the knife is fastened to the waist or shoulder of the lifejacket.

Specialized Ice Rescue Equipment

Ice awls and staff are important pieces of personal equipment that are used in self-rescue techniques. Ice awls are self-rescue devices that aid a person who has been submerged when ice breaks in getting out of the water. An ice awl can be made by filing down the points of two ice picks and strapping them together with a leather thong. Ice awls can also be made from dowel rods and 8 inch penny nails. To prevent injury, protect the points with cork when carrying the awl around the neck (see Figure 78).

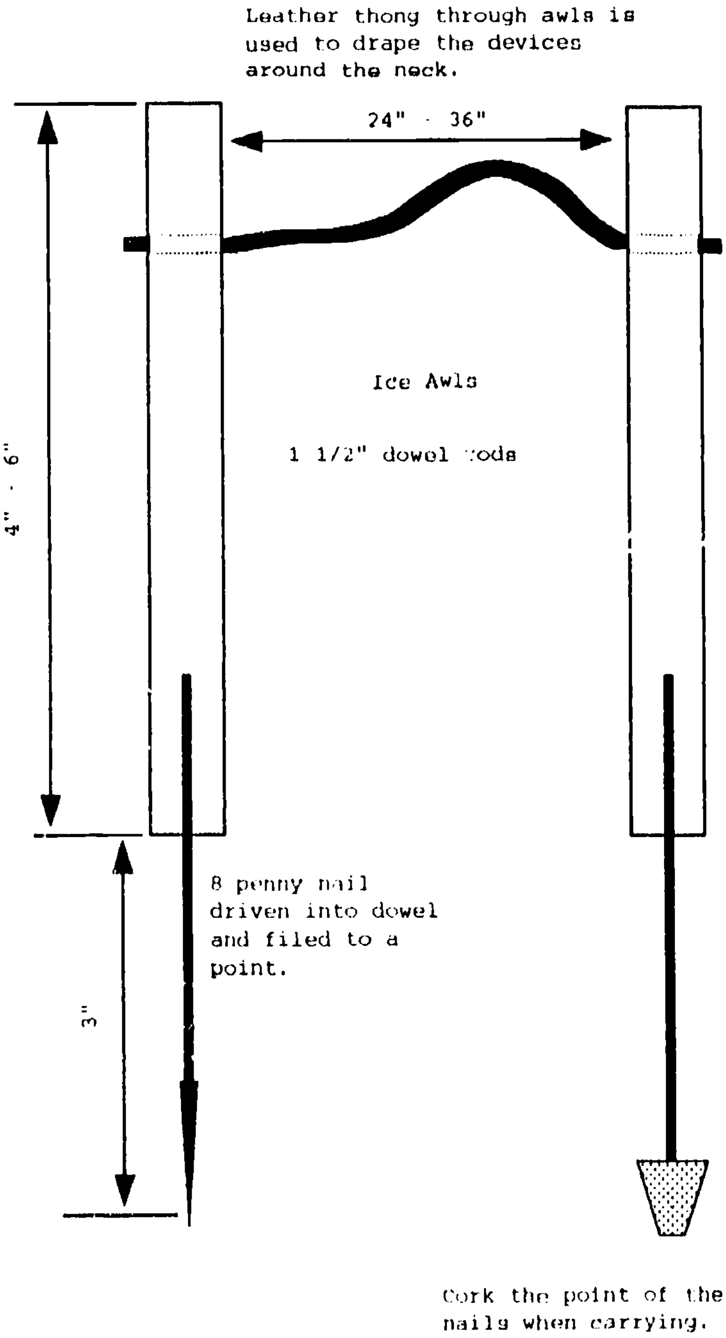


Figure 78. Ice Awls

An ice staff is a device used to test the quality of the ice while walking on it. A staff can be made by driving a spike into the end of a 1 1/2″ x 6′ dowel rod. Clip off the head of the spike and sharpen the end to a point (see Figure 79).

