

Murdoch University

Protocols for Underwater Activities

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1. PURPOSE

This document describes the procedures, qualification criteria and regulations that control snorkelling and SCUBA diving activities undertaken as part of work requirements on behalf of the University, or as part of a recognised programme of study at the University (including undergraduate and postgraduate studies).

2. SCOPE

These procedures shall apply to all people undertaking diving as part of research or study activities carried out under the auspices of the University. All divers (staff, students, volunteers and visitors) are obliged to study these procedures and adhere to them at all times.

3. REFERENCES

Relevant publications:

AS2299.1 Occupational diving operations – Standard operational practice

AS2299.2 Occupational diving operations – Scientific diving

AS2815 Training and certification of occupational divers (Parts 1 to 4)

AS2030 Gas cylinder specifications (Part 1, 2 and 4)

AS4005 Recreation diving set (Parts 1 to 5)

University of Western Australia Diving Procedures Manual

Edith Cowan University Diving Operations Procedures

Defence and Civil Institute of Environmental Medicine (DCIEM) Tables

4. DEFINITIONS

- *Ascent rate* a specified rate of travel that the diver has to maintain up to and between decompression stops. For the DCIEM tables, the ascent rate is 9 m/min
- *Bottom time* the total elapsed time from when a diver leaves the surface to the time (next whole minute) at which ascent is commenced, measured in minutes.
- *Breathing gas* the compressed gas intended for respiration by the diver.
- *Buddy system* a system in SCUBA diving operations whereby a team of two or three free-swimming divers communicate through visual or other means in order that they can help each other.

NOTE: Generally, one member of the team is nominated, and agreed to, as the leader and controller of the actions of the team.

- *Built-in breathing system (BIBS)* a system whereby oxygen or other breathing gas is supplied to a person in a compression chamber via a respiratory demand triggered gas supply device and orinasal face mask located inside the chamber.
- *Caisson gauge* a pressure gauge specifically designed for use inside pressure vessels.
- *Combined dive* the bottom times of more than one dive, added together and treated as a bottom time for a single dive to the deepest depth for the purpose of determining decompression requirements.
- *Commercial diver* An individual certified to AS2815
- *Competent person* a person who has acquired through training, qualifications or experience, or a combination of these, the knowledge and skills to enable that person to perform a specified task.
- *Compression (recompression) chamber* a surface chamber in which persons may be subjected to pressures equivalent to or greater than those experienced when under water,

or under conditions which simulate those experienced on an actual dive.

NOTE: For the purpose of this Standard, 'compression chamber' is taken to include 'recompression chamber'.

- *DCIEM Tables* Decompression tables developed by the Canadian Defence and Civil Institute of Environmental Medicine as issued by the University Dive Officer.
- *Decompression illness* a generic term for acute illness resulting when pathological consequences arise from decompression. This term covers the condition known as decompression sickness (also known as bends) and arterial gas embolism, but does not include barotrauma of ascent.
- *Decompression schedule* a specific decompression procedure for a given combination of depth and bottom time as listed in a decompression table; it is normally described as maximum depth (m or ft)/bottom time (min).
- *Decompression stop* the specific length of time that a diver must hold their ascent at a specified depth to allow for the elimination of sufficient inert gas from the body to allow a safe ascent to the next decompression stop or the surface.
- *Demand gas supply device* a device that provides breathing gas to the diver via a mechanism which provides a flow of breathing gas when the diver inhales.
- *Depth* the maximum depth attained, measured in meters (m) or feet (ft)
- *Descent rate* the maximum rate of travel allowed in descending to the bottom. For these tables, the descent rate is 18 m/min maximum.
- *Dive checklist* A form to be initialled by the Dive Team Leader that detailed requirements were carried out on the field trip (Form 1)
- *Dive control position* a single, designated location on the surface, adjacent to where a diver enters the water, from which it is possible to monitor all systems and functions which relate to the life support and safety of a diver in the water.
- *Dive log sheet* Individual dive log sheets which are completed by each diver daily and submitted to the Dive Team Leader at the completion of each field trip (Form 2)
- *Dive Officer* (also referred to as University Dive Officer) is a person appointed by the University Safety Committee. The Dive Officer is responsible for the organization and diving safety of all diving activities undertaken within the School.
- *Dive plan* a procedure specific to a given diving operation. (Form 3)
- *Dive team* the group of people, including the Dive Team Leader, diver(s), attendant(s) and other personnel as required, who are present at the dive site; directly involved in the dive; responsible for the safe conduct of the diving operation; and responsible for the availability and conduct of emergency procedures.
- *Dive Team Leader* (also referred to as Dive Coordinator) is a person who is appointed by the University Dive Officer to lead a diving operation. The Dive Team Leader is responsible for supervision of the diving operation and for ensuring that the safety provisions are maintained.
- *Diver* a staff member, student or other person who is authorised to dive with the School; any person who is accompanying the Dive Team Leader on a diving operation.
- *Diver's Hose* Hose used in surface-supplied breathing apparatus (SSBA) to carry breathing gas to the diver from a remote location.
- *Diving operation work* in which diving is conducted using underwater breathing apparatus, including work by the dive team in direct support of the diver. This includes the preparation before leaving the University and subsequent reporting upon return.
- *Effective Bottom Time (EBT)* For repetitive diving, the calculated bottom time for decompression purposes taking into consideration the residual nitrogen from the previous dive(s).
- *Effective depth* for a dive at altitude, the depth of an equivalent dive at sea level.
- *Employer* a corporation or individual employing or engaging a person or persons either

under a contract of employment, apprenticeship or traineeship, or for work. This includes self-employed persons.

- *Exceptional exposure dive* a dive where the maximum recommended dive time for a particular depth (sometimes shown by a limiting line in decompression tables) is exceeded by a diver at that depth.
- *Float line* a line connecting the diver to a high visibility float on the surface of the water enabling the approximate location of the diver to be known at all times.
- *Free-flow system* a breathing method used in SSBA diving operations whereby breathing gas enters the full-face mask or incompressible helmet in a continuous flow and is not controlled by a demand gas supply device.
- *Full-face mask* a face mask that is constructed in a single unit; encloses the total area of the face; and incorporates an integral breathing system.
- *Half-face mask* a mask that covers the eyes and nose only, and does not incorporate an integral breathing system.
- *Hookah* a colloquial, but widely used, term for a limited feature form of surface supply diving apparatus usually involving the supply of breathing air from a small compressor unit via a free floating air supply hose to a mouth held demand breathing gas supply device.
- *Incompressible helmet* a helmet that is constructed of rigid material; encloses the entire head area; and incorporates an integral breathing system.
- *Lazy shot* a free-hanging rope, running vertically from the dive control position to an attached weight positioned off the bottom or worksite.
- *Lifeline* a line attached to a diver, which is capable of being used to haul the diver to the surface. The line must be a diameter of not less than 8 mm, attached to the diver at one end and tended from the surface at the other.
- *Limiting line* a line shown in some decompression tables, which indicates time limits (bottom times) beyond which the decompression schedules in use are less safe.
- *NITROX (EANx)* a mixture of oxygen and nitrogen where the volume of oxygen in the mix is not under 22% NITROX Diver a staff member or an associate who is registered to dive and who holds a recognised certificate in Nitrox Diving.
- *Occupational diving* diving performed in the course of employment (irrespective of whether or not diving is the principal function of employment or merely an adjunct to it) and comprising all diving carried out as part of a business; as a service; for research; or for profit.
- *PPO₂* partial pressure of oxygen
- *Point of Interruption* the time at which normal decompression was interrupted as a result of an emergency procedure, i.e., loss of breathing air, O₂ symptom. Once the situation allows the return to normal decompression procedures, the table is to be re-entered where the interruption occurred.
- *Quick release mechanism* a readily operated mechanism that enables the immediate release (e.g. of diver's equipment) from the secured position by a single operation of one hand, but which is designed to minimize the risk of accidental release.
- *Rebreather* a closed or semi closed dive unit which cleans and reoxygenates air breathed out by the diver for reuse.
- *Repetitive dive* any dive that has a repetitive factor greater than 1.0 using the DCIEM tables
- *Repetitive factor (RF)* a figure, used for repetitive diving, determined by the repetitive group and the length of the surface interval after a dive. (For DCIEM Tables)
- *Repetitive group (RG)* a letter that relates directly to the amount of residual nitrogen in a diver's body immediately on surfacing from a dive. (For DCIEM Tables)
- *Residual nitrogen* nitrogen in excess of normal conditions, and which is still dissolved in

a diver's tissues after the surface has been reached.

- *Safety Line* Lifeline, Buddy Line, Float Line, or Current Line.
- *Shore Station* designated base station where safety equipment is available.
- *SHR* Safety and Health Representative.
- *SCUBA* Self-Contained Underwater Breathing Apparatus, is equipment designed to provide breathing compressed air under water, using an open circuit system independent of the surface.
- *Shot rope (Lazy Shot)* a rope running vertically from the dive control position and fixed to the worksite or bottom with a weight or attachment.
- *Stop time* the tabulated decompression stop time, which includes the travelling time to that stop at 18+/- 3 m/min (60+/- 10 ft/min).
- *Surface interval (SI)* the time that a diver has spent on the surface following a dive; beginning as soon as the diver surfaces and ending as soon as the diver starts the descent for the next dive.
- *Surface-supplied breathing apparatus (SSBA)* diving equipment that supplies breathing gas at the required pressure for the depth, through a diver's hose to a diver from plant at the surface.
- *Visiting Diver* other divers who are registered to dive in the Schools diving operations. A person who is not employed or enrolled in the University, but who is here to do work activities.

