TM 3-34.84

SWIFT WATER DIVING OPERATIONS

March 2015

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Headquarters, Department of the Army

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Swift Water Diving Operations

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Preface

TM 3-34.84 provides recommended swift (1-4 knots [1.85-7.41 kilometers per hour]) or fast (4+ knots [7.41 kilometers per hour]) water diving operational planning to include proven techniques and procedures. It recommends practices for experienced divers in order to safely conduct self-contained underwater breathing apparatus (known as scuba) diving operations in currents in excess of 1 knot (1.85 kilometers per hour) and surface supplied diving (SSD) in excess of 2.5 knots (4.63 kilometers per hour). Leaders must emphasize that swift/fast water diving operations are inherently more dangerous and pose additional risks to the diver and support personnel beyond those encountered in normal diving operations.

The primary audience for TM 3-34.84 consists of engineer divers (military occupational specialty 12D) or engineer officers with marine diver skill identifier 5V, and combat divers (awarded either Army skill identifier W7 or W9) or combat diving officers with skill identifier 4W. Familiarity with basic diving and rigging techniques, tactics, and procedures is recommended. This training circular supports multiple levels of understanding to include divers, diving supervisors, master divers, diving officers, and dive unit commanders.

Commanders, staffs, and subordinates ensure their decisions and actions comply with applicable United States, international, and, in some cases, host-nation laws and regulations. Commanders at all levels ensure their Soldiers operate in accordance with the law of war and the rules of engagement (see FM 27-10).

TM 3-34.84 uses joint terms where applicable. Selected joint and Army terms and definitions appear in both the glossary and the text. Terms for which TM 3-34.84 is the proponent (the authority) are marked with an asterisk (*) in the glossary. Definitions for which TM 3-34.84 is the proponent publication are boldfaced in the text. For other definitions shown in the text, the term is italicized and the number of the proponent publication follows the definition.

TM 3-34.84 applies to the Active Army, Army National Guard/Army National Guard of the United States, United States Army Reserve, and divers from all United States military Services unless otherwise stated.

A complete listing of preferred metric units for general use is contained in Fed-Std-376B.

The proponent of TM 3-34.84 is the United States Army Engineer School. The preparing agency is the Maneuver Support Center of Excellence (MSCoE) Capabilities Development and Integration Directorate (CDID); Concepts, Organizations, and Doctrine Development Division (CODDD); Doctrine Branch. Send comments and recommendations on DA Form 2028 (*Recommended Changes to Publications and Blank Forms*) to Commander, MSCoE, ATTN: ATZT-CDC, 14000 MSCoE Loop, Suite 270, Fort Leonard Wood, Missouri 65473-8929; by e-mail to usarmy.leonardwood.mscoe.mbx.cdidcodddengdoc@mail.mil; or submit an electronic DA Form 2028.

Unless this publication states otherwise, masculine nouns and pronouns do not refer exclusively to men.

Introduction

Supervisors and divers must be thoroughly familiar with the risks associated with swift/fast water diving operations. Train-ups, rehearsals, and unit standard operating procedures should be used when planning and conducting diving operations in currents above 1 knot (1.85 kilometers per hour) (scuba) and 2.5 knots (4.63 kilometers per hour) (SSD). For the purposes of this manual, swift water is defined as sustained current from 1 to 4 knots (1.85 to 7.41 kilometers per hour). Fast water is defined as sustained current in excess of 4 knots (7.41 kilometers per hour). The distinction is important as many of the safety steps for swift water DO NOT translate into safe practices for fast water.

Swift/fast water divers must know how to move in the water to lessen the chances of being trapped, or pulled off the project and thrown down stream. Careful consideration needs to be taken in regard to the divers' overall fitness level, underwater hazards, lost diver procedures, and the increased risk of arterial gas embolism should the diver experience an uncontrolled ascent.

Topside personnel must understand the forces acting on the diver, the tenders, and the support craft, as well as the potential for waterborne hazards to interfere with anchors, lines, and emergency recovery procedures. Supervisors must take into account additional risks associated with this type of operation. Leaders must plan for greater manning requirements, shorter bottom times, and increased fatigue of dive side personnel.

This publication is developed as a supplement to AR 611-75, FM 3-05.212/MCRP 3-11.3A, SS521-AG-PRO-010 0910-LP-106-0957, and TM 3-34.83. TM 3-34.84 provides recommended planning steps and procedures for conducting swift/fast water diving operations, to include the various techniques and equipment that will aid the dive team in mission accomplishment.

This publication is not all inclusive. Leaders must assess each diving operation independently and conduct proper risk management to ensure personnel safety. TM 3-34.84 covers basic risks associated with swift/fast water diving, planning procedures, recommended equipment, and procedures. The diving supervisor on-site will need to adjust based on the mission, enemy, terrain and weather, troops and support available, time available, and civil considerations.

This TM is designed to provide training information, strategies, program development, and training support materials for swift/fast water diving operations. Leaders will receive relevant information to assist the development of individual training programs. Everything from supervisor/diver selection to diver tactics, techniques, and procedures are covered in the pages that follow. Applying strategies and planning considerations from this TM, United States Navy Diving Manual, and TM 3-34.83 will improve the dive team's performance when conducting operations in high current areas.

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Chapter 1
Planning

MANNING

1-1. Tactically, nonpermissive environments place a unique strain on diving operations during times of war or conflict. Manning requirements, safety protocols, and techniques may need to be altered by the diving supervisor at the scene. Neither the techniques listed in this training circular, nor the conditions encountered at the diving location, preclude the leadership, or diving supervisor, from ensuring that all diving operations are conducted in a safe manner.

1-2. Minimum manning for swift/fast water diving should be increased whenever tactically possible. At a minimum, the following positions should be identified and filled:

- **Scuba diving.** Scuba diving should include—
  - One diving supervisor.
  - One diver. Diving in buddy teams is not recommended.
  - Two tenders. If properly trained and briefed, the supervisor may elect to use nondive qualified personnel.
  - One upstream safety (see paragraph 1-4). If properly trained and briefed, the supervisor may elect to use nondive qualified personnel.
  - Two downstream safeties (see paragraph 1-5). If properly trained and briefed, the supervisor may elect to use nondive qualified personnel.
  - One dive recorder.
  - One standby diver.
- **Surface supplied diving.** SSD should include—
  - One diving supervisor.
  - One diver. Diving in buddy teams is not recommended.
  - Two tenders. If properly trained and briefed, the supervisor may elect to use nondive qualified personnel.
  - One upstream safety (see paragraph 1-4). If properly trained and briefed, the supervisor may elect to use nondive qualified personnel.
  - Two downstream safeties (see paragraph 1-5). If properly trained and briefed, the supervisor may elect to use nondive qualified personnel.
  - One dive recorder.
  - One standby diver.
  - One air console operator/communications.

SINGLE DIVERS

1-3. Single divers are recommended for all swift/fast water diving operations to avoid fouling or entrapment due to additional lines in the water. SSD, particularly the lightweight dive systems, are preferred if two or more divers are required to complete the mission. Full facemasks or dive helmets (Supermask, MK20, or SL37K) are preferred over standard regulators to reduce the risk of accidental loss of the air source due to increased current.

UPSTREAM SAFETY

1-4. An upstream safety is a nonstandard dive bill position. The upstream safety shall be located as far upstream as possible to provide early warning of vessel traffic, flotsam, or any other hazards to the diver.

The upstream safety should have at a minimum one 50-foot (15.25-meter) throw bag of line, and two-way communication with the diving supervisor. If communication is lost, diving operations will cease.

DOWNSTREAM SAFETY

1-5. A downstream safety is a nonstandard dive bill position. Two safety personnel, preferably in a motorized boat, should be positioned downstream. These downstream safeties should be positioned at an appropriate location, based on current velocity and navigational obstacles, which allows for the most safe and expedient recovery of a displaced diver or swimmer. The optimal downstream safety equipment should include two 50-foot (15.25-meter) throw bags and at least one rescue vest. One downstream safety will operate as coxswain, and also belay the second downstream safety if he must enter the water.

1-6. Shore-based downstream safeties shall have a throw bag with enough line to reach a victim washed from the dive site. For example, a diver inspecting a bridge piling located 75 feet (22.86 meters) from the nearshore would require a shore-based downstream safety to have at least 75 feet (22.86 meters) of line in his throw bag. This will allow the safety to rescue a diver who is washed downstream and unable to swim towards the shore.

1-7.

Note. All downstream safeties shall have at a minimum one 50-foot (15.24-meter) throw bag of line, and two-way communication with the diving supervisor. If communication is lost, diving operations will cease.

QUALIFICATIONS

1-8. Only fully qualified dive supervisors, according to AR 611-75, who have received specific swift/fast water training (see appendix A) should supervise swift/fast water diving operations without qualified backup.

1-9. Experienced divers who have completed unit swift/fast water training in currents above 3 knots (5.556 kilometers per hour) are preferred. Inexperienced divers without proper train up are at much greater risk of injury.

1-10. A master diver shall be present for all high-risk swift/fast water diving operations until the initial risk can be lowered through experience, familiarity with the dive site, and other risk mitigation factors at the discretion of the master diver.

RISK MANAGEMENT

1-11. An assessment of the site must be made as part of the preplanning phase of the operation. Areas to be considered are—

- River width, depth, velocity, and river hydrology.
- Identification of natural and man-made hazards (use maps, site reconnaissance, local resident input, local authorities, and so forth).
- Identification of access and evacuation routes, launch sites, and high-danger areas.
- Determination of whether river flow can be controlled; for example, an upstream dam.
- Availability of local terrain, man-made objects, and vegetation to aid in anchoring or stabilizing the diver and watercraft.

IDENTIFY POSSIBLE HAZARDS

1-12. First, identify the major events that are expected to occur during the operation and the hazards associated with all specified and implied tasks. The following are a few of the hazards associated with this type of operation:

- Drowning.
- Arterial gas embolism.

- Entanglement/trapping.
- Tending difficulty.
- Tending line injuries.
- Exhaustion.
- Pollution/raw sewage.
- Floating debris.
- Razor wire/enemy emplaced obstacles.
- Shallow water blackout.
- Pulmonary Overinflation Syndrome.
- Lost diver.
- Strainers.
- Foot entrapments.
- Swamping vessels.
- Low head dams.
- Enemy contact.

DEVELOP CONTROLS

1-13. Consider the following when determining what controls should be emplaced:

- Velocity of the water.
- Suspected location of object to be recovered.
- Equipment on hand (harness, rigging, throw bags, and so forth).
- Control of the rivers flow.
- Urgency of the mission (recovery versus rescue).
- Training and experience of the team conducting the operation.
- Cost to benefit ratio.

IMPLEMENT CONTROLS

1-14. Once the assessments and controls have been identified, the supervisor must implement them by—

- Choosing equipment appropriate for the river and for the mission.
- Selecting personnel that are properly trained and experienced.
- Designing a detailed and realistic plan.
- Not accepting unnecessary risks.

TEAM SELECTION

1-15. Team selection is an important dive planning step. Deployed quick reaction forces and theater ready dive teams may not have the personnel required to conduct swift/fast water diving organically. Any personnel assigned to support diving operations from outside units shall be briefed and trained on their specific job prior to conducting operations. The diving supervisor must verify that the dive side is experienced and capable of conducting swift/fast water diving prior to launching divers.

1-16. Whenever possible, the unit's most experienced divers should be selected for swift/fast water diving. If trained swift/fast water divers are available, they should be selected first. The dynamic and ever changing conditions imposed on the diver inhibits *on-the-job training* during swift/fast water diving.

1-17. Due to the increased likelihood of fatigue, additional personnel should be selected for the team if practical. This should include an additional diving supervisor to aid in surface coordination and to provide two experienced divers for the price of one (each supervisor can dive).

HYDROLOGY

1-18. Hydrology is the study of the movement, distribution, and quality of water. Swift/fast water operations require a thorough understanding of the hydrological forces at work on the surface and on the bottom to ensure vessels, platforms, and divers can operate safely.

1-19. When performing an on-site river evaluation, visually inspect the river both upstream and downstream of the dive site. Watch the flow of the river around bends and turns, look for dead spots and eddies, take velocity measurements, and evaluate the terrain for access to downstream areas to serve as secondary recovery locations.

Note: Consider using debris such as sticks, float buoys, and submersible mannequins to determine the rivers behavior. Also consider conducting a quick inspection dive along the river banks to determine potential hazards caused by roots, rocks, and debris in the area during casualty evacuation.

CAUTION

The river you were on yesterday is different than the river you are on today. Rivers are prone to changing their behavior at any moment and measurements, emergency plans, and dive plans must be evaluated each day during the operation.

DETERMINE RIVER VELOCITY

1-20. Refer to ATTP 3-90.4 for additional details and explanations for river velocity. The two methods used by engineer dive teams are hasty and deliberate. For velocity conversions, see table 1-1 and table 1-2.

Table 1-1. Velocity conversions

Velocity					
Knots	1.6880	Feet per second	Feet per second	0.5921	Knots
Knots	1.852	Kilometers per hour	Kilometers per hour	0.53996	Knots
Meters per second	2.237	Miles per hour	Miles per hour	0.8684	Knots

Table 1-2. Feet per second to knots conversion

Feet Per Second	***Knots***	***Feet Per Second***	***Knots***
1.0	.59	5.5	3.25
1.5	.88	6.0	3.55
2.0	1.18	6.5	3.85
2.5	1.48	7.0	4.14
3.0	1.77	7.5	4.44
3.5	2.07	8.0	4.73
4.0	2.36	8.5	5.03
4.5	2.66	9.0	5.33
5.0	2.96	9.5	5.6

Hasty Method

1-21. The hasty method uses a floating object and a known distance. Place the floating object in the water at point **a** and record the time it takes for that object to travel to point **b.** The current is equal to the distance divided by the time in seconds. See figure 1-1.

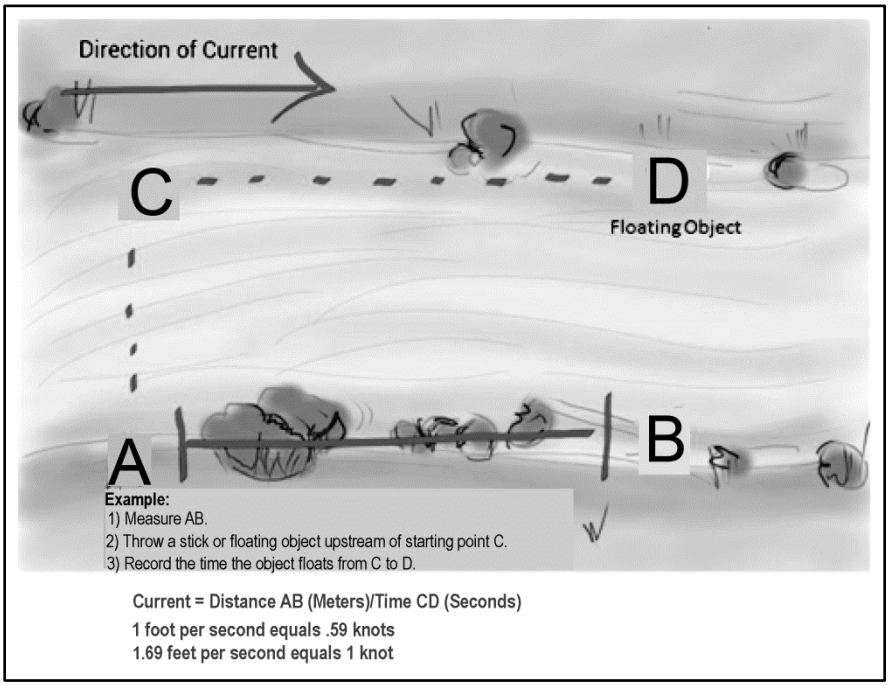


Figure 1-1. Hasty method

Deliberate Method

1-22. The deliberate method uses a current meter or water velocity meter to mechanically compute the current. Engineer dive teams are issued the Swoffer™ fiber-optic sensor. See figure 1-2.

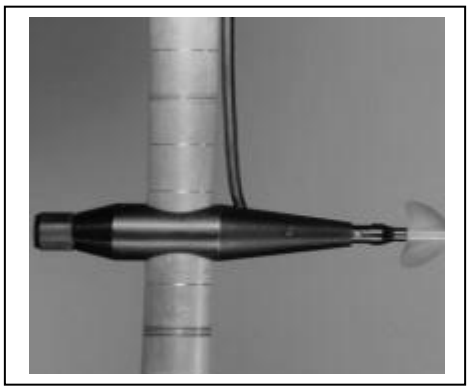


Figure 1-2. Swoffer

1-23. When determining river velocity all efforts should be made to take accurate measurements along the path that the diver will use to enter and exit the waterway, surface measurements, and measurements at depth of the work site.

UNDERSTAND RIVER CHARACTERISTICS

1-24. It is very uncommon for two individuals to look at a moving body of water and describe it in the same way. To limit confusion and miscommunication, river terminology is very specific and unique. Basic river directions are always relative to the direction of flow. See figure 1-3, page 1-6.