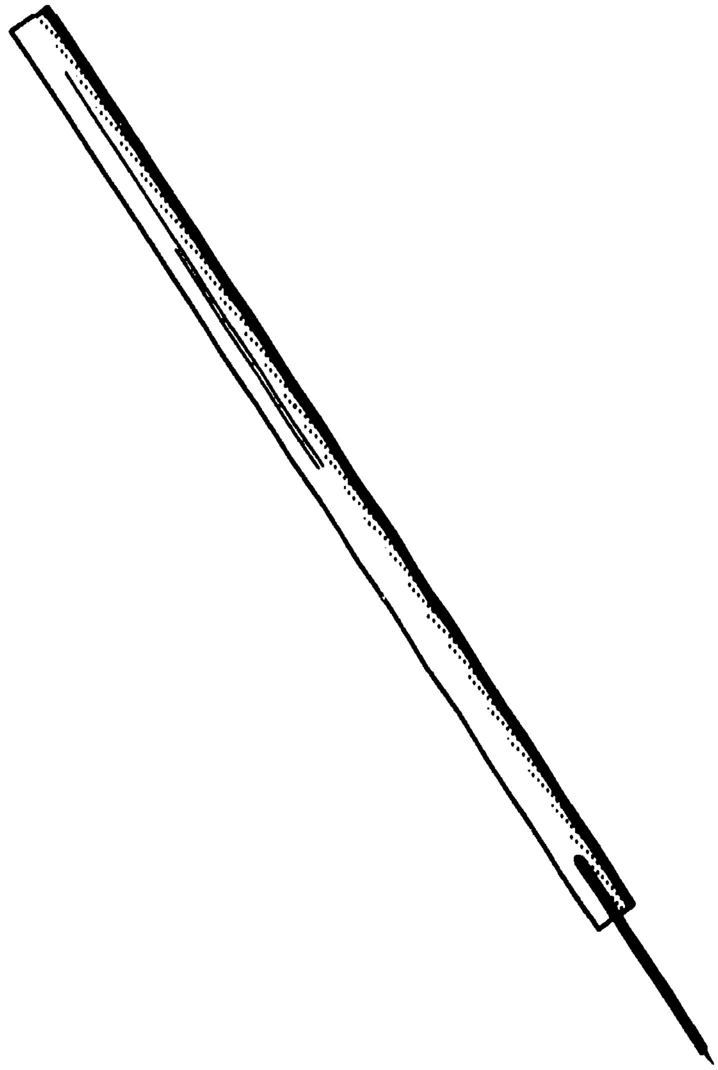


Figure 79. Ice Staff

SHORE-BASED RESCUE EQUIPMENT

Rope

For easy handling, the rope, (known as *line* for water rescue) needs to be 3/8″ to 1/2″ in diameter and have a tensile strength of 2,000 lbs. or greater. It should be highly visible, buoyant, soft, and pliable at low temperatures. It should also be deployable from a bag or other easy storage. Polypropylene line is very flexible and floats. Hemp rope, used by fire departments because it does not melt when it gets hot, is not acceptable for water rescue, because it soaks up water and becomes heavy quickly, and may sink when wet.

Throw Bags

A throw bag is a quick, efficient tool for a rescuer. It is composed of 60′ to 70′ of floating polypropylene line in a nylon bag, with an ethaform disc attached at one end. The line should be brightly colored, and with a diameter large enough for a victim to easily grab and hold. Most bags use a 3/8″ diameter line with a tensile strength of 2000 to 2300 lbs. Ready-to-use throw bags can be stored "tangle proof" in the back of any rescue vehicle as long as they have been stuffed properly (see Figure 80).

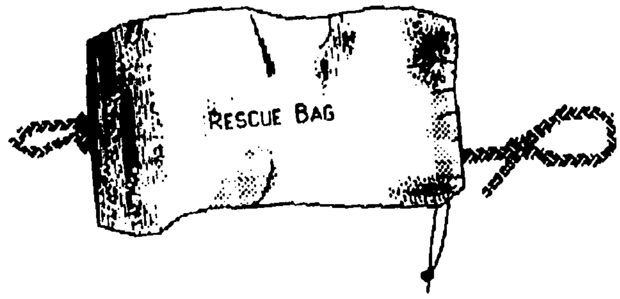


Figure 80. Rescue Bag (Throw Bag)

Line Bags

Line bags contain the other safety ropes used in water rescue. These bags are readily accessible, easy to store, and ready to deploy 250′ to 300′ of line at any time. Choosing the proper line for the job is very important. Modern technology has yielded advancements in the development of water rescue line, making it stronger, softer, and highly visible. This line is available in 3/8″ to 1/2″ diameters and with tensile strength of over 3600 lbs. and 5000 lbs. respectively.

NOTE: Water rescue line is **not** to be used for vertical rescue operations.

Line Guns

Line guns provide a method of advancing and making a shored-based rescue more effective. Guns can shoot lines up to 600′ and work well in conjunction with other rescue devices. For example, the tag line rescue technique can use a line gun to shoot a line across a river or inlet, providing a means to pull a rescue ring or fire hose to the victim.

Each of the following gun lines has its own unique characteristics:

Bow and arrow with spinning line, 100′-150′. Fairly easily stored, shoots lightweight lead line only; slow reshoot.

Cross bow and arrow with line, 150′-200′. Fairly easily stored; shoots lightweight line only; slow re-shoot.

Line gun, 150′-950′. Very accurate; easily stored; shoots test shotline: 950′ @ 70 lbs.
600′ @ 140 lbs.
325′ @ 310 lbs.

Rocket gun, 150′-1,000′. Shoots different diameters of line, shoots a type IV PFD attached to a line; easily stored.

Balcon Emergency Lifeline (BELL)

A *Balcon Emergency Lifeline* (BELL) contains 132′ of 260 lb., 1/8″ poly-line. This device is shaped like a German hand grenade, is 8″ long, has a weighted end, and can be thrown approximately 100′. The BELL can be used for retrieval of a victim or for getting lines of larger diameter across a river or pond.

BELLs are not reusable (see Figure 81).

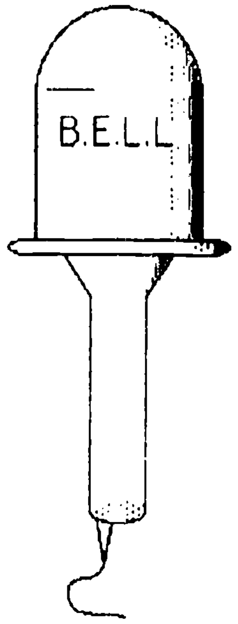


Figure 81. Balcon Emergency Lifeline (BELL)

Rescue Ring

Rescue rings are large, buoyant life rings used in a tag line, stabilization line, or two-boat tether rescue procedure. They are used when a type IV PFD does not have enough buoyancy or is not large enough. The Jim-buoy, and Res-Q-Ring are commercially made orange rescue rings. A good rescue ring can also be made by filling a truck tire inner tube with a buoyant, high-density, hard, non-absorbant foam. This foam is the type used for flotation in boats (as insulating foam by refrigeration factories and by roofing companies) (see Figure 82).

