# River & Flood Rescue

# 37

Section IV- Technical Operations

## Types of Water Rescue

## Water Rescue Terminology

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Revised - November 2020

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# Introduction

Water Rescue emergencies occur in San Diego every year, due to a variety of causes. Both dynamic and static water pose significant risks to victims and to rescuers responding to these types of incidents. Water rescue emergencies are low-frequency, high-risk types of technical rescue incidents. Water rescues are unique, because they often require skill sets used for other types of technical rescue responses. It is imperative that all personnel responding to these emergencies are trained, properly equipped, and operate as a team to be effective and safe when these emergencies occur.


Figure 37-32 Mission Valley during the flood of 1916 (pictured left) consisted mostly of cattle ranches and farms. Sweetwater Dam overflow during the flood of 1916 (pictured right).

# History

San Diego is a drought prone region that has historically seen flash floods. The region used to only be able to support a population of 5,000 people, due to the lack of natural water. In 1880 and 1890, dams were built on each of the 7 rivers in San Diego County. This supported a larger population with the ability to harvest water for agriculture, and to control the flooding that was occurring.

Although the dams were able to control the water, they weren't able to control the droughts. From 1900-1916 there was a terrible drought. A "rainmaker" named Charles Hatfield was hired by the City to end the drought. The next day, the largest flooding in the history of San Diego occurred, destroying the Otay dam and sent a 130-foot-high wall of water downstream. Other areas of the county were affected just as much. All of the bridges in San Diego County were washed out. Access to Los Angeles from San Diego was only possible by boat up the Pacific Ocean. Many people lost their lives and property during this flooding. Yet, population has increased significantly and homes and commercial structures have continued to be built in flood prone areas.

In Mission Valley, land was once very cheap to own. It was known to be the flood plain of the San Diego River. The few people that built there mainly used the land for agriculture and ranching. In 1862 and 1916 Mission Valley flooded completely and almost all development was wiped out. The affordable cost of land drove people to build and develop the valley. In 1960, Mission Valley Mall was built. This brought more development and population to the area. Resident population grew 41.8% between the years 2000 and 2005 alone. The development and population in Mission Valley continues to grow. Many residents are unaware that their homes and businesses are in a flood plain that is subject to "Hundred Year Floods."

# Types of Water Rescue

NFPA 1670 and 1006 categorizes water emergencies into the subdisciplines of:

- **Surface Water Rescue** – rescue at the surface of non-moving water, such as a lake or reservoir
- **Flood Water Rescue** – rescue in area that does not commonly hold water, that has been overwhelmed by accumulated water
- **Swiftwater Rescue** – rescue in moving water such as a river or flood control channel, or even a flooded environment that has moving water
- **Ice Rescue** – rescue from broken ice of a frozen waterway at or below the surface of the ice
- **Surf Rescue** – rescue in ocean environments where ocean currents or waves create moving water
- **Dive Rescue** – subsurface rescue of submerged victims

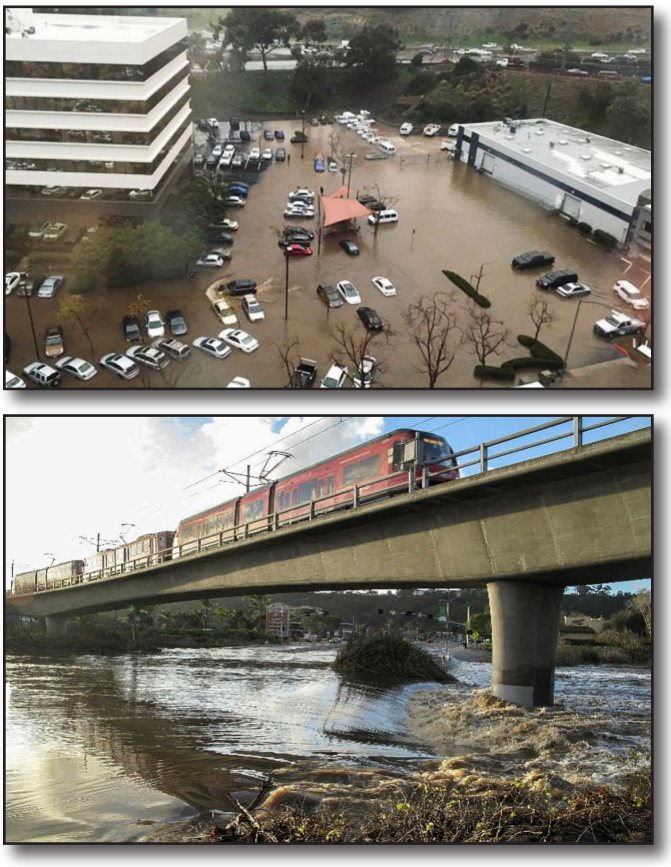


Figure 37-1 Examples of Flooding (top) & Swiftwater (bottom)

It is important to have an understanding of the differences between each type of rescue. There may be similarities in these subdisciplines in regards to PPE and tactics. More than one of these subdisciplines may be required during one incident.

## Swiftwater vs Flooding

Water, in relationship to rescues is typically referred to as flood or swiftwater. Swiftwater is any water way with movement over 1.3 mph. This is about ½ the speed of a human's walking pace. The term "flooding" is used when water has occupied an area it was not intended to, such as a structure or roadway. Flooding is usually a result of moving water that has settled in an area. In terms of rescue, "flood" refers to non-moving water, and "swiftwater" refers to moving water. Always anticipate that even in a flooded environment, there will be some areas that have swiftwater present.

*Note: CA State Fire Training refers to Swiftwater incidents as "River and Flood Rescue," as this terminology covers inland water rescue incidents throughout the State of California. Incidents occur throughout the year in rivers, including in San Diego, in which Swiftwater skill sets are applied. Many of the strategies, tactics, and equipment used for Swiftwater incidents came from recreational*

*river sports. Although we utilize the common term "Swiftwater" in this chapter frequently, "River and Flood" is the most appropriate description to encompass the various environments found at inland water rescue incidents.*

## Types of Floods

- **Flash flood** - a sudden localized or wide area flood event of great volume and short duration typically caused by unusually heavy rain affecting a defined geographical and/or topographical area. A flash flood often features high velocity attributes and can carry large loads of mud, rock, and man made debris.
- **Fluvial flooding** - flooding occurs in the floodplain or water shed of a defined water course (stream, creek, or river) when the capacity of the course is exceeded by rainfall orsnow/ice melts in the upstream catchment areas.
- **Pluvial flooding** - surface water flooding that is caused by rainwater runoff typically found or occurring in urban areas or areas that possess land with low water absorbency.
- **Tidal flooding/storm surge** - flooding as a result of abnormally high tides, strong winds, or significant low-pressure fronts thus causing sea levels to rise above normal levels.
- **Tsunami** - a seismic wave of water often referred to as a tidal wave. It is a series of large waves commonly caused by an earthquake or landslides. The large waves will cause rapid moving floods along low lying coastal areas.
- **Terrorist act** - a flood caused by the damaging or destruction of infrastructure, such as dams and levees.

Figure 37-2 Fluvial flooding of the Mission Valley Golf Course caused by the overflowing of the San Diego River River

Figure 37-3 Pluvial flooding of this South Bay intersection was caused by rain runoff that overwhelmed the storm drain system and pooled in low lying areas.

Figure 37-4 Tidal flooding / storm surge flooding the streets of Imperial Beach


Figure 37-5 The City of Montecito was severely impacted by the effects of mud and debris flows caused by a signicant storm system immediately folloiwng a wildfire in the foothills. Pictured above is Highway 101.

## Mud & Debris Flows

If rescuers are unable to move themselves or their equipment through the water, then they are considered to be in a Mud Flow or Debris Flow. This often occurs when heavy rain impacts an area that sustained wild fire damage, or in areas where soil is unstable. Mud and Debris Flows are very dangerous to victims and rescuers, as travel through the flow is impossible, and escape from the flow may be difficult. Often times these flows engulf homes, property, and lives without warning or adequate time to escape. Damage to structures compromises the integrity of the buildings, making search for victims in and around the incident hazardous to rescuers. Specialized training in search and rescue and structure collapse, in addition to water rescue training, is required of rescuers performing operations at Mud and Debris Flow incidents.

Figure 37-6 A broken water main in the hillside above this home in 20's district caused a significant mud flow that filled the entire home in a matter of minutes. Fortunately, the homeowner was able to escape unharmed despite the structure being a total loss. 2018.

# Water Emergency Causes

Water rescues can occur at any time of the year due to the forces of nature and because of the possibility of man made water control failures. Usually, these incidents take place due to heavy rain events in, or near, the region thus causing flooding and swiftwater environments. Most naturally caused incidents have the advantage of being forecasted, which gives responders the opportunity for response pre-planning, while man made caused incidents can happen without notice. Water control failures can be a result of degradation, terrorism, accidental disruption, or a natural disaster. Whatever the cause of the incident, the resulting damage is the same. Storm drains can overflow, creeks can become raging rivers, and roadways can turn into rivers themselves.

*Natural Causes:*

- Winter Storms
- Summer Monsoons
- Atmospheric Rivers
- El Niños
- Hurricanes
- Tsunamis
- Coastal Flooding

Figure 37-7 A broken water main flooded the streets of North Park caused an out of season swiftwater environment.

*Manmade Causes:*

- Overwhelmed Water Control (Flood) Channels
- Water Supply System Failure
- Dam Collapse
- Pump Failure
- Storm Drain Failure

Figure 37-8 Seasonal flooding on the streets of Ocean Beach due to heavy rainfall.

# San Diego Target Hazards

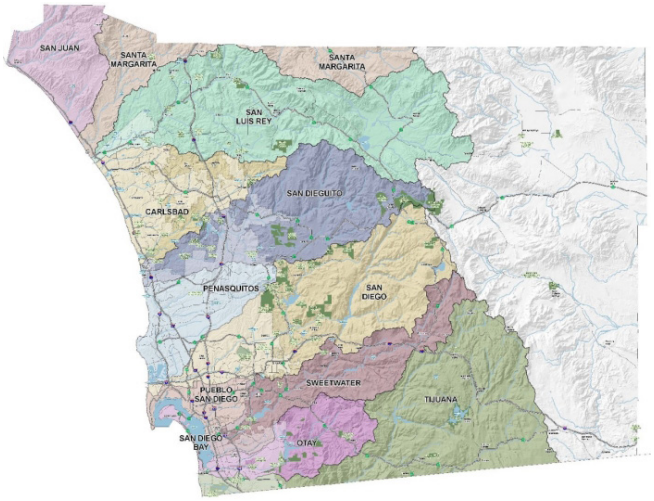



Figure 37-9 San Diego County Watersheds

## San Diego County

The County of San Diego is home to 11 westward flowing watersheds and over 70 miles of coastline. There are 54 dams in the county. In 2017, the State of California released a report that identified 9 of these dams "fair" for safety and an "extremely high downstream hazard status for potential loss of life and property damage."

