EPA DIVE SAFETY PLAN

Site Name and Location:	**San Jacinto River Waste Pits Superfund Site.** Harris County, Texas			Dates:	December 9-10, 2015
Prepared by:	Bill Luthans	Signature:		Date:	
UDO Approval:	Alan Humphrey	Signature:		Date:	
	Bill Luthans				
SERAS Approval:		Signature:		Date:	
Regional EPA Project Coordinator:	Gary G. Miller	Signature:		Date:	

INTRODUCTION:

This plan establishes proper safety procedures during performance of the first of four anticipated, interrelated diving operations at the San Jacinto River Waste Pits Superfund Site in Harris County, Texas where Interstate Highway 10 (I-10) bridge crosses the San Jacinto River. This first diving operation is to serve two primary purposes: (1) investigate the physical integrity of the multilayer impermeable cap installed over waste pits as part of the Time Critical Removal Action (TCRA); hereinafter referred to as the "TCRA Cap", and (2) to implement and validate procedures that will be used for the installation and retrieval of TCRA Cap pore water sampling devices during the full investigation of ongoing performance of the TCRA Cap (dive operations 2 through 4).

This plan establishes general guidelines and procedures for safe and efficient Self-Contained Underwater Breathing Apparatus (SCUBA) and tethered diving for the combined U.S. EPA Region 6 and U.S. EPA Environmental Response Team Center (ERTC) Dive Team. Federal law requires that individual underwater activities (diving) conducted in performance of any employment condition must conform with Occupational Safety and Health Administration (OSHA) regulations 29 CFR Part 1910 — OSH Standards; Subpart T — Commercial Diving Operations. EPA has opted, as the basis for its policy, to conduct its diving operations in accordance with the scientific diving exemption as codified in that document. All dive activities will adhere to the U.S. EPA Diving Safety Manual, this site specific Dive Safety Plan and all applicable Dive Standard Operating Procedures.

Site History: The San Jacinto River Waste Pit Site history has been documented in several documents prepared for, submitted to, and approved by the EPA, which will not all be repeated here. In brief, paper mill wastes were disposed in impoundments about 14 acres in size at the site in the 1960's resulting dioxin and furan contamination in the adjacent waterbody of the San Jacinto River. The impoundments/waste pits are situated on a 20 acre parcel immediately north of Interstate Highway 10 (I-10) at the I-10 bridge over I-10 and on the west bank of the river.

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Pursuant to an EPA-issued Unilateral Administrative Order, International Paper Company (IPC) undertook a Time Critical Removal Action (TCRA). As a central component of that action, IPC and MIMC and McGinnes Industrial Maintenance Corporation (MIMC) implemented action to stabilize the waste pits and to install the TCRA Cap. The original 1966 boundaries of the northern impoundments/waste pits and impacted area extend into the current basin of the San Jacinto River, and thus a portion of the cap is underwater in depths extending to a maximum of about 16 feet. The TCTA Cap is designed to prevent the migration of dioxins and furans from the historic boundaries of the northern impoundment into the San Jacinto River and its sediments.

Purpose of Investigation:

TCRA Cap installation was completed in July 2011. The current investigation (and the portion assisted by the U.S. EPA dive teams from Region 6 and ERT) is designed to safely assess ongoing TCRA Cap integrity and performance as measured by the continued physical integrity of the cap and its boundaries and also the absence of detectable migration of dioxin and furans from the waste pit beneath the Cap and into the San Jacinto River.

Divers will be used to visually inspect TCRA Cap integrity, particularly at the Cap perimeter to determine if the hard armor (gravel and stones place over the cap) are remaining in place and if the boundaries are maintaining integrity as installed. Diver observations will be supplemented by GPS coordinate and depth measurements, and by side Dual-Frequency Imaging Sonar or Acoustic Camera. Visibility is anticipated to be very poor, but an attempt will be made to collect photographic images.

Commented [HA1]: Dual-Frequency Imaging Sonar or Acoustic Camera

The entire investigation will entail placement and retrieval of Solid Phase Micro-Extraction (SPME) sampling devices designed to passively collect dioxin and furan pollutants in the pore water of the interstitial spaces of the hard armor cover of the Cap. This first diving operation will focus simply on verifying effective techniques for installing, securing, and then retrieving such sampling devices.

This dive safety plan is the primary document guiding EPA dive operations during installation of the SPME passive sampling devices, and visual/photographic/instrumental observation of the TCRA Cap. Verification of sample placement and marking procedures will take place on November 10, 2015. Observations of the Cap integrity will take place immediately following that afternoon of November 10 and, if necessary the following day on November 11. Other documents including (the REGION 6 Amended Site QAPP??), the San Jacinto River Waste Pits EPA Dive Team Inspection and Sampling Plan (DTISP), and the general site Health and Safety Plan are documents which pertain to these dive operations.

Alternatives to Diving: For each underwater survey or sampling operation, alternatives to diving are explored on a case-by-case basis. In the case of this Region 6 Site project, installation of the underwater passive samplers by divers is the safest way to both deploy the monitors and ensure effective placement and retrieval of monitors without risking damage or cross-contamination. Access to the shallower water zones by using waders presents treacherous walking conditions and potential for exposure to contamination that swimming divers in proper encapsulated dry suits with full face masks will avoid. The samplers must be "activated" once installed by physically twisting them to open screened sections to the sampling media; and this process, especially in the deeper

Commented [HA2]: OTS not positive pressure, and suits are not pp either, by design, could say "in proper encapsulated dry suits with full face masks will avoid "

waters, can only be performed by a submerged person or prior to installation creating the small risk of contamination by sources outside the desired sampling zone. That said, there may be a limited role for a person in waders operating from a small craft to assist in water too shallow for a diver to operate safely. In such case, the wading tender will be outfitted with chest waders, and splash/water protection for the face, hands and arms.

Value to EPA: Use of the EPA ERT and Region 6 Dive personnel will avail scientific expertise to the dive operation in support of Superfund not otherwise available from private contractors. EPA divers also bring polluted water diving experience, which can effectively limit exposure and spread of contaminants, which is not available on a routine basis.

PERSONNEL:

	Name	Signature
Unit Diving Officer (UDO):	Alan Humphrey, ERT	
	Bill Luthans, Region 6	
Divemaster:	Alan Humphrey, ERT	
	Brandi Todd, Region 6	
Dive Team Member:	John Penland, Region 6	
	Nick Gannon , Region 6	
	Valmichael Leos, Region 6	
Trainee Divers:		
Standy-By Divers:	Rotation of Divers*	
Dive Tenders:	Rotation of Divers	
Boat Operator:	TBD	

*If deemed necessary by the Divemaster.

SAFETY EQUIPMENT:

Item	Location
First Aid Kit/AED	Dive Vessel
Medical Grade Oxygen	Dive Vessel
Dive Ladder	Dive Vessel
Dive Flag	Dive Vessel/Floating buoy
Dive Safety Line	Dive Vessel
Diver Recall System	NA (tethered diver on comms)

Dive Safety Plan	Dive Vessel
Cellular Phone	Dive Vessel
Marine Radio	Dive Vessel
Backboard	NA
Fluids	Shore

DIVE PLAN:

This dive operation is a joint US EPA dive project between US EPA Region VI and the US EPA Environmental Response Dive Teams and funded by US EPA Region VI with contributions in sampling equipment and logistics support from the site Responsible Parties. All participating divers are qualified US EPA Scientific Divers or Dive Masters. All dive operations will function according to OSHA 1910.120 HazWoper Operations and the US EPA Diving Safety Manual, Version 1.2. Following the requirements of the Region 6 QAPP and the DTISP, divers will perform two basic functions: (1) installation of passive underwater sampling devices in TCRA Cap, and (2) visual and "hands-on" observation of the TCRA Cap assisted by GPS and depth navigation, photography (if feasible) and boat mounted imaging sonar sonar with hard-wired communications to divers.

Commented [HA3]: Imaging sonar

Divers will use tethered SCUBA diving methods to provide the safest and most efficient mission possible. Due to the shallow depths (<18 feet) and survey area, SCUBA with 80 cubic foot bottles provides more than adequate sample placement time. A 19 or 30 cubic foot pony bottle, equipped with regulator, will be staged aboard the vessel as the primary diver's emergency gas supply. The standby diver will deliver the pony bottle and regulator to the primary diver should it become necessary.

Placement of Sampling Devices

The divers will be tended from the dive vessel and will be in constant communication with the surface to describe dive conditions and observations. The diver will be directed by the dive master and/or tender for sampler placement. The sample locations will be identified by EPA contractors, marked by GPS, and checked for depth prior to dive operations. The sampling trains (passive samplers, line, markers, etc.) will be configured as much as possible prior to sampling. The diver will only handle the sampling devices on the aluminum frame, not on the sample media to avoid contamination prior to installation. Since installation is into an "armored cap" (i.e. up to 18 inches of gravel stone placed over the synthetic cover), it is anticipated that an opening will need to be forcefully created for insertion. This will be accomplished using rebar driven by either a hammer or pile driver. This dive plan includes a contingency for two divers in the water together, both on tether and comms so that one diver may manipulate the sampling device into the TCRA Cap while a second diver operates the rebar to open the sampling space. Divers should practice neutral buoyancy techniques for this activity to the extent possible. Though, since the work is being performed above a hard bottom (rock and oyster shells) and leverage may be needed to physically create the sampler opening in the TCRA Cap, the divers may settle on the hard cap. If necessary, rebar may be used to determine the soft sediment thickness. This first diving operation is intended to refine methods of sampler installation into

Commented [HA4]: Aluminum frame houses the polyethylene media for PEDs, SPMEs are fragile fibers coated with sorbent material, inserted into a narrow aluminum tube with a T handle, assume we are using SPMEs?

Commented [HA5]: Two divers in the water working together,

the armored Cap, and improvisation may be required within the safe diving parameters that are established.

Observational Verification of Cap Integrity

Tethered divers on wired communications will be guided by voice command to assess the perimeter and outer few meters of the armored cap. The command center on the Dive Vessel will utilize imaging sonar and GPS tracking to locate the outer edges of the Cap and the diver will utilize sight and photography (if feasible) and hands to assess the integrity of the "armor" at the toe of the synthetic cap.