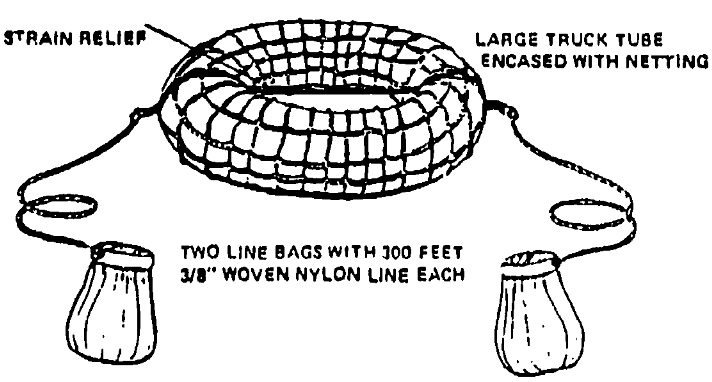


Figure 82. Rescue Ring

Hose Rescue Device

Fire hose and a pressurized air cylinder, two standard pieces of fire fighting equipment, can be combined to form a water, river, or ice rescue device. The device consists of one or more fifty-foot sections of 2 1/2″ or 3″ hose charged with air from an air cylinder, which is carried on all fire apparatus for use with breathing masks. Once filled with air, the hose becomes rigid and buoyant. Tests have shown that a fifty-foot section of hose will support ten or more people. It has been demonstrated that during a panicky situation, it is possible to rescue people if they hold on to an inflated hose.

To effect a rescue any number of sections of hose may be coupled together and pushed into a river, lake, ice-covered body of water, or even an hydraulic created by a lowhead dam. A hose rescue tool can be put into service quickly since it is portable. It requires approximately six seconds to fill a fifty-foot section of hose to the recommended 100 psi (pounds per square inch) from a thirty-minute, 45 cu. ft. capacity air-cylinder. This will drop the pressure in the air cylinder approximately 500 to 600 psi. The pressure in the hose can be regulated to a maximum of 120 psi by the relief valve on the rescue device.

Being able to regulate the air pressure in the hose will prevent overfilling, as well as possible injury to rescue personnel. If rescuers use apparatus air tanks to fill the hose, it will take approximately one minute and twenty-two seconds. The investment for an air cylinder is minimal and worthwhile for its effectiveness.

A hose rescue device (see Figure 83) includes the following:

- 2 1/2″ female cap
- 2 1/2″ male cap with 18″ flexible 1/2″ hose
  NOTE: The flexible 1/2″ hose has a quick connect coupling for the air cylinder. The shut-off is located near the 2 1/2″ coupling (male). Set the relief valve at 120 psi.
- 2 1/2″ or 3″ hose from an engine
- Rope to assist in guiding the hose
- Hooks to snag an unconscious victim or body
- Hose straps (to attach hooks)

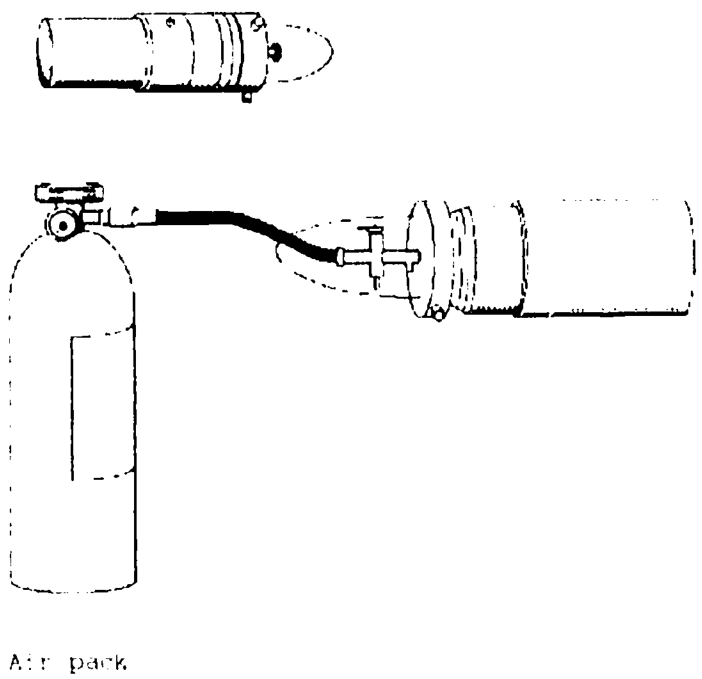


Figure 83. Fire Hose Rescue Device

BOATS

Since river rescues typically account for only a small percentage of rescue operations that use boats, most boats for rescue service are not selected for use on moving water. The average rescue boat's design may inhibit its use for the river. The same is often true for equipment being carried inside the boat.

Boat hulls are designed with specific uses in mind. A hull selected for use on a lake for fishing or for recovery operations will not serve well on moving water. A craft selected exclusively for river running may not be practical or useful on still water, since it may be uncomfortable, cramped, and even unstable. The selection of a good multi-use boat may require some compromise.