## San Diego City

Of the 11 westward watersheds in San Diego County, 7 of these are within the City of San Diego limits. Hundreds of miles of creeks and manmade waterways intertwine the City, but 4 of these watersheds are consistent hazard areas during rain events:


Figure 37-10 Sorrento Valley intersection

### Sorrento Valley

Located in the northern area of San Diego City, it incorporates Peñasquitos Creek, Sorrento Creek, and Carroll Creek. It flows out into the ocean through Torrey Pines, just south of Del Mar. This is an area that is home to many businesses and has a history of flooding, while other areas of the city remain unharmed. These creeks are usually nearly dry, but can quickly turn to rivers and overflow into adjoining roads and structures.

Figure 37-11 Mission Valley Golf Course and San Diego River

### Mission Valley

Mission Valley can be broken into two major areas, East and West. Once farmland, Mission Valley is where the San Diego River reaches its widest point Today, the valley is filled with developments such as apartments and condos, businesses, shopping malls, roads, stadiums, and hotels. The river banks with tall reeds and trees are used by many homeless seeking shelter. There are many roads that cross over and through the river that cause issues for people in their vehicles when rain is filling the river banks. This is an area that has a long history of flooding, both in the past and in present times.

## Chollas Creek

Chollas Creek runs in and through canyons and urban areas from Lemon Grove and La Mesa, through San Diego, south of City Heights and then Barrio Logan before it empties into San Diego Bay. Because of the urban areas it runs through, it is known to be very polluted and often littered with waste and debris.

## Tijuana River Valley

The Tijuana River runs through Mexico's cities of Tecate and Tijuana before entering the United States. It flows into the Tijuana River Valley of San Diego City along the US/Mexico border and out to the ocean. Along the way, the river passes by retail shopping malls and winds its way through small ranch properties in the valley. Unfortunately, waste and pollution are not regulated in Mexico as much as in the United States. This has caused the Tijuana River to be one of the most polluted waterways in the United States. This valley is also a well-traveled area for illegal immigration, resulting in many rescues when people are confronted with a river as their last obstacle entering the United States.

Figure 37-12 Chollas Creek

Figure 37-13 Tijuana River

# Hazards At Water Incidents

Water rescue incidents are incredibly hazardous to crews and can quickly become dynamic incidents. These incidents pose risk of injury or death from drowning and/or trauma to both victims and rescuers.

- **Subsurface Hazards**
  - Entrapment in storm drains or holes
  - Foot entrapment
  - Failed roads or walkways
  - Energized electrical conduction
  - Subsurface currents
  - Water traveling underground
  - Swiftwater Hazards
  - Debris (top, suspended, bottom)
  - Strainers
  - Holes
  - Rocks
  - Man-made Objects
- **Speed and Volume of Water**
- **Water Quality Hazards**
  - Chemical and biological waste products
  - Gastrointestinal illnesses
  - Infectious hepatitis
  - Aseptic meningitis
  - Leptospirosis
  - E. Coli, Salmonella
  - Shifella
  - Hepatitis A
  - Agents of typhoid
  - Paratyphoid
  - Tetanus

Figure 37-14 Contaminated water conditions should be expected during water rescue incidents.

## Flood Control Channels

Flood control channels present a difficult environment for water rescues. They are designed to move water as fast as possible, and do not contain features that create safe areas within the moving water. They can be classified as Trapezodial, Straight Walled, or be a combination of either. They may have sloping or straight walls that create a difficulty in exiting as a rescuer, or for removing victims. Flood control channels are easy to enter, difficult to exit. There are many hazards contained within these channels. These channels may contain:

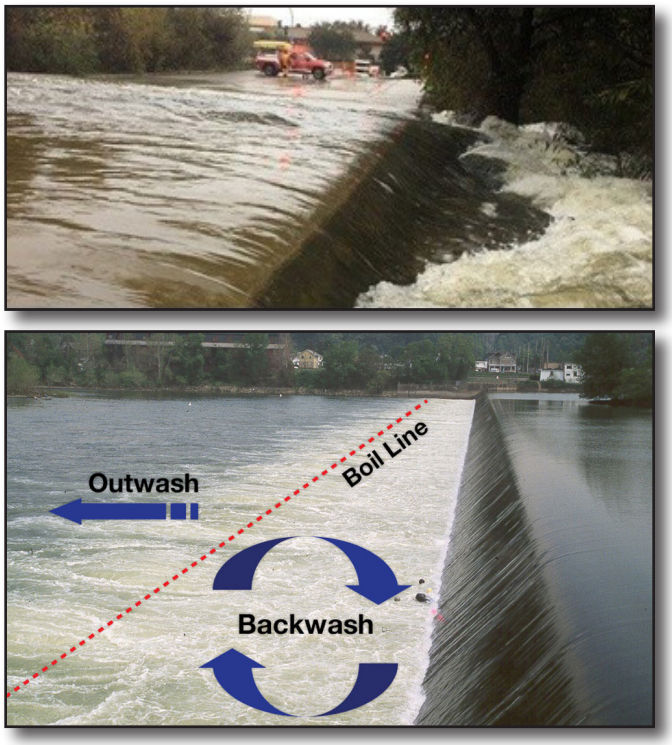
- Strainers caused by vegetation or debris
- Grates or "Gorilla Cages"
- Constricting channels
- Underground passages

Figure 37-15 Water rescues in flood control channels are a high risk evolution and present many challenges and dangers.

## Low Head Dams

Low head dams are vertical or near vertical walls that span a waterway and cause water to drop over the downriver side. The dropping of the water causes a hydraulic to form, in which water sucks back into the falling water. Once a hydraulic "grabs" an object, it can be kept there for long periods of time and tumbled in the "boil" of water. This can include a victim or a rescuer, and usually results in the person trapped in the hydraulic to drown. Rescuers have died attempting to rescue victims in hydraulics caused by low head dams. The best way to escape a hydraulic is to swim away from the hydraulic with maximum effort underwater at the bottom of the boil caused by the hydraulic. Another option, usually less successful, is to swim with maximum effort on the surface at the boil line and attempt to break back into the downstream flow.

Low head dams often appear to be innocent water features, and can hide themselves and their hydraulics when water levels rise. Sometimes roads that cross waterways can form low head dams and create the same deadly hydraulics below them.

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Rive

Figure 37-16 To the untrained rescuer, a low head damn may not seem overly concerning, however, the true danger lies below the water line in the hydraulic water current. Although low head damns are not common in San Diego, roadways that cross our rivers create the same dangers as a low head damn when the river floods. (Top photo of Mission Valley).

Figure 37-17 During periods of significant rainfall, storm drain systems often become overwhelmed. This results in a buildup of water pressure that is powerful enough to dislodge and move manhole covers (picture on left). When a manhole cover has been dislodged and water begins to recede, a drain path is created. These situations are extremely dangerous for rescuers and may not be as visible from the surface or as obvious as the picture on the right.

## Differential Pressure

This phenomenon, often referred to as Delta P, happens when a body of water that is elevated above a drain path creates a suction force when water flows down the drain. A small scale example of this would be the draining of water in a bathtub. The suction force in the bathtub example is easily overcome, but when dealing with larger openings, large volumes of water, and longer drain paths, the force can be thousands of pounds. Often times in flood situations, the force of water coming up from the ground will dislodge sewer manhole covers. These become the drain path entrances for Delta P's. They are deathtraps for rescuers performing operations in what may look like still, shallow water. You may or may not see a small whirlpool forming, or a disturbance in the water's surface as an indicator that a drain path is present. Murky water or darkness can add to the masking of these hazard areas. If a rescuer gets too close to a Delta P opening, the force of the suction can drown them by pinning or flushing them away. This is why it is important to be extremely cautious of even non-moving water. If water must be walked across, always use a long tool for "sounding" or feeling the surface below the water to ensure you do not walk anywhere near one of these areas.

# Flooded Structures

Houses and buildings can trap victims and rescuers searching for victims in their void spaces. As water levels rise inside of a structure, the potential for entrapment inside increases. The reduction of space inside of the structure caused by high flood water and the addition of floating debris and furniture make searching for victims inside of flooded structures difficult. The structure itself may be compromised by the influx and load of the flood water. It is common to find victims trapped inside of their attics or on their roof tops when flood levels rise and they have no place else to go other than in the water. If a victim is suspected to be trapped in their attic, care must be taken when cutting an escape hole with an axe or a chainsaw. Only rescuers with structural collapse, swiftwater technician, and roof ventilation training should attempt these tactics.


Figure 37-18 Victims trapped in their homes by flooded waters during Hurricane Katrina escape to their rooftops to await rescue by helicopter.

# Driving Apparatus During Water Emergencies

A vehicle trapped in water is a common type of search and rescue scenario that rescuers will encounter. By driving rescue vehicles into water, the rescuers could easily become victims themselves. It only takes 1 foot of water to lift and move a vehicle. In addition to the presumed hazards in floods and swiftwater, there are many other hazards to consider when driving near water or into water:



- You probably cannot see the depth of the water, or what obstacles are in the water
- Water may have caused undermining and trenching of the bottom surface, roadway, or adjoining roads
- Electronics on the vehicle or the vehicle's motor can become disabled, leaving the vehicle stranded
- The vehicle can float and/or lose traction
- An unstable vehicle can become overturned by the forces of moving water

Driving fire apparatus and heavy vehicles is especially dangerous in and around flooded and swiftwater environments. Consideration must be given to the weight of the apparatus and its influence on roads that have been compromised by weather and water. Large fire apparatus are difficult to maneuver in tight areas that water typically runs through. Larger apparatus are generally higher from the ground than most light duty apparatus. Do not mistake the height of a larger fire apparatus as a safer option to use for crossing water. Consider that water flowing at just 6 mph exerts the same force per unit area as air blowing at EFS tornado wind speeds. Avoid driving your apparatus through water that is:

- Over 6" Deep
- Water that is moving
- If you cannot see the road surface

# Water Rescue Training Levels

NFPA 1006 and 1670 classify training for responders as Awareness, Operations, and Technician levels. Each level of training is a prerequisite for the next level. Awareness Level trained responders are qualified to perform the following tasks at a water rescue incident:

- Assess the situation
- Recognize the need for specialized teams
- Identify the necessary resources
- Site control and scene management
- Recognize general hazards
- Determine rescue vs recovery

*Operations Level trained responders are qualified to perform the following tasks at a water rescue incident:*

- Assess moving water conditions
- Don the proper PPE
- Perform support operations
- Construct rope systems
- Perform nonentry rescue
- Terminate an incident

*Technician Level trained responders are qualified to perform the following tasks at a water rescue incident:*

- Perform entry rescue
- Construct and operate rope systems (tension diagonals, highlines, tethered boats)
- Operate a human powered boat
- Perform a rescue from a boat

*Specialized skillsets and certifications for water rescues include:*

- Rescue Boat Operations / Technician
- Personal Watercraft Rescue Operations
- Rope Rescue Technician
- Helicopter Aquatic Rescue Operations
- Structure Collapse Technician
- Vehicle Extrication
- Animal Rescue

# Personal Protective Equipment


Figure 37-19
Awareness Level PPE


Figure 37-20
Operations Level PPE

Figure 37-21
Technician Level PPE

The proper PPE shall be worn by rescuers at flooding and swiftwater incidents, and should be the correct type for the level of training the rescuer has received.