5. RESPONSIBILITIES

5.1 Dive Officer

- Also referred to as the University Dive Officer
- Advise the University Safety Officer and Committee regarding safe diving procedures
- Maintain an up-to-date Diving procedures manual
- Ensure all divers have been issued with a copy of the diving procedures
- Maintain a detailed Dive Register of all divers in the University and ensure all certification and training requirements are met
- Advise during the planning of diving operations
- Ensure a dive plan is prepared and approved for each diving operation
- Ensure divers are trained in the use of emergency and resuscitation equipment
- Conduct diving inductions
- Remove from use any equipment reported as unserviceable
- Ensure the regular maintenance of all dive gear
- Ensure the regular maintenance of resuscitation equipment, SCUBA tanks and compressors
- Maintain records of dive plans, dive sheets and equipment maintenance
- Investigate and report to the University all dive incidents and injuries

5.2 Dive Team Leader

- Must be appropriately trained and listed in the Dive register maintained by the Dive Officer
- Prepare a dive plan and ensure it is approved by the dive Officer
- Assumes full responsibility for a diving operation upon the departure of the diving team
- Supervise diving in the field and ensure that it is conducted in accordance with these procedures
- Ensure that all necessary emergency equipment is available at the dive site and is fully operational
- Review Diving Procedures, in particular Emergency Procedures with the dive team at the beginning of each trip
- Brief dive team before each dive
- Ensure each dive is recorded on a dive log sheet and returned to Dive Officer at completion of trip
- Maintain communication with the shore
- Assist in the recovery of divers and all equipment and samples from the water
- Record the time of entry and exit
- Investigate and report to the Dive Officer all dive incidents and injuries

5.3 Diver

- Must meet minimum requirements as per section 6.2
- Must be appropriately trained and listed in the Dive Register maintained by the Dive Officer
- Ensure that they are medically and physically fit for each dive
- Ensure that they are familiar with and understanding the provisions of the diving procedures
- Comply with the instructions of the Dive Team Leader
- Maintain an up-to-date log book detailing all of their dives

- Record dive details on dive log sheet daily and submit to Dive Team Leader at the end of each day
- Monitor air supply and ensure all SCUBA dives are completed with not less than 30 bar of air remaining in SCUBA tank on surfacing
- Ensure diving is conducted within the limits of the DCIEM tables
- Ensure all necessary personal diving equipment is operational and available at dive site
- Conduct a functional check of the diving equipment and that of their buddy(ies) before leaving the University and before each dive
- Check diving equipment issued is regularly serviced according to Dive Officer's requirements, and is washed and stowed in a clean, dust free environment
- Report all hazards, incidents and injuries to the Dive Team Leader

5.4 Dive Boat Operator

- Must meet minimum standards as per section 6.2
- Ensure boat safety equipment is on board and fully operational and that fuel supplies are adequate
- Move the boat in order to render assistance to divers as required
- Ensure the Dive Team Leader briefs him/her on the diving operations to be completed each day
- Launching and recovery of the boat
- Cancel diving operations when the safety of the vessel and /or personnel would be at risk
- Post lookouts, hoist signals and warn approaching vessels when necessary
- Maintains radio communications with shore
- Report all hazards, incidents and injuries to the Dive Team Leader

The University will only accept responsibility for those divers officially approved by the Dive Officer on field trips. All divers must be registered on the University Dive Register.

5.5 Diving restrictions

5.5.1 Food and drink

In most circumstances normal daily food and fluid intake is left to individual discretion. Where diving is to be conducted in remote areas, a balanced diet must be planned and adequate fluid intake ensured; ensure there is at least 2L per person per day.

Diving should be avoided for 2 hours following a heavy meal. Regular light meals should be taken during the day's diving activities.

5.5.2 Alcohol

Alcohol must not be taken until after normal diving for the day is over. Alcohol should be consumed only in moderation during prolonged diving operations. Diving should not be undertaken within 8 hours of consuming any intoxicants.

Diving with a hangover is dangerous and is not permitted. Alcohol may increase the susceptibility to decompression sickness, enhance the effects of inert gas narcosis and may enhance heat loss in cold water exposure.

5.5.3 Sleep

Adequate rest and sleep will be defined by the requirements of the diving programme and the fitness of the divers. Fatigue during diving can be dangerous, so a tired diver should not be

permitted to dive. It is recommended that divers should have no more than 3 days of diving followed by one day off.

5.5.4 Cold

A cold diver is liable to rapid fatigue and to errors of judgement as well as an increased risk of decompression sickness. The diver will be less able to cope with emergencies and will be unable to concentrate. The combination of fatigue and cold should be avoided at all costs in diving operations. If this is not possible, the Dive Team Leader must consider abandonment, or revision of the diving programme, if accidents are to be avoided.

It is widely appreciated that divers continue to lose heat for some time after leaving the water. This “after-drop” in central body temperature can reach dangerous levels, even if the diver was in a reasonable state upon exiting the water. Some of the following precautions can be used to minimise this problem:

- Divers should keep warm before the dive.
- Limit dive times to reduce the amount of heat loss.
- Plan dives to avoid frequent immersion and draining of wet suits in cold water. e.g. a series of short multiple dives.
- Try to take a warm shower or bath (37-42°C), as soon as is possible
- Allow sufficient time between dives for the divers to rewarm adequately.
- Provide hot drinks and a high daily calorie intake during cold water diving. Alcoholic drinks are NOT to be used to warm up a cold diver, as they have the opposite effect.

5.5.6 Drugs

In general, drug administration during diving should be avoided where possible due to the possibility of covering up serious symptoms. At present, little or no change in the toxicity of many drugs in common use has been shown in hyperbaric conditions. However, drugs can influence diving safety in indirect ways, by impairing judgement and concentration, or by altering a diver’s susceptibility to narcosis and decompression sickness. Individuals under medical orders are unlikely to be diving, but the common practice of “self-medication” may present a hazard, particularly in three situations: headaches, upper respiratory tract problems (e.g. hay fever), and seasickness.

- Headaches: Pain relieving drugs of all types should be avoided during diving. If pain is sufficiently severe to require drugs then the diver is not fit to dive.
- Upper Respiratory tract problems: Routine self-medication with nasal drops to facilitate ear cleaning may be medically hazardous. Such routine use should only be undertaken under medical supervision. The presence of any form of upper respiratory tract infection (common cold, sinusitis, middle ear infection, tonsillitis, sore throat...) imposes an absolute ban on diving until the infection has cleared.
- Seasickness: 2 groups of drugs are used
 - (i) Hyoscine: this is the most suitable drug, however, marked drowsiness can occur, and if possible the drug should be tried initially during a period of non-diving sea travel. Brand name: Hyoscine.
 - (ii) Antihistamines: these are often more effective against motion sickness, but drowsiness is frequently marked. Considerable individual variation occurs in response to the drugs. They MUST be tried initially during a period of non-diving sea travel. Medical advice should be sought if a suitable drug is not found. Brand names: Cyclizine and Meclozine

5.5.7 Diving before or after travel (by car or aeroplane) or after decompression sickness

- When diving after travel, the diver shall have adequate rest before undertaking any diving operations.
- When travelling after diving, altitude exposure after diving is a potent precipitator of decompression illness. After a dive, a minimum delay time should be observed:

Altitude (m)	Time after last dive (hours)		
	Category of dive (see legend)		
	1	2	3
0 – 150	Nil	Nil	2
150 – 300	Nil	2	4
300 – 600	2	12	24
600 – 2400 (see note)	12	24	48
Greater than 2400	24	48	72

NOTE : In pressurized aircraft, the altitude referred to is the effective altitude within the cabin. Commercial aircraft are usually pressurised to an effective cabin pressure of 2400 m or less.

LEGEND:

Category 1 = single dive to $\leq 50\%$ of no-decompression limits, with no decompression or repetitive dives in previous few days.

Category 2 = Routine no-decompression diving; single decompression dives

Category 3 = Multiple decompression dives; extreme exposures; omitted decompressions; other adverse events.

The recommendations in this table are for routine diving operations. The risk of decompression illness varies substantially with differing dive profiles, and data regarding the risks associated with altitude exposure after diving is limited. The advice of a medical practitioner appropriately trained in underwater medicine is recommended where altitude exposure after diving is required.

- Travel after decompression sickness. After decompression illness, a diver shall not be exposed to greater than 300 m altitude until cleared for travel to altitude by a medical practitioner with specialist training in underwater medicine.

6. CLASSIFICATIONS AND TRAINING

6.1 Medical requirements

- Must be performed by a doctor who is qualified to administer the Professional Air, Scientific and Shallow Water Divers Medical
- All divers will have a dive medical annually to AS2299
- All Visiting divers will have had a dive medical within the last 12 months to AS2299 or equivalent
- All volunteer divers to have a current medical to AS4005
- After any accident/injury or illness, the Dive Officer may require that the diver be medically re-examined before they are considered fit to dive

6.2 Status and training

To retain the status of Scientific Diver or Dive Team Leader, divers must complete a minimum of 10 dives per year. If a diver does not maintain this frequency of diving activity, their classification will revert to restricted diver until approved by the Dive Officer for upgrading.

With the advent of the new AS2299, all staff who dive are required to have a Scientific Diving qualification, as specified in AS2299.2:2002. A Restricted Scientific Diver category exists for staff, students or visitors who are involved in research requiring diving, but who do not have the appropriate experience and qualifications, and who do not dive regularly for work purposes. A Restricted Scientific Diver must comply with the criteria specified in AS2299.2:2002; minimum requirements are:

- Minimum age 18 years
- Must hold an open water diving qualification from a recognised SCUBA training and certifying organisation
- Must have at least 15 hours of underwater diving experience after certification.

It is expected that staff who are involved in regular scientific diving as part of their work will be qualified to full Scientific Diver level, as specified in the standard.

NOTES:

1. All of the minimum requirements must be met prior to any diving unless permission is given by the Dive Officer
2. The Dive Officer and/or Dive Team Leader has the right to refuse approval for diving to any person they feel may jeopardise the safety of others or the individual
3. All divers may refuse any diving task they believe to be unsafe or a danger to others, or that contravenes these diving procedures, or beyond their skill levels without fear of retribution

6.3 Minimum requirements

Dive Officer

- Depth restriction 30 m
- Must be qualified to AS2815.1
- Dive medical AS2299 (annually)
- Diver rescue training (current)
- CPR and O₂ training (current)
- Senior First Aid certificate (current)
- 100 hours logged open water experience with at least 5 hours >20 m and a minimum of 20 hours scientific diving

- Tasks: Diver supervision
Conduct diving assessments
Dive planning and record keeping
Scientific diving
Night diving

Dive Team Leader

- Depth restriction 30 m
- Must be qualified to Scientific Diver or equivalent (AS2299.2)
- Dive medical AS2299 (annually)
- Diver rescue training (current)
- CPR and O₂ training (current)
- Senior First Aid certificate (current)
- 50 hours logged open water experience with at least 20 hours >15 m and a minimum of 20 hours scientific diving
- Night diving experience : >10 hours if night diving planned
- Tasks: Diver supervision
Dive planning and record keeping
Scientific diving
Night diving

Scientific Diver

- Depth restriction 30m
- Must be qualified to Scientific Diver or equivalent (AS2299.2)
- Dive medical AS2299 (annually)
- Diver rescue training (current)
- CPR and O₂ training (current)
- Senior First Aid Certificate (current)
- 50 hours logged open water experience with at least 20 hours >15 m
- Night diving experience: >5 hours if night diving planned
- Tasks: Scientific diving
Night diving

Restricted Scientific Divers

- Depth restriction 15m or subject to Dive Officer approval
- Qualified to Open Water Diver or equivalent
- Dive medical AS2299 or equivalent to that required by AS2299 dated within previous 12 months
- Basic First Aid and CPR training
- 15 hours logged experience
- Must complete a check out dive with the Dive Officer or other person nominated by the Dive Officer (minimum qualification Dive Master)
- Tasks approved by Dive Officer

Boat Handlers

- Will have a TL3 boat handlers certificate (Murdoch University or equivalent qualification).