Because of the many variables involved in river rescue, no single boat is considered the best. An inflatable boat is the safest if swept into an hydraulic; however, it is not as strong as a hard-hulled boat. A good rescue boat should meet the following specifications:

- 14′ to 19′ long
- Stable hull with minimal pitch and roll
- Large amount of freeboard
- Large payload
- Extra flotation near gunnels
- Easy to transport
- Void of unnecessary gear
- Dependable and simple
- Grab lines all around just above water lines, and not loose enough to catch on brush or debris
- Cleats on the bow, stern, and midship
- Easy to propel by oars or paddles

Airboats and hovercrafts are being developed and used to perform water, river, and ice rescues. Proper safety precautions and the rescue sequence must be followed when using these devices. Know the equipment and the limitations for each piece. **Good equipment will not replace proven principles in conducting a safe rescue.**

Motors

A good motor for a rescue craft should meet the following specifications:

- Powerful enough to move a loaded boat in moving water
- Propeller pitched for power, not speed
- Slip-clutch propeller drive, not shear pins
- Easy to transport by one or two persons
- Be in running condition
- Break-away safety strap
- Short shaft for river situations

Maintain two spare propellers.

Backup Propulsion

Every motorboat should carry a means of backup propulsion to cover the possibility of engine failure. On rivers, many boats are more easily maneuvered with canoe paddles than with oars. Test the boat to determine which backup method provides better performance.

Boat Trailer

The larger the wheels on a trailer, the easier it will be to tow down the rough roads commonly found in water rescue situations. Check the trailer's tongue frequently for signs of fatigue. A spare tire, lights that work, safety chains, and tiedowns are essential.

MISCELLANEOUS EQUIPMENT

The following miscellaneous equipment should be available for rescue procedures:

Carabiners are designed to connect equipment to equipment or set-up line systems (see Figures 84 & 85). They are designed for longitudinal loading

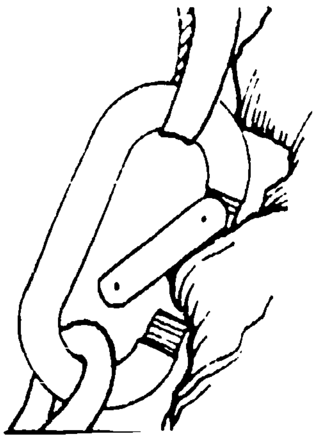


Figure 84. Nonlocking Carabiner

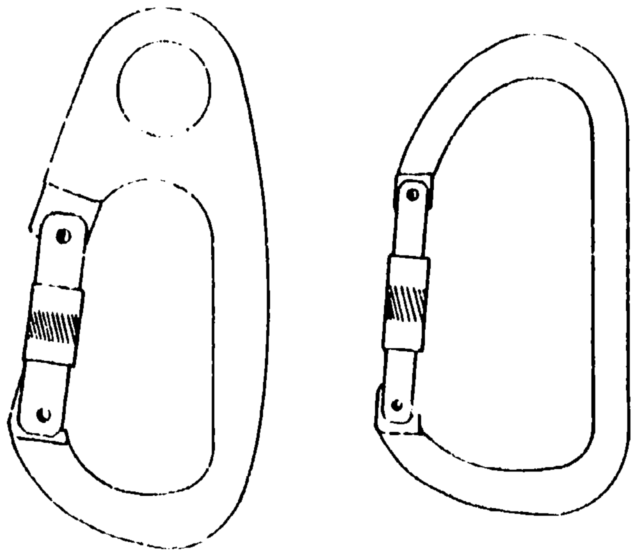


Figure 85. Locking Carabiners

only. Use aluminum carabiners with a tensile strength over 3,000 lbs. in water rescue situations because they will not rust. At least 12 locking carabiners will be needed.

A figure eight friction device is needed to belay or lower equipment and people in vertical rescue situations. Figure eight friction devices that are solid aluminum, have a minimum tensile strength of 8,000 lbs., and a hard anodized coating are recommended for water rescue (see Figure 86).

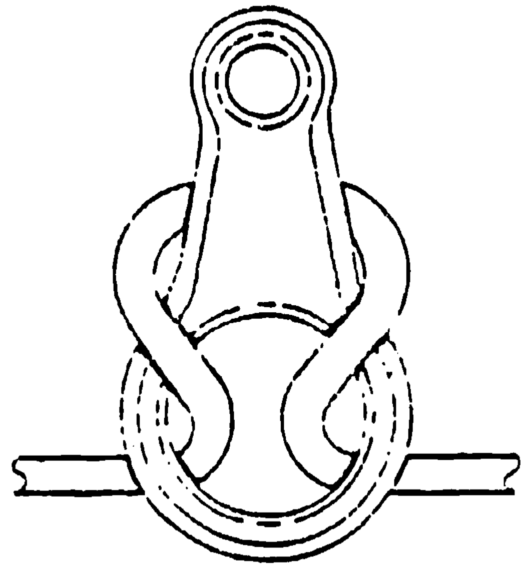


Figure 86. Figure Eight Friction Device

A steel "O" ring is used in the setup of rope systems when more than one carabiner will be clipped onto the equipment. An example is the moveable control point rescue technique. The shape allows plenty of room for all the carabiners. The steel O ring should be made of forged alloy steel with a minimum tensile strength of 10,000 lbs.

Webbing is used for Swiss seats in quick vertical rescue procedures, anchoring rope systems, runners, and for loops used to get victims into boats. The webbing should be 1 inch wide, nylon, of tubular or flat design, and with a minimum test strength of 4,000 lbs.