*Rescuers trained to the Awareness Level shall wear:*

- Class C Uniform
- Swimmable footwear (running shoes, not boots)
- Brush Jacket or reflective weather jacket
- NO TURNOUTS OR BRIMMED HELMETS

*Rescuers trained to the Operations Level shall wear:*

- Type III Personal Floatation Device (PFD) w/Whistle & Knife
- Water Rescue Helmet
- Swimmable footwear (running shoes, not boots)
- Class C Uniform
- NO TURNOUTS OR BRIMMED HELMETS

*Rescuers trained to the Technician Level shall wear:*

- Type V PFD (has blowout ring) w/Whistle & Knife
- Water Rescue Helmet
- Drysuit w/ Undergarments
- Water Rescue Footwear
- Water Rescue Gloves
- Rescue Fins
- Personal Waist Throwbag

Water Rescue PPE is specifically designed to protect rescuers from hazards at these types of incidents. Take for example the water rescue helmet: these helmets do not have a brim that could become a hazard to the rescuer if moving water were to "catch" under the helmet. Drysuits create a barrier between the skin and contaminated water, in addition to providing thermal protection with the correct undergarments. Personal Floatation Devices (PFD's) help to keep the rescuer on the surface of the water and provide lifesaving buoyancy to victims and rescuers alike. **A PFD shall be worn by anyone that is within 10 feet of the edge of any type of water. A water rescue helmet should be worn if a PFD is being worn.**

Training in the appropriate PPE is critical to success at water rescue incidents. The rescuer must be familiar with the way their PPE affects their movement in and out of the water. For example, wearing a drysuit can cause the rescuer to become more bouyant and cumbersome if not used properly. "Burping" a

drysuit before and after entering the water is a technique used to avoid this, however, this skill must be practiced to avoid water from entering the drysuit.

Following contact with water at an incident or during training requires proper decontamination of PPE and equipment. Most of the equipment must be hand washed, rinsed, and air dried. Citro-Squeeze has been proven to clean many of the petroleum contaminants found in these environments. Warm water and Dawn dish soap can be used to clean other contaminants on PPE. There are several other products available that are specially formulated for cleaning water rescue equipment. Always follow the manufacturer's recommendations for cleaning specific to the type of equipment being cleaned.

# Types of Swiftwater Rescue Teams

Swiftwater teams in California follow the Firescope ICS-SF-SAR 020-1 for typing standards. The following is a brief overview of what the typing requirements are for Type 1, 2, 3, and 4 swiftwater teams:

## Type I Swiftwater Team

Capabilities: Manage search ops, Power vessel ops, In-water contact rescues, Helicopter operational, Animal Rescue, Communications, Logistics

- 14 personnel
- 2 Inflatable Rescue Boats (IRB's) with motors
- Rope Rescue Equipment – capable of constructing highlines
- Hand held GPS
- ALS Medical Kit

## Type 2 Swiftwater Team

Capabilities: Manage search ops, Power vessel ops, In-water contact rescues, Helicopter operational, Animal Rescue

- 6 personnel
- 1 Inflatable Rescue Boat (IRB) with motor
- Rope Rescue Equipment – capable of constructing highlines
- Hand held GPS
- BLS Medical Kit

## Type 3 Swiftwater Team

Capabilities: Assist in search ops, In-water contact rescues, Paddle vessel ops, Animal Rescue

- 4 personnel
- 1 Inflatable Boat, non-powered, 4-person
- Rope Rescue Equipment – Basic Rigging
- BLS Medical Kit

# Type 4 Swiftwater Team

Capabilities: Low risk, Land based

- 3 personnel
- Small amount of rope and hardware
- BLS Medical Kit

# Specialty Water Rescue Resources


Figure 37-22 A San Diego Lifeguard River Rescue Unit with a D.I.B. (two-person paddle raft).


Figure 37-23 SDFD USAR-2 is a Type 3 Swiftwater Unit


Figure 37-24 Cal-OES SF-S&R-8 F-450 and Trailer, stored with SDFD. This equipment can be staffed and utilized locally during storm events, or deployed throughout the State of CA

## San Diego Lifeguard River Rescue Units

3 person team

Small inflatable open transom raft

## Technical Rescue Team

US&R-2 and US&R-41 both have Swiftwater PPE and Equipment

US&R-2 is a Type 3 Swiftwater Unit

US&R-2 has whitewater paddle boat

## *Cal-OES Swiftwater Flood Search & Rescue (SF-S&R-8)

Type 1 Team

2 Inflatable Rescue Boats with Motors

## *FEMA Urban Search & Rescue CA-TF8 MRP (Water Mission Ready Package)

Type 1 Team

Two Inflatable Rescue Boats with Motors

4 Jon Boats with Motors

## SDFD Air Operations

Crews have Swiftwater & Staticwater Hoist Capabilities

Deployable Water Rescue Basket

Ability to skid deploy qualified rescue swimmers

Night Ops capable with FLIR and night vision goggles

**SDFD must request the use of this resource for local area use from Cal-OES or FEMA*

# Specialized Water Rescue Equipment

1. Carlson Rescue Board
2. Line Launching Guns
3. Reach Devices
4. Throw Bags (Polypropolene rope)
5. Marking Devices
6. Inflatable Rescue Boat (IRB)
7. Jon Boat
8. Whitewater Raft
9. Personal Water Craft (PWC)


In addition to specialized equipment, a typical water rescue equipment cache will consist of forcible entry tools, ropes and rigging hardware, and communication equipment.




# Aerial Ladders For Water Rescue

Aerial Ladder Trucks may seem like a good option for water rescues, however, there are a significant risks involved with using them and use of these devices should be carefully weighed. Considerations for use of an aerial ladder may include:

- How heavy these apparatuses are and how close to the water you may have to place your apparatus/ outriggers to be within reach of the victim(s).
- The road and banks of the waterway may be compromised and weakened.
- Potential for the aerial ladder to be submerged into the moving water due to added weight of personnel/victims or surges in water. The force of the water could damage or destroy the ladder, or cause the apparatus to overturn or be swept away.
- Risks to the rescuers that would be climbing out over the water on the ladder.
- A Lyfe pulley operation should not be attempted, as this requires tying a fixed rope line to the rescuer and victim. There are much safer options that do not subject rescuers and equipment to as much risk that should be utilized in place of aerial ladders.
- If it is determined that an aerial ladder will be utilized at a water rescue, a swiftwater technician trained rescuer in the proper PPE should perform the rescue from the aerial ladder.

# River Terminology

The use of a standardized terminology system is used by first responders for river and flood environments. To understand and use this terminology correctly, it is imperative you orient yourself so that you are looking in the same direction that the water is flowing or moving towards, also known as looking "Downstream."

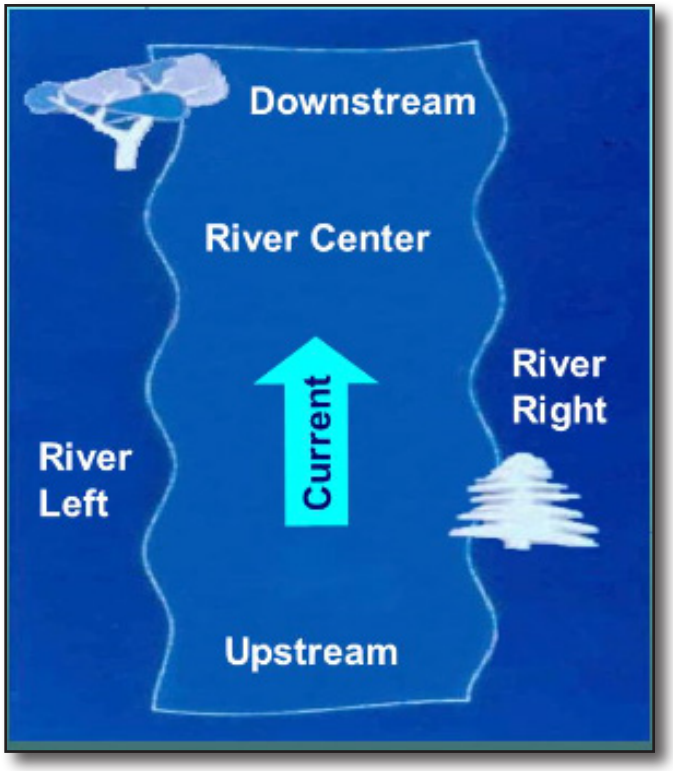
*Downstream*
The view point from where water is moving away from you. River rescue terminology is based from the perspective of looking downstream.

*Upstream*
The view point from where water is moving toward you.

*River Right*
Facing downstream, the view to the right side of the moving water is known as "River Right."

*River Left*
Facing downstream, the view to the left side of the moving water is known as "River Left."

*Center River*
The center of the moving water or river.




If you needed to give directions to someone to go upstream or downstream, you would say "move *Down River*," or "move *Up River.*" Because moving water does not flow in a straight line, it is best to communicate your directions according to the flow of the water. rather than use one compass directions. In flood waters, compass directions may be more appropriate as there may not always appear to be moving water.

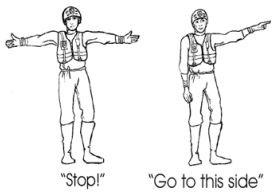
# Communications

Good communication is key to a successful incident. This is especially true during water rescue incidents. Turbulent waters can create enough noise that makes hearing difficult, especially when combined with the size and scale of the scene; making the use of a whistle a key piece of water rescue communication equipment. Every rescuer, no matter what their training level should have a whistle that is accessible, in addition to their radio. During the rescue, it is usually better for rescuers to communicate with a whistle over using a radio. Whistles will be heard by everyone at the incident, and it allows the rescuer to keep their hands free during the rescue. It is important that everyone on the response understand basic whistle signals:

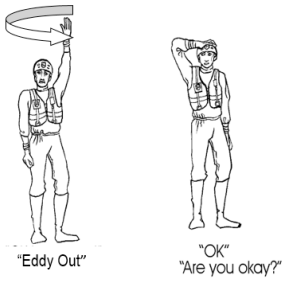
## Whistle Signals


- 1 Blast = Look at Me
- 2 Blasts = Look or Move Upstream
- 3 Blasts = Look or Move Downstream
- 3 Blasts Repeated = EMERGENCY/I NEED HELP!