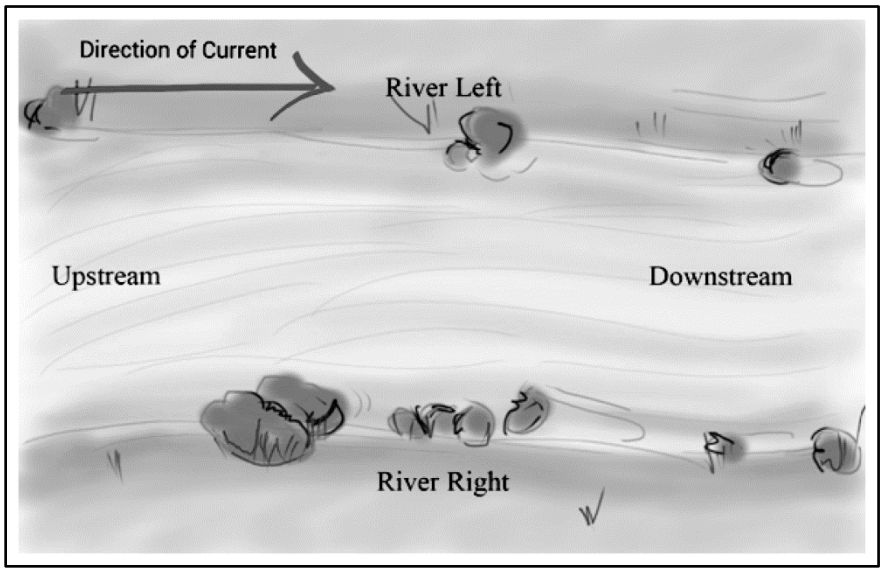


Figure 1-3. Direction of river flow

1-25. Any section of moving water can be characterized using three basic factors: gradient, obstruction, and constriction.

- **Gradient.** Gradient is when water moves down a slope, picking up both speed and direction. The steeper the grade, the faster the water moves.
- **Obstruction.** Obstruction is anything that impedes downstream flow. Water is always striving to reach equilibrium and will fill and take the shape of its container. The river bed is a container. If the river bed is smooth, the water running through it will match. When the river bed is textured or blocked with rocks and debris, the flow of the water is halted resulting in features that mimic the river bottom. For example, waves, eddies, hydraulics.
- **Constriction.** Constriction is when water does not compress, it accelerates. Anytime a volume of water moves from a larger area to a smaller area it is said to be constricted. Because water does not compress, as air does, it must move faster through a constricted area due to the volume of water that builds from upstream. For example, shoots, flumes, pillows, and fire hoses.

Waves

1-26. Unlike the ocean, where waves are created by wind and tide, waves in swift/fast water are created when water flows over an obstruction. These waves are tied directly to the underwater object that creates them.

- **Breaking wave.** A breaking wave is a wave that continuously breaks in place.
- **Standing wave.** A standing wave is a steep defined wave with no break.
- **Wave train.** A wave train is a wave with enough energy to create multiple peaks and troughs. They appear as a series of waves with the first wave in the series being the largest and the following waves decreasing in size as energy decreases.

Laminar Flow

1-27. Water moves in layers. Each layer can be thought of as riding atop one another. This occurrence allows each layer to move faster than the one beside it as it is insulated from drag. See figure 1-4.

1-28. Layers of moving water are slower on the bottom and at the banks; moving water is faster toward midstream and on the outside of bends.

Note. Man-made canals with smooth surfaces do not have pronounced laminar velocity differences. Water WILL be moving rapidly at the shoreline and on the bottom.

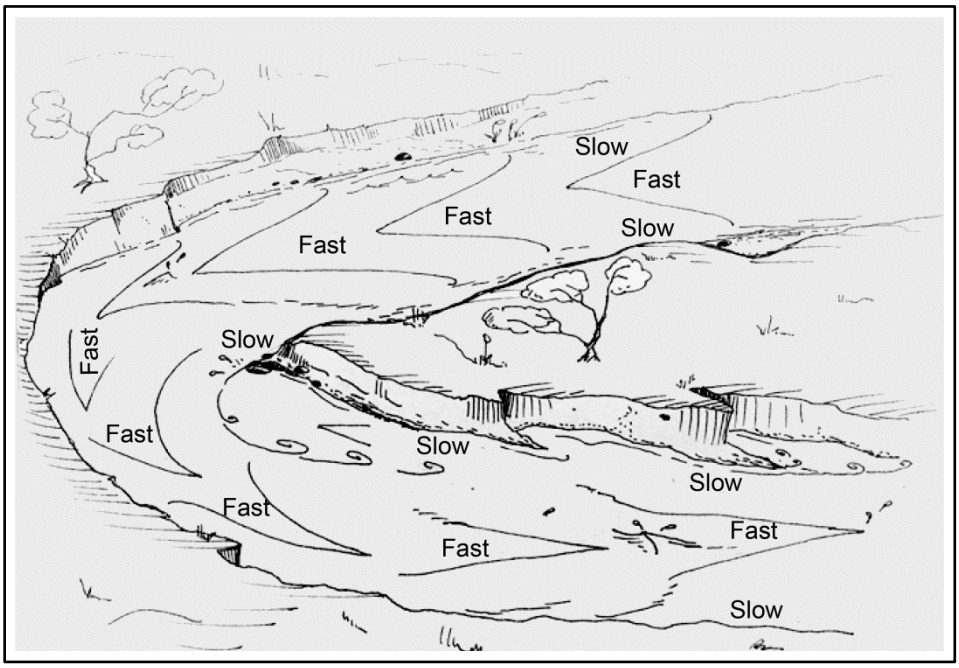


Figure 1-4. Turbulent/laminar flow

Helical Flow

1-29. Helical flows occur when two laminar flows move in the opposite directions, interact, and create a whirlpool. See figure 1-5.

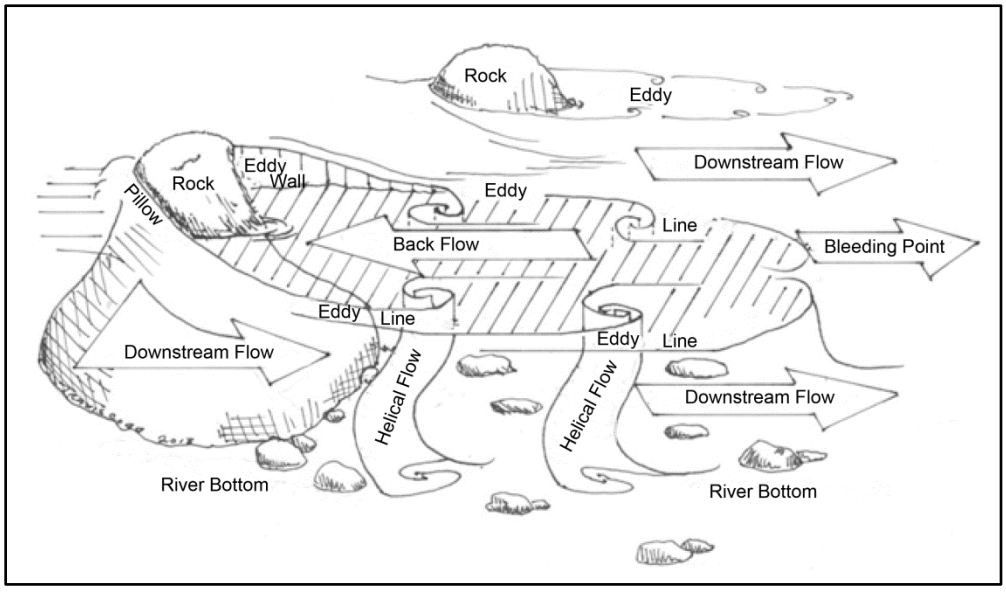


Figure 1-5. Surface/subsurface eddy parts

Turbulent Flow

1-30. Turbulent flow is the opposite of laminar flow. When water encounters an obstruction, the layers of flow twist and turn against one another. Unlike helical flow, turbulent flow is not uniform or predictable. For example, the foam pile of a hydraulic. See figure 1-8, page 1-9.

1-31. In the cross section in figure 1-6 it would be safest for the diver to enter the water at the bank on the river's left and follow the bottom contour to the center of the river.

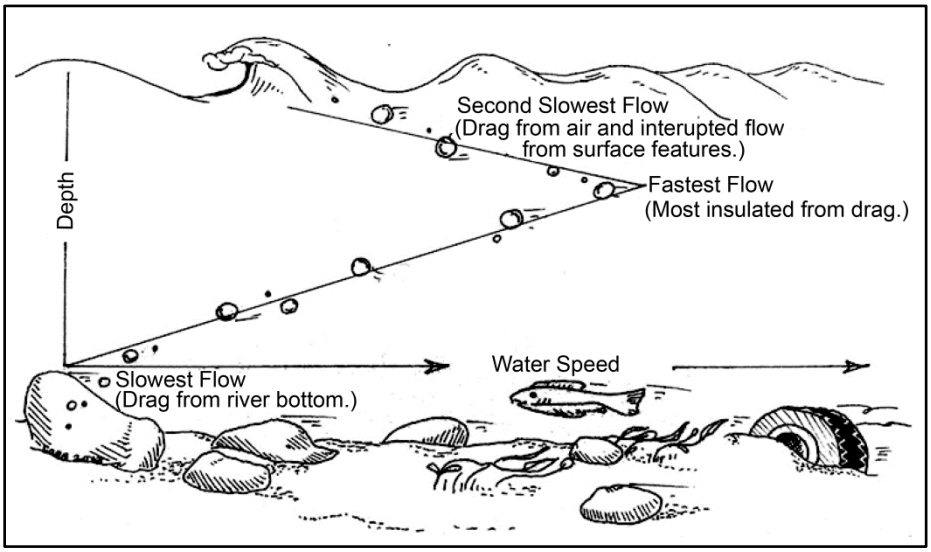


Figure 1-6. Water velocity cross sections

Pillows

1-32. Pillows are the swelling on the surface caused by an obstruction. The obstruction is usually just beneath the surface, or may break the surface in which case the pillow will be in front of the object rather than above and in front. In deeper water, pillows may not be visible on the surface, but will exist underwater as the diver approaches the obstruction. This will tend to push a diver off the project. See figure 1-7.

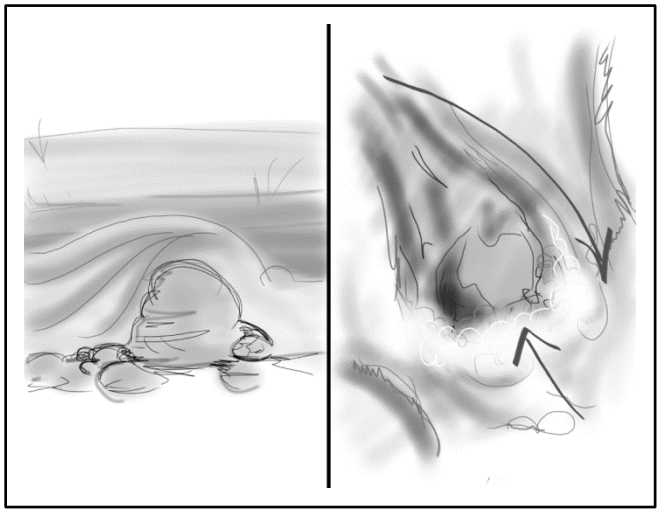


Figure 1-7. Pillow and holes

Hydraulics/Holes

1-33. Hydraulics/holes are water that drops vertically over an obstruction. The larger the drop, the more defined the hole. A hole creates a back current where water is trapped behind an obstruction. Divers should take care to avoid becoming trapped in a hole. Large, white water holes can even swamp combat rubber raiding crafts or other small vessels.

1-34. Hydraulics impedes the downstream flow and can create a useful workspace for divers under the right conditions. See figure 1-8 for backflow, boil line, and green water.

Note. Moving water always follows the path of least resistance.

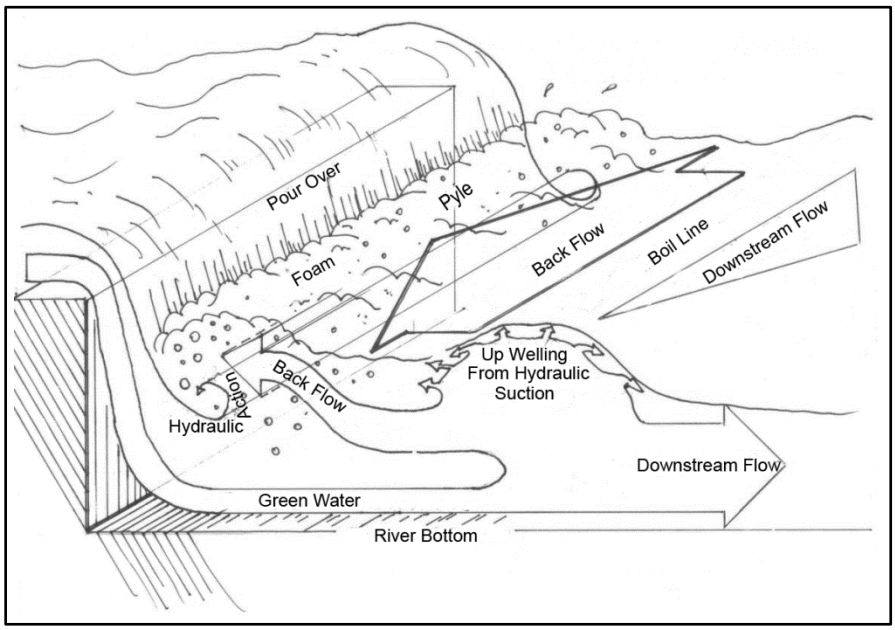


Figure 1-8. Cross-section of a hydraulic/hole

CAUTION

Hydraulics can be an extremely powerful river feature. They can trap divers, swamp combat rubber raiding craft, and other small vessels.

Strainers and Sieves

1-35. Sieves and strainers are technically different methods to produce the same hazard. Water moving through either wood (strainer) or rock (sieve) via spaces smaller than a diver is a serious hazard. While water flows relatively unhindered through small spaces, large solid objects (such as divers and equipment) can be pinned to the object and trapped in the same manner as a ship's suction.

Eddies

1-36. When water encounters an obstruction, the downstream flow is diverted to either side of the obstruction. The space between these diversions where the water slows and can even flow upstream is called an eddy. See figure 1-5, page 1-7, for eddy wall, backflow, eddy line, and bleeding point.

Downstream V's

1-37. Water travels downstream around obstructions following the path of least resistance. It creates either upstream V's or downstream V's (see figure 1-9, page 1-10). A downstream V will have the apex of the V downstream of the legs. A downstream V is an excellent indicator of the deepest and fastest moving flow of water. This indicates safer passage for vessels as well as swimmers and divers when moving on the surface.

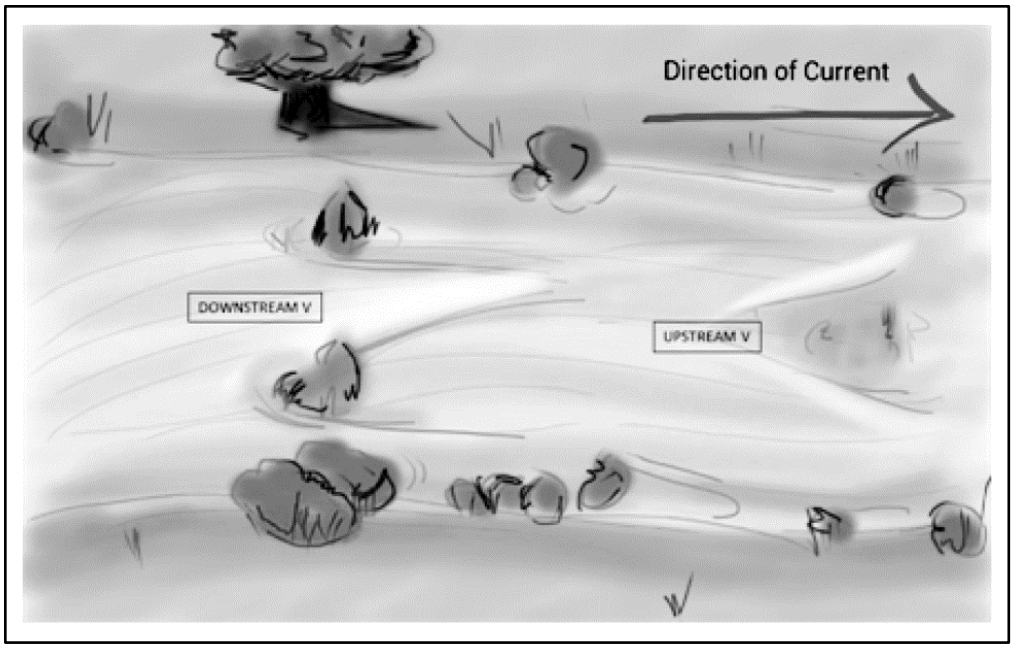


Figure 1-9. Upstream and downstream V's

1-38. When the apex of the V is upstream of the legs, this creates an upstream V. An upstream V indicates an obstruction just below the surface and should be avoided by vessels, swimmers, and divers. It is the simplest form of river reading, commonly taught as *always aim for the downstream V*.