Prusiks or ascenders are used as brakes, safeties, and ratchets for the setup of rope systems. The **ascender** is a mechanical device and should be made of aluminum for water rescue situations. Choose an ascender that works well on wet, icy, or muddy lines, will not twist or pop off the line, and will not damage or cut through the line when under pressure. It should have a minimum cam strength of 2,500 lbs.

The **Prusik** should be used in the same situation as an ascender, but requires the skill of knot tying. The line should be nylon static-kernmantle construction of low-stretch and a high-breaking strength (minimum 2,000 lbs. tensile strength). The Prusik

line must be of a smaller diameter than the line to which it will be attached. Usually a 6mm or 7mm diameter line is a good size.
NOTE: This line is not to be used as a hauling line, only as a brake, ratchet, or safety lock.

Chocks, nuts, pitons, and ice screws are all specialized devices used to anchor rope systems in rock climbing and ice climbing. **Chocks and nuts** are placed into rock cracks. **Pitons** and **ice screws** are hammered into rock or ice to provide an anchoring system for the lines.

Pulleys are used in the line systems where there is a change of direction or where it is necessary to increase the mechanical advantage. In water rescue situations, it is recommended to use anodized aluminum sealed ball-bearing pulleys with side plates and a minimum tensile strength of 5,000 lbs.

The pike pole, boat hook, ice staff, and ice cross are all pieces of shorebased reaching equipment (see Figure 87). These can be used for quick, reaching rescues and also as improvisation tools in search and recovery operations.

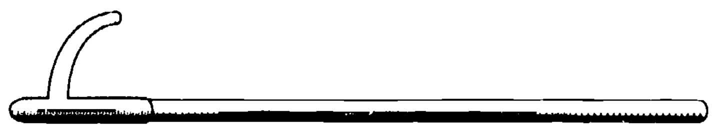


Figure 87. Boat Hook

Fire extinguishers (for boats with gasoline on board) must be U.S. Coast Guard approved and of the proper size and quantity for the boat.

A backboard with straps or webbing, and a wire basket are used to transport hypothermic or injured victims. The wire baskets can be outfitted with flotation devices or can be floated by a fire hose.

Marker buoys and anchors are used in search and recovery operations to mark where the victim was last seen, and to mark search patterns.

Hooks are used for quickly snagging onto boats, trees, debris, aircraft, and, as a last resort, victims. Depending on the situation, four-pronged drag hooks work well for snagging boats, aircraft, etc. and 2″ and 3″ treble hooks work better for victims, but the barbs must be cut off the points prior to use. To make hooks, use 1/2″ dowel rods and drive 1 1/2″ nails through the rods. Bend the nails in different directions and sharpen each one. These work well for snagging bodies, and cause little damage to the skin.

Wool blankets are used to treat hypothermic victims and are used in the blanket-roll extrication technique.

First aid kit containing supplies in accordance with level of training of rescuers.

Surfboards, paddleboards, and Boogieboards are being recognized as quick, efficient, rescue devices in river, water, and ice rescue operations. Use proper safety precautions and follow the rescue sequence when incorporating these devices. Know each piece of equipment, how it is used, and its limitation.

CONCLUSION

New products and techniques are continually being developed for water rescue operations. Proper evaluation, consideration, and research must be made when selecting and purchasing equipment.

Some key decisions must be made before purchasing the equipment. What kind of rescue situations will require what equipment? Ice rescues? River rescues? Open water rescues? All types of water rescues? What kinds of environment? What type of access? What kind of storage facility is available for the equipment? What kind of maintenance schedule will be conducted and how often will the equipment be used? What kind of use will the equipment be subjected to? How much workforce is available and what kind of skill, practice, and training is needed for effective use? What limitation does the equipment have? How much will the equipment cost and how much will maintenance cost? How often will it need to be replaced?

These are only a few of the questions that need to be answered when purchasing equipment. The best equipment will not ensure a successful rescue. Teamwork, practice, training, experience, and following the rescue sequence are all important to the success of a rescue.

WATER RESCUE SAFETY TIPS

KEY POINTS

- **Guidelines for the development of training and equipment**
- **The water rescue preplan**
- **Rescue team development**
- **Local policies made prior to water rescue operation**
- **Resources for information and training in water rescue techniques**

INTRODUCTION

Water rescue operations can be dangerous and complex. Specific skills and training are necessary for safe water rescue procedures. The following guidelines for development of water rescue training and equipment purchases should be noted.

- The safety of the rescuer must always be a priority.
- Rescue techniques must be simple so they can be learned and mastered quickly.
- The equipment must be practical, readily available, affordable, and suitable for other departmental needs.

PREPLANNING FOR WATER RESCUE

Allocating time to identify potential hazards and to practice rescue techniques is a necessity. A good preplan is mandatory for a successful rescue operation. During a post-accident debriefing, the need for a workable preplan is reinforced.

Preplanning a water rescue requires the rescuer to identify potential hazards and accident sites; select the safe, effective rescue approaches; and then practice those tactics at that rescue site. During practical exercises, rescuers will discover if the preplan is workable and flexible in actual conditions.

A water rescue preplan should include the following:

1. A survey of all water within a department's jurisdiction during a river's low flow, and recording its width, depth, velocity, and structure.
2. A survey of all water (rivers, creeks, and streams) within a department's jurisdiction during the high water, and a recording of changes in characteristics and measurements for each.
3. Training sessions held at potential accident sites when a river or stream is approaching high water, but is not beyond the ability of the rescue team.
4. An examination of the water and its source to identify natural or constructed hazards. Special attention should be given to those with a history of repeated accidents. Include the location of access sites, direct access routes, and areas that are particularly inaccessible or dangerous, such as canyons or viaducts.
5. Share the preplan with any agency that might be called to the scene. Discuss any foreseen problems before an accident occurs.