Commented [HA6]: Imaging sonar

Logistical and sampling support and vessels are being provided by

_____

_____

Dive Protocol: Tethered diving operations to assess Cap integrity will be conducted using a four (or three) man dive team, with primary single diver on a com rope supported on the surface by a tender, a standby diver and a Dive Master who is in voice communication with the diver. If necessary, the standby diver or the Dive Master may also tend the diver. The primary diver will use a 80 cubic foot bottle and full face mask (Guardian) with comms. At each location the primary diver will begin with a full (2800-3200 psi) bottle. The primary diver may carry a spare air to safely ascend to the surface in an emergency. If the primary diver becomes tangled and cannot cut free, he/she will communicate to the surface for standby assistance. The standby diver will deliver a pony bottle and regulator to the primary diver should it become necessary. The standby diver will attempt to free the primary diver from the tangle hazard. Communications gear will be hard-wired to a Guardian full face mask through the com rope.

For sampler placement in deep (up to 15 feet) water, an attempt will be made to make this a single diver operation following the procedure outlined above assessing Cap integrity. Should it be determined that one diver cannot effectively both create the opening in the armored Cap with rebar and driver, and manipulate the insertion of the sampling device and perform the work necessary to attach tethers and location devices to the sampler; then the procedure will be modified to utilize two tethered divers, both on comms. In such situation, each diver is available to provide emergency assistance to the other until divers can return to the boat or a free-swimming standby diver following the appropriate tether line can deliver a pony bottle of emergency air or provide further assistance as appropriate.

Commented [HA7]: Bill, have you put two divers in the water on tether and done a three way communication? This is not standard practice, but may be needed if two hands are not sufficient Diver #2 could also ferry sample ger or equipment to boat if needed

If necessary, the dive team can request a non-diver familiar with the dive operation to tend the diver. If the primary diver needs assistance, the standby diver must be prepared to enter the water in a timely manner and should be in contact with the primary divers comm rope at all times while in the water. The standby diver will also use scuba, dry suit, dry gloves, and full face mask.

The vessel must be anchored by two anchors (stern and bow). The dive operation will include a secondary vessel (flat bottom boat or rubber raft to assist divers and equipment with safe access to waters too shallow for the dive boat to enter.

Before the primary diver enters the water a Comm check is done, once in the water a buoyancy and leak check is done before descent. Surface personnel and the diver must communicate and be observant. Due to very low visibility, if the diver develops a leak anytime during the dive the dive will be aborted and equipment repaired. The diver and surface personnel must communicate and be observant to any changing conditions.

Dive Dress: Deconable dry suit (Whites/Viking) with full face mask (Guardian) and dry hood connected to a 200 foot com rope. Dry, chemical resistant gloves over cuff rings, secured with rings and tape will be used. Inner gloves will be latex surgicals. The diver will wear a deconable BC vest over a harness with a secure attachment and quick release com rope. The com rope includes the communication line and strength member. All components must be leak proof to insure isolation against site contaminants.

Commented [HA8]: And quick release

Diver Air quality: Region 6 EPA will provide SCUBA tanks (aluminum 80's and steel 72's) filled with CGA grade E standard air, bailout bottles, dive weights, and medical grade oxygen for emergency use. A local dive shop will be used as backup for rental of scuba tank air. The most recent air quality testing (CGA grade E standard) and maintenance schedule on the compressor will be requested.

DIVE CONDITIONS ANTICIPATED:

Wave Heights:	Minor – less than 6 inches; no white caps: probably none depending on wind.
Water Current:	Variable, typically less than 0.5 feet/second during low flow and normal tide cycle.
Tidal Heights:	Tidal influence is 1 to 2 feet during normal tide cycles. Projection for December 9 and 10 during daylight hours is less than 1 foot (peaking at about 1.3 feet at night).
Maximum Depth:	20 feet
Visibility:	0 to 2 feet
Weather:	Variable (cool to warm), may have winds 10-30 mph
Boat Traffic:	Limited, but possible, will need to mark dive vessel with dive flags and have at least one floating diver bouy with diver flag. Both domestic and alpha flags will be raised.

PHYSICAL HAZARDS:

- Low to Zero Visibility – Divers must feel comfortable diving in low to zero visibility since these conditions may occur throughout the dive operations.
- Boat Traffic. The area of planned diving operations is in relatively shallow water and outside the main navigation channel with low probability for boat traffic. There is barge traffic in the main channel in the vicinity of the site. Historic postings of fish advisories, the industrial/commercial character of the area and other factors result in little recreational boat traffic in the area. Dive Flag Markers will be utilized.
- Cold or Heat Stress – Divers will wear temperature appropriate clothing under their dry suits. Divers will warm-up or cool off on the surface between dives. Any divers that get chilled, sweating profusely or start shivering will safely terminate their dive.
- Vessel traffic-No vessel traffic is expected; but is possible. Dive boat will be marked with dive flag and at least one floating diver buoy marker will be placed.
- Entanglement with loose lines. The divemaster will go through hand and body positioning throughout the dive to emphasize ways to keep entanglement prone areas clear of lines (e.g., tank yokes). During dive operations, a single diver will be line tended

on a com rope to reduce entanglement hazards. In the event that sampler placement requires a two-diver dive team, verbal communications and diver-to-diver communications will be used to preserve orientation of the two divers to minimize the potential for line-wrapping. Boat operators, tenders, and line handlers will use techniques to ensure the line is taut on the bottom such as weighting each end for deployment (to be retrieved by buoys/lines at the end of the deployment), and pulling tension when releasing the bitter end of the line.

- Bounce diving: The divemaster will minimize the number of ascents and descents to the extent possible. Due to the shallow depths anticipated on this project (20 feet max), such dive profiles are not considered a hazard.
- Overhead hazards. Divers will be informed when entering areas under the dive vessels to ensure that they are aware of the location of the vessels above them.
- Tending the diver: The dive tender must listen to commands from the diver and be in contact with the umbilical at all times. During descent and ascent the tender must provide and take the umbilical as needed to ensure the diver is not adversely affected by pressure changes. Ascent rates of less than 30 ft/min must be followed. Too much slack in the line or too much strain on the diver should be avoided. If a compass is not visible by the diver the dive master will provide instruction to properly orient the diver.
- Cuts or abrasions-Any open cuts or abrasions should be covered, kept dry, and avoid contact with river waters.
- Anchoring-With the tether/communication line diving method, the dive vessel MUST be securely anchored to the river bottom. If the vessel moves from its original position the Dive Master will determine whether to immediately abort the dive.

BIOLOGICAL HAZARDS:

- Bites, stings or cuts from aquatic life and insects, possible biological contamination from indigenous biological life.
- This section of the San Jacinto River is a well-mixed esturine water body, and there is an advisory against eating fish or shellfish from the vicinity due to PCB and dioxin in edible fish tissue throughout the water body. One segment, from Lynchberg Ferry Road to Goose Island is also on the TCEQ 303d list as impaired for bacteria.

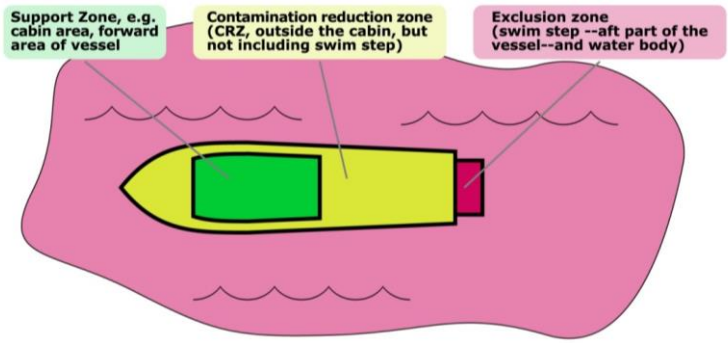
CHEMICAL HAZARDS/SOURCES OF POLLUTION:

- The primary contaminants identified are dioxins and furans. Upstream of the site is commercial/industrial with other known sources of dioxin and furan contamination. Such contaminants may be entrained in the water column in suspended sediments. The primary dioxin potential exposure pathway would be dermally through direct contact with dioxin contaminated water or sediments. Dioxin concentrations in the sediment beneath the cap were significantly higher than dioxin concentrations in the sediment beyond the perimeter of the cap, lowering potential for exposure to high concentrations.

DECONTAMINATION PLAN:

The diver exiting the water will be decontaminated per the following procedure:

1. For gross decontamination, the diver will be rinsed of visible sediments using river water while on the ladder.
2. The diver will board the vessel and be sequestered in one area of the vessel for decontamination. This area will be divided from the rest of the vessel as much as possible to minimize cross contamination of other items on the vessel.
3. Once the diver has boarded the vessel, the divers mask area will be scrubbed with anti-microbial soap and potable water as necessary to remove visible contamination. Once the divers head and mask area have been decontaminated, the diver will be permitted to doff their mask. As the diver doffs their mask, the sealing area will be wiped with a clean dry paper towel and followed with an alcohol wipe.
4. The diver's suit and equipment will be scrubbed as necessary to remove visible contaminated sediments with particular attention given to the areas around the diver's wrists where the gloves attach to the suit. In general, dioxins will be associated with sediment particles, so cleaning the diver of all visible solids is the most effective decontamination practice.
5. All dive equipment will remain in the contamination reduction zone (CRZ) in an organized manner and will be shared by the divers throughout the day with the exception of dry suits and full face masks. Exposed gear will be thoroughly scrubbed and decontaminated at the conclusion of the day's activities.
6. The CRZ is on the dive vessel, but if space does not allow, only the divers mask will be cleaned and removed on the vessel and the CRZ will be moved to the shoreline.
7. All divers and support personnel will wash or wipe hands with anti-microbial soap and practice good hygiene. Consuming food and water will only take place in designated support zone areas, as shown below, which may be modified according to the specific vessel configuration and location of the dive ladder. These practices are covered in more detail in the Diver Decontamination Procedures, Appendix P to the US EPA Diving Safety Manual.



Decontamination Equipment for Surface Personnel:

__ Outer Protective Suit (Tyvek Saranex Barricade Other: _____)
__ Booties
X Gloves (Nitrile Surgical)
__ Hard Hat
__ Steel Toe/Shank Boots
X Safety Glasses

Decontamination Procedure:

Step 1	Gross decon using non-potable river water on ladder.
Step 2	Rinse with potable water.
Step 3	Wash with anti-microbial soap (to be Evaluated on Site)

Describe disposition of wastes: All water decon rinse can flow back into the channel.