7. EQUIPMENT

7.1 Dive Equipment

All diving equipment must be properly maintained, regularly serviced and tested. NO DIVING SHALL TAKE PLACE WITH EQUIPMENT KNOWN TO BE FAULTY OR MISSING.

Divers must:

- ensure equipment is regularly serviced
- wash and clean all dive equipment after use and stow in a clean, dust-free environment.

Each diver will be equipped with the following:

- mask and snorkel
- Buoyancy Compensating Device (BCD) (with whistle)
- regulator with extra 2nd stage
- depth and pressure gauges
- diver's watch or submersible timing device
- DCIEM tables
- quick release dive weights
- fins
- exposure protection appropriate for conditions.

7.1.1 Dive computers

Dive computers may be used to record depth and diving time. They may not be used to control a dive, but are to be used to check the dive plan is being adhered to.

7.2 Safety Equipment on Dive Boats

All boats used for diving must carry:

- oxygen resuscitation equipment
- lifelines
- dive flag
- radio
- water bottle
- anchoring system
- emergency marker buoy
- spare search and rescue tank(s) to be carried if diving at a distance of more than 5 minutes running time from the shore station
- water proof safety container containing safety equipment in accordance with the Department of Transport's small vessel equipment requirements.

7.3 Pneumatic tools

Where pneumatic tools are being used, air for these tools shall be taken from a source entirely separate from the diver's breathing air supply.

8. PROCEDURES

The dive planning of any underwater project must take into account scientific objectives as well as physiological and practical limitations.

8.1 Pre-departure

- A dive plan must be submitted by the Dive Team Leader and approved by the University Dive Officer prior to any dive operation (Form 3).
- Specific prior approval for night dives must be obtained from the University Dive Officer.
- Specific prior approval for deep diving (>20m) must be obtained from the University Dive Officer.

8.2 Normal Diving Procedures

- Each diver shall be equipped as per section 7.1.
- Divers using SCUBA shall dive in pre-arranged groups of two or three divers.
- The lead diver must be designated and noted in the dive plan for approval by the Dive Officer.
- While in the water each buddy pair or team will at all times remain in visual contact with each other.
- All divers should complete the dive with not less than 30 Bar remaining in the SCUBA tank regardless of the dive plan. The AS2299.2 standard specifies “Every SCUBA diver shall carry sufficient quantity of breathing gas to complete the planned dive plus a reserve supply providing a minimum one quarter safety margin”.
- All dives are to be planned in accordance with DCIEM Tables.
- It is recommended that divers should have a 24-hour continuous period free of diving every 4-7 days depending on depth of dives and exertion.
- Decompression dives are not permitted.
- A safety stop is to be conducted at 5 meters for at least 3 minutes after all dives greater than 15 meters.
- Ascent and descent rates are to be a maximum of 9 meters per minute.

8.2.1 Pre-dive Preparation

- Before work is commenced, the Dive Coordinator will make an assessment of diving skills of Restricted Scientific and Visiting divers (See Appendix 1)
- If the assessment shows the diver is less than competent, the diver should be restricted from diving
- The Dive Coordinator must brief the:
 - Shore station on the location and expected duration of each dive and confirm radio schedules
 - Dive team on
 - Local hazards
 - Objectives of the dive
 - Signals
 - Maximum depth
 - Loss of buddy contact procedures.
- The dive boat operator must ensure that the boat anchor and safety gear are on board and that there is sufficient fuel for the proposed journey and possible emergencies
- Dive boat operators must ensure that all personal equipment is working and safely stowed in the dive boat.

8.2.2 On-site

Before entering the water:

- the Dive Coordinator must brief divers on the dive plan and conditions controlling the termination of the dive:
 - time
 - air supply not to be less than 50 bar on surfacing
 - missing diver procedure must be reviewed
 - one diver of each group shall be designated the lead diver
- divers must thoroughly check their own diving equipment and conduct a buddy check
- diver-recall signal must be agreed to, such as starting motor and revving 3 times.

8.2.3 Loss of buddy contact

If a diver loses contact with the other(s), each diver will complete a 360° turn, ascend 1 metre and then repeat the 360° turn to attempt to re-establish contact. This procedure should take no more than 1 minute and if contact cannot be re-established then the diver(s) shall make a normal ascent to the surface. If contact re-established, the lead diver will assess the need to abort or continue the dive. If contact not re-established, then missing diver procedures should be initiated (section 9.1)

8.2.4 Post Dive

- Report any problems to the Dive Coordinator immediately.
- Divers must log each dive.
- All divers should be aware of possible symptoms of decompression illness for up to 2 days after a dive. Divers are therefore advised:
 - to maintain hydration by drinking plenty of fresh water after diving
 - not to engage in exhausting athletic activities immediately after diving
 - not to fly within 24 hours of a repetitive dive.
- For factors influencing Decompression Illness see Appendix 3.

8.3 Shore Diving

In addition to normal diving procedures, the following procedures must be followed for diving from shore:

- Diving restricted to 50 metres from shore or greater subject to Dive Officer approval
- Diver's attendant must have communication link to emergency services
- Access to oxygen resuscitation equipment within 5 minutes from point of entry
- When shore diving is being conducted in an environment of strong currents, strong surge and limited visibility, a rescue tender shall be on standby.

8.4 Night Diving

In addition to normal diving procedures, the following procedures must be followed for a night dive:

- The dive site must be marked prior to the night dive, using an anchored buoy with a flashing yellow/orange light, visible to at least 200m, attached
- An activated Cyalume (or other suitable light) must be attached to each diver, each diver must also carry an operational diving light/torch
- Drift diving must not be carried out at night.

Note: if night diving from a boat, the boat must show the International lights to indicate that "a vessel is restricted in her ability to manoeuvre". These are three lights in a vertical line, the top and bottom are red and the middle one is white. This is in addition to normal navigation lights.

8.5 Deep Diving (greater than 30 metres)

Deep diving is not permitted.

8.6 Solo Diving

Solo diving is not permitted unless attached to the surface by a lifeline, with a dedicated surface attendant.

8.7 Diving with other Organisations

In situations where University staff or students are operating at another institution or organisation's workplace, they must follow the diving procedures of that workplace subject to approval by the University Dive Officer.

All divers must:

- Prepare and plan for emergency situations
- Discuss risk management and specialised dive procedures with the University Dive Officer.

8.8 Diving Overseas

All University divers diving overseas must:

- Prepare and plan for emergencies
- Have travel insurance with emergency evacuation
- Discuss risk management and specialised dive procedures with the University Dive Officer.

8.9 Snorkel Diving

All persons wishing to snorkel must:

- Complete medical conditions form (if not holding a current medical) and submit to the University Dive Officer (Form 5)
- Be competent swimmers
- Be listed on the dive plan
- Follow instructions of the Dive Coordinator
- Snorkel in pairs or singly with dive attendant on lookout

It is recommended inexperienced snorkel divers wear a life jacket with whistle.

Snorkelling is not recommended under the following conditions:

- Strong currents
- Rough surface conditions.

8.10 Decompression dives

Decompression dives are NOT PERMISSABLE except with the express permission of the Dive Officer.

8.11 Precautionary Decompression stops

Divers who have approached the time limits set out for no-decompression dives identified in the DCIEM decompression tables, should carry out a precautionary decompression schedule equivalent to that shown in the tables if they had just exceeded the no-decompression time. Precautionary decompression stops are to be used and should be included in the dive plan.

8.12 Diving in Low Visibility

In conditions of low underwater visibility divers shall take additional precautions to ensure that they maintain contact with each other. Appropriate additional precautions must be taken. This means diving in the tethered mode.

NOTE: A horizontal visibility of 2 m is usually considered to be the limit below which additional precautions should be taken.

8.13 Towed divers

Divers being towed by a boat and using sleds, “manta-boards” or other towed devices shall be able to release themselves from the towed device at any time.

In addition:

- Towing speed should be below 3 knots and preferably between 1 and 2 knots;
- The device should be attached to a float line equal to or greater in length than the water depth;
- There should be both a boat handler and an observer experienced in such underwater towing operations present on the boat.

8.14 Termination of a dive

A dive shall be terminated in accordance with the pre-dive plan, or when:

1. The Dive Coordinator or person remaining at the surface requests termination;
2. A diver requests termination;
3. A diver loses contact with, or fails to respond correctly to communications from a buddy diver;
4. A diver fails to respond correctly to communications from the divers attendant;
5. A diver begins to use their reserve air supply (the last 50 bar);
6. A diver is aware of any sign of malfunction of equipment or any sign or symptom of distress; or
7. A diver becomes aware of any unusual or unplanned situation that threatens the health or safety of any dive team member.

Diving activities may only be resumed, after the decision to terminate using point 3 or 4 above, if the contact has been restored.

8.15 Hazardous conditions

The following conditions are potentially hazardous and may require special training, precautions and equipment:

- Diving using dry suits
- Being towed on a “manta-board”
- Diving in zero or low visibility
- Diving at night
- Deep diving (greater than 20 m)
- Diving in caves, enclosed spaces, or places where there is danger of entanglement (this requires further qualification)
- Blue water diving (diving in open water where the bottom is beyond permitted diving depth)
- Diving in surf, strong currents (in excess of 1 knot or 55 cm s^{-1}), or heavy seas
- Other conditions that present unusual hazards.

The Dive Coordinator shall ensure that every diver diving in the conditions set out above has the appropriate training and equipment.

NOTE: Hazardous conditions for diving vary widely throughout Australia and require that additional training, equipment, operational procedures and emergency procedures be specifically developed by employers according to location and environment.