Note. Large downstream V's may have a hole at the apex.

SWIFT WATER CATEGORIES

1-39. There are six swift water categories. They include—

- **Class I.** Few obstructions; very small waves.
- **Class II.** Easy rapids up to 3 feet (0.914 meters) wide; obvious clear channels.
- **Class III.** High irregular waves, narrow channels, and require scouting.
- **Class IV.** Difficult long rapids and turbulent water requires scouting; rescue is difficult.
- **Class V.** Violent long rapids, scouting is mandatory, and is an extremely dangerous rescue.
- **Class VI.** Almost impossible to navigate; rescue is almost impossible.

1-40. Rivers are typically classed in the aforementioned manner based on the surface navigability of the water. White water rafting guides and swift water rescue teams typically use this classification system. For swift/fast water diving operations, the class system will give indications of the water speed but will not be enough for the diving supervisor's planning purposes. Underwater current flow, obstructions, and depth may render a Class I river more dangerous to a diver than a higher class river.

Chapter 2
Safety

SWIFT/FAST WATER HAZARDS

2-1. The following are a few hazards which may be encountered when conducting swift/fast water operations:

- **Poor line management.** An unmanned line in swift or fast moving water can quickly become an entanglement hazard to divers in the water as well as personnel on the surface. It takes focused effort, practice, and skill to avoid getting entangled in a whipping line and pulled into the water.
- **Entrapment.** Any passage that water flows through, but a diver cannot cleanly swim through poses significant risk. For example, sieves, undercut rocks, man-made debris.
- **Pinning.** Water has the ability to press boats and bodies against an obstruction with enough force to hold them there. For example, strainers, broach pin, center pin, end-to-end pin.
- **Physical hazards.** Turbulent water has the ability to throw boats and bodies around. Divers should remain alert and be careful to avoid hazards such as hazards as hydraulics, breaking waves, crashing waves, and extreme helical flow. Moving water alone can cause rapid and uncontrolled downstream movement capable of fatiguing and drowning a diver even if they are not fully submerged. This is known as a flush drowning.

GENERAL SAFETY PRACTICES

2-2. In any swift/fast water diving scenario, the most important safety factor is experienced personnel. Every opportunity should be taken to conduct training dives, or specialized swift/fast water training, prior to the execution of these missions. If trained and experienced personnel are unavailable, the diving supervisors should carefully weigh the benefits of conducting the mission against the risk to personnel.

2-3. Commanders and diving supervisors must always place personnel safety first in an emergency. The desire to retrieve the victim(s) in need of a rescue or recovery is strong, and can easily lead to additional victims without proper restraint. During rescue and evacuation training, emphasize the importance of individual safety of the rescuer.

2-4. In any new environment that is tactically permissive, a full walk through of the emergency action plan and causality evacuation plan shall be conducted. If conducting swift/fast water operations at multiple locations with different evacuation routes, test the casualty evacuation plan at each location.

2-5. Ensure that all line is of the proper kernmantle construction and in good repair. Kernmantle rope consists of an abrasive resistant sheath of braided fibers over a core of parallel fibers which supply most of the rope's strength. Kernmantle ropes are durable and easy to knot. A quality 1/2-inch static kernmantle rope's static working load is 10,000 pounds (4,535.92 kilograms).

2-6. Ensure that all pulleys are Prusik Minding and all Prusik/Bachmann lines are of the proper diameter when compared to the rigging lines. As the difference in diameters between the Prusik line and the fixed rope to which it is attached increases, the gripping strength of the knot also increases. Conversely, the working load for the smaller Prusik line will decrease as the difference in diameters increases.

2-7. The diver should be properly harnessed to the tending line. When possible avoid the use of a tending line tied around the diver's waist. This will place the fulcrum in the wrong location and may cause injury to the diver in strong currents. A forklift safety harness can be used with slight modification to provide a divers tending line harness by moving the D-ring attachment point from the center of the back to the center of the chest. Other field expedient options are also available, such as running the tending line through the

chest strap of a buoyancy compensator after being tied to the waist and thereby placing the fulcrum point higher.

Note. Use of a full facemask is recommended to avoid having the regulator pulled from the diver's mouth.

2-8. When swimming in currents to attain a target, use the current to push you into place by swimming at a steep approach angle. This will minimize downstream movement and allow the diver or swimmer to move perpendicular to the current. See figure 2-1.

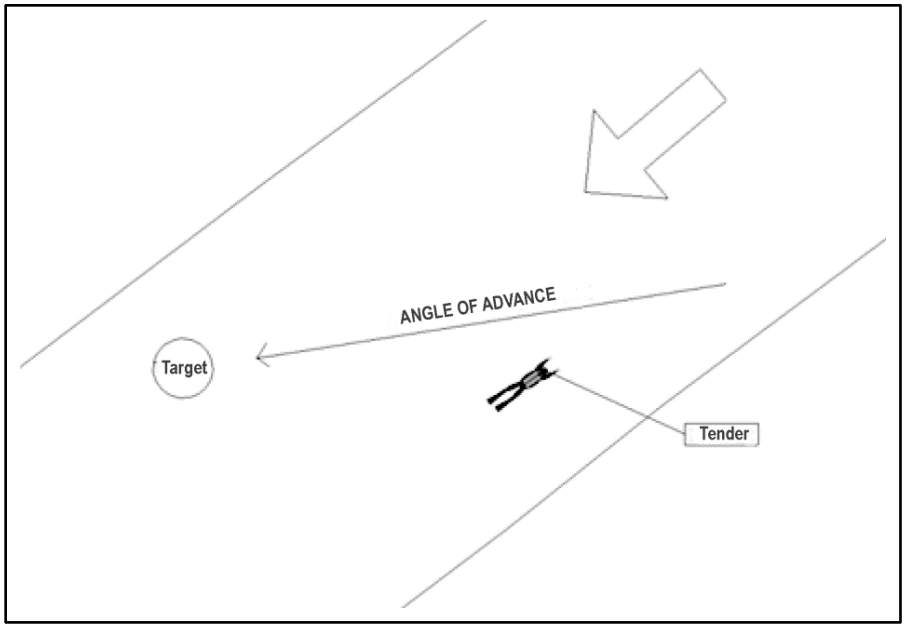


Figure 2-1 Angle of advance when swimming upstream

SAFETY PRACTICES UNIQUE TO SWIFT WATER

2-9. Tending the diver at the chest is recommended. The tending line may be permanently attached in swift water as the chance of entrapment is lower than fast water. However, emergency planning should include procedures for pulling the diver into the boat or to shore from the work site.

2-10. In most instances, the diver can either be tended from a small boat or from the shoreline at an angle appropriate to the current. While a diver cannot typically swim against the current, they are usually able to navigate perpendicular to the current.

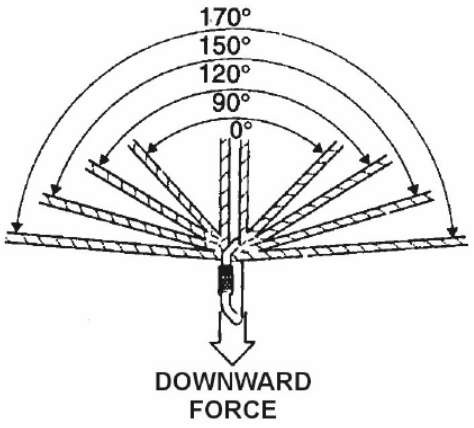
2-11. Plastic, neutrally buoyant helmets can be worn to protect the divers head in the event flotsam or other objects impact the diver. Objects and tools should be minimized. The use of special tools like creepers, ice climbing axes, or an e-tool may help the diver navigate. All objects should be secured to the diver.

SAFETY PRACTICES UNIQUE TO FAST WATER

2-12. Tending the diver at the chest is recommended to avoid pitching the diver head up and risking an arterial gas embolism. The tending line shall not be permanently attached (must use a quick release) in fast water as the chance of entrapment is high. In fast water the ability to pull a diver who is trapped back upstream is limited and dangerous. All fast water dive emergency procedures should include the releasing of the tending line and defensive swimming to the downstream safety.

2-13. In most instances, the diver can either be tended from a small boat or from the shoreline at an angle appropriate to the current. The angle of advantage in fast water is of paramount importance. High line diving or any method that uses a transverse line at a 90-degree angle to the current is ineffective in wide

rivers. The weight of the diver will cause the line to bow heavily and may prevent retrieving the diver. Using a 90-degree or lower angle increases the mechanical advantage and should be used in fast water. If tending from a boat, a belay may need to back up the primary tender, and the boat should be tended by multiple lines at angles not to exceed 45 degrees (90 degrees total) from the direction of the current. See figure 2-2.



TENSION IN MULTIPLE ANCHOR RIGGING	
ANGLE	RESULTING LEG TENSION*
170^0	1150%
150^0	200%
120^0	100%
90^0	70%
0^0	50%
*On each leg relative to downward force.	

Figure 2-2. Angle of advantage

Note. Use of a full facemask is required to avoid having the regulator pulled from the diver's mouth. Additionally, the octopus should be fitted with an in line shut off valve to prevent free flowing in high current.

2-14. Plastic neutrally buoyant helmets should be worn to protect the divers head in the event flotsam or other objects impact the diver, or the diver is swept downstream and will bang against rocks.

2-15. Objects and tools should be minimized. Special navigation tools will be ineffective in fast water. An underwater line, ladder, or other device which allows for multiple hand/footholds may be used (see figure 2-3, page 2-4). Fast water rarely has a soft bottom due to current velocity; often the most effective movement technique is to simply climb the rocks. Fins should not be worn. The diver will seldom be able to navigate with them, and they are an extreme entrapment hazard.

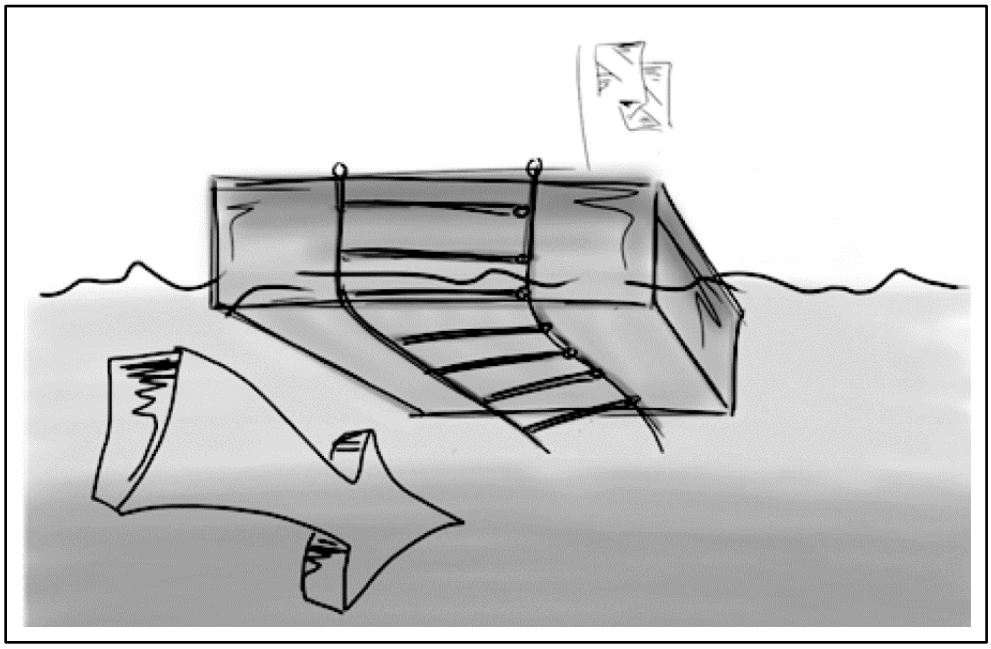


Figure 2-3. Ladder system

Chapter 3
Equipment

EQUIPMENT

3-1. Swift/fast water diving often necessitates specialized equipment to safely conduct the operation. This chapter outlines some of the equipment currently available and indicates situations where the equipment is best suited.

DIVE MASK

3-2. Low volume dive masks have a smaller surface area and are less likely to be torn from the diver's face by fast moving water.

DIVE FINS

3-3. Special care should be taken to use fins that DO NOT have holes or vents to reduce the chance of debris lodging in the holes or vents and then trapping the diver. In fast water, fins provide no aid and can become entrapped and should not be worn.

DIVE KNIFE

3-4. Preferably a diver should have two knives. The primary knife should be on the upper thigh or waist to prevent snagging and to limit sacrificing solid positioning when reaching for the knife. A secondary knife should be slightly smaller and attached to wrist/lower arm. Surgical scissors also work well as a secondary cutting tool. All cutting tools should be tied to the diver with paracord.

THERMAL PROTECTION AND CHAFFING GEAR

3-5. Thermal protection and chaffing gear needs to be properly fitted and not bulky to reduce the overall physical size in the water. Fast currents will chill the diver rapidly. Ensure that thermal requirements account for the fact that wetsuits are of limited use for thermal protection as the current continually floods new cold water into the suit. Wetsuits do serve as effective chaffing gear.

DIVERS LIFE SUPPORT AIR SYSTEMS

3-6. A divers life support system may include the following:

- **Extreme Lightweight Diving System (XLDS)**. The XLDS is a lightweight system that provides for many of the benefits of SSD in swift/fast water but can be deployed on a small craft.
- **AGA mask/MK 20.** These masks are full face masks capable of supporting either a scuba or surface supplied diver and are much less likely to be removed by the current. Additionally, they can facilitate the use of communications to augment line pull signals.
- **Supermask/M-48.** This mask is a full face mask that accepts an existing scuba regulator with an elongated mouthpiece. The M-48 mask clips the mouthpiece to the mask and aids in retention of the divers air source.

CONTROL DEVICES

3-7. A control device is a tool that the diver can embed into the bottom of the stream to control his movement (see figure 3-1). These are not effective in large aggregate gravel environments. Devices include—

- **Entrenching tools (E-Tool).** This tool works well in mud and silt environments.
- **Picks.** A pick is much like ice climbing tools that are pointed or flat ended. Picks work well in clay and hard bottom conditions.
- **Trowels.** A trowel is similar in nature to a small garden hoe or two pronged rake. Trowels work on a variety of bottom conditions.
- **Creeper.** A creeper allows controlled progress moving downstream and occasionally slow upstream movements. It will also allow the diver to lock into a position during work. See figure 3-2.

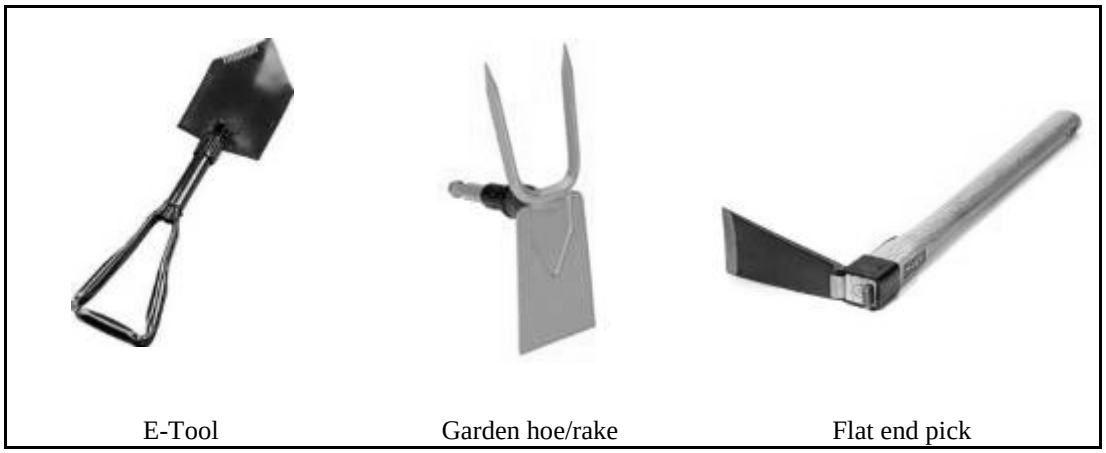


Figure 3-1. E-tool, rake, and pick

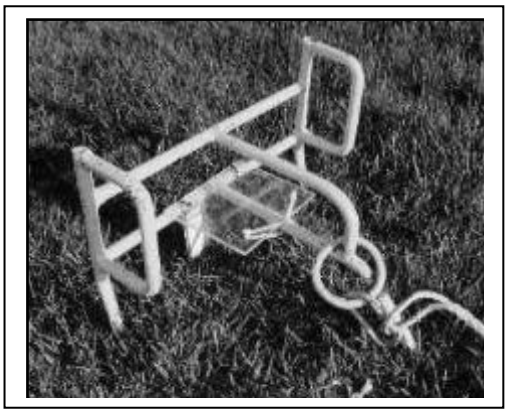


Figure 3-2. Creeper

TENSIONED DIAGONAL TRAVERSE SYSTEM (ZIP LINE)

3-8. Use the current to the advantage of the diver. A line, webbing strap, and two carabineers and/or a pulley make up this system. See chapter 4 for details.