DIVE EQUIPMENT:

Breathing Gas: Air Nitrox I (32%)Nitrox II (36%) Other:_____ % Oxygen

Air Source: Certification Date: _____

Primary Diver:	Standby Diver:
AGA Mask	AGA Mask
Dry Suit	Dry Suit
Dry Gloves	Dry Gloves
BCD	BCD
Dive Computer	Dive Computer
Dive Knife	Dive Knife
SCUBA Tank 80 CF	SCUBA Tank 80 CF
Spare Air (3 CF)	Weight Belt
Weight Belt	Fins
Fins	

Emergency Evacuation Plan:

Emergency Transportation:	Ambulance
Emergency Vehicle:	Ambulance/Government Vehicle
Communications:	Cell Phone
Egress Location:	Diver will be brought onto dive vessel and transported to nearest egress location
Response Personnel	Dive Tender, Dive Master
Medical Records:	Dive File
Dive Profile:	Will be supplied by Dive Master or Standby Diver

Emergency Contact Numbers:

DAN (Emergency) (919)-684-9111

DAN (Non-emergency)	(919) 684-2948
Bill Luthans Region 6 (Liz)	(972) 256-6825 (Liz)
Alan Humphrey, EPA ERT UDO	(609) 865-4546
Brandi Todd, EPA Region 6	
Gary Miller, EPA Region 6	
Valmichael Leos, EPA Region 6	
Nick Gannon, EPA Region 6	

HOSPITAL with CHAMBER: Directions from the site, if safe Egress onto the facility is available, call 911 for pickup on-site if a life-threatening emergency is suspected.

Houston Methodist San Jacinto Hospital

General- 281-420-8600
Emergency-911
4401 Garth Road
Baytown Road, TX 77521

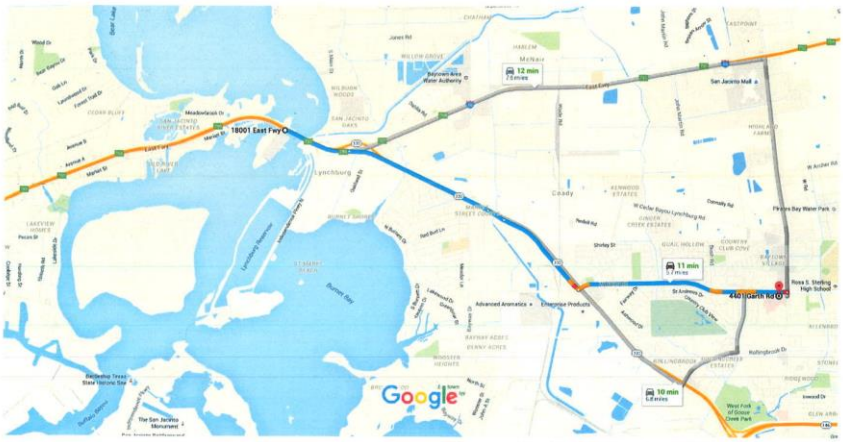
Directions Via I-10/TX 330 (SEE MAP Next Page)
East on I-10 (0.9 mi.)
Right at fork to TX330 Spur South – follow signs to Baytown (1.6 mi.)
Exit toward Wade Rd/Baker Rd (0.2 mi.)
Merge onto Decker Drive (1.1 mi.)
Left onto West Baker Rd. (2.2 mi.)
Right on Garth Rd – Destination on Right
Total Distance: 5.9 mi, Time Estimate: 11 min. **(9 with no traffic)**

Directions via I-10 (SEE MAP Next 2 pages)
East on I-10 (0.9 mi.)
Left at Fork to I-10 E (4.0 mi.)
Exit 792 toward Garth Rd (0.2 mi.)
Merge onto E Freeway Service Rd/I-10 Service Rd (0.2 mi.)
Right on Garth Rd (2.5 mi.) – Destination on Right
Total Distance: 7.8 mies; Time Estimate: 13 min. **(10 without traffic)**

Recompression Chambers:

Houston Methodist San Jacinto Hospital – see above information. Confirmed operational and qualified to treat diving accidents by Bill Luthans via phone call with hyperbaric department on October 29, 2015. Operational M-F without special arrangemen

Google Maps 18001 East Fwy, Channelview, TX 77530 to 4401 Garth Rd, Baytown, TX 77521 Drive 5.7 miles, 11 min



Map data ©2015 Google 2000 ft

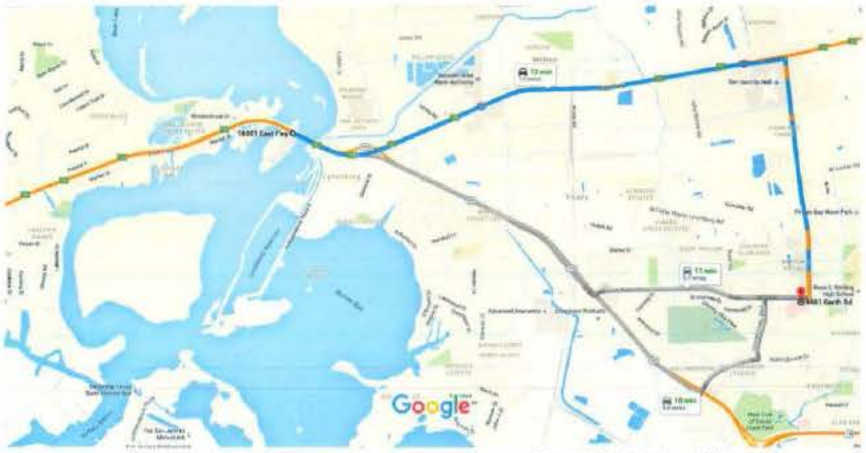
18001 East Fwy
Channelville, TX 77530

1. Head southeast on I-10 E — 0.7 mi
2. Keep right at the fork to continue on TX-330 Spur S, follow signs for Baytown — 1.6 mi
3. Take the exit toward Wade Rd/Baker Rd — 0.2 mi
4. Merge onto Decker Dr — 1.1 mi
5. Turn left onto W Baker Rd — 2.2 mi
6. Turn right onto Garth Rd — 200 ft
   Destination will be on the right

4401 Garth Rd
Baytown, TX 77521

These directions are for planning purposes only. You may find that construction projects, traffic, weather, or other events may cause conditions to differ from the

Google Maps 18001 East Fwy, Channelview, TX 77530 to 4401 Garth Rd, Baytown, TX 77521 Drive 7.6 miles, 12 min



Map data ©2015 Google 2000 ft

18001 East Fwy
Channelview, TX 77530

1. Head southeast on I-10 E — 0.7 mi
2. Keep left at the fork to stay on I-10 E — 4.0 mi
3. Take exit 792 toward Garth Rd — 0.2 mi
4. Merge onto E Freeway Service Rd/Interstate 10 Service Rd — 0.2 mi
5. Use the right 2 lanes to turn right onto Garth Rd — 2.5 mi
   Destination will be on the right

4401 Garth Rd
Baytown, TX 77521

These directions are for planning purposes only. You may find that construction projects, traffic, weather, or other events may cause conditions to differ from the map results, and you should plan your route accordingly. You must obey all signs or notices regarding your route.

DIVE EMERGENCY

In the event of a diving accident (severe symptoms) **SEE ATTACHMENTS**:

- Maintain Airway, Breathing, and Heart Functions,
- Administer Oxygen,
- Initiate Emergency Evacuation Plan/Contact Decompression Chamber, Transportation,
- Evacuate to Decompression Chamber,
- Reconstruct dive profiles and keep with victim,
- Dive partner (or standby diver) should accompany victim, or go to chamber ASAP,
- Retain all dive gear for examination.

After evacuation, divemaster to notify:

Bill Luthans	(214) 665-8154
Brian Kovak, ERT HSO	(908) 202-9848
Alan Humphrey, EPA ERT UDO	(609) 865-4546
Jon McBurney, LM SERAS	(609) 937-9116

CPR AND DIVING ACCIDENT MANAGEMENT FLOW CHART ARE IN ATTACHMENT

ATTACHMENTS

DIVE OPERATION GUIDELINES:

1. This dive plan will be approved by an EPA Unit Diving Officer (UDO) and by the SERAS Health and Safety officer prior to the start of diving operations.

2. Diving will be conducted in accordance with the U.S. Navy No-Decompression Limits and Repetitive Group Designation Table for No-Decompression Air Dives (dive time depth limits). Bottom times will not exceed no-decompression time limits and all dives will be limited to 130 feet of sea water (FSW). Shallower limits maybe designated for specific projects.

3. The dive vessel should be anchored or tied to a piling prior to the start of all dive operations. In certain circumstances "live boating" may be necessary to perform dive operations in a safe and efficient manner. During "live boat" diving, the dive tender shall maintain continuous visual contact with the divers, or their bubbles after they descend, and keep the boat operator informed of their position. The boat should always be positioned to provide immediate assistance to the divers. The vessels propeller must be in neutral when divers enter the water and when they reenter the vessel. If unsuitable conditions (visibility, wind, current, vessel traffic) exist, "live boating" should not be performed.

4. Based on the dive profile and at the divemasters discretion, during the ascent the diver should stop at approximately 15 FSW for a minimum of 3 minutes for a safety stop.

5. During the dive, all divers shall remain in contact (visual, auditory, or tactile) with either another diver or the dive tender. All divers must return to the surface if contact is lost.

6. A SCUBA diver should be on the surface before their main cylinder pressure reaches 500 psi. All SCUBA cylinders used for surface supplied operations should be switched at 500 psi.

7. During dive operations that warrant the use of a single diver, a SCUBA diver must be tethered to the dive tender via a safety/communication (comm) line attached to a chest harness or be using surface supplied air.

8. When working in conditions that may prevent the diver from traveling directly to the surface (overhead structures, potential for entanglement or entrapment) the "Thirds Rule" should be followed: the diver should hold approximately one third of the cylinder volume in reserve, but not less than 1000 psi. The initial two-thirds of the air supply should be used for descent, completing the work, and returning to the surface.

9. No entry should be made into enclosed or physically confining spaces unless the entry required to complete the specified dive objectives. If entering an enclosed space a safety line must be run from the point of entry to the diver(s). A diver should be positioned at the underwater point of entry.

10. At the Divemaster discretion when diving in rapid currents, divers should be line tended to ensure safe operations.

11. Based on conditions and if deemed necessary by the Divemaster, a standby diver will be ready to render immediate assistance.

12. Ascent rate must not exceed 30 feet/minute.

13. All Dive operations must be conducted in accordance with all appropriate state and federal regulations, the U.S. EPA Diving Safety Manual.