9. DIVING EMERGENCIES PROCEDURES

9.1 Missing diver

1. Dive team to notify the Diver's Attendant or Dive Coordinator of missing diver, e.g. five or more short blasts on a whistle is the international assistance signal
2. Diver's Attendant immediately calls the shore base detailing the situation and requests assistance; shore base to notify Police and University Dive Officer (Telephone 93602417 or 0411 069360)
3. Mark with an emergency marker buoy the last known position of the lost diver
NOTE: If any person sights the missing diver, they should maintain visual focus on that position.
4. If divers are still in the water, recall using the recall signal such as starting the motor and revving 3 times
5. Search should begin where diver was last seen using the emergency marker buoy as reference
6. Search should be conducted in pairs
7. Sink (do not swim) to the bottom to determine effect of current
8. Divers involved in search must not subject themselves to risks such as decompression illness.

9.2 Injured diver

The following actions must be taken during a diving emergency.

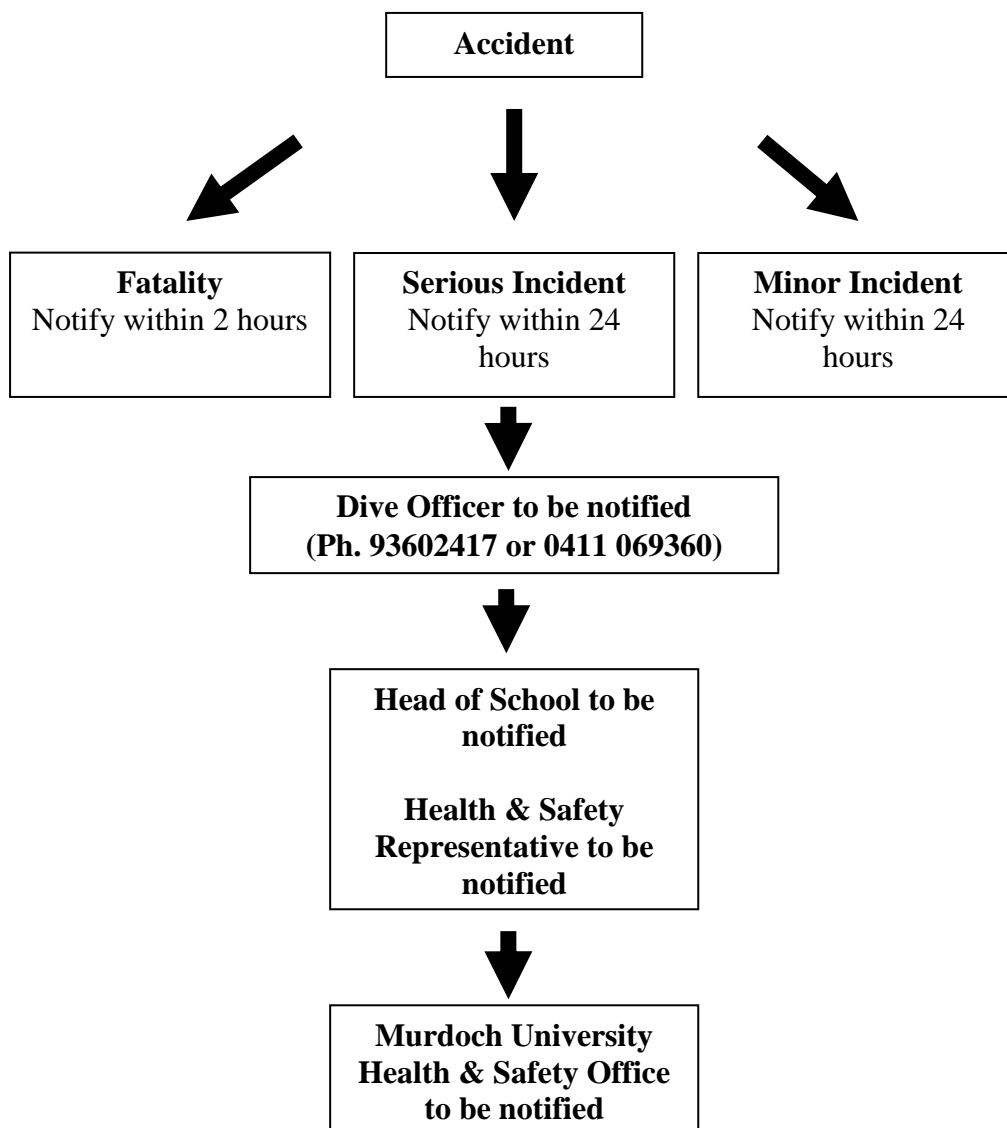
1. Assist the injured person(s) immediately by providing First Aid
2. Recall all divers or swimmers to the boat or shore
3. Ensure that other members of the diving team are not at risk and that all divers are present
4. Follow instructions laid down in Diving Emergency Procedures (Appendix 5)
5. Recover as much of the injured diver's equipment as possible after the emergency
*keep apart from other equipment prior to expert examination
*do not disassemble equipment
NOTE: the Dive Coordinator may decide not to recover items if to do so would be unsafe or cause undue delay
6. Ensure that no equipment has been left in a dangerous condition
7. Ensure that the diver's log sheet(s) and logbook are available for the doctor, particularly if recompression is required
8. In the case of a fatality or serious accident requiring recompression and/or hospitalisation, the Dive Officer must notify the University Safety Officer by telephone as soon as possible.
9. When the immediate emergency has passed, and all necessary steps have been taken to assist the casualty, a full record of the incident must be compiled. While details are still fresh in everyone's mind, the Dive Coordinator or another member of the team should start making notes, obtain details from other divers, record exact times, etc. (Form 7)
NOTE: The buddy of a diver who develops symptoms of decompression illness, even on a dive apparently carried out according to the DCIEM tables, may also develop symptoms later and require treatment.

9.3 Oxygen therapy

Provision of >60% oxygen by facemask on the surface is an emergency First Aid measure for decompression illness, air embolism and shock. It must be administered as necessary during transfer to hospital or recompression facilities or on advice from a diving medical doctor by a qualified operator.

Oxy-Viva or other approved equipment for this purpose must be available at all dive operations. All Scientific Divers and Dive Coordinators must be trained in its use.

9.4 Accident reporting procedures



All incidents need to have a Confidential Incident/Injury report from completed and sent to Murdoch Safety and Health Office within 24 hours (or as soon as practicable).

10. INFRINGEMENTS AND INQUIRIES

10.1 Infringements

If any infringements of the provisions set out in this document are reported, the University Dive Officer must first verify the report and then inform the University Safety Officer as soon as is practicable.

The University Safety Officer may decide that any of the following actions are appropriate.

- a) In the case of a minor infringement, the University Safety Officer may instruct the Dive Officer to discuss the matter with the Dive Coordinator and diver(s) involved, with a view to preventing repetition.
- b) The University Safety Officer may institute an internal enquiry into the incident and take whatever action deemed appropriate following the report of the inquiry.

10.2 Internal inquiries

The University Safety Officer may institute an internal inquiry into any diving related incident or accident. The internal inquiry should normally be carried out by the Dive Officer, Safety and Health Representative and any other School personnel deemed necessary by the University Safety Officer. The Dive Officer remains an *ex officio* member of the committee.

The internal inquiry should be conducted as follows:

- a) Specific terms of reference appropriate to the incident should be established by the University Safety Officer.
- b) All relevant information, both written and verbal, should be gathered from all persons involved in the incident, and from any other source deemed appropriate.
- c) The internal inquiry should compile a complete description of the incident and make any recommendations it considers necessary. The description and recommendations should be communicated to the University Safety Officer in the form of a report, after that report has been validated by all persons named therein. Any unresolved differences of opinion arising at the stage of validation should be noted.
- d) The internal inquiry may recommend to the University Safety Officer additional training or the adjustment or cancellation of the diver certification of the personnel involved. It may also recommend that the circumstances warrant disciplinary action but this will be at the discretion of the University Safety Officer.

11. CONTROLS

The University Dive Officer is to review these Diving Procedures bi-annually.

12. APPENDICES

1. Guidelines to Assessment of New Divers
2. Factors Affecting Decompression Illness
3. Diving Signals
4. Diving Emergency Procedures
5. Dive Tables
6. Dive Medicals
7. Hazard Identification, Risk Assessment and Control

Appendix 1 – Guidelines to Assessment of New Divers

The University Dive Officer should use the following guidelines to evaluate skills of new divers to the University Dive Register. As appropriate, the University Dive Officer may vary performance requirements and skills for the evaluation.

A1.1 - Pre-Dive/Theory

- Knowledge of University Diving Procedures
- Equipment familiarity and pre-dive checks
- Underwater signals and signs
- Buddy contact and lost buddy procedures

A1.2 - Swim And Surface Evaluation

- Swim 200 metres non stop without the use of swim aids, in less than 5 minutes;
- Fin 800 metres in less than 19 minutes;
- Perform an inert diver tow. That is, in less than 5 minutes tow or push another diver a distance of 100 metres, with both divers in full SCUBA.

A1.3 - SCUBA Skill Evaluation

- Fully assemble equipment, perform necessary checks and enter water;
- Surface swim 25 metres demonstrating the ability to alternate between snorkel and SCUBA while kicking;
- Demonstrate mask clearing;
- Demonstrate weight belt removal and replacement;
- Demonstrate removal and replacement of SCUBA equipment;
- Demonstrate regulator recovery and clearing;
- Demonstrate buoyancy control by fin pivot;
- Demonstrate buoyancy control by hovering motionless for at least 15 seconds;
- Demonstrate use of alternative air source stationary and while swimming;
- Rescue and transport, as a diver, a passive simulated victim of an accident (optional);
- Problem solving assessment (optional);
- Discussion of ascent rates, dive profiles and other University diving practices.

A1.4 - Snorkel Diving Skill Evaluation

- Swim 200 metres non stop without the use of swim aids, in less than 5 minutes;
- Fin 800 metres in less than 19 minutes;
- Perform an inert diver tow. i.e. in less than 3 minutes, tow or push another diver a distance of 100 metres, with both divers wearing snorkel equipment;
- Demonstrate mask clearing;
- Demonstrate two methods of snorkel clearing;
- Demonstrate weight belt removal and replacement;
- Duck dive to 2 metres and retrieve an item from that depth.