TWO- AND FOUR-POINT TETHERED BOAT/DIVER SYSTEM (HIGH LINE)

3-9. The Two- and Four-Point Tethered Boat/Diver System (High Line) uses mechanical advantage to position the diver or boat in the river. Multiple lines, webbing straps, pulleys, Prusiks, and drop bags are required. The system should be purchased before executing high line diving. See chapter 4 for details.

DIVER TRANSVERSE LINE

3-10. A diver transverse line is a single line pulled perpendicular to the current flow. The diver uses the line to move from bank to bank. This is not recommended in large rivers or very fast current due to the lack of mechanical advantage and the current straining the line and bending it.

TENDING SYSTEMS

3-11. Tending systems include float lines, buddy lines, tool bags/catch bags, and rescue throw bags. Each is discussed below.

FLOAT LINES

3-12. A float line should be 1.5 to 2 times the anticipated depth. This allows enough slack for the current to act as a buoy without snagging the line on the bottom.

BUDDY LINES

3-13. Buddy lines need to be fairly short to keep from snagging. A small float placed in the center of the line will help to prevent snagging on bottom debris. A dive buddy can also be tethered to the float line with a carabineer to allow freedom of movement. Diving multiple divers is not recommended and should only be done when necessary to complete the mission.

TOOL BAGS/CATCH BAGS

3-14. Tool bags/catch bags should be smooth and not mesh. They should be low profile with a quick release and single-handed operation is best.

RESCUE THROW BAGS

3-15. A rescue throw bag is a commercially available floating bag with coiled line designed to aid in rescue. The bag is designed to be thrown playing the line out and creating a large object to grab.

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Chapter 4
Swift/Fast Water Dive Side Setup

DIVE SIDE CONFIGURATIONS

4-1. The dive side configurations represented throughout chapter 4 are examples which have been used by engineer diving detachments while conducting swift/fast water diving operations. Dive side configurations during swift/fast water diving operations must be developed for each mission based on the specific conditions encountered at that location. A thorough risk assessment and dive plan should be developed prior to each swift/fast water diving operation.

Note: For dive side positions and manning refer to chapter 1.

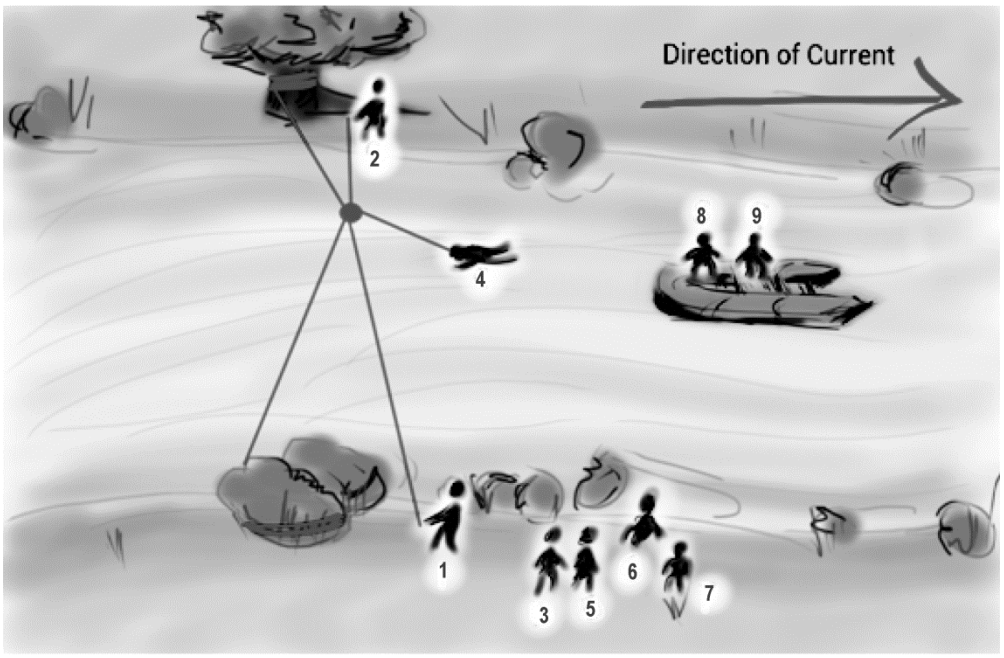
SAMPLE CONFIGURATION SYSTEMS

4-2. The paragraphs below discuss the various types of diving systems used by divers.

HIGH LINE FROM SHORE

4-3. The high line family of systems (see figure 4-1, page 4-2) are best for use with nearshore and far shore security, longer timelines in a tactically permissive environment, and narrow rivers (98 feet [<30 meters]). Once control of both banks is established, run a transverse line perpendicular to the flow of current. The diver or boat can be tended from the high line by use of pulleys. Tenders must be placed on the nearshore and the far shore to move the diver or boat both directions. Due to the infinite mechanical advantage of a 180-degree angle the line must be very taut and will still bow under weight. If the high line touches the water due to bowing, this system will not be effective.

4-4. High lines were designed as an answer to vertical rescue problems. Under those circumstances, with easily estimated or even known forces, high line techniques are invaluable tools. For swift/fast water applications where immense and varying drag is generated by lowered boats and divers, high lines become difficult to manage and are ineffective. Alternatively, proper use of a multipoint tethered boat lower system can offer the same traversing abilities as the high line system. Additionally, the multi-point tethered boat lower system uses less equipment and provides a more stable workspace.



Note: One nearshore tender; 2 far shore tenders; 3 supervisors; 5 logs; 6 standby divers; 7 tenders; 8 and 9 downstream safeties.

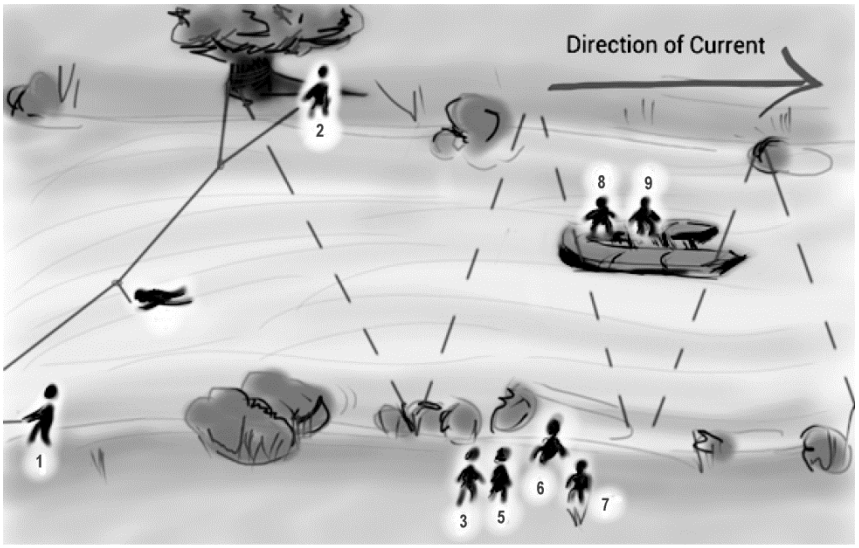
Scuba divers a minimum of 9 personnel.

Extreme Lightweight Diving System (XLDS) a minimum of 10 personnel (preferred method).

Figure 4-1. High line system

ZIP LINE SYSTEMS

4-5. Zip line systems (see figure 4-2) use the rivers current to move the diver downstream and across the river from nearshore to far shore. The zip line takes less time to set up than the high line system and can be used in faster currents. Both sides of the river should be secure. Once security is established, run a transverse line at about a 45-degree angle from the flow of current. The diver will move from the upstream side to the downstream side letting the current push them. Tenders must be placed on the nearshore and the far shore to move the diver or boat both directions. Once the diver has moved to the far shore, the nearshore tender will place the line downstream and allow the diver to move back. The search pattern will then be shaped in a /\/\/\ fashion. Ensure that the movement of the downstream tender is not so great as to miss large areas. For working dives, simply drop the diver down the zip line to the project site and hold. The far shore tender can also place a small line at the end of the zip line in order to add a vector pull.



Note. One nearshore tender; 2 far shore tenders; 3 supervisors; 5 logs; 6 standby divers; 7 standby tenders; and 8 and 9 downstream safeties.

Figure 4-2. Zip line system

2-1:3-1 MECHANICAL ADVANTAGE SYSTEMS

4-6. Mechanical advantage systems (MASs) work by magnifying the tender's strength against the current. By the addition of turns, the force needed to move an object can drastically be reduced. An anchored pulley is only a change of direction where a moving pulley will supply a mechanical advantage. Pulleys work in the system by magnifying the force that is run through them. In all cases the *anchors* or nonmoving points of the system are the tenders. The pulley or moving portion is the diver in the water. By placing a pulley (or carabiner in an emergency) on the divers tending harness, one tender can manuever the diver up and down the stream fairly easily. See figure 4-3 and figure 4-4, page 4-4, and figure 4-5, page 4-5. Pulleys do not create mechanical advantage, they only reduce friction. The term brake is used to describe Prusiks, ascendeders, and other friction devices used to stop rope from traveling.

4-7. A single moving pulley attached to the load has a 2:1 advantage, but the force can be magnified by adding more moving pulleys into the system. When using MASs, the amount of force needed to move and object is inversely proportional to the length of rope that must be pulled through the system. For example, to move a 20 pound (9.072 kilograms) object a distance of 4 feet (1.22 meters) using a 2:1 MAS, the tender will need to pull 8 feet (2.44 meters) of rope through the system using 10 pounds (4.54 kilograms) of force. The more mechanical advantage used, the greater the length of rope that must be pulled through the system to move it.

4-8. A commonly underutilized safety feature in a MAS is a dampener. A dampener is a weight attached to a system that drags the components of the system to the ground in the event of a failure. Without a dampener the stored energy in the system has the potential to turn rope and carabiners into projectiles. The dampener should be placed a distance of about 1/4 of the total system length away from the load. For example, if the total length between the load and the anchor is 100 feet (30.48 meters), the dampener should be placed in the system 25 feet (7.62 meters) from the load.

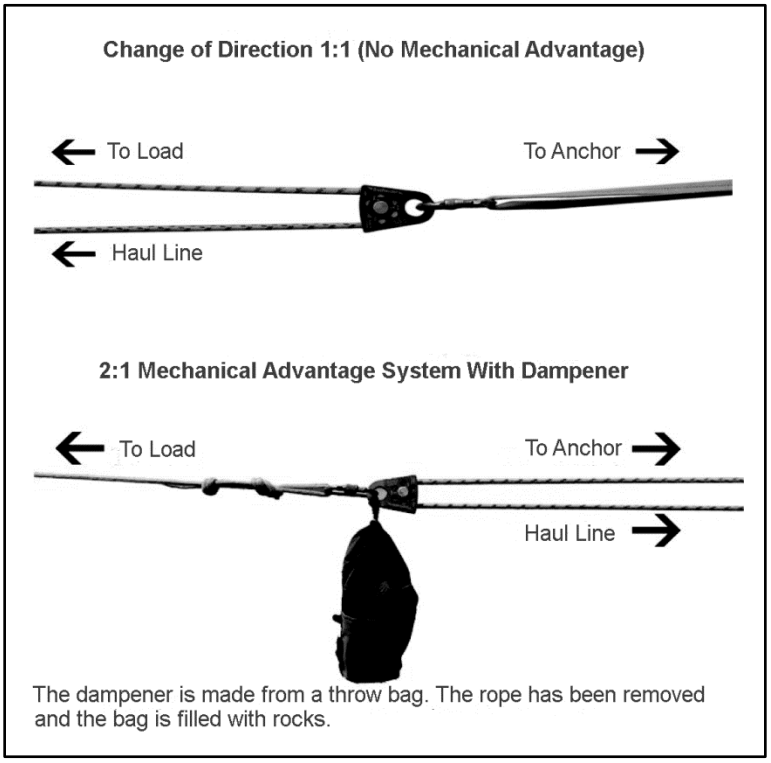


Figure 4-3. 1:1 and 2:1 pulley system

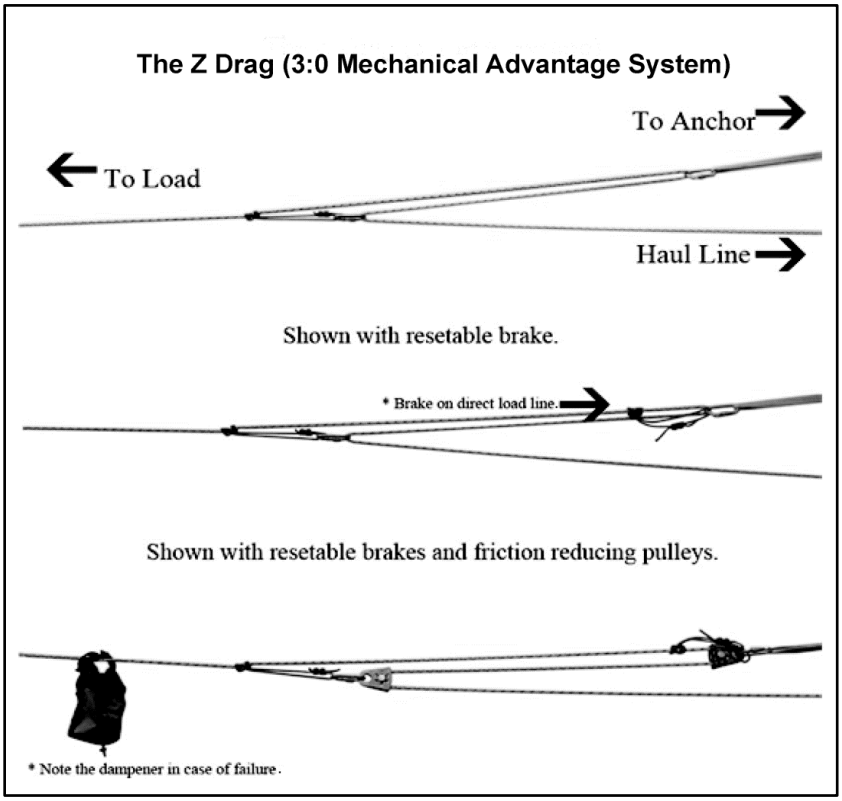


Figure 4-4. 3:1 Pulley system

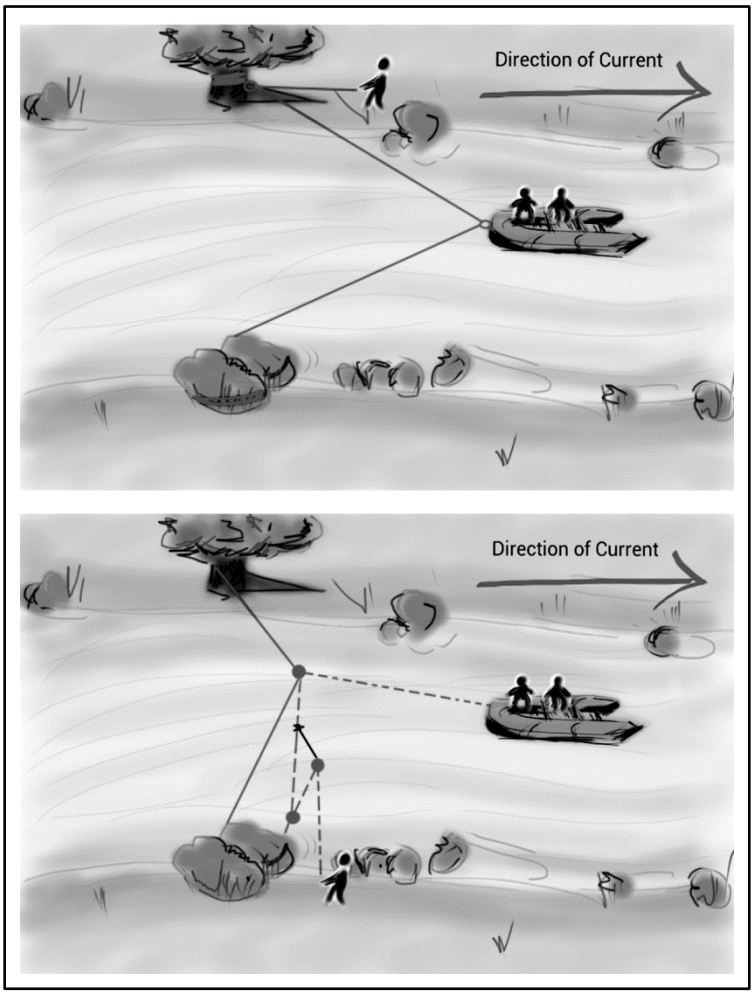


Figure 4-5. 3-1 and 2-1 MASs

BOAT SYSTEMS

4-9. When it is not practical to dive a diver from the shore, small boats can be used to provide a mobile dive side on the river. In slower currents an anchor can be used (see figure 4-6, page 4-6), while in faster currents a high line or a MAS should be used (see figure 4-7, page 4-6).