14. All divers must be trained in the mode of diving they will be utilizing for all work dives. If a diver is not familiar with the specific mode of dive (i.e , surface-supplied air or single line-tended diving), they will be required to make a training dive, in a safe environment, to become proficient with it prior to making a working dive using that equipment.

15. In an emergency, the divemaster/dive supervisor may have to make field decisions that deviate from the requirements of this safety plan to prevent or minimize a situation that may cause serious physical harm or death.

16. For all dives using surface supplied air or for SCUBA when deemed necessary by the divemaster, the diver must carry an independent reserve gas supply (e.g., pony bottle) connected to the underwater breathing apparatus. The independent reserve gas supply must have an independent valve (e.g., manifold block) and the valve must be in closed position at the start of the dive. A non-return valve must be used between the surface supplied air line and the manifold block. Over-pressure relief valves must always be installed on the primary stage regulator on the reserve gas tank. At a minimum, the diver must carry a sufficient supply of air to return to vessel from the dive location and have 500 psi remaining in the tank.

17. For all single diver operations (surface supplied or line-tended/comm. line SCUBA), the diver shall be continuously tended for the duration of the dive and must remain in communication with the surface. If communications fail at any point during the dive, the dive must be aborted.

18. Divers must wait a minimum of 12 hours after diving to fly. If diving occurs on multiple days and multiple dives per day the minimum should be increased to 24 hours.

19. For most typical work dives the number of personnel required for dive operations should be four. On smaller jobs under ideal conditions the dive supervisor may also act as the dive tender or standby diver reducing the number of personnel to three. All members of the dive team must be EPA-certified divers or diving with EPA under a reciprocity agreement. The dive crews would be as follows:

Surface Supply Single Diver or Line Tended Single SCUBA Diver*	Buddy Team SCUBA Divers
Divemaster	Divemaster/Tender**
Diver	Diver
Tender	Diver
Stand-by Diver	Stand-by Diver***

*If second diver is utilized, a second tender would also be required.
**Depending on dive operations the Divemaster also act as the dive tender.
***If deemed necessary by the Divemaster.

20. Enhanced air (Nitrox) may be used with oxygen concentrations up to 39%. All divers using Nitrox must have appropriate training and must personally verify oxygen concentrations prior to utilizing each tank. For Nitrox dives, the PPO2 must never exceed 1.6 ATA. For rigorous dives (deep, cold water, physically intense) a more conservative PP02 of 1.4 ATA should be used.

21 Dive computers may be used to control a dive if approved of the Divemaster and the dive computer will enhance the diver's ability to accomplish a given task while maintaining a safe dive profile.

RESPONSIBILITIES OF DIVE PERSONNEL:

Divemaster shall be in complete charge of the diving operation, and ensure that: (1) all equipment is in safe operating condition, (2) a predive safety briefing is given, (3) all divers are fit to dive, (4) water/surface conditions are adequate to safely execute dive plan, (5) all diving operations are conducted safely in accordance with this dive plan and prescribed EPA safety rules and regulations, (6) an accurate dive log, including bottom time, cylinder pressures, and maximum depth for each diver, is maintained, and (7) all team members are adequately trained in all modes of diving that will be utilized on the project.

All Divers shall: (1) dive only if they are physically and mentally fit and properly trained for the task to be performed, (2) keep their diving equipment in safe operating condition, (3) wear and monitor a gauge or dive computer that provides depth, tank pressure, and bottom time, and (4) refuse to dive if conditions are unsafe or unfavorable, or if the diving operation violates any EPA or OSHA safety rules and regulations.

All Standby Divers shall: (1) be fully equipped and ready to give immediate assistance at the dive site, (2) receive the same briefing and instructions as the working divers, and (3) monitor the progress of the diving operations.

All Tenders shall: (1) assist divers with their equipment, (2) track the divers location and status during the dive, (3) alert the divers, when necessary, on the status of their bottom dive, (4) advise other vessels of diving operations and warn off boat traffic which may pose a hazard to the divers, and (5) perform no other concurrent duty which may interfere with these responsibilities.

Communication Plan:

Diver Recall Signal Any signal sent by the diver recall will indicate that all divers should terminate their dive as soon as possible and safely ascend to the surface to be given direction by the Divemaster.

Primary Diver to Tender:

2-2-2 *I am entangled and OK, I am stopping to handle it myself but ready the backup diver.*

3-3-3 *I am in a difficulty but I am OK, I need assistance, send the backup diver.*

4-4-4-4-4-4-4... *I am not OK, I need immediate assistance.*

US EPA NO-DECOMPRESSION DIVE TABLES - AIR*

DEPTH->	10	15	20	25	30	35	40	45	50	55	60	70	80	90	100	110	120	130	140	SURFACE INTERVAL TABLE					
GROUP																									
A	57	36	26	20	17	14	12	11	9	8	7	6	5	4	4	3	3	2	2	->	->	->	->	A->	0:10 2:20
	101	60	43	33	27	23	20	17	15	14	12	10	9	7	6	6	5	4	4	->	->	->	B->	0:10 1:16	1:17 3:36
C	158	88	61	47	38	32	27	24	21	19	17	14	12	11	9	8	7	6	6	->	->	C->	0:10 0:55	0:56 2:11	2:12 4:31
D	245	121	82	62	50	42	36	31	28	25	22	19	16	14	12	11	10	9	8	->	D->	0:10 0:52	0:53 1:47	1:48 3:03	3:04 5:23
E	426	163	106	78	62	52	44	39	34	31	28	23	20	17	15	14	12	10	10	E->	0:10 0:52	0:53 1:44	1:45 2:39	2:40 3:55	3:56 6:15
F		217	133	97	76	63	53	46	41	37	33	28	24	21	18	16	15	->	F->	0:10 0:52	0:53 1:44	1:45 2:37	2:38 3:31	3:32 4:48	4:49 7:08
G		297	165	117	91	74	63	55	48	43	39	32	28	24	21	19	->	G->	0:10 0:52	0:53 1:44	1:45 2:37	2:38 3:29	3:30 4:23	4:24 5:40	5:41 8:00
H		449	205	140	107	87	73	63	56	50	45	37	32	28	25	20	H->	0:10 0:52	0:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:16	5:17 6:32	6:33 8:52
I			256	166	125	100	84	72	63	56	51	42	36	30	->	I->	0:10 0:52	0:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:08	6:09 7:24	7:25 9:44
J			330	198	145	115	95	82	71	63	57	47	39	->	J->	0:10 0:52	0:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:06	6:07 7:00	7:01 8:16	8:17 10:36
K			461	236	167	131	108	92	80	71	60	48	->	K->	0:10 0:52	0:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:06	6:07 6:58	6:59 7:52	7:53 9:09	9:10 11:29
L				285	193	148	121	102	89	74	->	->	L->	0:10 0:52	0:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:06	6:07 6:58	6:59 7:50	7:51 8:44	8:45 10:01	10:02 12:21
M				354	223	168	135	114	92	->	->	M->	0:10 0:52	0:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:06	6:07 6:58	6:59 7:50	7:51 8:42	8:43 9:37	9:38 10:53	10:54 13:13
N				469	260	190	151	125	->	->	N->	0:10 0:52	0:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:06	6:07 6:58	6:59 7:50	7:51 8:42	8:43 9:34	9:35 10:29	10:30 11:45	11:46 14:05
O				595	307	215	163	->	->	O->	0:10 0:52	0:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:06	6:07 6:58	6:59 7:50	7:51 8:42	8:43 9:34	9:35 10:27	10:28 11:21	11:22 12:37	12:38 14:58
Z					371	232	->	->	Z->	0:10 0:52	0:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:06	6:07 6:58	6:59 7:50	7:51 8:42	8:43 9:34	9:35 10:27	10:28 11:19	11:20 12:13	12:14 13:30	13:31 15:50
										Z	O	N	M	L	K	J	I	H	G	F	E	D	C	B	A

*Based on USN Tables, Latest Rev.

US EPA RESIDUAL NITROGEN TABLE FOR AIR*

DEPTH	Z	O	N	M	L	K	J	I	H	G	E	F	D	C	B	A	DEPTH
10								NO LIMIT									10
15								450 NO LIMIT		298							15
20								NO LIMIT									20
25			470 125	354 241	286 309	237 358	198 397	167 428	141 454	118 477	98 497	79 516	63 532	48 547	34 561	21 574	25
30		308 63	261 110	224 147	194 177	168 203	146 225	126 245	108 263	92 279	77 294	63 308	51 320	39 332	28 343	18 353	30
35		216 16	191 41	169 63	149 83	132 100	116 116	101 131	88 144	75 157	64 168	53 179	43 189	33 199	24 208	15 217	35
40			152 11	136 27	122 41	109 54	97 66	85 78	74 89	64 99	55 108	45 118	37 126	29 134	21 142	13 150	40
45				115 10	104 21	93 32	83 42	73 52	64 61	56 69	48 77	40 85	32 93	25 100	18 107	12 113	45
50						81 11	73 19	65 27	57 35	49 43	42 50	35 57	29 63	23 69	17 75	11 81	50
55							65 9	58 16	51 23	44 30	38 36	32 42	26 48	20 54	15 59	10 64	55
60								52 8	46 14	40 20	35 25	29 31	24 36	19 41	14 46	9 51	60
70									39 9	34 14	29 19	25 23	20 28	16 32	12 36	8 40	70
80									33 6	29 10	25 14	22 17	18 21	14 25	10 29	7 32	80
90										26 4	22 8	19 11	16 14	12 18	9 21	6 24	90
100											20 5	17 8	14 11	11 14	8 17	5 20	100
110												16 4	13 7	10 10	8 12	5 15	110
120													12 3	9 6	7 8	5 10	120