Begin preplanning with a review of the topographical maps of an area. Using the map legend, rescuers should find: commercially constructed features in black; water features in blue; roads, urban areas, and land lines in red; woodlands in green; and contour lines and values in brown. All photorevisions are noted in purple (see Figure 88).

Helpful information can often be found on maps obtained from a county engineer's office. Check with local boaters to identify hazards in remote areas. Check local newspapers and media personnel for stories dealing with previous accidents. State or local government offices might also have useful information. No source should be discounted.

Once the information has been collected, assemble it into a useful form. A simple hazard survey form can be used for this purpose (see Figure 89).

A topographic map illustrates the characteristics of a river and surrounding area. A hand-drawn map gives greater detail to the site, enabling the rescue

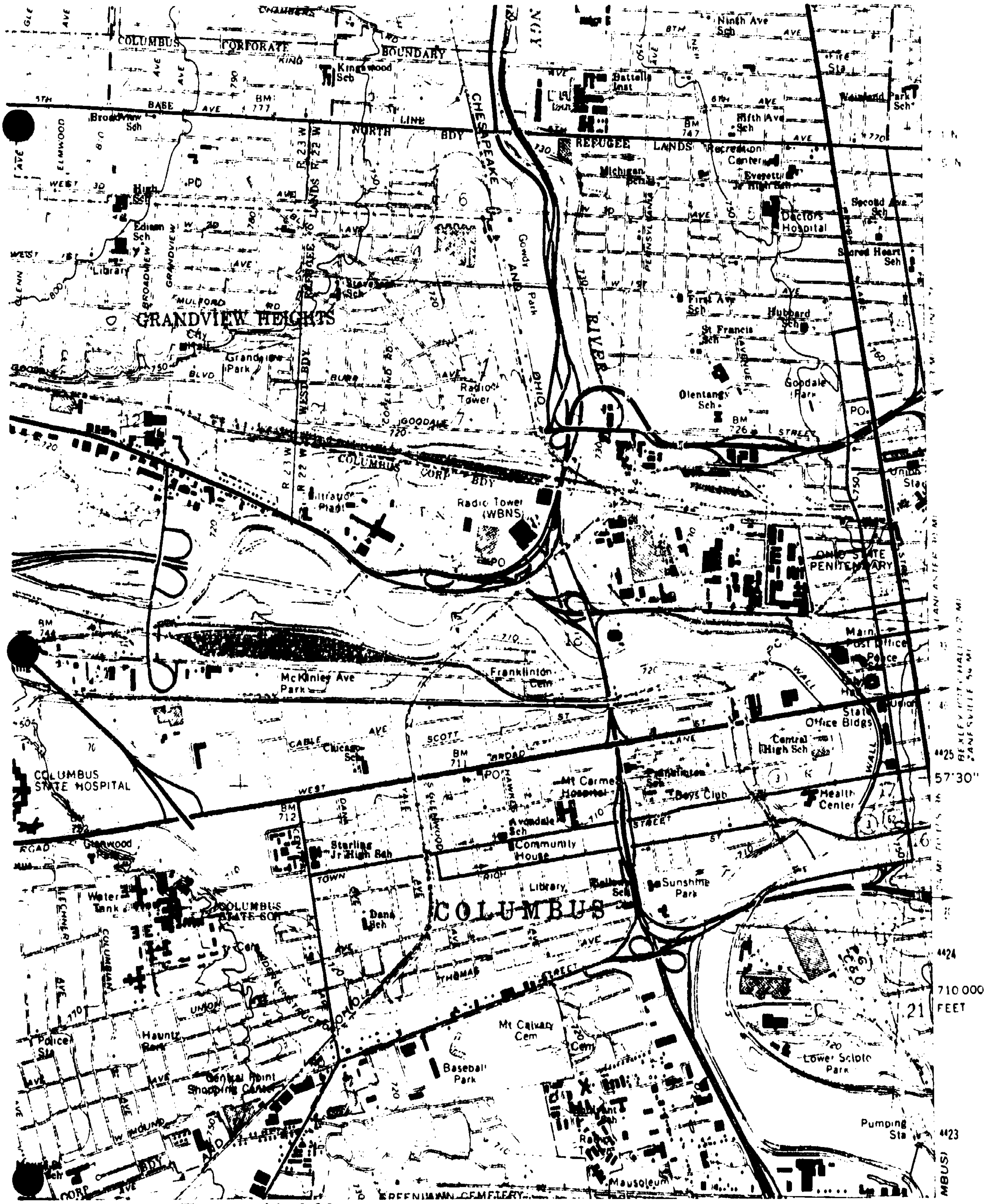


Figure 88. Sample Topographical Map

RIVER HAZARD

Natural Obstacles ____________ Commercially-Constructed Obstacles ____________

Body of Water ____________

Description of Hazard ____________

Exact Location and Access ____________

____

____

Accident History ____________

____

DAM HAZARD

Site Name ____________

Type of Markings ____________

Width Upstream ____________ Downstream ____________ Height ____________

Depth Upstream ____________ Downstream ____________ Slope ____________

Condition and Type of Construction ____________

____

LOCATION

Fire Department ____________ Law Enforcement Agency ____________

Address ____________ Address ____________

Phone ____________ Phone ____________

Condition of Rescue Site ____________ ____ Good ____ Fair ____ Poor

Accessibility ____________

Obstacles ____________

Terrain ____________

PHOTO (to show entire hazard area and any unusual features)

Figure 89. Sample Hazard Survey

team to identify access and obstacles to rescue approaches (see Figure 90). Together they prepare the rescue team for a textbook rescue as well as a rescue complicated by numerous circumstances.