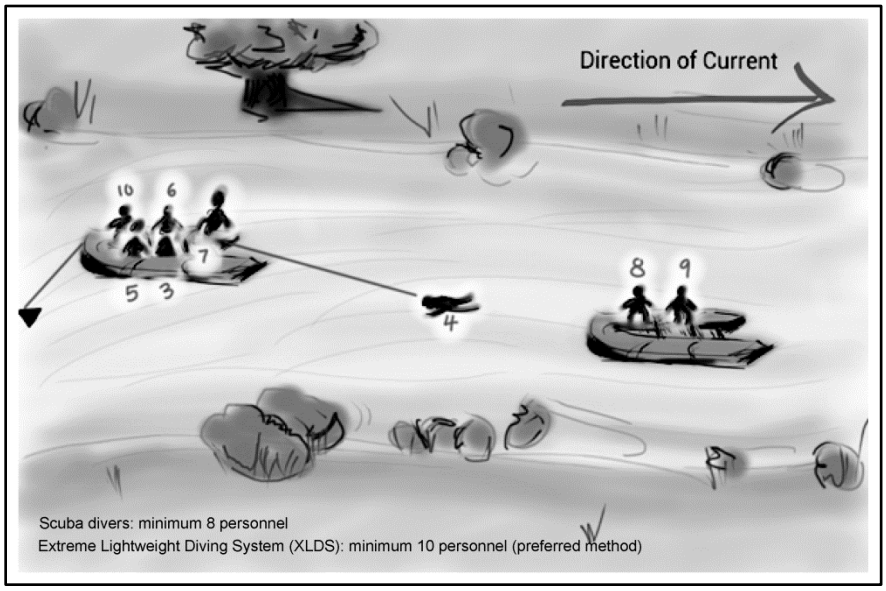


Figure 4-6. Boat system with anchor

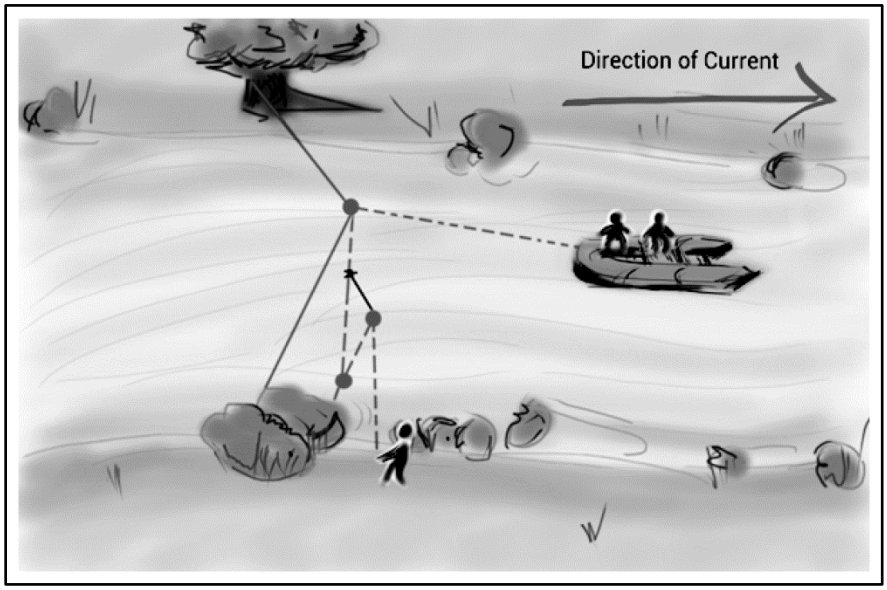


Figure 4-7. Boat system with a Z-drag

4-10. For a tethered boat lower (see figure 4-8), use the same principle as the pendulum swing. Multiple lines can be used from both shores to traverse the river in either direction and also stop midstream.

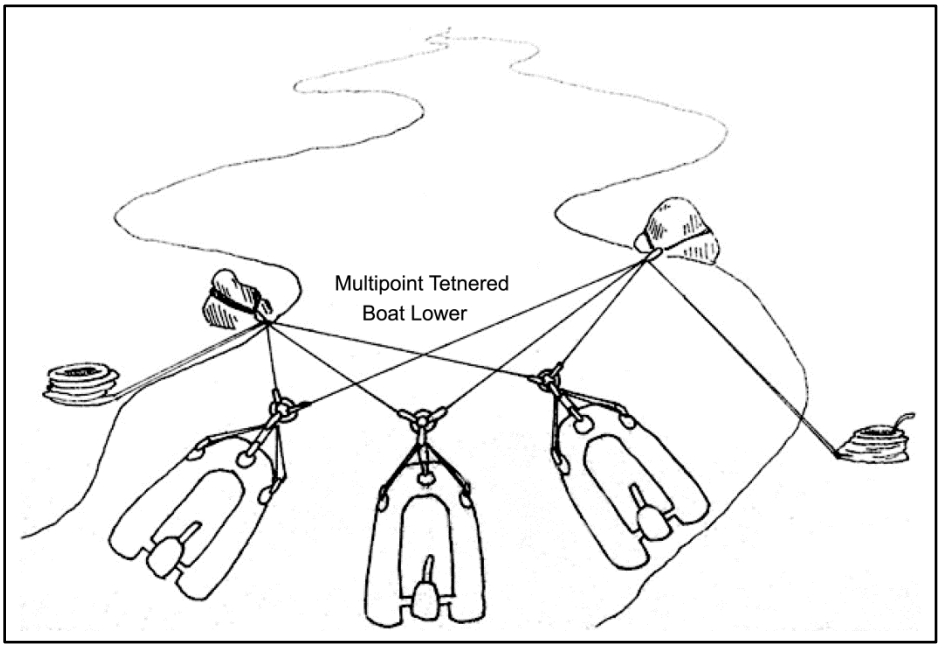


Figure 4-8. Two point tethered boat lower

4-11. The following are special considerations for multipoint tethered boat lowers:

- Always use a single and static attachment point to the boat's bridle for ALL tethers and tag lines. Otherwise, the broadside of the craft can be presented to the current, swamping the boat, and creating explosive amounts of force and drag.
- Proper boat trim can reduce drag (the flatter the better) still paying close attention not to submerge the bow.
- Motoring into position with lines prerigged to the shore can be easier than lowering the boat.
- When motoring, position the craft slightly upstream of the desired final workspace to allow for downstream rope stretch.
- Mechanical advantage can be rigged to tethers and tag lines.
- Quick releases can be rigged to tethers allowing for an immediate swing to shore in the event of an emergency or simply when the work is done.

BRIDGE SYSTEMS

4-12. Diving in the vicinity of a bridge yields unique oppourtunities to setup a functional system easily. A 2:1 MAS is ideal in this situation. The main issue is the deployment and recovery of the diver. Tall bridges may not be suitable for this diving system. In the event of a very tall bridge, use the pilings to provide anchor points for the system (see figure 4-9, page 4-8).

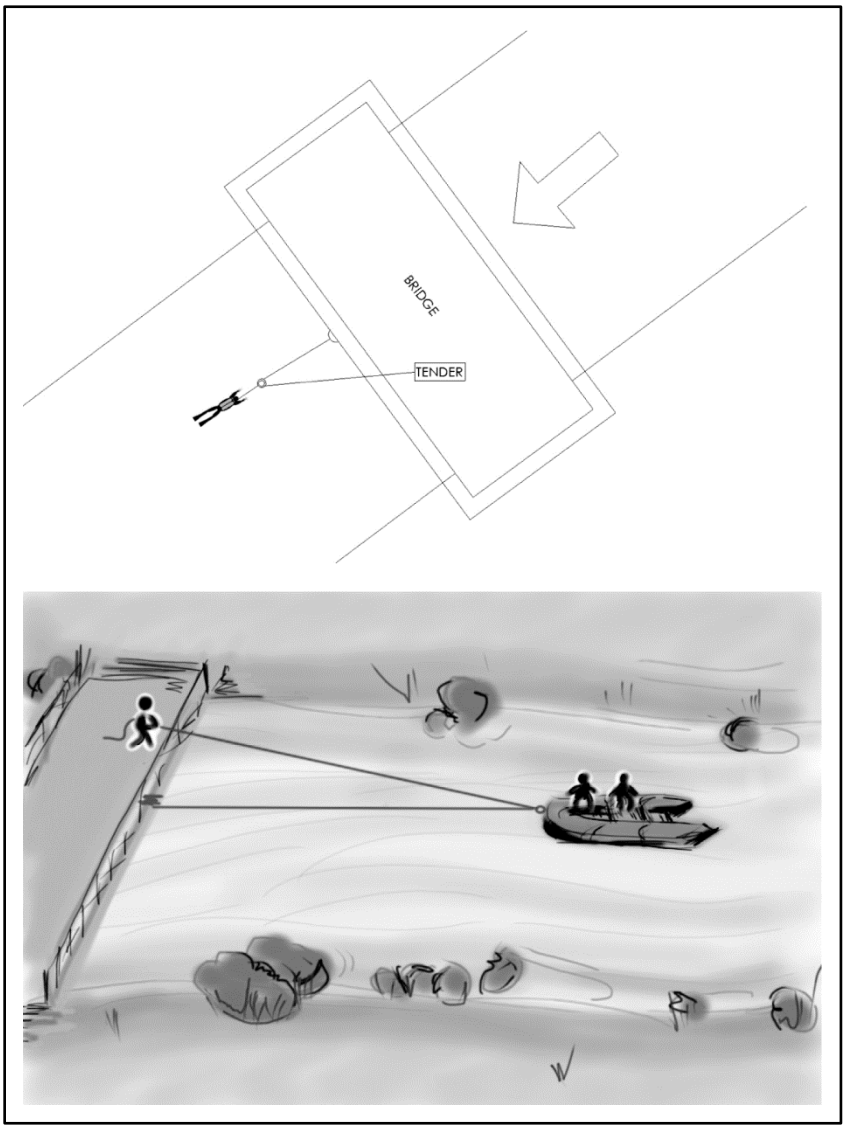


Figure 4-9. Bridge system

SHORE-BASED SYSTEMS

4-13. Ideally, diving from the nearshore provides the fastest and safest method of diver employment. Moving from the shore allows the diver to leave the surface and slowly work into the current while approaching the faster water in the middle of the river. The use of tools, tending/communications lines, and transverse lines can aid the diver in the mission. One technique is to have the first diver move to the project with a weighted clump, and run a *descent line* as a zip line system from the shore to the clump once it is located on the project.

4-14. An alternative is the pendulum swing (see figure 4-10). With a line anchored on shore opposite of the diver, a diver or boat can be swing from shore-to-shore using the downstream force of the water.

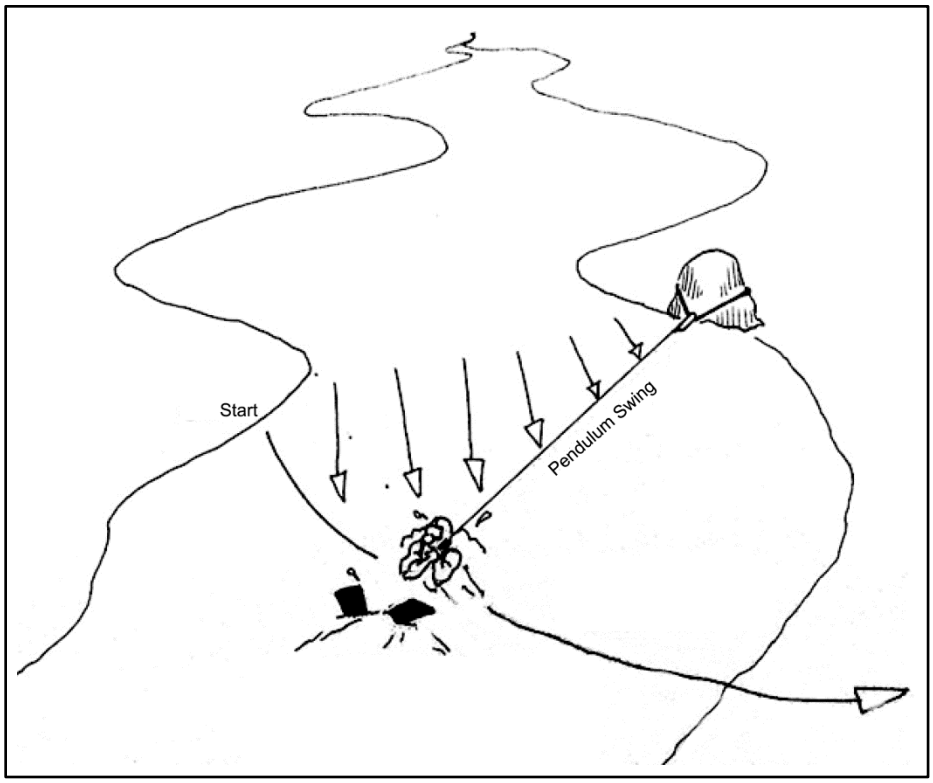


Figure 4-10. Diver tended from shore

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Chapter 5
Operations in Swift/Fast Water

SITE RECONNAISSANCE

5-1. In all operations, site reconnaissance is an important step in the military planning process. In swift/fast water diving operations, it is of paramount importance. The river's ever changing characteristics coupled with the multidimensional nature of operations renders a map only reconnaissance unsuitable for swift/fast water diving. During tactically challenging operations, security considerations may prevent an on-site reconnaissance. In these instances additional time should be planned at the beginning of the operation for a careful walk-through of the site prior to diving.

5-2. In addition to the hydrology of the dive site, the following items need to be identified and used to refine the operation:

- Separate nearshore and far shore evacuation routes.
- Locations for upstream and downstream safeties.
- Most likely *wash out* route in the event the diver has to release the tending line.
- Any area without shore access. This will affect the evacuation plans.
- Any obstacles that obstruct vessel navigation (both for work and for emergency).
- Distance from the shore/boat to the dive site. This is especially important if the dive site is not readily accessible by a powered boat.

5-3. Whenever practicable, always walk the river. Begin approximately 656 to 984 feet (200 to 300 meters) upstream from the dive site and walk to the location of the downstream safeties, or an area of slow current and shallow water. Pay attention to indicators of underwater obstacles, particularly strainers. Many swift/fast water environments have steep river banks that will inhibit vehicle traffic and emergency action plans should be adjusted.

5-4. Selection of the diving mode and technique is subject to many factors; however, in swift/fast water SSD is preferred. During the site reconnaissance, the selection of the diving mode and technique must be made based on the critical logistics and safety factors. If the site cannot support SSD, pay special attention to the location of the eddy currents around the dive site. Divers will need access to these both on the surface and while submerged. Additionally, tending the diver from a boat from an eddy current is an effective method.

UNDERWATER MOVEMENT TECHNIQUES

5-5. The essence of all diving is to move in harmony with the environment. Thus, the secret to successful river diving is to *go with the flow* and to do so in a controlled manner.

BODY POSITIONING

5-6. Always keep the head lower than the body. Elevating the head above the chest can cause an immediate uncontrolled ascent. In the event of an uncontrolled ascent in the water, the diver should face upstream, exhale and position his body in the head down and feet up position.

5-7. When untended, keep your fins lower than your buttocks. If the fins get higher than your buttocks, you are more likely to lose control and tumble downstream. Fins are not advised in fast water.

5-8. When moving along the bottom of the riverbed, move with the legs spread like a spider or crab and drag the fins along the bottom.

5-9. Keep the body as streamlined as possible. Searching in a side to side manner will allow the silt and small debris to flow to the side without disrupting visibility.

MOVEMENT TECHNIQUES

5-10. In addition to maintaining proper body position, various movement techniques may be employed by the diver to overcome, or utilize, the force of the current. The movement techniques below are used based on the mission objective and environmental factors found at the dive site.

Inch Worm

5-11. With the body flat, arms outstretched upstream, head down, and legs straight behind you begin by slowly pulling the knees up directly under the hips while keeping the arms and head firmly down against the riverbed. The flow of the water over the arms, head, and back will help keep you on the bottom. Once the knees are under the hips start slowly stretching the arms forward keeping the head low.

Pendulum

5-12. Using a creeper style tool, anchor, clump, or other methods of fixing a line to the river bottom, attach a knotted line to the fixed point. The diver will search the immediate area, move down the line a few feet, and swing as far left then right as possible. The diver continues moving in this process until the end of the line or until he is unable to swing left or right. The diver needs to remember how many knots he moved down and then relay this information to the dive supervisor who can estimate the area searched.

5-13. This process is slow and requires multiple overlapping sweeps to ensure the area has been thoroughly searched.

Creeper

5-14. Facing up stream with the creeper held securely in both hands, slowly pick up the left side spiked end and pivot it downstream. Push the spike back into the riverbed and repeat the process with the right side spiked end. This process allows a good search in a long narrow path.

Shore-to-Shore Jack Stay

5-15. The transverse line is stretched from shore-to-shore with support personnel anchoring the line on each shore. The diver transits from one shore to the other shore under water while attached to the transverse line. When the diver reaches the opposite shore, support personnel move the predetermined distance downstream and the diver again crosses the river to the nearshore. This process works very well in shallow rivers with a relatively flat bottom profile.

Drift Dives

5-16. During drift dives divers are launched upstream and drift downstream. Divers may use various hand tools to slow the drift in fast moving currents. Divers must wear a witness float during drift dives.