Appendix 2 – Factors Affecting Decompression Sickness

Taken from Diving and Subaquatic medicine (Edmonds C, Lowry C, Pennefather J, Walker R. (2002) Diving and subaquatic medicine. 4th ed. Oxford: Butterworth Heinemann.)

Factors:

- Exercise
- Physical fitness
- Temperature – cold water, hot shower
- Sex – women
- Age
- Obesity
- Dehydration
- Increased carbon dioxide pressures
- Alcohol Intake
- Physical injury
- Adaptation
- Dive profile
- Rapid and multiple ascents
- Repetitive and multi-day diving
- Altitude exposure

Exercise has various effects, which are sometimes contradictory. Exercise performed while at depth is likely to increase the blood supply to the muscular tissues, and increase the rate of inert gas absorption at that site, which is then the site of DCI. It can increase decompression requirements by a factor of 3.

Thus some muscle, which has a blood perfusion of 3 ml/min per 100 g at rest, has a half time of 23 min and will become 26% saturated with nitrogen during a 10-min dive. With half-maximum exercise the perfusion rises to 30 ml/min per 100 g and the half time to 2.3 min, and it becomes 95% saturated in a 10-min dive. The exercise level increases the nitrogen absorbed in muscle by 69% in a 10-min dive, or 16% in a 60-minute dive.

During or after decompression, severe exercise results in an increase in the speed of bubble development and in the number of bubbles – perhaps due to increased cavitation from tribonucleation of tissues, or the turbulence similar to shaking a bottle of champagne.

Mild exercise during recompression is of value in increasing the rate of gas elimination, perhaps by increasing tissue perfusion, if supersaturation and bubble growth have not been incurred.

Resting after decompression may give the body a longer time to liberate the inert gas it has absorbed during the dive, although occasional movements are warranted to ensure that paralysis or incoordination has not developed without the diver being aware of it. Thus, the routine practice of periodically walking the length of the compression chamber during decompression and therapy is to be commended.

Physical fitness, perhaps due to its relationship to more efficient muscular use and blood flow, seems to be of some protective value to divers.

Temperature may influence DCI in a complex manner, by its influence on perfusion (increased temperature producing increased blood flow) and solubility (lowered temperature producing increased gas solubility). Divers who were exposed to cold at maximum depth may have less

tissue perfusion and DCI in no-decompression dives than divers in warm water and with hot suits.

If the diver becomes mildly hypothermic, which is not uncommon in longer dives, the ability to eliminate the nitrogen is decreased, and DCI is more likely. In some studies the perfusion rate in muscle was halved, thus doubling the required duration of decompression.

Divers who become cold during decompression have a lowered perfusion of tissues during ascent, less gas uptake from the tissues and more DCI. The opposite occurs in warmer conditions. During decompression it is better to be warm, because the nitrogen elimination is increased (as are xenon and krypton, in experimental conditions).

After the dive, exposure to sudden and excessive heat, such as with a hot shower, produces increased superficial blood flow and lowered solubility of gas, resulting in a bolus of nitrogen being mobilized, with gas phase separation and delivery to the lungs, both skin and generalised DCI manifestations could develop.

Women may have a higher incidence of DCI than males. In altitude exposures, this is thought to be a four-fold increase, and in divers more than three-fold. The explanation may be a physiological difference between the sexes, or the effect of social conditioning (physical fitness, cold exposure etc.). Studies have shown higher blood perfusion in women, both in subcutaneous tissues and in muscle.

There is no support for the hypotheses that the contraceptive pill increases the incidence, but menstruation may.

Age: increasing age increases DCI incidence, possibly due to impaired perfusion or to already damaged vessels being more susceptible to other flow interferences. Abnormalities and degenerations within joint surfaces also increase the likelihood to tribonucleation in the aged. A 28 year old has twice the likelihood of DCI incidence of an 18 year old in aviation DCI statistics.

Obesity: increases the tissue mass available to absorb more inert gas. The fattest 25% of the diving population, as judged by skin fold thickness, have a ten-fold incidence of DCI. Not all surveys demonstrate an association between fat content and DCI among divers of normal weight (excluding the obese). Overweight and obesity can be measured by body mass index or skin fold thickness.

Nitrogen is 4.5 times more soluble in fat than in water and non-fatty tissues. In active adult populations, women have 20-30% body fat compared to 10-20% for men.

Dehydration, caused by environment, exercise, water loss from respiration and immersion, and the impracticability of fluid replacement while diving, will reduce perfusion of tissues and thus the elimination of inert gas.

Increased carbon dioxide pressures, from the effects of blood pressure, exercise or breathing resistances with equipment, may cause increased perfusion during the dive, with increased nitrogen loading. It is also a factor with inadequate ventilation in caissons, chambers and helmets.

Alcohol over-indulgency may influence judgement at the time, but more commonly the dehydration, vasodilation and heat loss that develops in the hours afterwards will aggravate DCI.

Physical injury, such as a sprained joint or previous episode of DCI, predisposes to DCI due to

scarring and the alterations in local tissue perfusion. Thus, some clinicians are concerned that spinal operations, such as laminectomy, may be associated with spinal DCI risk.

Dive profiles may influence the likelihood of DCI. The deeper the dive and the more decompression required, the greater the incidence of decompression illness. Surface decompression (returning to the surface before being recompressed) is also more dangerous.

For a single depth/duration exposure, DCI is more likely with a direct ascent to the surface than a gradual ascent interrupted by reasonable and shallower stops, i.e. with a safety stop or multilevel diving. The opposite will occur if there are increased depths at successive levels.

Multiple ascents during the dive may, by initiating venous gas emboli which are trapped in the pulmonary filter but escape to the arterial system during subsequent compressions, increase the likelihood of DCI. A dive exposure which will probably produce joint DCS is more likely to induce neurological DCI if excursions are made to the surface during the profile. Surface decompression procedures, repetitive dives with short surface intervals (<2 hours) and arterial gas emboli from pulmonary barotrauma may have similar effects.

Repetitive dives: if a diver exposes himself to increase pressures within 24 hours of a previous dive, the residual nitrogen remaining within his tissues will increase the likelihood of DCI. Mild or insignificant cases may be made much worse. Advice is often given to recreational divers to take a day off after every 3 days of repetitive diving.

If asymptomatic bubbles have been produced by diving, the subsequent diving even longer than 24 hours afterwards will probably precipitate an episode of DCI.

Travelling to **altitude** to dive, or exposure to altitude after diving, may provoke DCI by producing or expanding existing bubbles. Air travel may also predispose to DCI because of the dehydration effect in the cabin altitude, if not rectified by a compensatory fluid intake. More often, aviation exposure can induce DCI days after a dive, especially from repetitive, long or saturation dives. Flying is not advisable for at least 24 hours after normal, non-decompression, recreational diving.

Breathing different **gas mixtures**, such as nitrous oxide after air diving, decompressing on air after diving on Heliox, or breathing a slow dissolving gas while in a fast diffusing gas environment, may produce local or general pressure gradients which cause bubbles to develop. Existing bubbles may also expand if faster gases are breathed, e.g. breathing Heliox after producing air bubbles.

Decompression staging in a horizontal **position** results in an increased rate of gas elimination, as compared with the vertical or seated positions. In water, decompression has similar advantages over dry decompression, although this is not mirrored in practical situations because many adverse factors during diving compared to dry compression.

One factor reducing the likelihood of developing DCI is **adaptation** or **acclimatization** – the repetitive and recent exposure to increased pressures. DCI is more probable during the first week of diving operations, and following lay-off periods of more than a week. Although the more susceptible divers would be selectively eliminated at an early stage, this is not the whole explanation. It appears as if, with regular diving, a slight degree of resistance to DCI can develop for that diving depth. The incidence of DCI in caisson workers is halved in the second week and again in the third week.

The currently fashionable explanation for adaptation is the removal of naturally occurring gas

nuclei, which are thought to be the nidus on which the bubble develops. This is also the reason why divers and caisson workers are advised to work up to their maximum exposures gradually.

Many other possible aggravating factors have been proposed, both endogenous (serum complement, lipids, smooth muscle activating factors etc.) and exogenous (smoking, migraine, oral contraceptives etc.). They require more confirmation.

Appendix 3 – Diving Signals

Lifeline Signals

Signals comprise either pulls or bells or a combination of both. A pull is a steady single heave on the line. A bell is a sharp quick tug, always given in pairs as with a ship's bell, i.e. five bells is given as:

Two quick tugs pause with two quick tugs pause one quick tug. It should be noted that one bell does not exist as a signal on its own.

The absolute minimum commands to be familiar with are:

Four pulls..... Come Up (surface to diver) or May I Come Up? (diver to surface).

Succession of pulls (more than 4 pulls) EMERGENCY – Pull Me Up Immediately.

Other standard signals are:

Signals – Attendant to Diver

- (a) 1 pull To call attention. Are you alright?
- (b) 2 pulls Am sending down a rope's end (or as previously arranged).
- (c) 3 pulls You have come up too far. Go down slowly till we stop you.
- (d) 4 pulls Come up.
- (e) 4 pulls then 2 bells .. Come up, hurry up. Come up, surface decompression.

Direction signals

- (a) 1 pull Search where you are.
- (b) 2 bells Go to the end of distance line, jack-stay, or life line.
- (c) 3 bells Face shot lifeline then go right.
- (d) 4 bells Face shot lifeline then go left.
- (e) 5 bells Come into your shot, or turn back if on a jackstay.