## Hand Signals




Also useful are hand signals to communicate. Using the arm pointing in the direction you want the other rescuer to move would command them to "move" in that direction, when accompanied with respective whistle blasts. Additional hand signals that all responders should be aware of are:




- "I'm Okay" or confirming "Okay" = bumping your closed fist on top of your helmet
- "HELP" = waiving one or both arms over your head repeatedly
- "Eddie Out" = pointer finger raised upward over head and in a circular motion
- "Move This Direction" = straight arm pointing in the intended direction

Megaphones and PA's are useful when attempting to communicate with victims and/or the public.

# Hydrology

Current speed directly influences how much energy the water is carrying. Understanding current speed, or "the flow," can help rescuers determine where to begin a search for a victim and what features that are downstream may help in their search and rescue efforts. Water speeds reaching 25 mph and over are extremely dangerous to rescuers and should not be entered. For reference, a human's walking speed is about 3 mph and running speed is about 15 mph.

*Note: To measure the speed of water current in mph, time an object moving a distance of 100 feet, then divide the number 68.2 by the number of seconds it took the object to move the 100 feet.*

Water flow can be determined by estimating the volume and velocity of moving water. This is called cubic feet per second, or "CFS."

- Width *x* Depth *x* Velocity (feet of movement per second) = CFS
- Example: 20 feet wide *x* 10 feet deep *x* 5 feet per second = 1,000 CFS

Moving water is deceptively strong, weighing 8.35 pounds per gallon and 62.4 pounds per cubic foot. Water that is one foot deep and moving at just 4 mph exerts a force of 66 pounds on each square foot it touches. At 8 mph, the force increases to 264 pounds per square foot, enough to push a car or light truck downstream. Consider what this same amount of water could do if you were to be pinned against an object or how easily it can sweep you off of your feet. Unlike waves in the ocean, swiftwater currents are constant and do not let up.

**Current Speed Chart**

| MPH | Force on legs (Lbs.) | Force on body (Lbs.) |
|---|---|---|
| 3 | 17 | 33 |
| 6 | 67 | 134 |
| 9 | 151 | 302 |
| 12 | 269 | 538 |

Swiftwater can appear chaotic and confusing to untrained rescuers. It is in fact powerful and relentless, however, it is very predictable. Rescuers can develop the ability to "read" swiftwater and apply this knowledge to assess risk, size up an incident, and determine safe areas within the moving water.

## Laminar Flow

Laminar flow is the river's main current, typically near the center of the river and includes layers of water moving in the same direction but at different

speeds. The top layer moves the fastest with each layer below and to the sides moving slower due to friction caused by the bottom and competing currents.

## Reversal

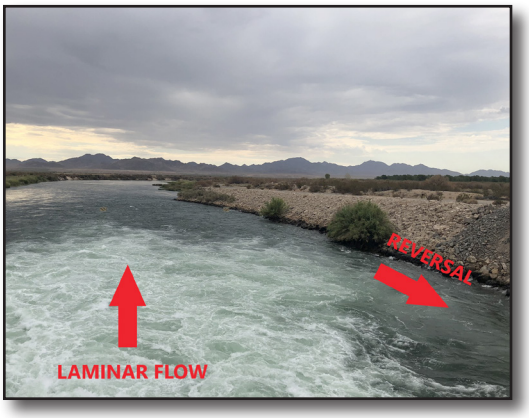



Figure 37-25 Laminar Flow and Reversal

When water flows by an object or bend in topography in the helical flow, the water that returns upstream to backfill is called a reversal. Reversals can be utilized by rescuers to gain access to areas upstream, and to enter into eddys. Not all reversals lead to safe areas though. Sometimes reversals can return water to dangerous areas of the river, such as past boil lines at dams. Prior to using a reversal, the technician should scout the hydrology to ensure it leads to a safe area such as an eddy, or back into the laminar flow.

## Helical Flow

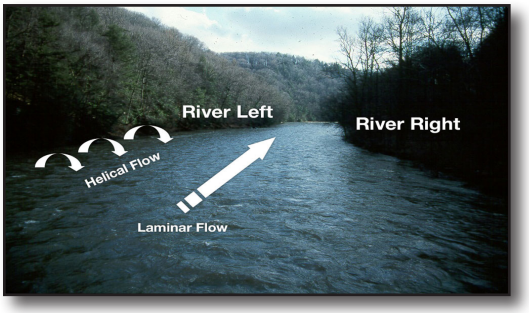



Figure 37-26 Laminar Flow and Helical Flow

Helical Flow are the areas between the shore and the laminar flow which are more shallow, in turn creating lots of friction. Typically, helical flow currents move in a corkscrew motion between the shore and the laminar flow in a reversal direction.

## Eddy

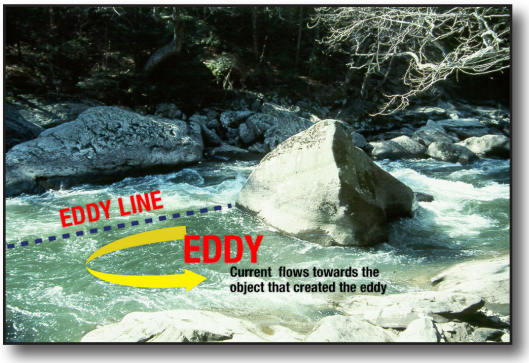



Figure 37-27 Eddy and Eddy Fence/Line

An eddy is when water currents move against an object on the upstream side, the water flows around that object and doesn't touch the downstream side. Water downstream returns upstream to fill that void behind that object, creating an upstream current behind the object. Eddys are generally safe areas in rivers where the currents are calmer than the downstream flow. Eddys can be utilized as strategic areas to stage or rest when moving through swiftwater. Eddys can be created by geographical features, boulders, bridge pilons and even by vehicles, so long as they are stable.

### Eddy Fence/Line

The eddy fence/line is the dividing line or lines between the eddy and the laminar flow. These are usually identifiable with an obvious line in the water in which two currents are moving in opposite directions of each other. Sometimes currents can move opposite of one another and cause a shelf or drop in the water at the eddy fence.

## Waves

Waves are created when water goes from deep water to shallow water. This action of water creates what is known as Compression Waves. Water that flows over a rock or object just

under the surface are known as Haystack Waves. Haystack Waves are more dangerous as they can cause bodily injury if the objects below the surface are contacted.

## Hydraulics /Pour Overs

Hydraulics are a type of water feature where water pours over a submerged rock or boulder (also referred to as "Pour Overs"). "Pour overs" can have steep drops on the downstream side of the boulder and the hydraulic that is created by this water flow can be powerful and hard to escape. Other names commonly used to describe these hydraulic features are *holes*, *keepers*, and *stoppers*.

## Pillows, Undercuts, and Sieves

When water piles up against an object, it creates a cushion of water on the upstream side called a pillow. These are generally safe as they will automatically push the person away from the object. However, if the water on the upstream side of an object is disappearing or the pillow is very small, it is an indicator of an undercut object that is very dangerous and should be avoided. Water that is forced between two rocks is called a "Sieve" and should be avoided as well.


Figure 37-28 Top photo depicts a "pour over" or hydraulic feature. Bottom photo depicts a "pillow."

## Boil Line

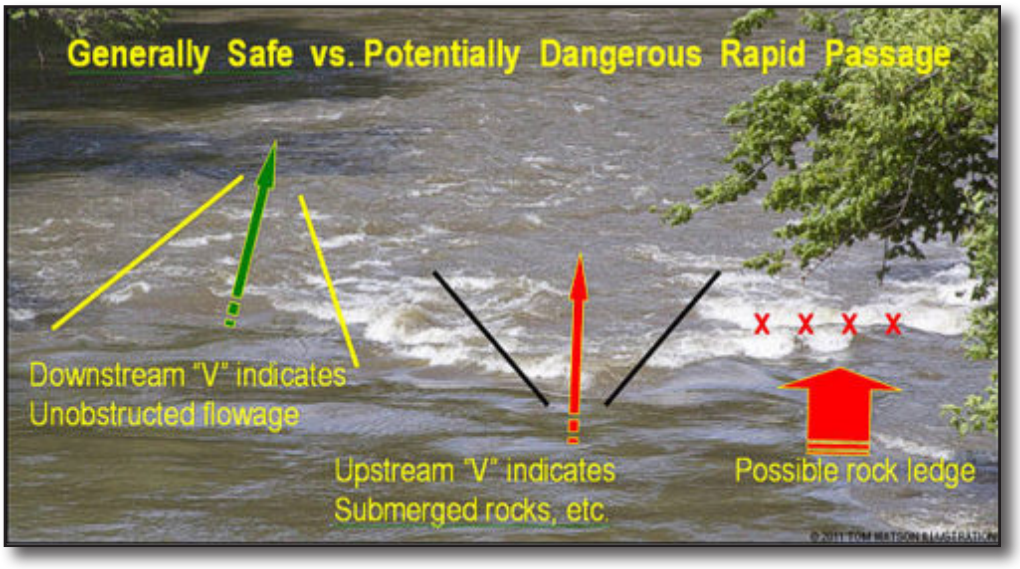
The boil line is the point in which turbulent water backflows upstream to fill in the displaced water of a hydraulic. Once the boil line is crossed from the downstream side, it is difficult to exit the hydraulic and escape the hazard.

## Strainer

Strainers occur when water passes through an object in the water, but it is not large enough for you to pass through. Almost any object in moving water can create a strainer. Some examples of strainers are: fences, guard rails, fallen trees, bushes or tree branches. The force of water can pin a person to a strainer and trap them against it or under it. Always avoid objects that can be strainers, and if you are forced to encounter the object, it is best to swim aggressively on your stomach in an attempt to swim over the object.

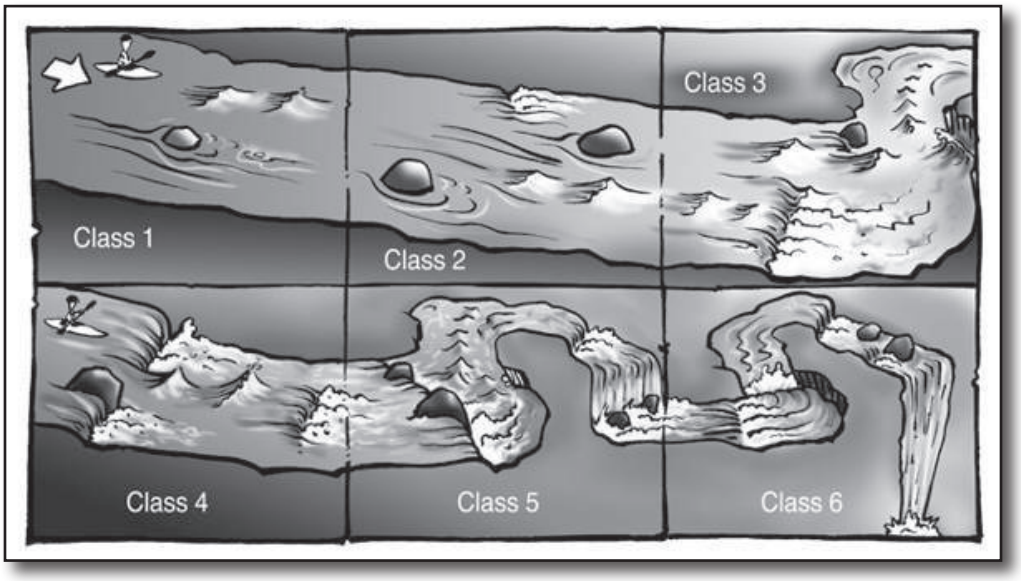
# Upstream and Downstream V's

Submerged objects will create a "V" with the point of the V facing upstream. The current will usually push you away from the object in the water, making upstream V's safer than downstream V's. Downstream V's occur when water passes between two objects. Sometimes downstream V's can create a hold and trap a rescuer or victim.