US EPA NITROX I (32% O_2) DIVE TABLES *

DEPTH->	15	20	25	30	40	45	50	55	60	65	70	80	90	100	110	120	130	SURFACE INTERVAL TABLE								
EAD->	8	13	17	21	30	34	38	43	47	51	56	64	73	81	90	99	107									
A	57	36	26	20	17	14	12	11	9	8	7	6	5	4	4	4	3	->	->	->	->	->	->	->	A->	0:10 2:20
	101	60	43	33	27	23	20	17	15	14	12	10	9	7	7	6	6	->	->	->	->	->	->	B->	0:10 1:16	1:17 3:36
C	158	88	61	47	38	32	27	24	21	19	17	14	12	11	11	9	8	->	->	->	->	->	C->	0:10 0:55	0:56 2:11	2:12 4:31
D	245	121	82	62	50	42	36	31	28	25	22	19	16	14	14	12	11	->	->	->	->	D->	0:10 0:52	0:53 1:47	1:48 3:03	3:04 5:23
E	426	163	106	78	62	52	44	39	34	31	28	23	20	17	17	15	14	->	->	->	E->	0:10 0:52	0:53 1:44	1:45 2:39	2:40 3:55	3:56 6:15
F		217	133	97	76	63	53	46	41	37	33	28	24	21	21	18	16	->	->	F->	0:10 0:52	0:53 1:44	1:45 2:37	2:38 3:31	3:32 4:48	4:49 7:08
G		297	165	117	91	74	63	55	48	43	39	32	28	24	24	21	19	->	G->	0:10 0:52	0:53 1:44	1:45 2:37	2:38 3:29	3:30 4:23	4:24 5:40	5:41 8:00
H		449	205	140	107	87	73	63	56	50	45	37	32	28	28	25	20	H->	0:10 0:52	0:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:16	5:17 6:32	6:33 8:52
I			256	166	125	100	84	72	63	56	51	42	36	30	30	->	I->	0:10 0:52	0:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:08	6:09 7:24	7:25 9:44
J			330	198	145	115	95	82	71	63	57	47	39	->	->	J->	0:10 0:52	0:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:06	6:07 7:00	7:01 8:16	8:17 10:36
K			461	236	167	131	108	92	80	71	60	48	->	->	K->	0:10 0:52	0:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:06	6:07 6:58	6:59 7:52	7:53 9:09	9:10 11:29
L				285	193	148	121	102	89	74	->	->	->	L->	0:10 0:52	0:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:06	6:07 6:58	6:59 7:50	7:51 8:44	8:45 10:01	10:02 12:21
M				354	223	168	135	114	92	->	->	->	M->	0:10 0:52	0:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:06	6:07 6:58	6:59 7:50	7:51 8:42	8:43 9:37	9:38 10:53	10:54 13:13
N				469	260	190	151	125	->	->	->	N->	0:10 0:52	0:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:06	6:07 6:58	6:59 7:50	7:51 8:42	8:43 9:34	9:35 10:29	10:30 11:45	11:46 14:05
O				595	307	215	163	->	->	->	O->	0:10 0:52	0:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:06	6:07 6:58	6:59 7:50	7:51 8:42	8:43 9:34	9:35 10:27	10:28 11:21	11:22 12:37	12:38 14:58
Z					371	232	->	->	->	Z->	0:10 0:52	0:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:06	6:07 6:58	6:59 7:50	7:51 8:42	8:43 9:34	9:35 10:27	10:28 11:19	11:20 12:13	12:14 13:30	13:31 15:50
											Z	C	N	M	I	K	J	I	H	G	F	E	D	C	B	A

*Based on USN Equivalent Air Depth (EAD)

US EPA RESIDUAL NITROGEN TABLE FOR NITROX I*

DEPTH	Z	O	N	M	I	K	J	I	H	G	F	E	D	C	B	A	DEPTH
15								NO LIMIT									15
20								450		298							20
25								NO LIMIT									25
30			470 125	354 241	286 309	237 358	198 397	167 428	141 454	118 477	98 497	79 516	63 532	48 547	34 561	21 574	30
40		308 63	261 110	224 147	194 177	168 203	146 225	126 245	108 263	92 279	77 294	63 308	51 320	39 332	28 343	18 353	40
45		216 16	191 41	169 63	149 83	132 100	116 116	101 131	88 144	75 157	64 168	53 179	43 189	33 199	24 208	15 217	45
50			152 11	136 27	122 41	109 54	97 66	85 78	74 89	64 99	55 108	45 118	37 126	29 134	21 142	13 150	50
55				115 10	104 21	93 32	83 42	73 52	64 61	56 69	48 77	40 85	32 93	25 100	18 107	12 113	55
60						81 11	73 19	65 27	57 35	49 43	42 50	35 57	29 63	23 69	17 75	11 81	60
65							65 9	58 16	51 23	44 30	38 36	32 42	26 48	20 54	15 59	10 64	65
70								52 8	46 14	40 20	35 25	29 31	24 36	19 41	14 46	9 51	70
80									39 9	34 14	29 19	25 23	20 28	16 32	12 36	8 40	80
90									33 6	29 10	25 14	22 17	18 21	14 25	10 29	7 32	90
100										26 4	22 8	19 11	16 14	12 18	9 21	6 24	100
110										26 4	22 8	19 11	16 14	12 18	9 21	6 24	110

USEPA NITROX II (36% O_2) DIVE TABLES*

DEPTH->	20	25	30	35	40	50	55	60	70	75	80	90	100	110	SURFACE INTERVAL TABLE									
EAD->	10	14	18	22	26	34	38	42	50	54	59	67	75	83										
A	57	36	26	20	17	14	12	11	9	8	7	6	5	4	->	->	->	->	->	->	->	->	A->	0:10 2:20
	101	60	43	33	27	23	20	17	15	14	12	10	9	7	->		->	->	->	->	->	B->	0:10 1:16	1:17 3:36
C	158	88	61	47	38	32	27	24	21	19	17	14	12	11	->		->	->	->	->	C->	0:10 0:55	0:56 2:11	2:12 4:31
D	245	121	82	62	50	42	36	31	28	25	22	19	16	14	->		->	->	->	D->	0:10 0:52	0:53 1:47	1:48 3:03	3:04 5:23
E	426	163	106	78	62	52	44	39	34	31	28	23	20	17	->		->	->	E->	0:10 0:52	0:53 1:44	1:45 2:39	2:40 3:55	3:56 6:15
F		217	133	97	76	63	53	46	41	37	33	28	24	21	->			F->	0:10 0:52	0:53 1:44	1:45 2:37	2:38 3:31	3:32 4:48	4:49 7:08
G		297	165	117	91	74	63	55	48	43	39	32	28	24	->		G->	0:10 0:52	0:53 1:44	1:45 2:37	2:38 3:29	3:30 4:23	4:24 5:40	5:41 8:00
H		449	205	140	107	87	73	63	56	50	45	37	32	28	->	H->	0:10 0:52	0:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:16	5:17 6:32	6:33 8:52
I			256	166	125	100	84	72	63	56	51	42	36	30	I->	0:10 0:52	0:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:08	6:09 7:24	7:25 9:44
J			330	198	145	115	95	82	71	63	57	47	39	J->	0:10 0:52	0:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:06	6:07 7:00	7:01 8:16	8:17 10:36
K			461	236	167	131	108	92	80	71	60	48	K->	0:10 0:52	0:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:06	6:07 6:58	6:59 7:52	7:53 9:09	9:10 11:29
L				285	193	148	121	102	89	74		L->	0:10 0:52	0:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:06	6:07 6:58	6:59 7:50	7:51 8:44	8:45 10:01	10:02 12:21
M				354	223	168	135	114	92		M->	0:10 0:52	0:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:06	6:07 6:58	6:59 7:50	7:51 8:42	8:43 9:37	9:38 10:53	10:54 13:13
N				469	260	190	151	125		N->	0:10 0:52	0:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:06	6:07 6:58	6:59 7:50	7:51 8:42	8:43 9:34	9:35 10:29	10:30 11:45	11:46 14:05
O				595	307	215	163		O->	0:10 0:52	0:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:06	6:07 6:58	6:59 7:50	7:51 8:42	8:43 9:34	9:35 10:27	10:28 11:21	11:22 12:37	12:38 14:58
Z					371	232		Z->	0:10 0:52	0:53 1:44	1:45 2:37	2:38 3:29	3:30 4:21	4:22 5:13	5:14 6:06	6:07 6:58	6:59 7:50	7:51 8:42	8:43 9:34	9:35 10:27	10:28 11:19	11:20 12:13	12:14 13:30	13:31 15:50
									Z	O	N	M	L	K	J	I	H	G	F	E	D	C	B	A

*Based on USN Equivalent Air Depth (EAD)

US EPA RESIDUAL NITROGEN TABLE FOR NITROX

DEPTH	Z	O	N	M	L	K	J	I	H	G	F	E	D	C	B	A	DEPTH
20								NO LIMIT									20
25								450 NO LIMIT		298							25
30								NO LIMIT									30
35			470 125	354 241	286 309	237 358	198 397	167 428	141 454	118 477	98 497	79 516	63 532	48 547	34 561	21 574	35
40		308 63	261 110	224 147	194 177	168 203	146 225	126 245	108 263	92 279	77 294	63 308	51 320	39 332	28 343	18 353	40
50		216 16	191 41	169 63	149 83	132 100	116 116	101 131	88 144	75 157	64 168	53 179	43 189	33 199	24 208	15 217	50
55			152 11	136 27	122 41	109 54	97 66	85 78	74 89	64 99	55 108	45 118	37 126	29 134	21 142	13 150	55
60				115 10	104 21	93 32	83 42	73 52	64 61	56 69	48 77	40 85	32 93	25 100	18 107	12 113	60
70						81 11	73 19	65 27	57 35	49 43	42 50	35 57	29 63	23 69	17 75	11 81	70
75							65 9	58 16	51 23	44 30	38 36	32 42	26 48	20 54	15 59	10 64	75
80								52 8	46 14	40 20	35 25	29 31	24 36	19 41	14 46	9 51	80
90									39 9	34 14	29 19	25 23	20 28	16 32	12 36	8 40	90
100									33 6	29 10	25 14	22 17	18 21	14 25	10 29	7 32	100
110										26 4	22 8	19 11	16 14	12 18	9 21	6 24	110

US EPA MAX DEPTH/PPO TABLE

%O_2	DEPTH @ 1.6	DEPTH @ 1.5	DEPTH @ 1.4	DEPTH @ 1.3	DEPTH @ 1.2	DEPTH @ 1.1	DEPTH @ 1.0
21	218	203	187	171	156	140	124
22	207	192	177	162	147	132	117
23	197	182	168	154	139	125	110
24	187	173	160	146	132	118	105
25	178	165	152	139	125	112	99
26	170	157	145	132	119	107	94
27	163	150	138	126	114	101	89
28	156	144	132	120	108	97	85
29	149	138	126	115	104	92	81
30	143	132	121	110	99	88	77
31	137	127	116	105	95	84	73
32	**132**	**122**	**111**	**101**	**91**	**80**	**70**
33	127	117	107	97	87	77	67
34	122	113	103	93	83	74	64
35	118	108	99	90	80	71	61
36	**114**	**105**	**95**	**86**	**77**	**68**	**59**
37	110	101	92	83	74	65	56
38	106	97	89	80	71	63	54
39	102	94	85	77	69	60	52
40	99	91	83	74	66	58	50