Signals – Diver to Attendant

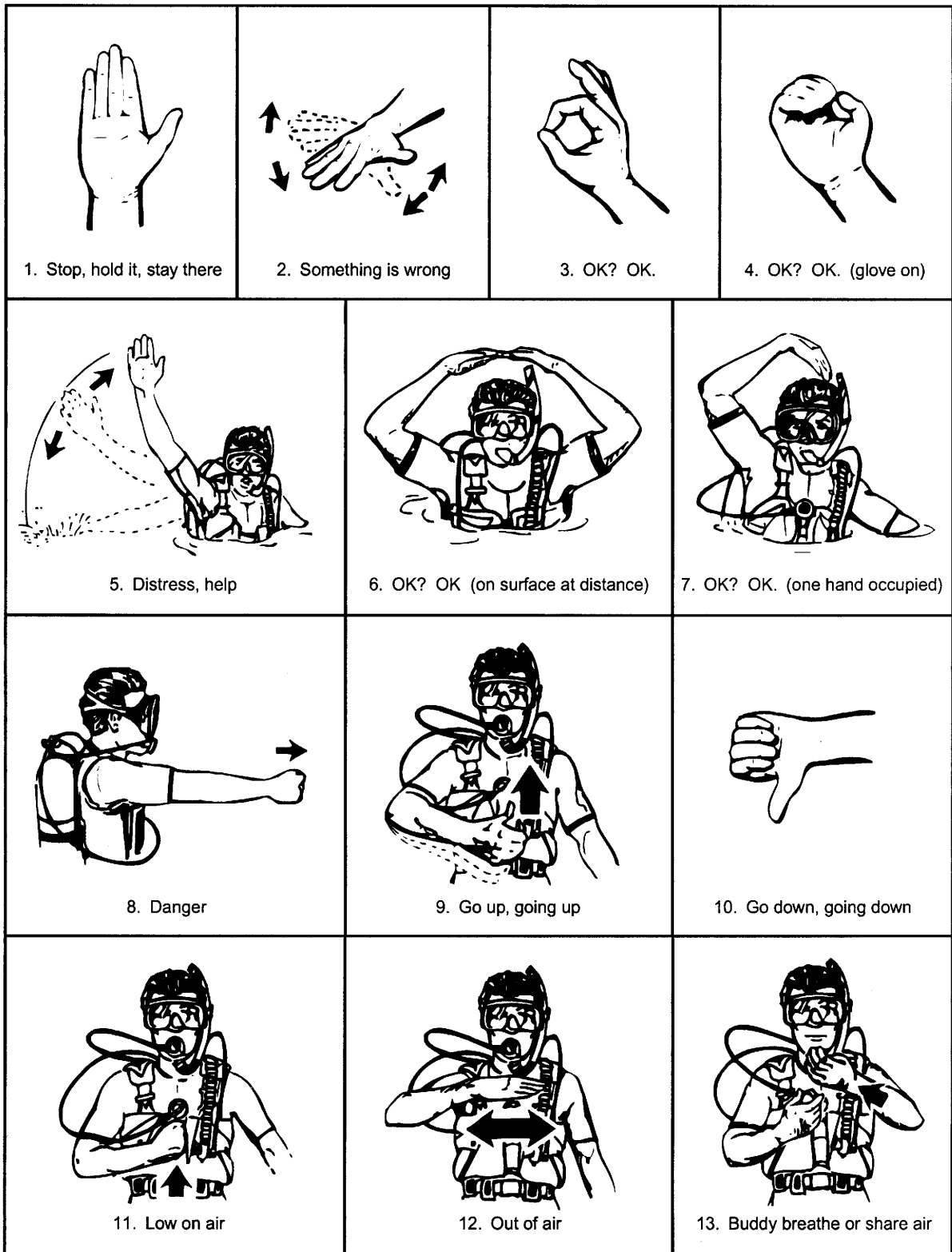
General signals



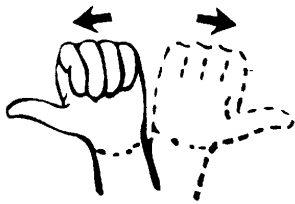


- (a) 1 pull To call attention. Made bottom. Reached end of jackstay.
- (b) 2 pulls Send me down a rope's end (or as previously arranged).
- (c) 3 pulls I am going down again.
- (d) 4 pulls May I come up?
- (e) 4 pulls then 2 bells Assist me up. I want to come up.
- (f) Succession of pulls EMERGENCY signal (ONLY to be used in GREAT (must be more than 4) EMERGENCY). Need not be answered but must be obeyed IMMEDIATELY.
- (g) Succession of 2 bells .. Am foul and need the assistance of another diver.
- (h) Succession of 3 bells .. Am foul but can clear myself if left alone.

Working signals

- (a) 1 pull Hold on or stop.
- (b) 2 bells Pull up.
- (c) 3 bells Lower.
- (d) 4 bells Take up slack lifeline. You are holding me too tight.
- (e) 5 bells Have found, started or completed work.

Figure A3.1 illustrates the hand signals most commonly used in SCUBA diving operations.



 <p>14. Come here</p>	 <p>15. Me, or watch me</p>	 <p>16. Under, over, or around</p>
 <p>17. Level off, this depth</p>	 <p>18. Go that way</p>	 <p>19. Which direction</p>
 <p>20. Ears not clearing</p>	 <p>21. I am cold</p>	 <p>22. Take it easy, slow down</p>
 <p>23. Hold hands</p>	 <p>24. Get with your buddy</p>	 <p>25. You lead, I'll follow</p>

Appendix 4 – Diving Emergency Procedures

A4.1 – Emergency Plan

In the event of an emergency it is essential to immediately assist the injured person. To help with this, as part of the Risk Assessment process for any Murdoch University diving operation, the Dive Coordinator for the operation must prepare an emergency response plan for the area of operation.

The Diving Emergency Protocols flow chart (see *Section A4.3*) may be customised to fulfil this requirement.

A4.2. – Emergency Reporting Procedures

For any accident requiring medical treatment, a Murdoch University Accident Report Form must be completed by the injured person (if possible). A copy of this form may be obtained from the University Dive Officer or Safety Representative if required.

A summary of events leading up to the accident obtained from the person in charge of the workplace should be appended to this report form. The circulation of the report and the detail required will depend on the nature of the incident.

The procedures given below are the minimum that should be carried out in the various circumstances.

A4.2.1 – Minor Accidents and Near Accidents

Problems of this nature are to be included in the Diver's Log Book and a short report on the incident is to be lodged with the University Dive Officer as soon as possible after the event (Telephone 93602417 or 0411 069360).

A4.2.2 – Accidents Resulting In No Permanent Injury

Such accidents include large flesh wounds, broken bones, concussion and any other injuries that would bar the diver from normal work or diving for a period.

The University Dive Officer must be notified as soon as possible after the accident, and a detailed report on the accident must be provided to the University Dive Officer as soon as possible after the event.

The University Dive Officer must decide whether there is any evidence of negligence or unsafe diving practice and report as appropriate to the Murdoch University Occupational Health and Safety Committee.

Before recommencing diving after such an accident, any injured diver should have a full medical examination.

A4.2.3 – Accidents Resulting In Permanent Injury, Inability to Dive, or Death

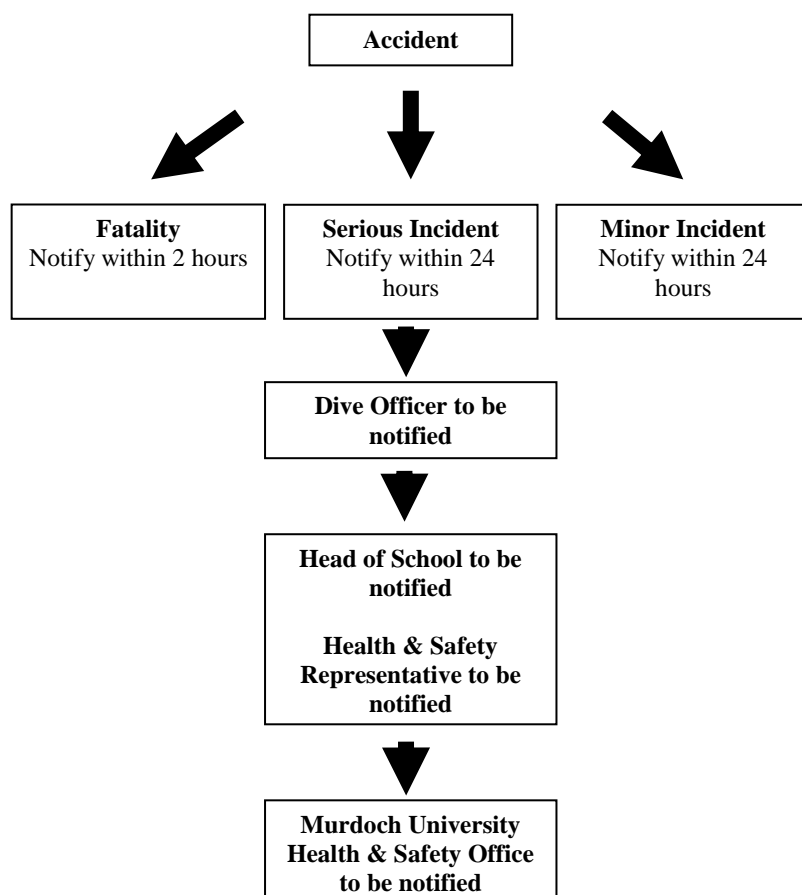
With regard to such accidents, the University Dive Officer must be notified immediately, and should help facilitate retrieval. As soon as possible, a complete report should be compiled by the Dive Coordinator involved and submitted to the University Dive Officer.

This should then be forwarded, with the Diving Officer's comments and recommendations attached, to the Murdoch University Occupational Health and Safety Committee.

FOR ANY INCIDENT INVOLVING A MURDOCH UNIVERSITY DIVER, PARTICULARLY IN CASE OF A SERIOUS ACCIDENT OR FATALITY, THE UNIVERSITY DIVING OFFICER MUST BE NOTIFIED AS QUICKLY AS POSSIBLE

Telephone 93602417 or 0411 069360

A4.2.4 – Administrative Reporting Procedures



All incidents need to have a Confidential Incident/Injury report from completed and sent to Murdoch Health & Safety Office within 24 hours (or as soon as practicable).