5-17. Drift dives work best when the current is not extreme, visibility is good, and tending lines are not feasible due to the high probability of entanglement, snagging, or choking.

5-18. A boat should keep pace with the diver adjacent to the witness float, and be prepared to mark with a Global Position System as soon as the diver signals something is found or when the diver surfaces, to narrow down the search area. Global Positioning System devices that record a *bread trail* are very useful in determining the extent of the area covered during the search day.

Tended Free Fall Diving

5-19. When diving tended in extremely swift or fast water, the flow of current will simulate the forces of sky diving. In a similar manner, body position will affect the lateral and vertical movement of the diver in the water column. For example, a diver facing the bottom that raises his right arm 45 degrees from the body will shift left in the current and vice versa. Vertical positioning in the water column can be maintained by

placing the head down and the feet up to allow the current to push the diver to the bottom. To maintain control while surfacing, divers should travel with the current; facing into the current will result in a rapid, uncontrolled ascent.

ROPE MANAGEMENT AND EQUIPMENT

5-20. The rope is a vital piece of equipment used in climbing, rappelling, building, and diving operations. Special care must be taken to properly utilize and maintain this piece of equipment. Swift/fast water diving operations leverage many of the rope systems in a similar manner to mountaineering.

DANGER

If rope is not managed or maintained properly, serious injury or death may occur.

PREPARATION, CARE AND MAINTENANCE, INSPECTION, AND TERMINOLOGY

5-21. The service life of a rope depends on the frequency of use, applications (rappelling, climbing, rope installations), speed of descent, surface abrasion, terrain, climate, and quality of maintenance. Any rope may fail under extreme conditions (shock load, sharp edges, misuse). Particles present in water will drastically increase the wear rate of ropes.

Preparation

5-22. The Soldier must select the proper rope for the task to be accomplished according to the type, diameter, length, and tensile strength. It is important to prepare all ropes before departing on a mission. Avoid rope preparation in the field.

- **Packaging.** New rope comes from the manufacturer in different configurations—boxed on a spool in various lengths, or coiled and bound in some manner. Precut ropes are usually packaged in a protective cover such as plastic or burlap. Do not remove the protective cover until the rope is ready for use.
- **Securing the ends of the rope:** If still on a spool, the rope must be cut to the desired length. All ropes will fray at the ends unless they are bound or seared. Both static and dynamic rope ends are secured in the same manner. The ends must be heated to the melting point so as to attach the inner core strands to the outer sheath. By fusing the two together, the sheath cannot slide backward or forward. Ensure that this is only done to the ends of the rope. If the rope is exposed to extreme temperatures, the sheath could be weakened along with the inner core, reducing overall tensile strength. The ends may also be dipped in enamel or lacquer for further protection.

Care and Maintenance

5-23. The rope is a Soldier's lifeline. It must be cared for and used properly. The following general guidelines should be followed when handling ropes:

- Do not step on or drag ropes on the ground unnecessarily. Small particles of dirt will be ground between the inner strands and will slowly cut them.
- Do not allow the rope to come in contact with sharp edges. Nylon rope is easily cut, particularly when under tension. If the rope must be used over a sharp edge, pad the edge for protection.
- Keep the rope as dry as possible. Should the rope become wet, hang it in large loops off the ground and allow it to dry. Never dry a rope with high heat or in direct sunlight. Diving by definition will cause the rope to become wet during use. This will reduce life expectancy and will necessitate post mission maintenance. Never store a wet rope; always allow rope to dry fully after diving is complete.

- Never leave a rope knotted or tightly stretched longer than necessary. Over time it will reduce the strength and life of the rope.
- Never allow one rope to continuously rub over, or against, another. Allowing rope-on-rope contact with nylon rope is extremely dangerous because the heat produced by the friction will cause the nylon to melt.
- Inspect the rope before each use for frayed or cut spots, mildew or rot, or defects in construction (new rope).
- Whip or melt the ends of the rope to prevent unraveling.
- Do not splice ropes for use in swift/fast water diving.
- Do not mark ropes with paints or allow them to come in contact with oils or petroleum products.
- Ensure that each rope has a corresponding rope log [DA Form 5752-R, *Rope Log (Usage and History*)], which is also a safety record. It should annotate use, terrain, weather, application, number of falls, dates, and should be updated each time the rope is used. DA Form 5752-R is authorized for local reproduction on standard letter size paper.
- Never subject the rope to high heat or flame. This will significantly weaken it.
- Wash all ropes post dive to remove dirt and grit, and rinsed thoroughly. Commercial rope washers are made from short pieces of modified pipe that connect to any faucet. Pinholes within the pipe force water to circulate around and scrub the rope as is slowly fed through the washer. Another method is to machine wash, on a gentle cycle, in cold water with a nylon safe soap. Never use bleach or harsh cleansers. Ensure that only front loading washing machines are used to wash ropes.
- Perform periodic inspections to check for deterioration if rope installations are left in place over a number of months. Ultraviolet radiation (sunlight) tends to deteriorate nylon over long periods of time.
- Coil loosely and hang ropes not in use on wooden pegs rather than nails or other metal objects. Storage areas should be relatively cool with low humidity levels to prevent mildew or rotting. Rope may also be loosely stacked and placed in a rope bag and stored on a shelf. Avoid storage in direct sunlight, as the ultraviolet radiation will deteriorate the nylon over long periods.

Inspection

5-24. Ropes should be inspected before and after each use, especially when working around loose rock or sharp edges.

5-25. Although the core of the kernmantle rope cannot be seen, it is possible to damage the core without damaging the sheath. Check a kernmantle rope by carefully inspecting the sheath before and after use while the rope is being coiled. When coiling, be aware of how the rope feels as it runs through the hands. Immediately note and tie off any lumps or depressions felt.

5-26. Damage to the core of a kernmantle rope usually consists of filaments or yarn breakage that results in a slight retraction. If enough strands rupture, a localized reduction in the diameter of the rope results in a depression that can be felt or even seen.

5-27. Check any suspected areas further by putting them under tension (the weight of one person standing on a Prusik tensioning system is about maximum). This procedure will emphasize the lump or depression by separating the broken strands and enlarging the dip. If a noticeable difference in diameter is obvious, retire the rope immediately.

5-28. Many dynamic kernmantle ropes are quite soft. They may retain an indention occasionally after an impact or under normal use without any trauma to the core. When damage is suspected, patiently inspect the sheath for abnormalities. Damage to the sheath does not always mean damage to the core. Inspect carefully.

Terminology

5-29. When using ropes, understanding basic terminology is important (see figure 5-1). The following terms are the most commonly used:

- **Bight**. A bight of rope is a simple bend of rope in which the rope does not cross itself.
- **Loop.** A loop is a bend of a rope in which the rope crosses itself.
- **Half hitch**. A half hitch is a loop that runs around an object in such a manner as to lock or secure itself.
- **Turn.** A turn wraps around an object, providing 360-degree contact.
- **Round turn**. A round turn wraps around an object one and one-half times. A round turn is used to distribute the load over a small diameter anchor (3 inches or less [0.0762 meters or 7.62 centimeters]). It may also be used around larger diameter anchors to reduce the tension on the knot, or provide added friction.
- **Running end**. A running end is the loose or working end of the rope.
- **Standing part**. The standing part is the static, stationary, or nonworking end of the rope.
- **Lay.** The lay is the direction of twist used in construction of the rope.
- **Pigtail.** The pigtail (tail) is the portion of the running end of the rope between the safety knot and the end of the rope.
- **Dress.** Dress is the proper arrangement of all the knot parts, removing unnecessary kinks, twists, and slack so that all rope parts of the knot make contact.

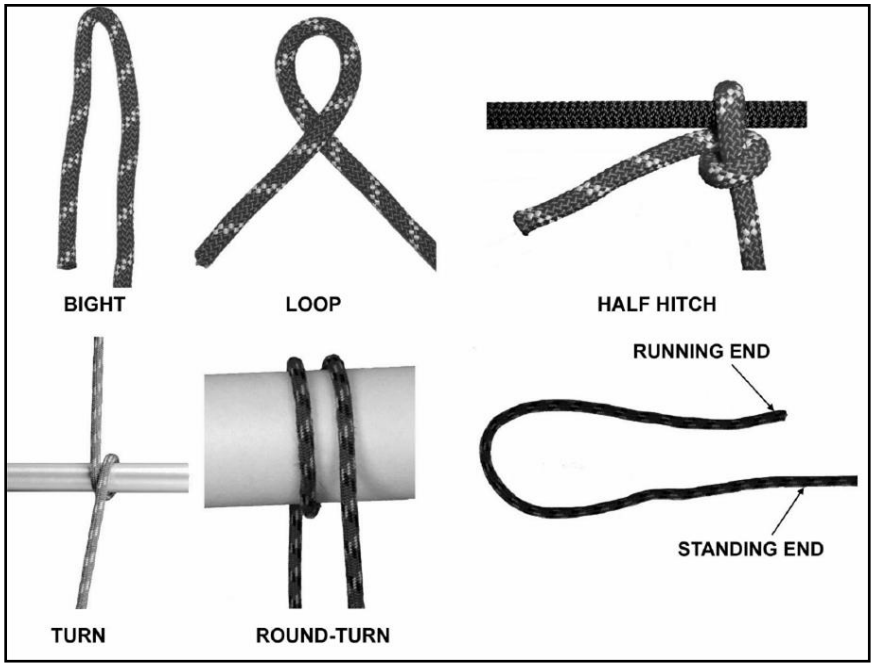


Figure 5-1. Rope terms

Climbing Software

5-30. Climbing software refers to rope, cord, webbing, and harnesses. All specific equipment, to include hardware, should only be used if it has the International Mountaineering and Climbing Foundation (UIAA) certificate of safety. UIAA is the organization that oversees the testing of equipment. It is based in Paris, France, and comprises several commissions. The safety commission has established standards for equipment that have become well recognized throughout the world. Their work continues as new equipment develops and is brought into common use. Community Europe recognizes UIAA testing standards and, as the broader-based testing facility for the combined European economy, meets or exceeds the UIAA standards for all climbing and mountaineering equipment produced in Europe. European Norm and Community Europe have been combined to make Combined European Norm. While the United States has no specific standards, American manufacturers have their equipment tested by UIAA to ensure safe operating tolerances.

Ropes and Cord

5-31. Ropes and cords are the most important pieces of equipment and proper selection deserves careful thought. These items are the lifeline, so selecting the right type and size is of the utmost importance. All ropes and cord used today are constructed with the same basic configuration. The construction technique is referred to as kernmantle, which is a core of nylon fibers protected by a woven sheath, similar to parachute or 550 cord (see figure 5-2).

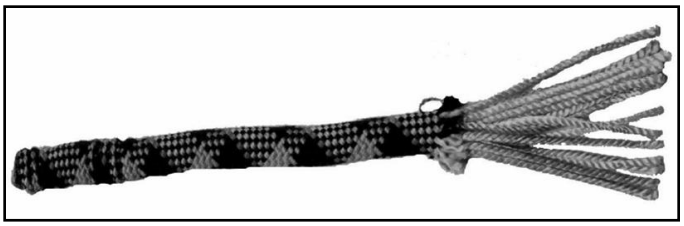


Figure 5-2. Kernmantle construction

5-32. Ropes come in two types—static and dynamic. This refers to their ability to stretch under tension.

- **Static.** A static rope has very little stretch, perhaps as little as one to two percent, and is best used in rope installations.
- **Dynamic.** A dynamic rope is most useful for climbing and general mountaineering. Its ability to stretch up to 1/3 of its overall length makes it the right choice any time the user might take a fall.

5-33. Dynamic and static ropes come in various diameters and lengths. For most military applications, a standard 7/16 inch by 164-foot (10.5- or 11-millimeter by 50-meter) dynamic rope and 7/16 inch by 174-foot (11-millimeter by 45-meter) static rope will be sufficient.

5-34. When choosing dynamic rope, factors affecting rope selection include intended use, impact force, abrasion resistance, and elongation. Regardless of the rope chosen, it should be UIAA certified.

5-35. Cord or small diameter rope is indispensable to the Soldier. Its many uses make it a valuable piece of equipment. All cord is static and constructed in the same manner as larger rope. If used for Prusik knots, the cord's diameter should be 3/16 inches to 1/4 inches (5 to 7 millimeters) when used on a 7/16-inch (11-millimeter) rope.

Note. Measurements listed for ropes, cords and webbing/slings are the standard through which these items will be procured. Ropes used for these operations will be procured, labeled, and used specifically for swift water operations.

Webbing and Slings

5-36. Loops of tubular webbing or cord, called slings or runners, are the simple and useful pieces of equipment. The uses for these simple pieces are endless, and they are a critical link between the climber, the rope, carabiners, and anchors. Runners are predominately made from either 9/16-inch or 1-inch (14.2875-millimeter or 25.4-millimeter) tubular webbing and are either tied or sewn by a manufacturer (see figure 5-3). Runners can also be made from a high-performance fiber known as spectra, which is stronger, more durable, and less susceptible to ultraviolet deterioration. Runners should be retired regularly following the same considerations used to retire a rope. For most military applications, a combination of different lengths of runners is adequate.

- **Tied runners.** Tied runners have certain advantages over sewn runners—they are inexpensive to make, can be untied and threaded around natural anchors, and can be untied and retied to other pieces of webbing to create extra-long runners.

- **Sewn runners.** Sewn runners have their own advantages—they tend to be stronger, are usually lighter, and have less bulk than the tied version. They also eliminate a major concern with the homemade knotted runner—the possibility of the knot untying. Sewn runners come in four standard lengths—2 inches (50.8 millimeters [5.08 centimeters]), 4 inches (101.6 millimeters [10.16 centimeters]), 12 inches (304.8 millimeters [30.48 centimeters]) and 24 inches (609.6 millimeters [60.96 centimeters]). They also come in three standard widths—9/16 inch (14.28 millimeters [1.428 centimeters]), 11/16 inch (17.46 millimeters [1.746 centimeters]), and 1 inch (24.5 millimeters [2.54 centimeters]).

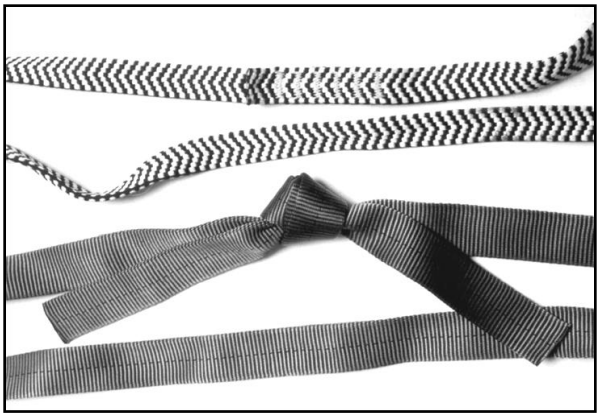
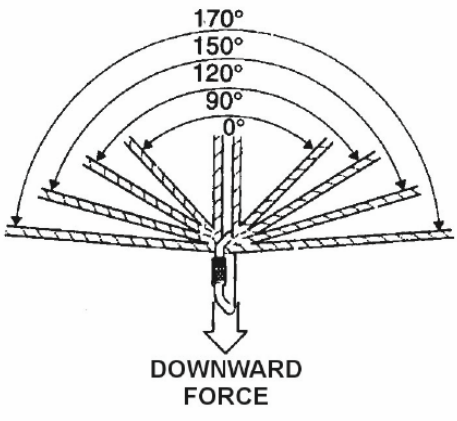


Figure 5-3. Webbing, tied, and sewn runners

Load Amplification

5-37. Load amplification is always a concern when dealing with any type of rigging. In rigging, all forces are equal when the angle is 120 degrees. If the angle is greater than 120 degrees, the forces acting on that part of the system begin to amplify. Conversely if the angle is less than 120 degrees it lessens the amount of force that is acting on that part of the system. As a rule of thumb, never allow any angle in the system to exceed 90 degrees. Figure 5-4 shows examples of how this is applied.



TENSION IN MULTIPLE ANCHOR RIGGING	
ANGLE	RESULTING LEG TENSION*
170^0	1150%
150^0	200%
120^0	100%
90^0	70%
0^0	50%
*On each leg relative to downward force.	

Figure 5-4. Load amplification chart

Carabiners

5-38. One of the most versatile pieces of equipment available to the Soldier is the carabiner. This simple piece of gear is the critical connection between the climber, his rope, and the protection attaching him to the mountain. Carabiners must be strong enough to hold hard falls, yet light enough for the climber to easily carry a quantity of them. Today's high tech metal alloys allow carabiners to meet both of these requirements. Steel is still widely used, but is not preferred for general mountaineering, given other options. Basic carabiner construction affords the user several different shapes. The oval, the D-shaped, and the pear-shaped carabiner are just some of the types currently available. Most models can be made with or without a locking mechanism for the gate opening (see figure 5-5). If the carabiner does have a locking mechanism, it is usually referred to as a locking carabiner. When using a carabiner, great care should be taken to avoid loading the carabiner on its minor axis and to avoid three-way loading (see figure 5-6).

Note: Great care should be used to ensure all carabiner gates are closed and locked during use.