# Swiftwater Classifications

The most widely used classification system for whitewater is the International Scale of River Difficulty. This scale can be applied to swiftwater rescues in the size up and report on conditions phase of the incident. The water area of the incident scene can be classified on a scale of 1 though 6, from easiest/safest to most difficult/dangerous.




*Class 1:*
Very small rough areas, requires no maneuvering

*Class 2:*
Some rough water, some rocks or objects, might require maneuvering

*Class 3:*
Medium waves, some danger, may require significant maneuvering

*Class 4:*
Whitewater, large waves, long rapids, rocks, may have considerable drops, sharp maneuvers may be needed

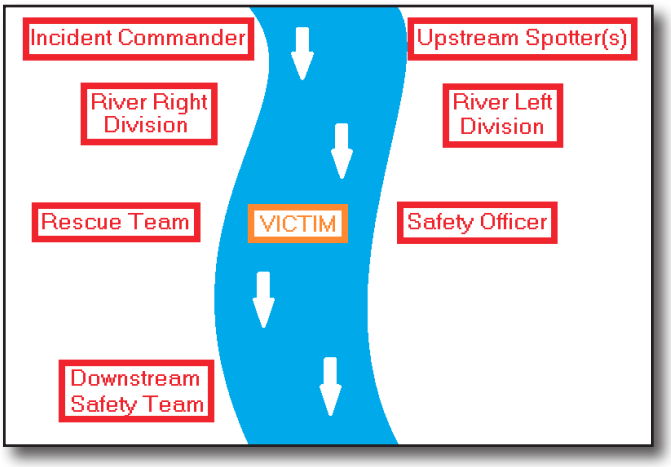
*Class 5:*
Whitewater, large waves, continuous rapids, large rocks and hazards, may have large drops, precise maneuvers needed to avoid injury or death

*Class 6:*
Rapids that are not passable and any attempt to do so would result in serious injury or death

# ICS for Water Rescues

NFPA 1670 classifies swiftwater and surface water (flood) rescues as technical rescue incidents. Leadership in the Incident Command System should be familiar with the strategies and tactics used at these types of incidents. At a minimum, the following ICS positions should be filled prior to performing rescues at water rescue incidents:

- Incident Commander
- Safety Officer
- River Right Division Supervisor
- River Left Division Supervisor
- Upstream Spotter
- Downstream Safety Team
- Rescue Team




Additional ICS positions can be filled as necessary and as more personnel are available to the incident. Additional positions to consider are:

- Search Groups
- Public Information Officer
- Liaison(s)
- Air Ops Branch
- Law Enforcement Branch
- Medical Group
- Decon Group

# Water Rescue Response Levels for San Diego Metro Zone

*Water Rescue 1:*
A report of persons or occupied vehicles trapped by non-moving water less than three feet deep. An example would be a vehicle in a flooded intersection after a heavy downpour.

*Water Rescue 2:*
A report of a water emergency in deep, non-moving water. An example would be a call of a capsized vessel in a lake.

*Water Rescue 3:*
A report of persons trapped by moving water. An example would be a vehicle that becomes stranded trying to drive through a flowing creekbed.

*Water Rescue 4:*
A report of someone who is free floating in moving water. An example would be that person falls into a river or culvert and is floating down stream.

# Water Rescue Alert Levels

Water Rescue Alerts I, II, and III are determined by the amount of rain that is being recorded by the National Weather Service at the Coastal, Inland, and Mountain regions of San Diego. ECDC will receive and communicate these Alert Levels through the station alerting system. Higher Alert Levels will prompt the staffing and deployment of swiftwater teams. Typically, teams will be on standby/callback status during an Alert Level I. During an Alert Level II, some swiftwater teams will be staged near target hazard areas and Engine and Truck Companies should perform Windshield Surverys of their target hazards in their districts. An Alert Level III will involve the available swiftwater teams to actively patrol their assigned areas.

| Alert Status | Coastal | Inland | Mountain |
|---|---|---|---|
| Water Rescue Alert I | ½ to 1 inch | 1 to 1 ½ inches | 1 ½ + inches |
| Water Rescue Alert II | 1 to 2 inches | 2 to 3 inches | 3 + inches |
| Water Rescue Alert III | 2 to 3 inches | 3 to 4 inches | 4 + inches |

# Pre-Incident Planning

There are many areas throughout San Diego County that flood regularly when rain events occur. In addition to being familiar with your Engine and Truck Company districts and surrounding districts, it is important to know where these hazard areas are prior to a flood occurring. Flood control channels, creeks, rivers, tunnels/drains, and low elevation points should be scouted for ingress, egress, and potential hazards. Preemptive road closures should be noted and communicated to your Battalion Chief as well as ECDC. Water crossings and bridges should be identified. It is advantageous to know what the bottom of a dry waterway or road looks like prior to it being covered in flooded water. Periodic windshield surveys should be performed during the storm event to reassess these areas. Windshield surveys may be ordered during significant rainfall. Report significant findings to your Battalion Chief following your surveys.

Prior to and during storm events, Law Enforcement resources can assist in making notifications to civilians in threatened structures as well as in places that are not meant for human occupation, such as river beds, creeks, canyons, and storm drain systems.

Water Rescue PPE should be placed on the apparatus (if it is not permanent inventory to the apparatus), in an accessible location to the user. PPE should be inspected and ready to be donned for a response. Prepare lighting devices for potential night operations. Water Rescue PPE may be required to be kept on the apparatus during and after heavy rainfall events. For US&R units, Water Rescue PPE is part of the apparatus inventory.

Swiftwater units may be staged at your fire station and/or assigned to your area. Swiftwater teams should review water rescue strategy and tactics, perform training, and share information about the local area with First Responder crews. Units can benefit from the shared knowledge of the area and their own crew and equipment capabilities.

# Water Rescue Guides

Water Rescue Guides are informational tools to reference for target hazard areas in San Diego City. These guides contain the following information:

- Location, Map Page Numbers, and GPS Points
- Hazard Assessment Matrix (High, Moderate, Low)
- Critical Information
- Alert Levels
- Flood Level Categories and Historic Crests
- Incident Command Post and Staging Locations
- Water Rescue Categories
- Swiftwater Resources
- Size-Up, Hazard Identification, and Scene Safety
- Primary, Alternative, Contingency, and Emergency Plans
- Maps with ICP, Staging, and Evacuation Sites Marked
- Evacuation Plans Based on Flood Levels
- Evacuation Routes
- Maps Showing Flood Inundations

| | | | | |
|---|---|---|---|---|
| | Water Rescue Guide: **Mission Valley, West** | | *QR Code* | **SND WR-01** |
| | Location: **San Diego River, West of I-805** | | | |
| | Public Safety Grids: **2223 J-2** | Thomas Guide Grids: **1268 J-3** | USNG 10K: **11S MS 82** | Inspected By: Newell/Sandmeyer |
| **HAZARD ASSESSMENT** Critical Information | Tactical Plan | Tactical Map | Road Closure & Evacuation Plan / Flooding Projection | Date: 13 JAN 16 |

**HAZARD ASSESSMENT MATRIX – HIGH MODERATE LOW**

| | | | |
|---|---|---|---|
| **FF/LG Safety** | Significant hazards to rescue personnel such as low head dams, strainers, sub-surface entrapment features | Moderate hazards to rescue personnel. Strainers have been identified and hazards mitigated. | Low hazards to rescue personnel. |
| **Civilian Safety** | High potential for civilian entry and entrapment in moving water. | Moderate potential for civilian entry and entrapment in moving water. | Moderate potential for civilian entry and entrapment in moving water. |
| **Air Safety** | Narrow canyons or aboveground utilities pose a hazard to Air Operations. | Few hazards to Air Operations | Flat terrain features and no above ground hazards to Air Operations |
| **HAZMAT** | above and/or underground storage tanks, fertilizers and pesticides. | Moderate HAZMAT hazards | Little or no HAZMAT present |
| **Access** | No paved access. High likelihood of inaccessible populations | Potential blocked access with roadway or bridge washout. | Paved reliable access throughout potential incident |
| **Topography** | Narrow canyons with steep walls | Wide canyons and/or moderate slope walls | Flat, wide floodplain |
| **Drainage** | No storm drainage system and/or high likelihood of debris blockage | Established storm drainage system with moderate potential for debris blockage | Established storm drainage system with low debris blockage potential |
| **Soil Stability** | Unstable soil high landslide potential. | Moderate landslide potential | Low landslide potential |
| **Residential** | Multifamily residential. | Mixed multifamily and single family. | Few or no residential structures. |
| **Business** | Significant business exposure | Moderate business exposure | Low business exposure |
| **Utilities** | High risk to aboveground and below ground utilities. | Moderate risk to utilities | Low risk to utilities |
| **Transport** | High risk to road and rail disruption. | Moderate risk to road and rail disruption. | Low risk to road and rail disruption. |
| **Livestock** | High risk to livestock | Moderate risk to livestock | Low risk to livestock. |

## CRITICAL INFORMATION

**Responder Safety**- All personnel working within close proximity to the water (<10') must have on appropriate PPE. This would include a PFD (personal floatation device) and helmet, if available. Fire personnel providing shoreline support should wear brush gear (never turnouts) and station boots or tennis shoes. TRT personnel will be in FULL PPE, including dry suits at the IC direction. All water will be assumed contaminated and direct contact shall be avoided. Decon should be done for all first responders and victims. Be cautious of hypothermia in victims with prolonged exposure. High concentration of tourists will be unfamiliar with flooding safety/evacuation routes and shelter locations. Abundant Homeless in encampments in the river flood plain.