Bail out Bottle Size	Starting Pressure	Time @ Depth 30FSW	Time @ Depth 40FSW	Time @ Depth 60FSW	Time @ Depth 80FSW	Time @ Depth 100FSW	Time @ Depth 120FSW	Time @ Depth 140FSW	Time @ Depth 160FSW	Time @ Depth 180FSW	Time @ Depth 200FSW
13	**3000**	5.8	5.0	3.9	3.2	2.8	2.4	2.1	1.9	1.7	1.6
19	**3000**	8.5	7.3	5.8	4.7	4.0	3.5	3.1	2.8	2.5	2.3
30	**3000**	13.4	11.6	9.1	7.5	6.4	5.5	4.9	4.4	4.0	3.6
40	**3000**	17.9	15.5	12.1	10.0	8.5	7.4	6.5	5.9	5.3	4.8
50	**3000**	22.4	19.3	15.2	12.5	10.6	9.2	8.2	7.3	6.6	6.1
63	**3000**	28.2	24.4	19.1	15.7	13.4	11.6	10.3	9.2	8.4	7.6
72	**2450**	31.6	27.3	21.4	17.6	15.0	13.0	11.5	10.3	9.3	8.5
80	**3000**	35.9	30.9	24.3	20.0	17.0	14.8	13.1	11.7	10.6	9.7
100	**3300**	45.2	39.0	30.6	25.2	21.4	18.6	16.5	14.7	13.4	12.2
13	**2500**	5.7	4.9	3.9	3.2	2.7	2.4	2.1	1.9	1.7	1.5
19	**2500**	8.4	7.2	5.7	4.7	4.0	3.4	3.0	2.7	2.5	2.3
30	**2500**	13.2	11.4	8.9	7.4	6.3	5.4	4.8	4.3	3.9	3.6
40	**2500**	17.6	15.2	11.9	9.8	8.3	7.2	6.4	5.7	5.2	4.8
50	**2500**	22.0	19.0	14.9	12.3	10.4	9.1	8.0	7.2	6.5	5.9
63	**2500**	27.7	23.9	18.8	15.5	13.1	11.4	10.1	9.0	8.2	7.5
72	**1950**	30.7	26.5	20.8	17.1	14.5	12.6	11.2	10.0	9.1	8.3
80	**2500**	35.2	30.4	23.8	19.6	16.7	14.5	12.8	11.5	10.4	9.5
100	**2800**	44.5	38.4	30.2	24.8	21.1	18.3	16.2	14.5	13.2	12.0
13	**2000**	5.6	4.8	3.8	3.1	2.6	2.3	2.0	1.8	1.6	1.5
19	**2000**	8.1	7.0	5.5	4.5	3.9	3.3	3.0	2.7	2.4	2.2
30	**2000**	12.8	11.1	8.7	7.2	6.1	5.3	4.7	4.2	3.8	3.5
40	**2000**	17.1	14.8	11.6	9.5	8.1	7.0	6.2	5.6	5.1	4.6
50	**2000**	21.4	18.5	14.5	11.9	10.1	8.8	7.8	7.0	6.3	5.8
63	**2000**	27.0	23.3	18.3	15.0	12.8	11.1	9.8	8.8	8.0	7.3
72	**1450**	29.1	25.1	19.7	16.2	13.8	12.0	10.6	9.5	8.6	7.9
80	**2000**	34.2	29.5	23.2	19.1	16.2	14.1	12.5	11.2	10.1	9.3
100	**2300**	43.6	37.6	29.5	24.3	20.6	17.9	15.9	14.2	12.9	11.8

DIVER WORK OF BREATHING RATE IS 30 RMV FOR CALCULATIONS, RATES LOWER OR HIGHER WILL ALTER RESERVE

Bail out Bottle Size	Starting Pressure	Time @ Depth 30FSW	Time @ Depth 40FSW	Time @ Depth 60FSW	Time @ Depth 80FSW	Time @ Depth 100FSW	Time @ Depth 120FSW	Time @ Depth 140FSW	Time @ Depth 160FSW	Time @ Depth 180FSW	Time @ Depth 200FSW
13	**3000**	8.7	7.5	5.9	4.9	4.1	3.6	3.2	2.9	2.6	2.4
19	**3000**	12.8	11.0	8.7	7.1	6.1	5.3	4.7	4.2	3.8	3.5
30	**3000**	20.2	17.4	13.7	11.2	9.6	8.3	7.3	6.6	6.0	5.5
40	**3000**	26.9	23.2	18.2	15.0	12.7	11.1	9.8	8.8	8.0	7.3
50	**3000**	33.6	29.0	22.8	18.7	15.9	13.8	12.2	11.0	9.9	9.1
63	**3000**	42.4	36.5	28.7	23.6	20.1	17.4	15.4	13.8	12.5	11.5
72	**2450**	47.4	40.9	32.1	26.4	22.5	19.5	17.3	15.5	14.0	12.8
80	**3000**	53.8	46.4	36.4	30.0	25.5	22.1	19.6	17.6	15.9	14.5
100	**3300**	67.8	58.5	45.9	37.8	32.1	27.9	24.7	22.1	20.0	18.3
13	**2500**	8.6	7.4	5.8	4.8	4.1	3.5	3.1	2.8	2.5	2.3
19	**2500**	12.5	10.8	8.5	7.0	5.9	5.2	4.6	4.1	3.7	3.4
30	**2500**	19.8	17.1	13.4	11.0	9.4	8.2	7.2	6.5	5.9	5.4
40	**2500**	26.4	22.8	17.9	14.7	12.5	10.9	9.6	8.6	7.8	7.1
50	**2500**	33.0	28.5	22.4	18.4	15.6	13.6	12.0	10.8	9.8	8.9
63	**2500**	41.6	35.9	28.2	23.2	19.7	17.1	15.1	13.6	12.3	11.2
72	**1950**	46.0	39.7	31.2	25.7	21.8	19.0	16.8	15.0	13.6	12.4
80	**2500**	52.8	45.6	35.8	29.4	25.0	21.7	19.2	17.2	15.6	14.3
100	**2800**	66.8	57.6	45.2	37.2	31.6	27.5	24.3	21.8	19.8	18.1
13	**2000**	8.3	7.2	5.7	4.7	4.0	3.4	3.0	2.7	2.5	2.3
19	**2000**	12.2	10.5	8.3	6.8	5.8	5.0	4.4	4.0	3.6	3.3
30	**2000**	19.3	16.6	13.0	10.7	9.1	7.9	7.0	6.3	5.7	5.2
40	**2000**	25.7	22.2	17.4	14.3	12.2	10.6	9.3	8.4	7.6	6.9
50	**2000**	32.1	27.7	21.7	17.9	15.2	13.2	11.7	10.5	9.5	8.7
63	**2000**	40.4	34.9	27.4	22.5	19.1	16.6	14.7	13.2	12.0	10.9
72	**1450**	43.7	37.7	29.6	24.4	20.7	18.0	15.9	14.3	12.9	11.8
80	**2000**	51.3	44.3	34.8	28.6	24.3	21.1	18.7	16.8	15.2	13.9
100	**2300**	65.4	56.4	44.3	36.4	31.0	26.9	23.8	21.3	19.3	17.7

DIVER WORK OF BREATHING RATE IS 20 RMV FOR CALCULATIONS, RATES LOWER OR HIGHER WILL ALTER RESERVE

Bail out Bottle Size	Starting Pressure	Time @ Depth 30FSW	Time @ Depth 40FSW	Time @ Depth 60FSW	Time @ Depth 80FSW	Time @ Depth 100FSW	Time @ Depth 120FSW	Time @ Depth 140FSW	Time @ Depth 160FSW	Time @ Depth 180FSW	Time @ Depth 200FSW

13	**3000**	11.7	10.1	7.9	6.5	5.5	4.8	4.2	3.8	3.4	3.2
19	**3000**	17.0	14.7	11.5	9.5	8.1	7.0	6.2	5.6	5.0	4.6
30	**3000**	26.9	23.2	18.2	15.0	12.7	11.1	9.8	8.8	8.0	7.3
40	**3000**	35.9	30.9	24.3	20.0	17.0	14.8	13.1	11.7	10.6	9.7
50	**3000**	44.8	38.7	30.4	25.0	21.2	18.5	16.3	14.6	13.3	12.1
63	**3000**	56.5	48.7	38.3	31.5	26.7	23.3	20.6	18.4	16.7	15.3
72	**2450**	63.2	54.6	42.8	35.2	29.9	26.0	23.0	20.6	18.7	17.1
80	**3000**	71.7	61.9	48.6	40.0	34.0	29.5	26.1	23.4	21.2	19.4
100	**3300**	90.4	78.0	61.2	50.4	42.8	37.2	32.9	29.5	26.7	24.4
13	**2500**	11.4	9.9	7.7	6.4	5.4	4.7	4.2	3.7	3.4	3.1
19	**2500**	16.7	14.4	11.3	9.3	7.9	6.9	6.1	5.5	4.9	4.5
30	**2500**	26.4	22.8	17.9	14.7	12.5	10.9	9.6	8.6	7.8	7.1
40	**2500**	35.2	30.4	23.8	19.6	16.7	14.5	12.8	11.5	10.4	9.5
50	**2500**	44.0	38.0	29.8	24.5	20.8	18.1	16.0	14.4	13.0	11.9
63	**2500**	55.4	47.8	37.6	30.9	26.3	22.8	20.2	18.1	16.4	15.0
72	**1950**	61.4	53.0	41.6	34.2	29.1	25.3	22.4	20.0	18.2	16.6
80	**2500**	70.4	60.8	47.7	39.2	33.3	29.0	25.6	23.0	20.8	19.0
100	**2800**	89.0	76.8	60.3	49.6	42.2	36.7	32.4	29.1	26.3	24.1
13	**2000**	11.1	9.6	7.5	6.2	5.3	4.6	4.1	3.6	3.3	3.0
19	**2000**	16.3	14.0	11.0	9.1	7.7	6.7	5.9	5.3	4.8	4.4
30	**2000**	25.7	22.2	17.4	14.3	12.2	10.6	9.3	8.4	7.6	6.9
40	**2000**	34.2	29.5	23.2	19.1	16.2	14.1	12.5	11.2	10.1	9.3
50	**2000**	42.8	36.9	29.0	23.8	20.3	17.6	15.6	14.0	12.7	11.6
63	**2000**	53.9	46.5	36.5	30.1	25.5	22.2	19.6	17.6	15.9	14.6
72	**1450**	58.3	50.3	39.5	32.5	27.6	24.0	21.2	19.0	17.2	15.8
80	**2000**	68.4	59.1	46.4	38.2	32.4	28.2	24.9	22.3	20.2	18.5
100	**2300**	87.1	75.2	59.0	48.6	41.3	35.9	31.7	28.4	25.8	23.6

DIVER WORK OF BREATHING RATE IS 15 RMV FOR CALCULATIONS, RATES LOWER OR HIGHER WILL ALTER RESERVE

Diver Training and Certifications Records

Diver training levels will be evaluated by the Dive Master at the time of diving. Records that will be verified are: Medical Certification Date, OSHA 40 hour and 8 hour refresher dates, CPR Certification, First Aid Certification, Oxygen Administration Training, Backboard Training, and the last dive completed.