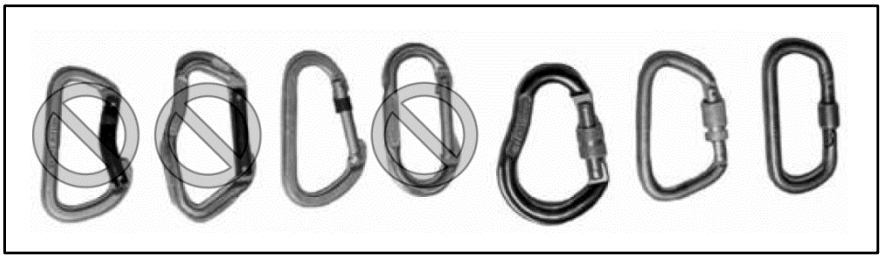


Figure 5-5. Nonlocking and locking carabiner

WARNING

Never use nonlocking carabiners in swift/fast water diving. Carabiners can unintentionally be pushed against an object opening the carabiner, effectively turning it into a fish hook, snagging and injuring divers.

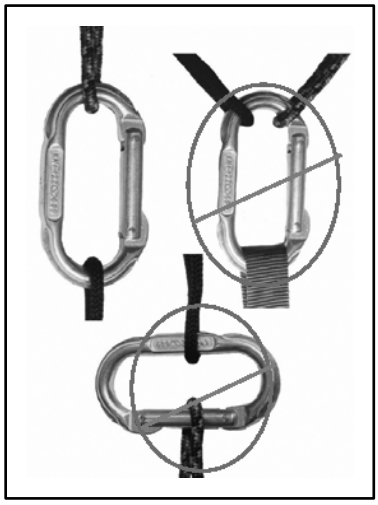


Figure 5-6. Major/minor axis and three-way loading

Pulleys

5-39. Pulleys (see figure 5-7) are used to change direction in rope systems and to create mechanical advantage in hauling systems. A pulley should be small, lightweight, and strong. They should accommodate the largest diameter of rope being used. Pulleys are made with several bearings, different-sized sheaves (wheel), and metal alloy side plates. Plastic pulleys should always be avoided. The side plate should rotate on the pulley axle to allow the pulley to be attached at any point along the rope. For best results, the sheave diameter must be at least four times larger than the rope's diameter to maintain high rope strength.

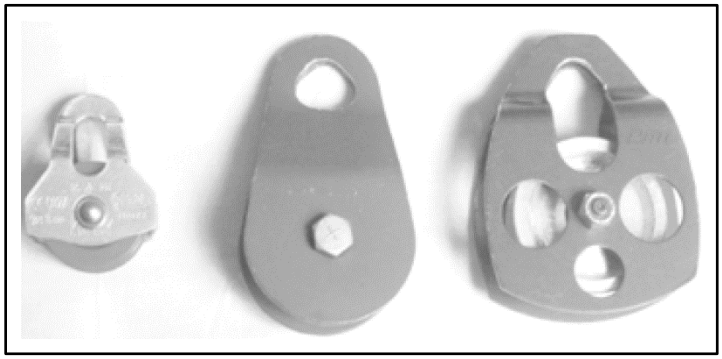


Figure 5-7. Pulleys

KNOTS, BENDS, AND HITCHES

5-40. The paragraphs below describe knots, bends, and hitches and their uses.

Water Knot

5-41. The water knot is used to attach two webbing ends (see figure 5-8). It is also called a ring bend, overhand retrace, or tape knot. It is used in runners and harnesses and is a joining knot.

- Tying the knot.
  - **Step 1.** Tie an overhand knot in one of the ends.
  - **Step 2.** Feed the other end back through the knot, following the path of the first rope in reverse.
  - **Step 3.** Draw tight and pull all of the slack out of the knot. The remaining tails must extend at least 4 inches (10.16 centimeters) beyond the knot in both directions.
- Checkpoints.
  - There are two overhand knots, one retracing the other.
  - There is no slack in the knot, and the working ends come out of the knot in opposite directions.
  - There is a minimum 4-inch (10.16 centimeters) pigtail

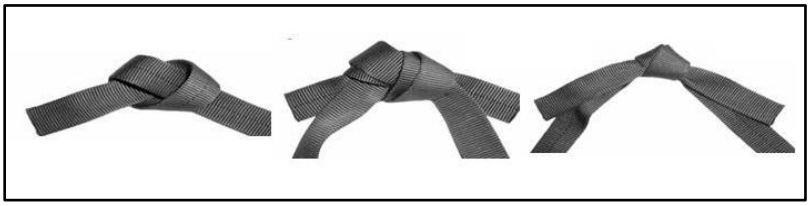


Figure 5-8. Water knot

Prusik Hitch

5-42. The Prusik hitch is used to put a moveable rope on a fixed rope such as a Prusik ascent or a tightening system. This hitch can be tied as a middle or end of the rope Prusik. It is a specialty hitch.

5-43. The middle-of-the-rope Prusik (see figure 5-9) hitch can be tied with a short rope to a long rope. Perform the following steps to tie the hitch:

- **Step 1.** Double the short rope, forming a bight, with the working ends even. Lay it over the long rope so that the closed end of the bight is 12 inches (30.48 centimeters) below the long rope and the remaining part of the rope (working ends) is the closest to the climber. Spread the working end apart.
- **Step 2.** Reach down through the 12-inch (30.48 centimeters) bight. Pull up both of the working ends and lay them over the long rope. Repeat this process making sure that the working ends pass in the middle of the first two wraps. Now there are four wraps and a locking bar working across them on the long rope.
- **Step 3.** Dress the wraps and locking bar down to ensure they are tight and not twisted. Tying an overhand knot with both ropes will prevent the hitch from slipping during periods of variable tension.

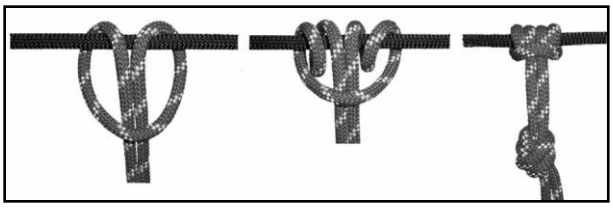


Figure 5-9. Middle-of-the-rope Prusik

Double Fisherman's Knot

5-44. The double fisherman's knot (also called double English or grapevine) is used to tie two ropes of the same or approximately the same diameter (see figure 5-10). It is a joining knot. Use the following steps to tie the knot:

- **Step 1.** With the working end of one rope, tie two wraps around the standing part of another rope.
- **Step 2.** Insert the working end (Step 1) back through the two wraps and draw it tight.
- **Step 3.** With the working end of the other rope (containing the standing part [Steps 1 and 2]), tie two wraps around the standing part of the other rope (the working end in Step 1). Insert the working end back through the two wraps and draw tight.
- **Step 4.** Pull on the opposing ends to bring the two knots together. (1) Two double overhand knots securing each other as the standing parts of the rope are pulled apart. (2) Four rope parts on one side of the knot form two **x** patterns and the four rope parts on the other side of the knot are parallel. (3) The ends of rope exit the knot opposite each other with 4-inch (10.16-centimeter) pigtails.

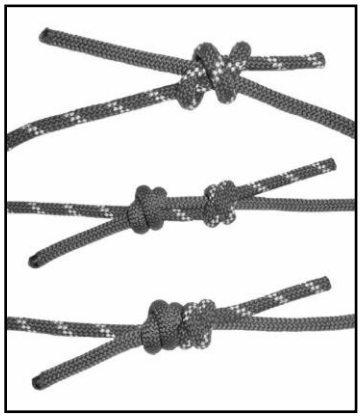


Figure 5-10. Double fisherman's knot

Figure-Eight Loop (Figure-Eight-on-a-Bight)

5-45. The figure-eight loop, also called the figure-eight-on-a-bight (see figure 5-11), is used to form a fixed loop in a rope. It is a middle of the rope knot.

5-46. Tying the knot:

- **Step 1.** Form a bight in the rope about as large as the diameter of the desired loop.
- **Step 2.** With the bight as the working end, form a loop in the rope (standing part).
- **Step 3.** Wrap the working end around the standing part 360 degrees and feed the working end through the loop. Dress the knot tightly.

5-47. Checkpoints.

- The loop is the desired size.
- The ropes in the loop are parallel and do not cross over each other.
- The knot is tightly dressed.

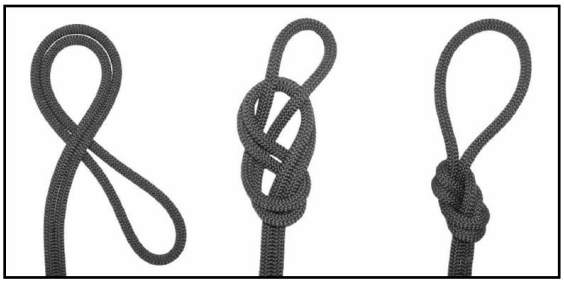


Figure 5-11. Figure-eight-on-a-bight

Directional Figure-Eight

5-48. The directional figure-eight knot forms a single, fixed loop in the middle of the rope that lays back along the standing part of the rope (see figure 5-12, page 5-12). It is a middle rope knot.

5-49. Tying the knot.

- **Step 1.** Face the far side anchor so that when the knot is tied, it lays inward.
- **Step 2.** Lay the rope from the far side anchor over the left palm. Make one wrap around the palm.
- **Step 3.** With the wrap formed, tie a figure-eight knot around the standing part that leads to the far side anchor.
- Step 4. When dressing the knot down, the tail and the bight must be together.

5-50. Checkpoints.

- The loop should be large enough to accept a carabiner but no larger than a helmet-size loop.
- The tail and bight must be together.
- The figure eight is tied tightly.
- The bight in the knot faces back toward the near side.

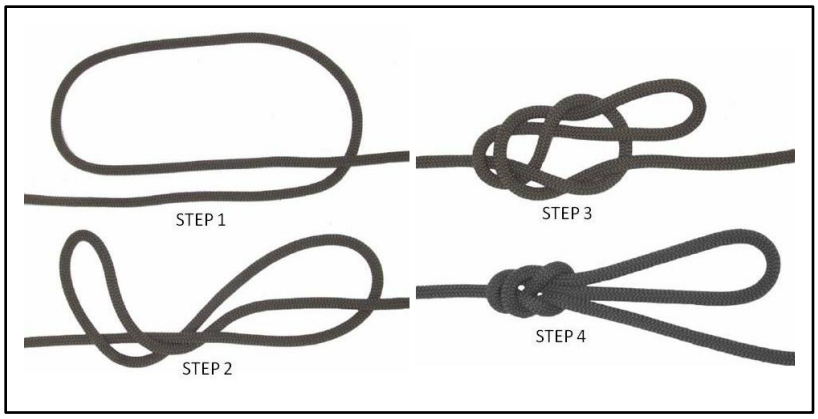


Figure 5-12. Directional figure eight

Figure-Eight Retrace (Rerouted Figure-Eight)

5-51. The figure-eight retrace knot (see figure 5-13) produces the same result as a figure-eight loop. However, by tying the knot in a retrace, it can be used to fasten the rope to trees or to places where the loop cannot be used. It is also called a rerouted figure-eight and is an anchor knot.

5-52. Tying the knot.

- **Step 1.** Use a length of rope long enough to go around the anchor, leaving enough rope to work with.
- **Step 2.** Tie a figure-eight knot in the standing part of the rope, leaving enough rope to go around the anchor. To tie a figure-eight knot, form a loop in the rope, wrap the working end around the standing part, and route the working end through the loop. The finished knot is dressed loosely.
- **Step 3.** Take the working end around the anchor point.
- **Step 4.** With the working end, insert the rope back through the loop of the knot in reverse.
- **Step 5.** Keep the original figure eight as the outside rope and retrace the knot around the wrap and back to the long-standing part.
- **Step 6.** Remove all unnecessary twists and crossovers; dress the knot down.

5-53. Checkpoints

- A figure eight with a doubled rope running side by side, forming a fixed loop around a fixed object or harness.
- There is a minimum 4-inch (10.16-centimeter) pigtail.

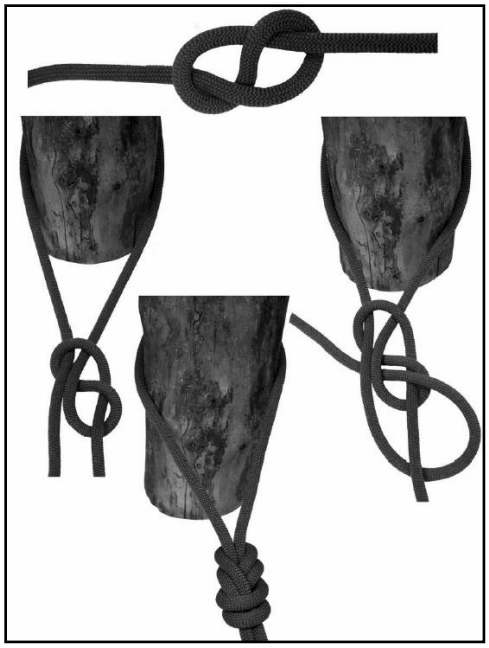


Figure 5-13. Figure eight retrace

ANCHORS

5-54. This section discusses different types of anchors and their application in rope systems and climbing. Proper selection and placement of anchors is a critical skill that requires a great deal of practice. Failure of any system is most likely to occur at the anchor point. If the anchor is not strong enough to support the intended load, it will fail. Failure is usually the result of poor terrain features selected for the anchor point, or the equipment used in rigging the anchor was placed improperly or in insufficient amounts. When selecting or constructing anchors, always try to make sure the anchor is *bombproof*. A bombproof anchor is stronger than any possible load that could be placed on it. An anchor that has more strength than the climbing rope is considered bombproof.

TENSIONLESS ANCHOR

5-55. The tensionless anchor (see figure 5-14) is used to anchor the rope on high-load installations such as bridging and traversing. The wraps of the rope around the anchor absorb the tension of the installation and keep the tension off the knot and carabiner. The anchor is usually tied with a minimum of four wraps, more if necessary, to absorb the tension. A smooth anchor may require several wraps, whereas a rough barked tree might only require a few. The rope is wrapped from top to bottom. A fixed loop is placed into the end of the rope and attached loosely back onto the rope with a carabiner.



Figure 5-14. Tensionless anchor

WEBBING

5-56. When using webbing as an anchor, the best method is the wrap three, pull two (see figure 5-15). To use webbing as an anchor in this manner, make three wraps with the webbing around the tree and then tie the free ends in a water knot. Pull the two strands of the webbing that do not have the knot in them, leaving the actual knot against the tree. Four strands of the webbing, at a point farthest from the knot, will be connected to the system. The knot remains isolated against the tree by friction and carries minimal load.



Figure 5-15. Wrap three, pull two using webbing

5-57. MASs are simple machines which drastically reduce the force needed to move an object through the use of pulleys. An anchored pulley is only a change of direction where a moving pulley will supply a mechanical advantage. Pulleys work in the system by magnifying the force that is run thru them. A single moving pulley attached to the load will give a 2:1 advantage, but the force can be magnified by adding more moving pulleys into the system. When using MASs the amount of force needed to move an object is inversely proportional to the length of rope that needs to be pulled through the system. For example, when using a 2:1 MAS to move an object that weighs 20 pounds (9.07 kilograms) 4 feet (1.22 meters), it will only require 10 pounds (4.54 kilograms) of force to move the object. However, to move the object 4 feet (1.22 meters), 8 feet (2.44 meters) of rope will have to move though the system. So the more mechanical advantage there is, the greater the length of rope that must be pulled through the system to move it.

- **2:1 set up.** A very simple MAS is the 2:1 which requires half the force to move the object.
- **3:1 set up.** Z drag.
- **9:1 set up.** Stacked Z's.

HIGH LINE SETUP

5-58. A high line is a system of ropes and pulleys that can be used to control a diver in swift water or to control the platform from which the diver is deployed. Remember that the system is only as strong as its weakest link. A high line consists of a main traversing line, two control lines that move the main pulley laterally along the traversing line, and a diver control line that controls how far the diver is from the traversing line. To set up the system—

- Take the free end of the traversing line to the far shore and secure it using a tensionless anchor. On the nearshore, use 1-inch (2.54 centimeters) tubular webbing as the anchor.
- Run the traversing line through a Prusik minding pulley and secure it to the webbing anchor.
- Attach two Prusik's of different lengths to the traversing line just down from the prussic minding pulley.
- Secure the free ends into the carabineer that is securing the pulley to the anchor (see figure 5-16).

- Construct a 3:1 MAS and tension the traversing line using no more than two Soldiers. Care must be taken when tensioning the traversing line. It is very easy to stress the traversing line to its breaking strength if too many Soldiers pull on the MAS or if too much mechanical advantage is used (see figure 5-17).
- Connect the main knot passing pulley to the traversing line.
- Connect control lines to either side of the main pulley.
- Connect a pulley to the bottom most attachment of the knot passing pulley.
- Run the diver control line through this pulley. In extremely swift water it is highly recommended that a commercial climbing harness be worn under the diving equipment to provide a solid attachment point for the diver control line.