**Aviation Hazards**- Transmission power lines run the length of mission Valley north of Friars Rd, and cross North to South on the west side of I-805

**Potential road closures/Entrapments**:- Avenida Del Rio, Fashion Valley Rd, Camino Del Este, Qualcomm Rd, Mission Center Rd,

### Lifeguard Alert Levels

| | |
|---|---|
| **Alert 1** | Rain forecast- 1/2"-1" Coastal, 1"-1 1/2" Inland, 1 1/2"+ Mountain. Lifeguards- assemble personnel and equipment |
| **Alert 2** | Rain forecast- 1"-2" Coastal, 2"-3" Inland, 3"+ Mountain. Lifeguards- assemble personnel, take home Vehicles. Fire-Rescue personnel to review Water Rescue Plans |
| **Alert 3** | Rain forecast- 2"-3" Coastal, 3"-4" Inland, 4"+ Mountain Lifeguards- deploy personnel to High Hazard areas. Fire-Rescue to initiate windshield water rescue surveys |

### NWS Flooding Categories (Mission Valley)

| Flood Categories (ft.) | Historic Crests |
|---|---|
| **Pre-Action Stage 5 ft.** | 19.30 ft on 1/27/1916 |
| **Action Stage 7.5 ft.** | 16.30 ft on 2/21/1980 |
| **Flood Stage 11.3 ft.** | 14.01 ft on 12/22/2010 |
| **Mod. flood Stage 13.5 ft.** | 13.47 ft on 3/06/1995 |
| **Major Fold Stage 16.5 ft.** | 11.53 ft on 2/ 24/ 2008 |
| **100 Year Flood 16.5 ft.** | 10.89 ft on 2/21/2000 |
| **500 Year Flood 18.5 ft.** | |

**Incident Command Posts**:
1. Kearny Mesa Rec Center, 3170 Armstrong St, 2. Veterans War Memorial, 2920 Zoo Dr, 3. Serra Mesa Rec Center 9020 Village Glen Dr.

**Staging Locations**:
1. Mesa College parking lot, 7250 Armstrong Pl, 2. Zoo parking lot 2900 Zoo Dr. 3. Qualcomm Employee parking lot 2200 Mission Village Dr.

# Water Hazards Report

During an Alert II, Engine and Truck Companies should perform a Windshield Survey and record their findings on a Water Hazards Report. These reports have predesignated locations and GPS coordinates that are specific to each Engine Company District. Companies should go to each location and record the following:

- A Depth Estimate
  - N = No Water
  - L = 1’ - 2’
  - M = 2’ - 6’
  - H = 6’ +
  - WB = Within Bank
- Speed of Moving Water
  - S = Slow
  - M = Moderate
  - F = Fast
- Additional Information (Hazards, Road Closures, Mud or Rock Slides)

Information collected on the Water Hazards Report should be relayed to the Battalion Chief, who should share this information with their Battalion and adjoing resources.

# Incident Response

Extreme caution and reduced speeds should be utilized when responding to incidents during inclement weather. Posted speed limits do not account for slick road surfaces, pooled water, heavy and large apparatus, reduced visibility, strong winds, debris on the road, compromised road surfaces and sub surfaces.

Access to a response area may have changed, and it may be necessary to request additional resources to gain better access to the incident. Based on the type of response, consider directing other units assigned to the incident to other sides of the body of water, as well as to locations downstream of the incident.

## Size-Up

Sizing up an incident gives other responding units and ECDC critical information for the incident. A size-up report will help everyone on the response to have an understanding of the situation and help guide other units in their decision making process prior to arriving at the incident. A water rescue size-up should include the following information:

- Unit ID
- At Scene
- Location of your unit
- Number of victims (if visible)
- Location of victim(s) in the water
- Water Speed (still, slow, moderate, or fast moving)
- Whitewater hazard class
- Significant hazards present
- Actions being taken
- Need for additional resources
- Establish IC

A size-up of a Water Rescue 3 might sound like this:

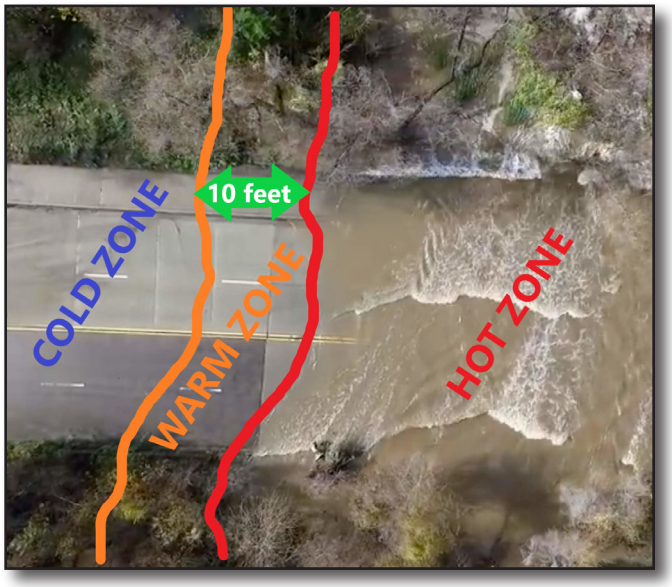
“Metro, Engine 23 is at scene at Avenida Del Rio and Riverwalk Drive on River Right. We have 2 adult victims on top of a partially submerged car stranded center river in moderate flow Class 3 water with strainers directly downstream. Engine 23 is setting control zones, will need PD for traffic control. Engine 23 is assuming Avenida IC.”

The size-up should be followed up with direction to incoming units based on local area knowledge, Water Rescue Guide and/or area maps. Once strategy

and tactics have been determined, communicate the P.A.C.E. (primary, alternate, contingency, emergency) plans over the radio to inform all units on the response of the desired actions to be taken. Direct the appropriate units to locations along the waterway that will be advantageous and allow for contingency plans.

## Control Zones

Establishing control zones early in the incident provides for better safety of response personnel and the public. If available, utilize law enforcement to assist with establishing and maintaining barriers for your control zones. These zones should be established and maintained on all sides of the waterway.




### Hot Zone

This is the hazard area of the incident defined by the actual waterway. Only personnel trained to the Technician level and wearing the proper PPE should be allowed to operate in the Hot Zone. This may include areas adjacent to the water that are unsafe for personnel to operate in, such as a steep or slippery bank or on the walls of a flood control channel.

### Warm Zone

The area adjacent to the Hot Zone, defined by the waterway's edge or the hazard area edge plus a minimum of 10 feet. The Warm Zone may be widened depending on terrain, hazards, or the need to have a larger area prior to the Cold Zone barrier. Only personnel with the minimum training of First Responder Operational and wearing a minimum of a Type 3 PFD and helmet should be present in the Warm Zone.

### Cold Zone

This area is away from any hazard of the incident, adjacent to the Warm Zone. Water rescue PPE is not required in this area. It is a suitable area for the ICP, Staging, Decon, Rehab, incident support resources, law enforcement, civilians, and the media. Barriers will usually need to be established and maintained between the Cold Zone and the Warm Zone.

## Search for Victims

Not all incidents will have an obvious victim. A report of someone seen in moving water will change strategy and tactics until the victim is located. Start by giving a size-up, establishing control zones, and establishing safety posi-

tions such as upstream spotters and downstream safety teams. Using the acronym "L.A.S.T." is a good starting point for a search operation:

## L.A.S.T

- Locate
- Access
- Stabilize
- Transport

As part of your investigation, collect information from any witnesses. Pertinent information should include:

- Number of victims
- Gender(s)
- Age(s)
- Clothing Description
- Point last seen
- Time last seen
- Conscious or unconscious
- Was the victim on the surface or did they go under?
- If available: parked vehicle location, description, license plate, victim's and victim's friend/family phone numbers and addresses (rule out the victim leaving the area to go home)

Communicate this information to all units on the response and direct resources to the appropriate locations based on speed and the hydrology of the water. Swiftwater teams will have devices such as float markers and dye markers that can help determine potential areas a victim may have ended up along the shore or downstream. A half full water bottle containing a chemical light stick dropped in the water at the PLS (point last seen) can be a useful tool for downstream units to determine if they are far enough downstream to perform a rescue of a missing victim. The unit that drops in the bottle should mark their unit number and time on the bottle.

A Search Group can be formed and include search teams along the waterway banks in the Warm Zones in addition to teams made up of Swiftwater Technicians in the Hot Zone. Useful tools during land-based search include flashlights, TIC's, and chainsaws to gain access. Water-based search tools include swimmer rescue boards and either motorized or paddle boats. If a helicopter is available and capable of flying in the weather conditions, it should be utilized for aerial search operations. Once the victim(s) has been located, the Search Group can support the Rescue Group's operations.

If the victim is confirmed to be deceased, the rescue effort becomes a body recovery. Search and rescue teams can slow their pace, as body recoveries

typically do not include a time wedge. Swiftwater teams carry mesh body bags designed for recovering bodies from the water. Teams on shore assisting with removing the body from the water should be ready with a blanket to cover the body once it has been removed from the water and placed in a safe location.

## Incident Support Resources

Water rescue incidents can take place in cold or hot weather. The PPE and arduous work can quickly exhaust rescue personnel. Hypothermia can set in fast for rescuers working in inclement weather. Shelter can be a very beneficial thing during these incidents. Anticipating the needs of rescue personnel is crucial to their ability to continue to operate through the operational period. On prolonged incidents, consider ordering support resources such as Logistics, Medical, and Rehab early on in the incident. Some specialty resources utilize enclosed trailers to transport their equipment, and have rehab equipment as part of their inventory. A city bus with Heat/AC can be a great resource for rescuers to rehab and/or don or doff PPE in shelter. It could also be used to transport large amounts of victims or evacuees to a shelter location.

# The 15 Absolutes of Swiftwater Rescue

***1. Always wear a personal floatation device (PFD).***
A PFD is the number one life safety device for rescuers and for victims. If you fall in the water and you cannot swim or you have become unconscious, the PFD will float you on the surface, preventing you from drowning.

***2. Always have upstream spotters above the area of operations, ideally on both sides of the river.***

***3. Prioritize life safety in this order: Rescuer, Team Members, Victims.***
You are of no help to the rescue effort if you jeopardize your own safety and become a victim yourself. Your team members are your next highest priority. Ensure that they are acting safely and are in the proper PPE. Lastly, consider the risk vs gain when encountering victims. Is your PPE, training, and capabilities of yourself and your team adequate for the rescue?

***4. Always have a backup plan.***
Start with the safest, easiest, fastest plan and start working on the backup plan. Have a contingency and emergency plan in place. Communicate all plans to all personnel on the rescue.

***5. Have multiple downstream safety teams in place.***
Place your safety teams at strategic points far enough downstream of the rescue for them to be effective. Have more than one team, and ensure all teams are alert, properly equipped, and capable of their assigned rescue plans.

***6. Keep it simple.***
Rescue plans should be based on the safest, simplest, most efficient strategies and tactics.

***7. Use the right equipment for the task.***
Select the most appropriate equipment based on the "Best Order of Tactics."

***8. Never put your feet down if swept away.***
Foot entrapment is likely to happen if you are floating downstream and attempt to touch the bottom with your feet. The force of the current pushing against your legs can wedge your foot under an object and seriously injure or drown you. Always float and swim on the surface. Swiftwater Technicians are taught to jump into the water chest first and flat on the surface to avoid foot entrapment. Foot entrapment is a common emergency in recreational whitewater sporting.