DIVE MASTER or UNIT DIVE OFFICER CERTIFICATION OF RECORDS:

_____

Date: _____

_____

Date:_____

ERT/SERAS Dive Logs

Site Name: _____ Date:_____ Standard Equipment:_____ _____

Weather:_____ Wind:_____ Air Temp:_____ Water Temp:_____ Swells:_____ Surge:_____ Visibility:_____

#	Date	Diver	Standby	Tender	Divemaster	Time (start)	Tank Pres (start)	Time (end)	Tank Pres (end)	Bottom Time	Max. Depth	Comments

Dive Plan Briefing Checklists

Operation Briefing:

Location of the Dive
Relevant Dive Operation Regulations
Dive Team Roles/Responsibilities (Diver/Tender/Standby Diver/Divemaster/Alternative Divemaster)
Dive Objective
Dive Plan
Assigned Diver Tasks
Dive Equipment/Project Specific Equipment
Environmental/Dive Conditions (Wave Heights, Current, Tidal Heights, Maximum Depth/Bottom Time, Visibility, Weather, Boat Traffic, Water Temperature)
Entry/Exit Points
Questions About the Mission?

Safety Briefing:

Emergency Evacuation Plan/Procedures
Diving Accident Management and Emergency Equipment
- First Aid Kit
- Oxygen Kit
- Cellular Phone
- Diver Recall System

Diver Recall Procedures/Signal
Location of the Emergency Numbers/Directions
Dive Safety Procedures:
Diver Separation
- Safety Stop Requirements
- Loss of Communications
- Diver's Tank Pressure Reaches 500 PSI
- Alternate Air Source
- Termination of a Dive

Physical Hazards
Biological Hazards
Chemical Hazards
Diver Decontamination Plan
- Equipment/Required Decontamination Fluids/Procedures

Any Diver Deems Conditions Unsafe
Questions on Safety Issues?

Communications Briefing:

Diver to Diver Hand Communications
Diver to Diver Audible Signals
Diver to Diver Line Communications
Recall Signal
Questions on Communications?

PREDIVE CHECKLIST - SCUBA

___ Dive and Health and Safety Briefing

___ Oxygen and First Aid Equipment Ready and Accessible

___ Dive Flag

___ Diver Recall System Setup and Speaker Deployed

___ Equipment Set-up

- ___ Pony Bottle Tank Pressure (if needed) (_____ psi)
- ___ Primary Tank Pressure (_____ psi)
- ___ Communication Test (if using hard-wired communications)
- ___ Manifold Block in Closed Position (if needed)

___ Equipment Check

___ Dress Diver (Weight Harness _____ lbs, Dive Harness, Hood, Outer Gloves, Fins)

___ Standby Diver Readied (if needed)

___ Insure Primary and Backup Air Is Open

___ Dive Log (time of start of dive/starting tank pressure/conditions)

___ DON Mask and Check Communications

___ Enter Water

___ Dive Log (time of start of dive/starting tank pressure/conditions)

___ Check Communications

___ Leak Test

___ Check Buoyancy

___ Conduct Dive

___ Complete Dive Log (time of end of dive/final tank pressure/maximum depth/comments)

___ Clean and Stow Equipment

PREDIVE CHECKLIST - SURFACE SUPPLY/AGA MASK

Diver: _____ Tender:_____ Divemaster:_____ Date: _____ Dive #:_____

___ Dive and Health and Safety Briefing

___ Oxygen and First Aid Equipment Ready and Accessible

___ Dive Flag

___ Diver Recall System Setup and Speaker Deployed

___ Set-up Surface Supply Control Box

- ___ Purge Air Lines
- ___ Over-pressure Relief Valve Installed on 1st Stage Regulator on Pony Bottle
- ___ Non-return Valve Between Umbilical and Manifold Block and is Functioning
- ___ Pony Bottle Tank Pressure (psi)
- ___ Primary Tank Pressure (psi)
- ___ Secondary Tank Pressure (psi)
- ___ Ensure Gas Flow to Mask or Helmet and Test Primary and Backup Gas Supply Including Function of Valve on Manifold Block
- ___ Communication Test
- ___ Manifold Block in Closed Position

___ Equipment Check

___ Dress Diver (Weight Harness _____ lbs, Dive Harness, Hood, Outer Gloves, Fins)

___ Standby Diver Readied

___ Insure Primary and Backup Air Is Open

___ DON Mask and Check Communications

___ Enter Water

___ Dive Log (time of start of dive/starting tank pressure/conditions)

___ Check Communications

___ Leak Test

___ Check Buoyancy

___ Complete Dive Log (time of end of dive/final tank pressure/comments

DIVNIG ACCIDENT MANAGEMENT

ADULT CPR/AED

Emergency Action Steps

- Assess Scene. If the scene is not safe or at any time becomes unsafe, GET OUT!
- Assess Victim. Not Moving? No Response?
- Alert. Shout for help. No Help? Alert EMS or activate your emergency action plan. Get the AED and oxygen.
- Attend to ABCDs

A	**Airway. Open Airway** • Tilt the head, lift the chin
B	**Breathing. Check Breathing** • Look, listen, and feel for 5, but no more than 10 seconds. • If the victim is not breathing normally, give 2 breaths that make the chest visibly rise, but no more than that.
C	**Compressions** • Give 30 chest compressions, 2 rescue breaths. Repeat. - Middle of the chest between the nipples. - Push hard and fast (100x per min.) 1 ½ - 2 inches deep. - Allow the chest to recoil completely. Minimize interruptions. - Continue 30:2 until an AED or EMS/advanced providers arrive, or victim shows signs of life
D	**Defibrillation** • Expose the chest, turn on the AED. Select and attach the ADULT pads. Follow the AED voice prompts. - SHOCK advised: CLEAR and give 1 shock. Immediately resume chest compressions. - NO SHOCK advised: Immediately resume chest compressions - 30:2 x 5 cycles. Continue as directed by AED

From American Safety & Health Institute

DIVING ACCIDENT MANAGEMENT FLOW CHART

Mild Signs/Symptoms
Immediate Evacuation
Not Necessary

1. Fatigue
2. Skin Rash
3. Indifference
4. Personality Change

YES →

First Aid

1. Administer oxygen 30 mins.
2. Observe for onset of more serious symptoms.

YES **Relief** → Keep patient under prolonged observation and have him consult diving physician as soon as possible.

No More Relief Symptoms ↓

No Relief ↓

Severe Signs/Symptoms
Immediate Evacuation
To 6 ATA Recompression Chamber

1. Joint Pains
2. Dizziness or weakness
3. Paralysis of face
4. Visual disturbances
5. Feeling of blow on chest
6. Chest pain
7. Severe hacking cough
8. Shortness of breath
9. Bloody, frothy mouth
10. Staggering
11. Difficulty telling direction
12. Paralysis or weakness of extremities
13. Collapse or unconsciousness
14. Convulsions
15. Cessation of breathing

→ Did patient take a breath underwater, regardless of depth (2 feet or deeper) from a SCUBA tank, hose, bucket, submerged car, etc?

YES →

1. CPR, is necessary to restore breathing and/ or heart function.
2. Place patient on oxygen and ensure that he remains on oxygen until taken off by diving physician even if breathing normally.
3. Alert evacuation system
4. IV Fluids (0.9 N.S., L.R. or D 1/2 N.S.).

↓

1. Evacuate directly to an E.R. room/ recompression facility and a diving physician.
2. Maintain cabin pressure as close to sea level as possible for pressurized aircraft, or below 1000 feet for non-pressurized aircraft.
3. Forward complete history of all events leading up to accident.

No ↓

If patient was not under the water for the past 24 hours
1. Begin CPR, if needed.
2. Administer oxygen.
3. Evacuate to nearest physician or medical facility

↓

U.S.C.G. (at sea)
VHF 16 HF 2182

Duke University
Diving Accident Network
(919) 684-8111

FOR YOUR DIVE AREA:

Chamber _____

Rescue _____

Coast Guard _____

Diving Doctor _____

By Dick Rutkowski

HYPERBARICS INTERNATIONAL, INC.

Signs and Symptoms

Knowing the causes, signs and symptoms is necessary in ensure the proper treatment of a diving accident victim. You should be able to recognize the follow:

Gas Embolism

As a diver surfaces, the gas trapped in the lungs expands, rupturing the alveoli. Bubbles of gas are forced into the circulatory system, to the heart, and distributed to the body tissues. As the ascending diver is normally in a vertical position, these bubbles tend to travel upward toward the brain. As the bubbles enlarge and pass into smaller arteries, they reach a point where they can move no further, and cut off circulation. The effects of halting circulation, especially to the brain, are serious and require immediate treatment. Symptoms of embolism occur within 3-5 minutes of surfacing. One, a few, or all of the symptoms may be present.

Symptoms:

- Fatigue
- Weakness
- Dizziness
- Paralysis of extremities or face
- Visual disturbances such as blurring
- Feeling of blow on chest, progressively worsening
- Cough or shortness of breath

Signs:

- Sudden unconsciousness
  (usually immediately after surfacing, possibly before surfacing)
- Bloody, frothy sputum
- Staggering
- Confusion or difficulty in seeing
  (i.e., moving in a wrong direction, bumping into objects)
- Paralysis or weakness in extremities or face
- Collapse or unconsciousness
- Convulsions
- Cessation of breathing

Treatment:

Immediate first aid is to place the victim on 100 percent pure oxygen. Begin oxygen treatment for embolism en route to a recompression chamber. Treatment for air embolism is immediate recompression in a recompression chamber. This may reduce the size of the bubbles to the point where the circulation of blood may resume. The victim should be recompressed as soon as possible, and treated on the appropriate treatment table only after it is determined that no everyday medical problem may be the cause of coma, i.e., diabetes coma, drugs, etc. Under no circumstances should be victim be taken back into the water to depth for treatment.