A4.3 – Diving Emergency Protocols

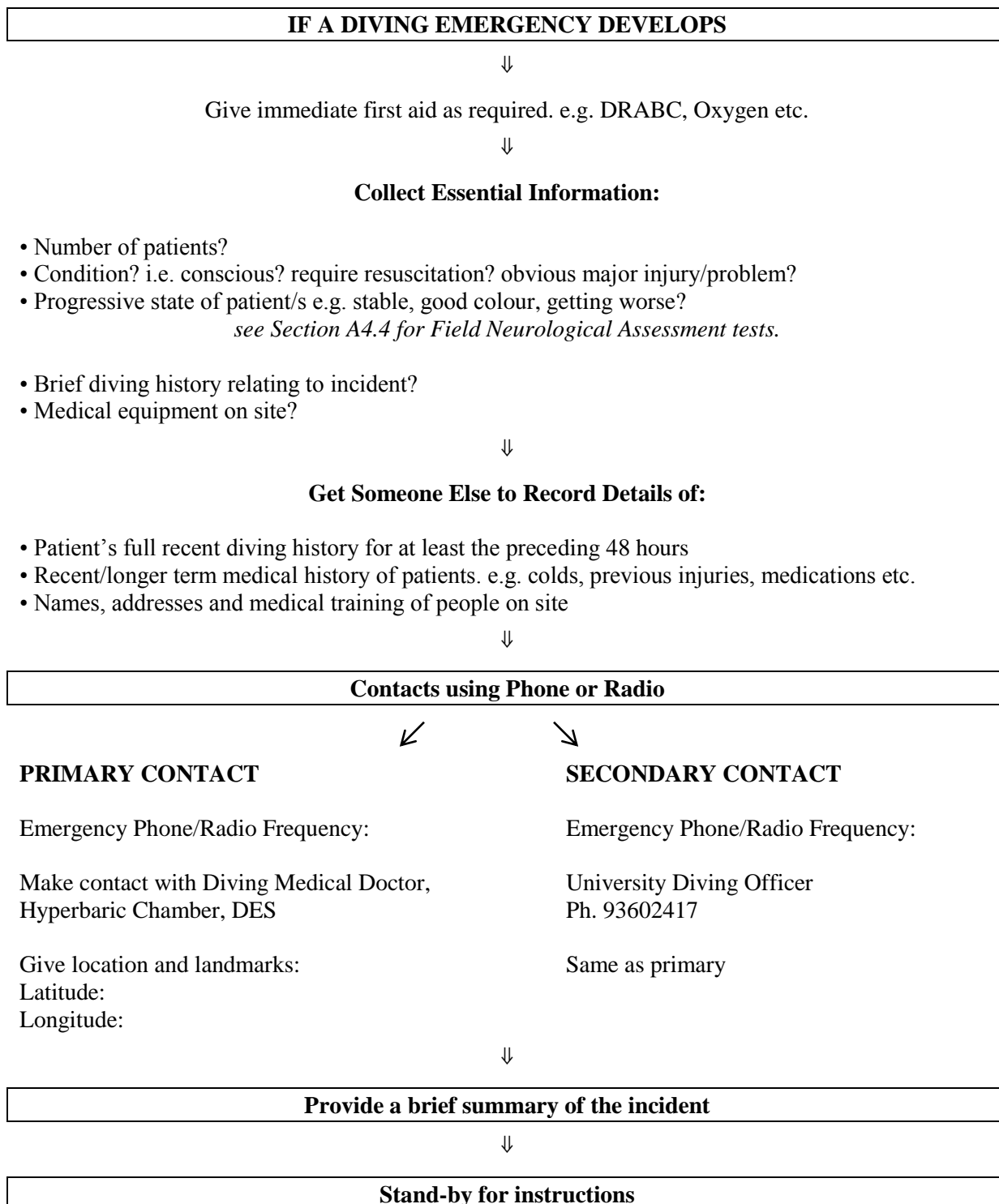
As all divers should be aware, many diving medical problems require immediate hyperbaric treatment if they are to be successfully resolved. In the field, or during transport to a recompression facility, the best first aid that can be administered for injuries/illnesses such as DCI or air embolism (and others) is oxygen delivered at as close to 100% as possible.

The flow chart below may be used by Dive Coordinators as a basic template to design a site-specific Emergency Response Protocol. The flow chart would slot into place along with the other steps required during an emergency, for example:

- a) DRABC. Recall all divers/swimmers to the boat or shore. If possible recover all equipment after any accident, and separate it from other equipment for subsequent examination. The Dive Leader may decide not to recover equipment if doing so would be unsafe or cause undue delay;
- b) Seek appropriate medical assistance* and follow any directions you are given. *Appendix A6* provides a list of Western Australian medical facilities and doctors trained in diving medicine;
- c) Ensure other members of the dive team are not at risk and that all divers are present;
- d) Ensure that in the emergency, no equipment has been left in a dangerous condition;
- e) Organise evacuation to the nearest hospital or vacant recompression chamber as dictated by the circumstances, the casualty's condition, or medical advice (N.B. If you ring the DES, confirm whether they will organise the evacuation or not);
- f) Record the details of the casualty's dive immediately, including where the accident occurred, and the sequencing of treatment. Conditions of the emergency can often lead to neglect in completing the diving log/record, which may make it impossible afterwards to determine the time for which the diver was in the water. Such a record is extremely useful to the doctor treating the casualty, in the construction of a therapeutic profile, and in helping with the understanding and avoidance of future diving accidents;
- g) Ensure the diver's dive record sheets and (if possible) their log book are available for the doctor, particularly if recompression is required. Details of the diver's last medical examination may be useful if these can be obtained quickly;
- h) When the immediate emergency has passed and all necessary steps have been taken to assist the casualty, a full record of the incident must be compiled by the Dive Coordinator (or by the University Dive Officer in the event the Dive Coordinator is incapacitated). To help with this, all personnel involved in the incident should endeavour to make notes on what happened as soon as possible after the incident, obtaining details from other divers, noting exact times etc;
- i) It must be remembered that the buddy of any diver who develops symptoms of decompression sickness, even on a dive apparently carried out according to the tables, may also develop symptoms at a later time and require recompression. In such a situation, the dive buddy should be kept under observation for at least 24 hours after the incident.

* **Important:** Any call for medical assistance will be improved if you give important information such as your location, the type of emergency (diving, boating, etc), number of people affected, their approximate age and sex, signs and symptoms and vital signs (descriptions of pulse, breathing, consciousness level), first aid given and any changes in patient's condition.

A4.3.1 – Emergency Response Protocol – Flow Chart



A4.4 – Field Neurological Assessment Test

Five-Minute Neurological Exam

Examination of an injured diver's central nervous system soon after an accident may provide valuable information to the physician responsible for treatment. The Five-Minute Neuro Exam is easy to learn and can be performed by individuals with no medical experience. The examination can be done whilst reading from this manual. Perform the following steps in order, and record the time, and the results for each test.

1. Orientation

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

Even though an individual may appear alert, the answers to these questions can reveal confusion. Do not omit them.

2. Eyes

Have the diver count the number of fingers you display, using two or three different numbers of fingers. 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 slightly less than a half meter 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 (called nystagmus). Check that the pupils are equal in size.

3. Face

Ask the diver to whistle or purse their lips. Look carefully to see that both sides of the face have the same expression whilst whistling. Ask the diver to grit their teeth. Feel their jaw muscles to confirm that they are contracted equally.

Instruct the diver to close his/her eyes while you lightly touch your fingertips across their forehead and face. Confirm that sensation is present, and feels the same everywhere.

4. Hearing

Evaluate the diver's hearing by holding your hand about two feet from the individual's ear and rubbing your thumb and finger together. Check both ears by moving your hand closer until the diver hears it. Check several times and compare with your own hearing. N.B. If the surroundings are noisy, this test is difficult to evaluate. If necessary, ask any bystanders to be quiet and turn off unneeded machinery.

5. Swallowing Reflex

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

6. Tongue

Instruct the diver to stick out their 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 their shoulders while you bear down on them, to observe for equal muscle strength. Check the diver's arms by bringing their elbows up level with their shoulders, hands level with the arms, and touching their chest. Instruct the diver to resist while you pull their arms away, push them back, and move them up and down. The strength should be approximately equal in both arms in each any direction. Check leg strength by having the diver lie flat and raise and lower their 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. 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

Be prepared to protect the diver from injury when performing this test. Have the diver stand up with feet together, close their eyes and stretch out their arms. The individual should be able to maintain balance if the platform is stable. Your arms should be around, but not touching the individual, in case they fall.

Be prepared to catch a diver who starts to fall.

Check coordination by having the diver move an index finger back and forth rapidly between their nose and your finger – held slightly less than a half meter from their face. In another test of coordination, instruct the diver to slide the heel of one foot down the shin of the other leg while lying down.

Conduct these tests on both right and left sides, and observe carefully for differences between the two sides. 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 appear abnormal, injury to the central nervous system should be suspected.

The tests should be repeated at frequent intervals while awaiting assistance, 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 uninjured divers, to become proficient in the test.

Appendix 5 – Dive Tables

The Australian Standard (AS2299.2) prescribes the use of the DCIEM Sports Diving Tables for planning dives and calculating dive profiles and no-decompression limits. Copies of the Tables and the instruction booklet are available from the University Dive Officer – all divers must be familiar with their use.

Appendix 6 – Dive Medicals

Places where dive medicals can be obtained

Dive medicals must be performed to meet AS2299, for the specific diving activity of “Scientific Diver”. There are two places that are highly recommended for this to be completed:

A more comprehensive list of doctors qualified in diving medicine is available from the University Dive Officer.

Diving Medical Service

135 Dunedin Street
MOUNT HAWTHORN WA 6016
Ph 9444 8977, 9444 8296
A/Hrs 9385 2232
Fax 9444 8268
Dr Greg Deleuil

Westport Medical Centre

18 Pakenham Street
FREMANTLE WA 6160
Ph 9430 5282
Fax 9430 4975
Dr P.M. Martin
Dr E. Jenkins
Dr G.K. Martin

Appendix 7 – Hazard Identification, Risk Assessment and Control

NOTE: These guidelines are additional to, and do not replace, the University Fieldwork Policy (ref: <http://www.research.murdoch.edu.au/rds/downloadforms.asp#fieldwork>)

Hazards should be identified at the time of registration of the dive site, during the preparation of the dive plan and at the site prior to the commencement of the dive. Any hazards that arise during the dive should immediately be brought to the attention of the Dive Coordinator and the dive plan varied as necessary. To ensure the safety and health of the diver or the dive be aborted.

RISK ASSESSMENT

An assessment by a competent person is the critical appraisal of a diving operation with particular emphasis on the potential risk to divers. The assessment process focuses on the overall risk to a diver from a number of elements rather than from the risk from one of these elements in isolation. Thorough assessment assists in the identification and prioritisation of the control measures to be applied.

The assessment process should be undertaken in consultation with divers in the following three parts:

1. Dive site registration – in assessing the risks posed by working at a particular site at the beginning of a scientific program.
2. Before the diving operation – in the selection of appropriate control measures for inclusion in the dive plan.
3. At the dive site and during the diving operation – to ensure that the limitations of the control measures selected are not exceeded, including during the dive and post-dive activities.

Operational planning may take place well in advance of the intended diving operation based on assessment of likely conditions at the dive site. Prior to the commencement of any diving operation, the Dive Team Leader should ensure that a suitable dive plan, including objective assessment of all observed, known or charted site conditions is conveyed to, and understood by, all members of the diving team.