***9. Never count on the victim to help in their own rescue.***
Victims will be panicked and disoriented due to fear, confusion, fatigue, and/or hypothermia. You cannot expect a victim to be cooperative and to use good judgement in water rescue situations.

***10. Never tie a rope around a rescuer.***

Ropes attached to rescuers that are entering the water need to be secured to a blowout ring on the quick release strap of a Type V Water Rescue PFD. Tying a rope to a rescuer any other way puts that rescuer's life in danger. The technician needs to be able to quickly and easily release themselves from the rope if the line becomes caught or tight. If they are unable to do this, they may be pulled under the water and drowned by the tension of the rope and the current forces.

***11. Never tension a rope line perpendicular to the current.***

This can create a strainer to rescuers and victims who come into contact with the line. (However, if the line is tensioned diagonally and a rescuer or victim contacts the line, they will be deflected and possibly moved to the downstream side of the rope to the shore).

***12. Never stand downstream or inside the bight of a rope line.***

Standing in these positions could result in a rescuer being pulled into the water by a rope that tensions or a rope system or anchor that fails.

***13. Once a victim is contacted, never lose them.***

If the victim was in a position that was safer than what the rescuer brought them into, and the rescuer loses the victim, we have now placed that victim in harm's way. Losing a victim places liability on the rescuer and the department.

***14. Never wear a brimmed helmet.***

A structure or wildland fire helmet can injure or kill a rescuer in swiftwater. The brim of these can scoop water, and can drown or break the neck of the rescuer. Only use a helmet designed for whitewater.

***15. Always be proactive.***

Take advantage of the time before flooding occurs and become familiar with the strategies and tactics of water rescues. Scout areas unfamiliar to you and your crews before and during storm events. Take advantage of training opportunities and learn from the special teams that are trained as technicians.

# Best Order of Tactics

The following list of tactics are in order of the least risk to most risk and can be used by First Responder Operations trained personnel in the appropriate PPE.

The following tactics can be utilized with rescuers in the Warm Zone. In each of these tactics, always try to get the victim(s) to don a PFD and helmet. Never perform a tactic that will expose a victim or yourself to more danger if you are able to wait for a trained water rescue team to perform the rescue.

Figure 37-29 Reach Method

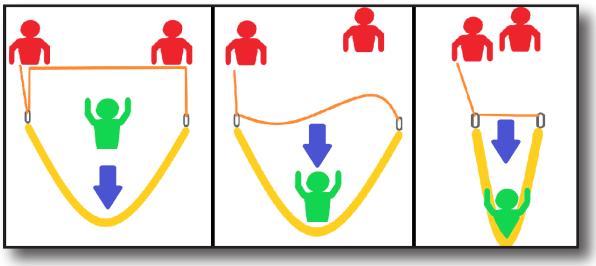


Figure 37-30 Box Cinch Method: 1.Rescuers hold a section of inflated hose by a bight of rope through two carabiners above the water surface. 2. Rescuer on standing end of rope lets go when the victim contacts fire hose, while other rescuer holds the running end of rope. 3. The rope cinches the hose around the victim, who is then belayed to river right.

Figure 37-31 Throw Method

## Talk

Speak to the victim(s) using your voice, a PA, or bull horn. If the water is still, shallow, and there are no hazards present, you may coach the person to the waters' edge for their own self-rescue. Ensure that you are not placing the victim in a more hazardous situation by requesting that they self-rescue.

## Reach

Use a pike pole or rubbish hook to reach out to a victim that is floating in static or moving water, and pendulum/pull them to the shore. Always hold the tool on the downstream side of your body. You may choose to tie yourself into edge protection as well as your tool to a separate rope line in case you lose your footing or your reach tool is pulled out of your hands by the force of the victim in the water. **Never tie a rope around yourself or someone that may enter the water.**

Use of an inflated fire hose, rope line or other capture devices is also considered a reach tactic. Once the victim is captured by one of these devices, they are pulled or allowed to pendulum to one side of the waterway. The "Box Stitch" method is appropriate to use on the downstream side of a bridge for this tactic.

## Throw

Use a water rescue throw rope bag or floating device on a rope thrown to a victim floating in static or moving water. Always have the rope on the downstream side of your body. Use voice instructions to the victim to reach and hold onto the rope. You will more than likely need to let some slack out on the rope or walk downstream and pace with the victim to avoid the victim being pulled

off of the rope by the force of the water when the rope gets tensioned. Pull the victim into the shore or work with the force of the water to pendulum the victim. Have a secondary throw rope bag ready to deploy in the event your first throw is unsuccessful. Rope can also quickly be recoiled and thrown again. Keep your coils small if you have to throw your rope again. If a third attempt is necessary, you can use the empty rope bag filled with water to throw out to the victim. Re-deploying rope from a throw bag multiple times takes practice and the distance will not be as great as the first throw.

*The following is a list of tactics in order of least risk to greatest risk that can be used by Water Rescue Technician trained personnel in the appropriate PPE. The previous listed tactics would have already been attempted or would not have been options prior to implementing the next order of tactics. These tactics take place in the Hot Zone but may be supported by personnel working in the Warm Zone.*

## Boat

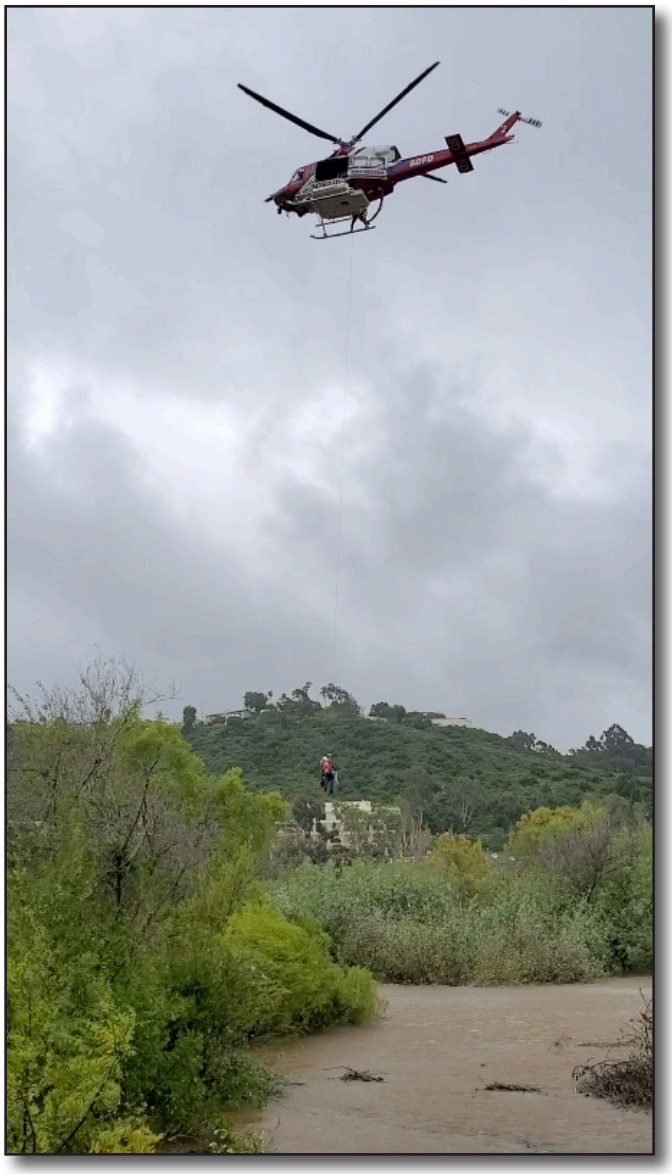
Using a boat to access a victim is the safest way to perform an in-water rescue. Rescuers have the most control with the least exposure to the water. The disadvantage is that boats require individual operators and crews that are trained and competent in motorized and paddle boat operations. Boats also require an area large enough to launch and can be heavy and cumbersome to move to and from the water. Here are some of the ways that boats can be used:

- Motorized – use an inflatable rescue boat (IRB) with an outboard motor (2-3 person crew)
- Paddled – use an IRB without a motor or a whitewater raft (3-4 person crew)
- Tethered – 2 or 4 point rope tether with shore-based teams controlling the boats movements
- Highline – Whitewater raft on a rope highline being controlled by rigging teams on shore
- *Tension Diagonal – non-motorized boat with a pulley on a fixed diagonal rope line across the water in which the current moves the boat from one side to the other

**Never place a fixed rope line perpendicular to the current. Always place these lines diagonally so that they do not become strainers*

## Go

These tactics include rescuers using swimmer rescue boards, wading, free swimming, or using a tension diagonal rope line. These tactics are typically utilized when setting up for a boat operation is not practical due to time constraints, equipment availability, or boat access issues. Swimming without a swimmer rescue board is a high-risk tactic that exposes rescuers to hazards on and below the surface of the water. Whether on a swimmer rescue board or swimming, rescuers in Type V PFD's have the ability to be tethered to a rope line. Tethering the rescuer will help prevent them from entering an area of the water that has significant hazards.



*Wading to a victim*

Always use a tool such as a pike pole to feel and confirm the bottom surface is safe to walk on. This is known as a "Shallow Water Crossing" and should be performed as a team. Stay in a V or line formation locked together with the front person calling step directions and using a sounding tool. The front person will help to create a break in moving water and the rest of the team will help to create an eddy behind the formation, safe for a victim to be assisted out.

## Helicopter

With a trained pilot and crew and in the right environment, a helicopter can be excellent for performing water rescues. However, helicopters may not be capable of flying during inclement weather, or a hoist operation may be deemed too unsafe due to various factors. Dynamic water, brush, trees, powerlines, and narrow areas present high risks for aerial hoist operations. Rotor wash can create hazardous conditions for victims and rescuers as well as aerosolize contaminated water. Extreme caution should be taken when working near helicopters in these situations. Helicopters are excellent for scene lighting and victim spotting at a higher altitude.

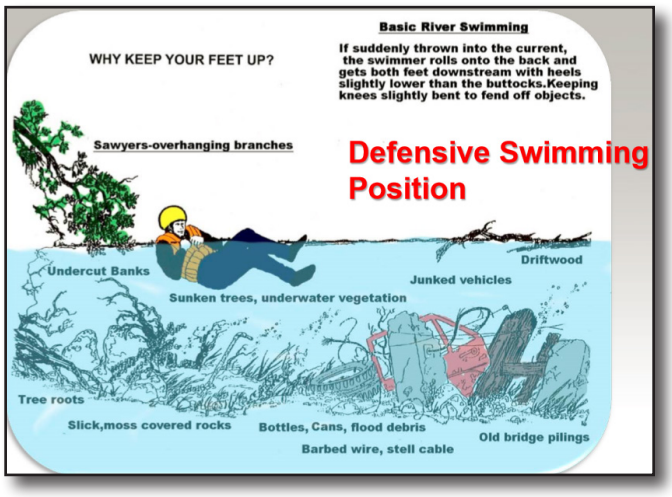
*Note: Due to the highly dynamic nature of water rescues and other situationally dependant factors, the use of a Helicopter may actually be determined to be a lower risk tactic than sending resucuers in the water for a victim. The final decision lies on the Incident Commander after a completion of a thorough risk assessment.*

# Self-Rescue

If you accidentally fall into moving water, do not panic. Utilize BOA (Breathe, Orient, Act). Your PFD will float you on the surface of the water. Water that is aerated may cause your PFD to be less effective, but once you have cleared the turbulent area your PFD will float you to the surface. Control your breathing and determine where you are in the water and where you need to go to reach safety. Communicate for help as soon as possible using three repetitive blasts on your whistle and call out "HELP" verbally if you are able to do so.