Decompression Sickness

Decompression sickness (bends, caisson disease, compressed air illness) is the result of inadequate decompression following exposure to increased pressure. While immediate recompression is not a matter of life and death as with air embolism, the quicker recompression is initiated the better the rate of recovery. While under pressure, the inert portion of the breathing gas (nitrogen, helium,etc.) is passed into solution in the blood and absorbed by the body tissues. As long as the diver remains under pressure, this gas presents no problems. Should the pressure be quickly removed, (as in rapid surfacing) the inert gas can come out of solution and form bubbles in the tissues and blood stream. The controlled ascent permits the body to rid itself of excess inert gas at a rate which will enable it to remain in solution.

Symptoms:

Symptoms of decompression sickness are extremely varied, and are in many cases similar to those of air embolism. The effects of air embolism will be noticeable prior to or immediately after the diver surfaces. Any occurrence of symptoms more than 1/4 hour after the diver reaches the surface can generally be assumed not to be air embolism. The most frequent symptoms of decompression sickness are listed below

Type I Presentation

Pain
- located on or adjacent to a joint
- does not radiate
- may be transient (niggles)
- often gradual in onset

Itching
- fiberglass irritation-like sensation (the only sensation in this category of DCS)
- more likely in gas switching and hot water suit use

Pitting Edema
- centers around areas of pain/discomfort
- more likely with treatment delay
- slow to resolve

Skin Blotching
- rash like mottling of skin, can be red or purplish-blue
- often associated with itching sensation
- responds rapidly to recompression

(Abdominal pain may be an early warning sign of spinal cord involvement. Proceed accordingly until proved otherwise)

Type II Presentation

Central Nervous System Symptoms (cranial and spinal cord)
- abnormalities
- may be subtle
- usually gradual in onset
- may not be recognized by patient

Cardiopulmonary Symptoms - can be life threatening
- classic manifestation is CHOKES (a dry persistent non-productive cough)
- common in blow-up accidents
- patient may subsequently develop cerebral symptoms

Abdominal Encircling Pain - precursor of overt spinal cord symptoms
- often misdiagnoses as Type I DCS

Unusual Fatigue Post Dive - a subtle symptom which may be associated with minute cerebral micro-embolism

Type I DCS Developing Under Pressure
- particularly surface oriented air diving

Treatment:

The treatment for decompression sickness is recompression as quickly as possible according to the symptoms. Any symptom except a rash and local pain is considered a serious symptom and should be treated as such. Administer 100 percent pure oxygen en route to a recompression chamber.

While decompression sickness may, in some rare cases, occur up to 24 hours after the exposure to pressure, the vast majority of cases (95 percent) will be evident within hours. Fifty percent will occur within 30 minutes and 85 percent within an hour. Only 1 percent will be delayed over 6 hours. Decompression sickness can occur while flying 24 hours after a diving exposure.

Pneumomediastinal, Pneumoparacardium

Pneumomediastinal emphysema may result from a ruptured pleural bubble or injury to the lung, esophagus, trachea, or main stem bronchus. While not serious in itself, it may be an indication of an air embolism.

Symptoms:

- Pain under the breastbone (sternum) which may radiate to the neck, neck bone or shoulder
- Shortness of breath
- Faintness

Signs:

- Blueness (cyanosis) of skin, lips, or fingernails
- Difficulty breathing
- Shock

Treatment:

Unless there is CNS or neurological symptoms, recompression is not neces-

Treatment:

Unless there is CNS or neurological symptoms, recompression is not necessary. Medical assistance should be obtained, and oxygen administered if necessary.

Subcutaneous Emphysema

Subcutaneous emphysema has the same initiating mechanism as gas embolism but is not as serious as gas embolism. This condition results when air escapes into the tissues just under the skin (subcutaneous) and normally occurs in the area of the neck and/or collarbone.

Symptoms:

- Felling of fullness in neck area
- Change in sound of voice

Signs:

- Swelling or distention around the neck
- Crackling sensation when skin is moved
- Change in sound of voice
- Difficulty in breathing or swallowing

Treatment:

Unless complicated by CNS or neurological sympstoms, recompression is not necessary. Seek the services of a physician and administer oxygen if breathing is impaired.

Pneumothorax

Pneumothorax is the result of the presence of air between the lung and the inner wall of the chest cavity. As the air continues to expand, partial or total collapse of the lung may result. In serious cases, displacement of the heart could result.

Symptoms:

- Sudden onset of cough
- Shortness of breath
- Sharp pain in the chest, usually made worse by breathing

Signs:

- Blueness (cyanosis) of skin, lips and fingernails
- Pain in the chest, evidenced by grimacing or clutching the chest
- A tendency to bend the chest toward the side involved
- Rapid, shallow breathing

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13. If it is a divi
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14. If the patient
risks.

On-Site Neurological Exam

The On-Site Neurological Exam is easy to learn and can be done by individuals with no medical experience. Perform as much of the examination as possible, but do not let it interfere with evacuation to a medical treatment facility. This is drawn from Divers Alert Network: http://www.diversalertnetwork.org/medical/neuroexam.asp .

Perform the following steps in order, and record the time and results.

1. Orientation

Does the diver know his/her own name and age?
Does the diver know the present location?
Does the diver know what time, day, year it is?

Note: Even though a diver appears alert, the answers to these questions may reveal confusion. Do not omit them.

2. Eyes

Have the diver count the number of fingers you display, using two or three different numbers.

Check each eye separately and then together.

Have the diver identify a distant object.

Tell the diver to hold head still, or you gently hold it still, while placing your other hand about 18 inches/0.5 meters in front of the face. Ask the diver to follow your hand. Now move your hand up and down, then side to side. The diver's eyes should follow your hand and should not jerk to one side and return.

Check that the pupils are equal in size.

3. Face

Ask the diver to purse the lips. Look carefully to see that both sides of the face have the same expression.

Ask the diver to grit the teeth. Feel the jaw muscles to confirm that they are contracted equally.

Instruct the diver to close the eyes while you lightly touch your fingertips across the forehead and face to be sure sensation is present and the same everywhere.

4. Hearing

Hearing can be evaluated by holding your hand about 2 feet/0.6 meters from the diver's ear and rubbing your thumb and finger together.

Check both ears moving your hand closer until the diver hears it.

Check several times and compare with your own hearing.

Note: If the surroundings are noisy, the test is difficult to evaluate. Ask bystanders to be quiet and to turn off unneeded machinery.

5. Swallowing Reflex

Instruct the diver to swallow while you watch the "Adam's apple" to be sure it moves up and down.

6. Tongue

Instruct the diver to stick out the tongue. It should come out straight in the middle of the mouth without deviating to either side.

7. Muscle Strength

Instruct the diver to shrug shoulders while you bear down on them to observe for equal muscle strength.

Check diver's arms by bringing the elbows up level with the shoulders, hands level with the arms and touching the chest. Instruct the diver to resist while you pull the arms away, push them back, up and down. The strength should be approximately equal in both arms in each direction.

Check leg strength by having the diver lie flat and raise and lower the legs while you resist the movement.

8. Sensory Perception

Check on both sides by touching lightly as was done on the face. Start at the top of the body and compare sides while moving downwards to cover the entire body.

Note: The diver's eyes should be closed during this procedure. The diver should confirm the sensation in each area before you move to another area.

9. Balance and Coordination

Note: Be prepared to protect the diver from injury when performing this test.

First, have the diver walk heel to toe along a straight line while looking straight ahead.

Have her walk both forward and backward for 10 feet or so. Note whether her movements are smooth and if she can maintain her balance without having to look down or hold onto something.

Next, have the diver stand up with feet together and close eyes and hold the arms straight out in front of her with the palms up. The diver should be able to maintain balance if the platform is stable. Your arms should be around, but not touching, the diver. Be prepared to catch the diver who starts to fall.

Check coordination by having the diver move an index finger back and forth rapidly between the diver's nose and your finger held approximately 18 inches/0.5 meters from the diver's face. The diver should be able to do this, even if you move your finger to different positions.

Have the diver lie down and instruct him to slide the heel of one foot down the shin of his other leg, while keeping his eyes closed. The diver should be able to move his foot smoothly along his shin, without jagged, side-to-side movements.
Check these tests on both right and left sides and observe carefully for unusual clumsiness on either side.

Important Notes:

Tests 1, 7, and 9 are the most important and should be given priority if not all tests can be performed.

The diver's condition may prevent the performance of one or more of these tests. Record any omitted test and the reason. If any of the tests are not normal, injury to the central nervous system should be suspected.

The tests should be repeated at 30- to 60-minute intervals while awaiting assistance in order to determine if any change occurs. Report the results to the emergency medical personnel responding to the call.

Good diving safety habits would include practicing this examination on normal divers to become proficient in the test.

Examination of an injured diver's central nervous system soon after an accident may provide valuable information to the physician responsible for treatment.

EPA ERT/SERAS POST DIVE REPORT

Site Name:_____ Date:_____

Location:_____ WA #:_____

Divemaster/Task Leader:_____ WAM:_____

Dive Team:

DIVER	AGENCY	NUMBER OF DIVES	BOTTOM TIME	COMMENTS

Equipment Used:

_____ _____ _____

_____ _____ _____

Dive Plan:

Were dive objectives achieved? Yes No

If no, please describe why:_____

_____

Were any modifications necessary in dive plan? Yes No

If yes, please describe modifications:_____

_____

_____

EPA ERT/SERAS POST DIVE REPORT (Cont'd)

Was all equipment in Dive Plan available on-site and functional? Yes No

If no, please describe: _____

_____

Equipment Problems/Lost Equipment:

Make	Model	S/N or EPA #	COMMENTS

Conditions/Hazards Encountered:

Were dive conditions as described in Dive Plan and were all hazards documented in the Dive Plan? Yes No

If no, please describe:_____

_____

_____

Accidents/Injuries:

Were there any accidents or injuries? Yes No

If yes, please describe accident/injury:_____

_____

_____

Additional Comments:_____

_____

_____

EPA ERT/SERAS TRAINING REPORT

Training Objective: _____

Training: _____

Name	Signature	Organization	Date

Comments: _____

_____

_____