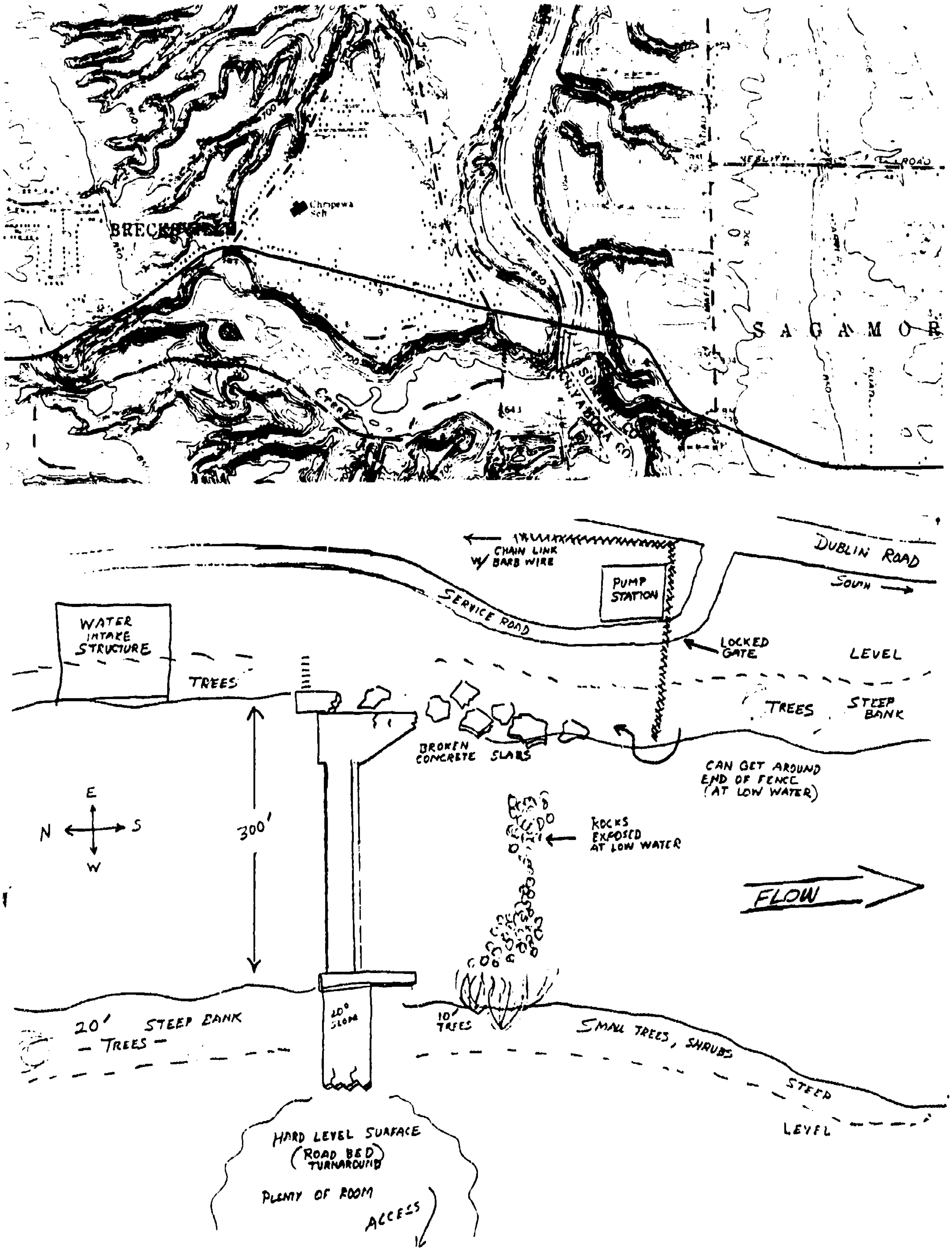


Figure 90. Sample Topographical and Hand-Drawn Maps for Comparison

Once a survey has been completed, continue to check it for accuracy. Go to the site during high water and low water to see if it has changed from year to year. A preplan made in the fall cannot be used in the summer or in the spring when high waters cover the access and staging areas.

Rivers and streams are used as geographical boundaries, so it is likely that different public safety departments will be called to an accident scene. Coordinate plans before an accident occurs to ensure the most effective, efficient rescue. It is important for the preplan to include the following:

1. Accident sites where two or more departments respond. Identify areas where additional backup will be required to protect the safety of the rescuers and the victims.
2. Information regarding notification of each department as to how the different department will be notified of the accident.
3. Equipment each department has available.
4. Who will act as the incident commander.
5. Agency that will provide medical care to the victims.

Practice a rescue plan to make sure each department, its equipment, and workforce are prepared.

RESCUE TEAM DEVELOPMENT

Successful rescue operations require teamwork. It is very important that each member of the team be in good physical condition. A seven-member rescue team usually works very well.