## Defensive Swim Position

Keep your feet on the surface of the water so that you do not get your feet or legs entrapped in debris or objects below the surface. Float on your back in a 45 degree "ferry angle" with your head facing upstream and in the direction that you want to move to. The current of the water will push your body towards the shore, as your body has created a wedge against the current.

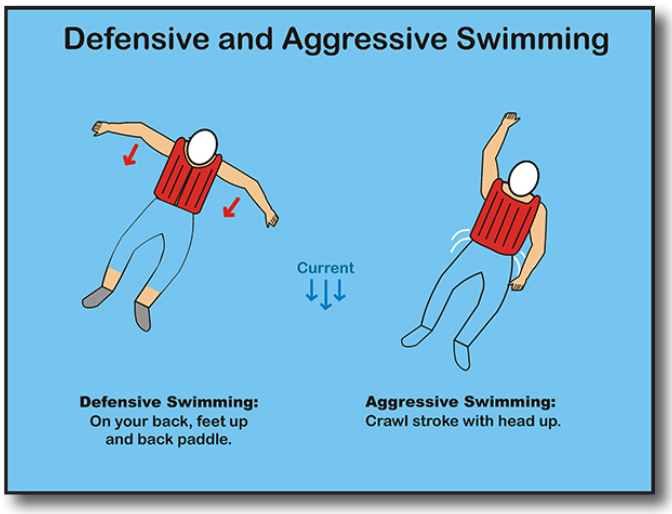



## Attack (Offensive) Swim Position

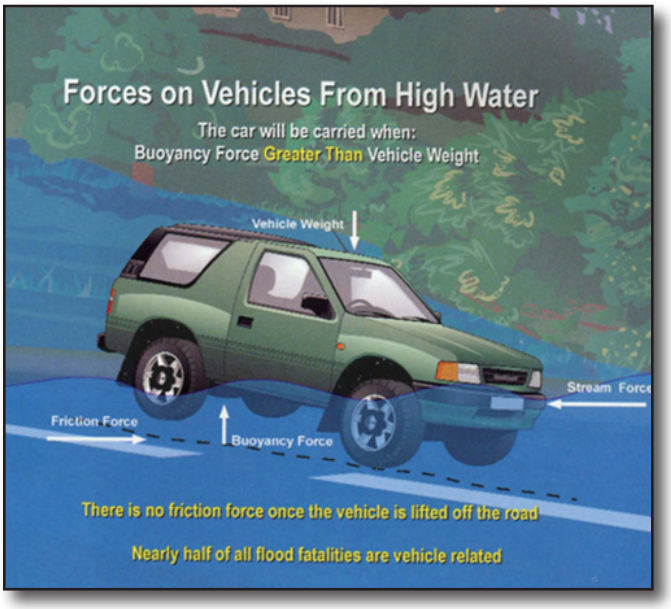
From the defensive swim position, roll onto your belly with your head facing the direction you wish to move. Use a surface crawl stroke to gain speed, with your head above water, aggressively swimming towards the area you want to move to. You can point your head upstream at a 45 degree angle to create a wedge in this position as well, allowing the current to assist you in your ferry angle.

If you encounter a strainer that you cannot avoid, swim aggressively head first toward the strainer in the attack swim position. Push yourself over the top of the strainer and pass over it with your chest and stomach while keeping your legs high up behind you to avoid getting pinned on the object.

Once you have reached safety, remember to communicate "I'm Okay" by tapping the top of your head with your hand to signal to other rescuers that you are safe.



# Vehicles In The Water





Drivers often attempt to drive through water that is too deep or moving too fast for their vehicle to safely cross. Vehicles can be floated, pushed, overturned, and disabled by the forces of water. These types of incidents are fairly common in storm and flood events. Victims in or on vehicles in water present challenges to rescuers. The force of water can easily dislodge a car onto a rescuer. An eddy created by a car is usually not a safe area due to the potential of the car moving back onto the rescuer. Approaching a vehicle from the upstream side is very dangerous as the rescuer could get swept and trapped under the vehicle. Approach should be done at a 45 degree angle, similar to a vehicle that is on fire.

The vehicle's motor block will usually sink and orient itself in the direction of the current. If you see a car with its trunk higher out of the water than its hood, the vehicle may be floating, or it may only be resting on the bottom by its front end. Modern electric cars have their weight more evenly distributed throughout the bottom of the vehicle and it may be difficult to determine if the car is floating or is resting on the surface.

Air trapped in vehicle void spaces can float the vehicle in moving water and deposit it in an unsafe area. When a vehicle fills with water, the pressure against the doors makes a victim's exit from a vehicle difficult. Often times, victims will self-extricate through a window and wait for help on the roof of their car. Until water has filled the cab of the vehicle, opening a door from the outside is very difficult, especially in moving water. Extrication attempts should be made first through the vehicle's windows. Utilizing extrication equipment to free victims is sometimes necessary if the vehicle is compromised before or after it had entered the water. Consider the weight that is being removed from a vehicle when victims are being extricated. Sometimes swiftwater technicians will leave a rescuer to sit on the vehicle as a ballast if more than one victim needs to be rescued from the vehicle.

Vehicle electronics may work underwater for up to 10 minutes. Studies have shown that electric vehicles and gasoline vehicles with their electronics do not present an electrocution hazard to rescuers, so long as the batteries and their components are not compromised.

Confirmation that there are no occupants in vehicles that look unoccupied needs to be confirmed. Rescuers should mark unoccupied vehicles as well as vehicles that victims have been extricated from with flagging or banner tape in a visible location. This will help to ensure that searches are not being duplicated by other rescuers.

# Night Operations

Water rescues at night are challenging due to the already hazardous and dynamic situations that are now presented to rescuers in little or no light. Depth perception on and around the water is compromised when driving, operating boats, and performing search and rescue. Air temperature can drop significantly, contributing to hypothermia in victims and rescuers. Some helicopters may be grounded during night operations.

Lighting devices should be prepared during daylight hours, and vessel navigation light should be used one hour before sunset. Engine, Truck, Brush, and US&R apparatus can be utilized to provide scene lighting during night operations. US&R-2 and US&R-41 have night vision goggles, and all Engine and Truck companies have thermal imaging cameras that can assist rescuers in locating victims. Green chemical light sticks can be used to mark safe areas on the water and for determining current speed and hydrology when placed in a water bottle. Red chemical light sticks should be used to mark significant hazards and no-go zones.

# Animal Rescue In Water

Domesticated animals such as dogs and cats may need to be evacuated or rescued with their owners. Animals have a natural instinct to swim but will generally avoid entering the water voluntarily, especially in a flood situation. Animals that are stressed or in fear can exhibit signs of aggression. Caution around animals in these situations must be utilized. Watch the body language of the animal for signs of fear and aggression. Utilize the owner, if safe to do so, to handle their pet. Use leashes and muzzles on dogs and bridles and blinders on livestock. Cats and reptiles can be placed in a pillow case. Placing animals in a rescue boat with their owner or handler is the safest way to move animals to safety. Consider requesting Animal Control or the Humane Society to assist with the animal when the rescue has been completed.

# Large Area Disaster Response

If the San Diego area were to suffer from a large-scale disaster involving flooding and swiftwater, help would come from outside agency swiftwater and US&R teams. These could be teams from other parts of the state or from other areas of the country. Most teams follow state and national standards for water rescue training and standard operating procedures. When these teams arrive at an incident, they will typically be assigned to a section or grid of the disaster area to perform reconnaissance, GPS data collection, and search and rescue operations. Historically, outside agency teams will attach to a local fire company for area familiarization, for local area knowledge, and may utilize the local fire station as their forward operating base. SDFD engine and truck companies may be assigned with one or more of these teams. It is important to know your district's target hazard areas for this purpose, in addition to knowing it for your own responses.

# After The Rescue

Victims should be given an ALS medical evaluation to assess for hypothermia, trauma, and other medical emergencies resulting from water. During strenuous and extended incidents, rescuers should receive an initial evaluation during rehab. Rehab and medical evaluations should take place in a warm and dry area.

Due to the unknown contaminants in flood waters, a water sample should be taken and tested for bacterium and pollutants. Rescuers that made contact with the water should document the exposure.

Following rescuer and equipment contact with storm or flood water, gross decon should occur. An apparatus equipped with a water tank and fire pump can spray off debris and some contaminants at scene. Utilize a stiff bristle brush on equipment and boots, and a soft bristle brush on PPE. Most swiftwater units carry decon kits that include Citro-Squeeze or Dawn Dish Soap to use for decon at scene. Do not use bleach or bleach mixtures to decon water rescue PPE and equipment. Use hand sanitizer and bag heavily contaminated PPE prior to re-entering your apparatus. Following heavy contamination or exposure, consider remaining assigned to the incident until your crew has the ability to properly clean equipment and PPE back at the fire station. Crew members should shower to remove any remaining contaminants at the end of the operational period and following any heavy contamination or exposure.

## Cleaning PPE

PFD's and helmets can be hand washed in a warm water basin with Citro-Squeeze or other mild laundry detergent. PFD's can be washed in a front load washing machine on gentle cycle. Remove knives and lighting devices prior to washing PFD's and helmets. PPE should be hung to dry in a shady location. Do not place PFD's or helmets in a dryer. Water rescue throw rope can be cleaned in the same manner as PPE. When washing in a front load washing machine, daisy chain the rope so that it does not tangle. Never place rope in a dryer, always hang dry in a shady location.

# Continual Training

Water rescue involves skillsets that are perishable. These skillsets must be regularly practiced to ensure they will be effective in a time sensitive, dynamic environment. Crews can practice throwing water rescue throw bags at a target while at the fire station. Practice throwing at a moving target and recoiling and throwing your rope. Training on rope rigging techniques and concepts is also very important. Reach out to swiftwater technicians and teams for extra knowledge and training opportunities. No matter what your role is at a water rescue, remember that supporting the operation is equally as important as being the person in the hot zone performing the rescue. Try to be your best at these incidents by knowing the skillsets you can perform within your level of training.

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# Credits

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# Revisions/Updates

| *Date* | *Revision/Update Description* |
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