Figure 5-16. High line pulley on transverse line

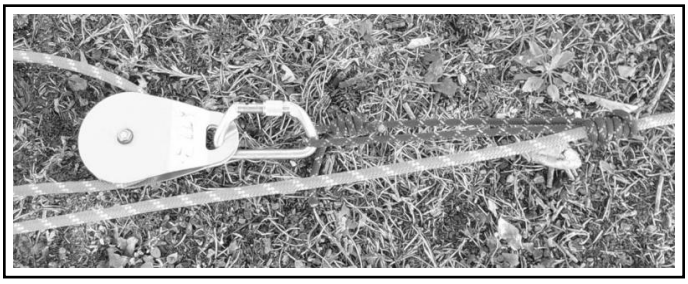


Figure 5-17. 2:1 high line pulley with Prusik knot

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Appendix A

Sample Swift Water Training Outline

A-1. Figure A-1 is a sample of a swift water training outline.

Figure A-1. Training outline

GOALS OF COURSE:	
1. Gain proficiency in swift/fast water rescue and diving techniques.	
2. Gain proficiency in boat operation in a class 3+ white water environment.	
3. Develop swift/fast water diving strategies to meet anticipated needs.	
4. Utilize new skills and preexisting skills in multiple scenario based culminating exercises.	
METHODOLOGY:	
1. Certified swift water rescue instructors facilitate surface and rescue portions and support diving.	
2. Boat operations skills consistent with National Fire Protection Association standards.	
3. Facilitate scuba and XLDS training in standalone and integrated scenarios.	
4. Diving operations according to United States Navy Diving Manual and AR 611-75.	
Day 0: Arrival	
No later than 1800 install and drop test chamber (ensure it is within 15 minutes of dive site).	
Day 1: Class 1-3 River	**Hours**
a. Introductions to instructors and facilities.	0.5
b. Safety brief.	0.5
c. Basic principles of rescue.	1
d. Equipment familiarization and proper use (rescue jackets, throw ropes, personal protective gear).	0.5
e. Hydrology (identifying risk and scene assessment).	2
a. Paddle technique.	0.5
b. Boat flip drills.	1
c. Paddle wading.	0.5
d. Team wade.	0.5
e. Panicked swimmer rescue.	0.5
f. Back board extraction.	0.5
g. Review/after action review.	0.5
Day 2: Class 1-3 River	**Hours**
a. Scene assessment/“what if?” Thinking/safety first.	1
b. Throw rope in current.	0.5
c. Aggressive/defensive swimming.	1
d. Pinned boat exercises.	1

Figure A-1. Safety checklist (continued)

Day 2: Class 3-4 River	**Hours**
a. Aggressive/defensive swimming in greater current.	0.5
b. Strainer bar exercises.	0.5
c. V lower technique.	0.5
d. Live bait technique.	1
e. Assisted swimmer.	0.5
f. Zip line technique.	0.5
g. Review/after action review.	0.5
Day 3: Class 3+ River	**Hours**
a. Practice scenarios utilizing all new skills in river environment.	3
b. Review.	0.5
c. Practical skill evaluations (American Canoe Association Swift Water Rescue Standard).	3
d. Review/after action review.	0.5
Day 4: Class 3+ River	**Hours**
a. Principles of rope based diving, rescue, and recovery.	2
b. Simple rope applications for diving and rescue.	1
c. Rope systems (mechanical advantage systems).	2
d. Scenario based dry land exercises.	1
e. On water team based rope rescue principles.	1
f. On water rope based scenarios combining all new skills (American Canoe Association Swift Water Rescue Standard).	1
g. On water dive side rope system setup.	1
h. Review/after action review.	0.5
Day 5: 1-3 Knot (1.852-5.556 Kilometers Per Hour) Current	**Hours**
a. Low to mid flow scuba training from shore.	4
b. Low to mid flow scuba training from small boat.	4
c. Emergency procedure training (pinned diver, swept diver, loss of regulator).	NA
d. Review/after action review.	0.5
Day 6: 3-5 Knot (5.556-9.26 Kilometers Per Hour) Current	**Hours**
a. Mid to high flow scuba training from shore.	4
b. Mid to high flow scuba training from small boat.	4
c. Review/after action review.	0.5
Day 7: 5+ Knot (9.26+ Kilometers Per Hour) Current/White Water	
a. High flow scuba training from bridge (or other man-made object) ***Note.*** Shore diving is not practical.	4
b. High flow scuba training from small boat.	4
c. Review/after action review.	0.5

Figure A-1. Safety checklist (continued)

Day 8: 3-5 Knot (5.556-9.26 Kilometers Per Hour) Current	**Hours**
a. Mid to high flow surface supplied diving training from shore.	5
b. Mid to high flow XLDS training from small boat.	5
c. Emergency procedure training (flooding hat, pinned diver).	NA
d. Review/after action review.	0.5
Day 9: 5+ Knot (9.26+ Kilometers Per Hour) Current/White Water	**Hours**
a. High flow surface supplied diving training from shore or bridge.	5
b. High flow XLDS training from small boat.	5
c. Review/after action review.	0.5
Day 10: Culminating Exercise	**Hours**
a. Brief warning order (body recovery, sensitive item recovery, obstacle reduction).	1
b. Plan mission/brief command and dive team.	2
c. Execute (include emergency procedure drill).	UTC
d. Review/after action review.	0.5
Day 11: Departure	
No later than 0800 breakdown chamber.	

Legend:
AR Army regulation
NA not applicable
UTC until complete
XLDS Extreme Lightweight Diving System

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Appendix B

Supervisor's Swift/Fast Water Safety Checklist and Brief

B-1. Table B-1 is a sample of a swift/fast water safety checklist. Table B-2, page B-2, is a sample of a swift/fast water scuba supervisor's brief. Table B-3, page B-5, is a sample swift/fast water scuba supervisor checklist.

Table B-1. Sample swift/fast water safety checklist

Location	
Nearshore Bank Condition	Slope ____ Height ____ Mud / Silt / Sand / Rock / Clay / Vegetation
Far Shore Bank Condition	Slope ____ Height ____ Mud / Silt / Sand / Rock / Clay / Vegetation
Water Velocity	Nearshore _____ Far Shore ____ Center Near Surface_____ Center Mid Depth____ Center Near Bottom_____
Bottom Condition	Mud / Silt Sand / Rock / Clay Notes:
Floating Debris Yes No	Notes:
Accessibility to Evacuation Vehicle	Notes:
Water Extraction Options	Notes:
Hazards (Pillows, Holes, Strainers) at Dive Site	Notes:
Upstream Safety Location/Equipment Communications	Notes:
Downstream Safety Location/Equipment/Communications	Notes:
Boat Launching and Recovery Areas	Notes:
Special Tools Required	Notes:
Special Lines and Rescue Gear Required	Notes:
Emergency Action Plan	Primary Extraction From Water:_____ Secondary: _____ Washed Out Diver Extraction:_____ Modification to Line Pulls Required in Current: (Y/N)

Table B-2. Sample swift/fast water scuba supervisor's checklist

_____ **STATION CHECKS/INSPECT DIVE STATION**

_____ **ASSIGNMENTS**

_____ Assume the side.

_____ Assemble dive team; call off dive bill and "**Extra Personnel to Diver Supervisor's Left**"

_____ Identify all divers. Can everyone clear? **Dirty Divers** **Clean Divers**

_____ Ask the following questions:

- Has anyone made any dives in the past 18 hours?
- Any one not physically qualified (NPQ) to dive?
- Is anyone on medicine?
- Does anyone have aches, pains, or numb spots?
- Does anyone have false teeth?
- Does anyone have contacts?
- Is there anything else that needs to be known?

MASTER DIVER (MDV): _____ DIVING MEDICAL OFFICER (DMO): _____DIVING OFFICER (DO): _____

_____ Cover E-bill and swift water safety checklist.

_____ Dive job is:_____

LIMITS: Depth _____ Bottom Time (B.T.) _____

BOTTOM: Type _____ Visibility _____ Current _____ Water Temperature _____

_____ Diver's Deployment = _____ Standby Diver Deployment = _____

_____ Primary Recovery = _____ Secondary Recovery = _____

SAFETY

_____ Hazards: _____

_____ Medical Gear Located: _____

_____ **DIVERS:** Divers should—

- Understand the job.
- Want to make the dive.
- Know the emergency procedures.
- Ensure that Red* is lead (on tender).
- Stay together.
- Ensure that if one diver goes on reserve or hits 500 pounds per square inch (PSI) (35.15 kilograms per square centimeter), both divers surface.
- Give a report upon surfacing (depth B.T. and PSI).
- Note how the he feels now and let the supervisor know if he is feeling differently during or after the dive.

Questions?

_____ **STANDBY:** The standby should—

- Pay attention during the dive.
- Know emergency procedures.
- Ensure that if he deploys, he understands what is wanted before leaving the surface.
- Ensure that once in the water, he gets on affected divers tending line.
- Ensure that he does his own checks.
- Let supervisor know when he leaves surface.
- Assess the situation, get vitals, and let supervisor know what is needed to solve the problem.
- Ensure he does not become part of the problem.

Questions?

Table B-2. Sample swift/fast water scuba supervisor's checklist (continued)

_____ **COVER EMERGENCY PROCEDURES:** _____ Loss of Air _____ Lost Diver

_____ Omitted "Decompression (D)" _____ Fouled/Trapped Diver _____ Unconscious Diver

_____ Loss of Tender

_____ **TENDERS:** Tenders should—

- Keep positive control of divers.
- Call out all line pulls.
- Bubble watch throughout the dive.
- Ensure that the Red tender is the chamber diver.

Questions?

_____ **STANDBY TENDER:** Standby tenders should—

- Deploy the lost diver buoy, if needed.
- Bubble watch throughout the dive.

Questions?

_____ **LOGS:** Logs should—

- Have everything needed.
- Sound recall and manage extra tanks, if needed.
- Listen for report (depth and B.T.).
- Let supervisor know if omitted "D."
- Give supervisor the stops and times.
- Recalculate and report changes in stop time for delays to stop or in water decompression sickness (DCS) protocol.
- Chamber logs and communications.

Questions?

_____ **DIVING MEDICAL TECHNICIAN (DMT) AND INSIDE TENDER (I/T):** DMT and I/T should—

- Inform supervisor of any dives or hyperbaric treatments (TX's) in last 48 hours.
- Ensure that medical gear is in good shape.
- Grab the medical kit and assist with neurological exam if there is a casualty in the chase boat.
- Get into chamber as I/T in the event of omitted "D" or TX.
- Ensure that hearing protection is on, that "OK" is in the viewport, and is ready to travel.

Questions?

_____ **UPSTREAM/DOWNSTREAM SAFETIES:** Upstream/downstream safeties should—

- Have throw lines
- Know emergency procedures.
- Let supervisor know if there are any problems.
- Stay alert for flotsam.
- Stay on communications.
- Be the outer lock driver in the event divers go into the chamber.

Questions?

_____ **COXSWAINS:** Coxswains should—

- Be qualified.
- Ensure there is fuel.
- Ensure there are lifejackets.
- Ensure there are handheld radios and know the channels.
- Ensure that the anchor, if deployed, is deployed with the bow facing into the wind and downwind of the divers.

Questions?

Table B-2. Sample swift/fast water scuba supervisor's checklist (continued)

_____ **EXTRAS:** Extras should—

- Manage the line systems.
- Maintain communications with the DMO or command, if needed.

Questions?

_____ **CHAMBER TEAM:** As part of the brief, the dive supervisor will say—

- Driver. The driver will answer up with "Here."
- Communications and Logs. The communication and logs person will answer up with "Here."
- I/T. The I/T will answer up with "Here."
- Outer locker driver. The outer lock driver will answer up with "Here."

BE THERE!!

_____ **CHASE BOAT:** In the event you have to travel to the recompression chamber by boat, the following personnel need to be onboard:

- Supervisor.
- Stricken diver.
- Buddy.
- DMT.
- Coxswain to maintain the logs.

BE THERE!!

_____ **DIVING OFFICER:** The diving officer should—

- Back supervisor up on watches.
- Ensure that if a standby is launched, the supervisor controls the dive.
- Keep the time and manage the diver's decompression.
- Ensure that if there is a casualty, the supervisor will take the affected diver.
- Monitor unaffected divers.

Questions or anything to add?

-
_____
_____

_____ Stay on Station _____ Fix Any Problems _____ Professionalism _____

Table B-3. Sample swift/fast water scuba supervisor's checklist

	Tenders Answer Up; Check Red, Green, and Standby	*Red*	*Green*	*Standby*
1	Predives, operations, and station set-up complete?			
2	**MINIMUM EQUIPMENT:** Dress – boots – gloves as needed Mask Fins as needed (not recommended for fast water) Harness with tending quick release BC – weight 2 knives Depth gauge Watch Standby: Harness with tending quick release Octopus			
3	**BOTTLE PRESSURES:** Red _____ Green _____ Standby _____ Extra _____			
4	Quick release properly rigged			
5	Dump valves are on and tightened			
6	BC not constrained			
7	Knife attached where it cannot be jettisoned (tied off to diver)			
8	Weights are installed and in the correct position			
9	Bottle valves open and backed off 1/4 turn			
10	Reserve is up and operates freely			
11	Check purge button and ensure that all regulators are free of debris			
12	Breath both regulators, in line valves secured, check extra tanks			
13	Test diver recall			
14	**DIVE SUPERVISOR CHECKS:** • Air on and reserve up and operates freely • Quick releases • Dump valves are tightened • Knife • Weight belt adequate and installed • Suit adequate/gloves • Standby harness with tending quick release and octopus attached			
15	All tools and equipment staged? Divers have any questions? **No deeper than** _____ **No longer than** _____			
16	Diving officer and divers are ready to enter the water			
Legend: BC buoyancy compensator				

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Appendix C

Swift/Fast Water Dive Kit Sample Inventory Sheet

Table C-1 is a sample of a swift/fast water dive kit inventory.

Table C-1. Swift/faster water dive kit inventory sheet

Quantity	*Item*
2	4-inch (10.16-centimeter) Pigeon Mountain Industries (PMI) steel rescue 8 with ears
20	Aluminum, 27 kiloNewton (6,069.84 pound-force), Omega locking carabiners
4	Large steel locking carabiners National Fire Protection Association (NFPA)
4	Swift Water Rescue Technician (SRT) Harnesses from CMC Rescue, 1 large/extra large and 3 small/medium (RESCUE NORTHWEST)
4	Fox 40 whistles
4	Force fins, extra extra large (large enough to fit over booties or boots)
4	NFPA Prusik minded pulleys
9	Protec ACE water rescue helmets: 3 extra large, 3 large, 3 medium
3	300-foot (91.44-meter) communications/tending cables for AGA dive masks (MK 20)
3	Ocean Technology Systems stuff sacks for communications/tending cables for AGA dive masks (MK 20)
4	Divators, also known as AGA dive masks (MK 20)
1	Spool of 1-inch (2.54-centimeter) tubular webbing (minimum 200 feet [60.96 meters])
8	3-inch (0.0762 meters) (small spinnaker shackles
1	100-foot (30.48-meter) spool of Prusik line (5/16 inch, 8 millimeter [0.3125 inches x 25.4 = 7.9375 millimeters]), kernmantle, technora: 6,000 pounds (2,721.55 kilograms), 26.69 kiloNewton (5,910.23 pound-force)
4	75 feet (22.86 meters), 1/2-inch (1.27 centimeters) diameter kernmantle rescue throw bags
3	300 feet (91.44 meters), 1/2-inch(1.27-centimeter) diameter water rescue line (kernmantle)
3	Large double ended rope bags (capable of holding 300 feet (91.44 meters) of rope with two padded shoulder straps)
1	Spool of 3/4-inch (1.91-centimeter) diameter kernmantle line: 5,000 pounds (2,267.96 kilograms) breaking strength
1	Bokat rope washer
4	Large equipment bags
1	Small double-ended rope bag (good for storing webbing and Prusik cord)
6	Highland inline shut-off-low pressure at 2nd stage

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Glossary

The glossary lists acronyms and terms with Army or joint definitions. Terms for which TM 3-34.84 is the proponent are marked with an asterisk (*). The proponent publication for other terms is listed in parentheses after the definition.

SECTION I – ACRONYMS AND ABBREVIATIONS

ADRP	Army doctrine refrence publicaton
AR	Army regulation
attn	attention
DA	Department of the Army
DC	District of Columbia
FM	field manual
JP	joint publication
MAS	Mechanical Advantage System
MSCoE	Maneuver Support Center of Excellence
No.	number
scuba	self-contained underwater breathing apparatus
SSD	surface supplied diving
TM	technical manual
UIAA	International Mountaineering and Climbing Foundation
XLDS	Extreme Lightweight Diving System

SECTION II – TERMS

None.

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These documents must be available to the intended users of this publication. Most Army publications are available online at <www.apd.army.mil>. Most joint publications are available online at <www.dtic.mil /doctrine/new_pubs/jointpub.htm>.

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RECOMMENDED READINGS

None.

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TM 3-34.84
16 March 2015

By Order of the Secretary of the Army

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