The seven-person team should include an incident commander, two boat operators, two rescuers, and two backup people. Seven people might not be the ideal number in all situations so the incident commander should evaluate the neeus for each rescue. Each member of a seven-person team has a job in almost every river rescue. If too few people try to do too much, the rescue will not proceed smoothly; however, if too many people are trying to do too much, the rescue may also fail.

RESPONSIBILITIES OF THE INCIDENT COMMANDER

The incident commander should observe, direct, and evaluate the over-all rescue. If the commander becomes involved in too much hands-on participation, it becomes difficult to oversee the rest of the operation. The commander must be in constant communication with the rescue team and any outside support agency involved. Updating the rescue team, the base station, and the support personnel of the progress of the rescue effort must be a continuous process if all personnel are to be aware of the rescue procedures.

RESPONSIBILITIES OF THE BOAT OPERATORS

The boat operator should maintain and deploy the boat according to the rescue plan and the incident commander. They should be familiar with the boat, and its operation, capabilities, and limitations. Rescuers (boat operators) should have experience at river-reading and river-running.

THE RESCUERS

The rescuers must make the actual contact with and extricate the victim(s). They should be involved in rescue planning and assessment. The rescuers should concentrate on each victim's condition, the safest approach to the rescue, and the care of each victim. Ideally, the rescuer should be a certified emergency medical technician. Each rescuer's life depends on the other team members, while the victim's life is in the hands of the rescue team.

Land-based Rescuers and Backup Personnel

The backup personnel are key people. They can make the difference between success or failure of the rescue operation. The backup rescuers make the first contact with the victim(s); they provide encouragement and the will to live. Backup rescuers take throw bags and scout the accident scene, often making a successful shore-based rescue before the heavy equipment arrives. If the rescue plan fails, the backup rescuers provide the safety net to avoid a further accident, or tragedy.

Selecting Team Members

It is sometimes difficult to evaluate an individual team member's abilities to determine who is the most suited for water rescue procedures. Each person's experience, physical condition, and attitude toward the water rescue program must be assessed. Swimming skills should be taken into account. Team assignments should be flexible to allow cross-training in as many areas as possible. Once the team has been selected, routine practice and training are important.

Practice should be geared toward improving speed of response and rescue techniques. Practice drills can separate parts of a rescue from the overall effort. The individual segments of the response can later be incorporated into the master plan. Examples of practice drills might be to set up the movable control point between two vehicles in a parking lot, or to rig a lowering system from an aerial ladder. Practice drills such as throw-bag practice using a tire as the target can be set up to improve throwing skills.

LOCAL POLICIES

Recent medical discoveries and technological advances can place moral decisions in the hands of the rescuers who are first on the water accident scene. Policies and protocols adopted must take into account proper treatment of the hypothermia and cold-water near-drowning victim. These decisions along with the proper training, will help determine rescue success or failure. The policies and protocol will also reduce the stress and pressure placed on the incident commander.

Other decisions a department should make in advance include answers to the following:

1. When does a rescue attempt become a recovery operation?
2. Will a rescue unit respond if several team members are absent?
3. When will the dive team and rescue medical helicopter be notified?
4. Will a department allow a boat on the water if a backup boat is unavailable?
5. How will a department determine when the rescue team has received adequate training?
6. Will a department risk human life to affect a recovery?
7. Is the local hospital emergency department trained and prepared to resuscitate a cold-water, near-drowning victim?

TRAINING

The information provided for wat rescue operations is just the beginning phase of developing an educational program needed to perform safe, effective water rescues. Reading material cannot act as a substitute for the hands-on training needed to understand the power of moving water, the dangers of ice and cold, and other potential dangers that may be present.

Many opportunities for information and training exist for people interested in water rescue. Many state and local governments have established training programs with qualified instructors. Private organizations like the American Red Cross or the American Canoe Association can also guide rescue personnel to new and different approaches to the many problems of water rescue. Movies explaining the aquatic environment are available from a number of sources. Books are written on the subject of river rescue for the river runners. It is the uninformed who usually get into trouble.

Rescuers must recognize when the dangers are too great, when the risk does not meet the benefit, and when a rescue becomes a recovery. Water rescue is a challenging task and seldom an easy job. Rescuers must respect the water and its power.

For more information and training, contact the following:

Special Programs Administrator
Ohio Department of Natural Resources
Division of Watercraft
Fountain Square C-2
Columbus, Ohio 43224

Rescue 3
Box 1686
Sonora, California 95370

Nantahala Outdoor Center
U.S. 19W, Box 41
Bryson City, North Carolina 28713

Pennsylvania Fish Commission
Bureau of Boating
P.O. Box 1673
Harrisburg, Pennsylvania 17105-1673

Colorado Dive Rescue Specialists
Concept Systems, Inc.
2619 Canton Court
Fort Collins, Colorado 80525

South Bend Public Recreation Commission
727 South Eddy Street
South Bend, Indiana 64415

Indiana Department of Natural Resources
Law Enforcement Division
606 State Office Building
Indianapolis, Indiana 46204

Boat and Water Safety Section
Minnesota Department of Natural Resources
500 Lafayette Road
St. Paul, Minnesota 55146

Saltsburg Volunteer Fire Co.
Box 242, Rd. #2
New Alexandria, Pennsylvania 15670

Education Department
SW General Hospital
18697 East Bagley Road
Middleburg Heights, Ohio 44130

Charlie Walbridge
American Canoe Association
230 Penllyn Pike
Penllyn, Pennsylvania 19422