An assessment should be based on at least:

1. The identification of hazards in the workplace;
2. The nature of the risks created by those hazards;
3. The degree of exposure to those risks;
4. The potential of those risks to cause injuries and illness; and
5. The measures required to control the exposure to those risks.

As a minimum, the factors listed above should be considered when conducting an assessment of risk.

Environmental conditions

Certain parameters should be examined for their effects on the dive from the perspective of operations both on the surface and below, including, but not limited to:

- Strength and direction of the wind and the degree of influence that it may have on the diving operation and emergency response capability;
- Current and tide;
- Visibility;

- Entrapment hazards;
- Depth at worksite;
- Water temperature;
- Time of day;
- Underwater terrain;
- Atmospheric temperature and humidity;
- Contaminants; and
- Isolation of dive site.

Task Related Factors

The complexity of the diving task or the presence of a component which is non-routine in nature may increase the level of risk associated with a diving operation.

Hyperbaric/Physiological Factors

Hyperbaric and physiological factors include:

- Frequency of diving, including multiple ascents, repetitive diving and multi-day diving;
- Depth of dive;
- Breathing gas;
- Exertion required to reach dive site task or conduct task;
- Excessive noise;
- Immediate pre-dive fitness (prior dives, prior physical exertion, fatigue, recent illness); and
- Altitude exposure.

Associated Activity Factors

The effects of associated activity factors should be assessed. These associated activities include:

- Manual handling;
- Boat handling; and
- Dive platforms.

Other Hazards

Presence of the hazards such as the following should be taken into account:

- Dangerous marine animals;
- Water inlets;
- Shipping movements;
- Use or presence of hazardous substances, biological pollutants or explosives;
- Other hazards peculiar to the dive location(s).

Emergency Response Factors

There should be an assessment of what would be required in case of an emergency.

The assessment should include consideration of:

- The location and availability of appropriate emergency systems; and
- Emergency response procedures.

Record of Assessment

The risk assessment process should be detailed in the diving operations manual. Such details should clearly demonstrate that the following processes have been addressed:

- Hazard identification – risk factors identified.
- Risk assessment – consideration of all relevant risk factors and their magnitude.
- Risk control – control measures proposed and basis for their selection.

- Monitoring – conduct of the operation assessed for effectiveness.

RISK CONTROL

Control of a risk is achieved by selecting from the hierarchy of control measures, one or more measures which individually or in combination achieve the required risk reduction.

Appropriate control measures should be applied to risks, using the hierarchy of controls in the following order:

1. *Elimination* – Where the level of risk cannot be controlled to an acceptable level, no diving should take place.
2. *Substitution* – Where the risk can be controlled by performing the task using alternative methods of diving, consideration should be given to using these alternative methods.
3. *Design* – Plants and procedures should be designed to minimize risk.
4. *Isolation* – Persons should be isolated from the identified hazards.
5. *Administrative* – Every dive plan should seek to minimize the degree and duration of the diver's exposure to risk.

NOTE: Almost every aspect of dive planning falls into this category.

Administrative controls include:

- Training, supervision, experience and selection of dive team members, including staffing levels;
 - Provision of an appropriate diving operations manual;
 - Organization and planning before, during and after the dive;
 - Selection of appropriate plant; and
 - Selection of the appropriate form and level of communication.
6. *Personal protective equipment* – Appropriately designed and sized personal protective equipment should be provided, used and maintained. The limitations of all equipment used should be identified as part of the risk assessment process. Information from manufacturers and from records of prior experience should be used to identify limitations.

13. FORMS

Electronic copies of these forms are available from the Dive Officer to be completed in electronic form.

1. Diver Registration Form
2. Snorkel Diver Registration Form
3. Dive Coordinator's Checklist
4. Dive Coordinator's Log Sheet
5. Dive Plan
6. Sample Diver's Log sheet
7. Diving Accident Report Form

Form 1 – Diver Registration Form

Before any person can dive with Murdoch University, they must complete a copy of this form and forward it to the University Diving Officer for approval. This must be accompanied by a copy of your diving qualifications and current (within last 12 months) scientific diving medical (in accordance with AS2299).

NB: a recreational medical is sufficient for restricted divers.

Surname: First Name(s):

Date of Birth: School:

Position at University:

Ph (h & w): E-mail:

Please supply a home address and details of next of kin on the reverse of this form.

Date started snorkelling? Date started SCUBA diving?

Date of last diving medical: Commercial/recreational? (attach copy of medical)

Details of SCUBA diving qualifications:

Instructors name and address:

Recreational boat licence:

Details of 1st aid / Oxygen therapy qualifications:

Dive Experience: Diving Hrs # of dives: Deepest dive: Date/depth most recent dive:

Meters		Approx. hours		Meters		Approx. hours	
*****	Day	Night	*****	Day	Night	*****	Night
0 -10			20-30			40-50	
10-20			30-40			50+	

Indicate with the appropriate letter if you have experience in diving in the following situations:

E - Extensive (>30 times); M - Moderate (5-30 times); L - Limited (1-4 times)

From small boats	Using SSBA	Diving using pneumatic tools
Large vessels (>7 m)	Mixed Gas diving	Diving in currents (> 0.5 knots)
Off beaches	Diving in fresh water
Surf entries/exits	Low visibility diving (< 1.5 m)	Diving using a drysuit
Cave/wreck diving

Details of previous work related diving:

.....

Have you ever been involved in a diving accident? **Y/N**

(If Y please provide details on a separate page)

The above is a true representation of my diving history. Signed: Date:.....

Your Address:
(In Perth)

Address:.....
.....
.....
.....

Contact Phone #:

Next of Kin:

Name:

Address:

Country:

Contact Phone #:

University Dive Officer Only. Log book checked: Qualifications Checked:

Medical Received:

Diver Status:

Comments:

Induction done: By: Date:

University Dive Officer Signature: Date:

Form 2 – Snorkel Diver Registration Form

Before any person can snorkel with Murdoch University, they must complete a copy of this form and forward it to the University Diving Officer for approval. Please note that you may be required to undergo a fitness test, at the discretion of the Diving Officer.

Surname: First Name(s):
Date of Birth: School:
Position at University:
Ph (h & w): E-mail:

Please supply a home address and details of next of kin on the reverse of this form.

Date started snorkelling? Do you hold a SCUBA ticket?
Date of last diving medical (if applicable): (attach copy of medical if done within last 2 years)
Details of snorkelling experience:
Approximate hours snorkelling: Date of most recent snorkel experience:
Principal Snorkelling Locations:
.....
Recreational boat licence:
Details of 1st aid / Oxygen therapy qualifications:

MEDICAL CHECK LIST FOR SNORKELLERS

Have you ever had:

- 1 Any cardiovascular disease? Y / N
- 2 Any lung disease? (asthma, TB, wheezing, pneumothorax, others) Y / N
- 3 Any epilepsy, convulsions, fits or blackouts Y / N
- 4 Any serious disease (such as diabetes) Y / N
- 5 Serious ear, sinus or eye disease? Y / N
- 6 Any neurological or psychiatric disease? Y / N

Over the last 12 months have you had any:

- 7 Operations, illnesses or treatment Y / N
 - 8 Drugs or medication Y / N
 - 9 If female, are you pregnant? Y / N
- Can you:**
- 10 Swim 500m without fins Y / N
 - 11 Swim 200m in 5 min. or less without fins? Y / N
 - 12 Equalise your ears when diving or flying? Y / N

Signed: Date:

Your Address:

(In Perth) Address:

.....
.....
.....
.....

Contact Phone #:

Next of Kin:

Name:

Address:

.....
.....
.....

Country:

Contact Phone #:

University Dive Officer Only. Log book checked: Qualifications Checked: Medical Received:

.....

Induction done: By: Date:

Diver Status:

Comments:

.....
.....

University Dive Officer Signature: Date:

Form 3 – Dive Coordinator’s Checklist

Trip Number: _____

		Initial
Pre Trip	Dive plan logged	
	Dive plan approved	
On board	Boat handling safety brief	
	Pre-diving brief Tasks, location, depths, times, hazards, emergency procedures (including discussion on use of life, buddy and float lines and assessment as to their use	
	Pre-dive Equipment check Check function of regs, BCD’s, gauges and other equipment	
Assessment dive	Assessment of diving skills for restricted divers and visitors	
Dive log sheets	Completed by all divers each day	
Post dive	Post-dive debrief Performance, problems, general discussion	
Comments		
Post trip	Log sheets returned to Dive Officer	

Dive Coordinator _____ Date _____
(Signature)

Dive Officer _____ Date _____
(Signature)

Form 4 - DIVE PLAN FOR SCUBA (Air only) (Page 1 of 3)

Dive Coordinator :

Contact Phone Number:.....

Mobile Number:

List of dive team members:

Diver 1 :

Diver 2:.....

Diver 3:.....

Diver 4:.....

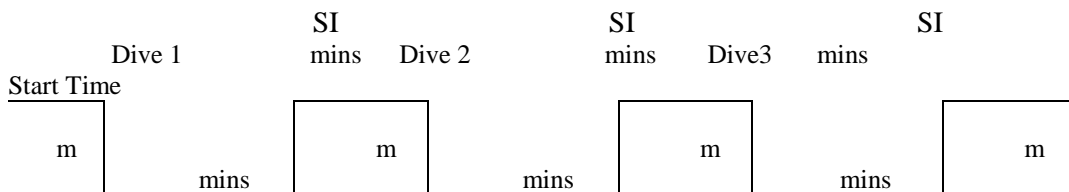
Diver 5:.....

Dive location :

Dates : From to

Type of dive(s) (eg. boat (incl. name of boat), shore, drift)

Dive Profile (specify as far as possible intended depth and duration of proposed dive(s):



Risk Assessment: Have you completed a risk assessment and emergency evacuation plan for this site ?

Yes: (Sighted by Diving Officer)..... Copy on site?

No: I affirm that a risk assessment will be conducted on site.....

Equipment: I affirm that all scuba equipment to be used has been serviced in the last 12 months as required by AS/NZS 2299.2:2002.

Signature

Dive Coordinator.....Date

1. What type of work is proposed?

.....
.....
.....

2. Do you anticipate any adverse weather conditions? YES / NO

If yes, what precautions will you take?

.....
.....
.....

3. What is the anticipated depth?

(Scuba diving will not be conducted at depths > 30 metres)

4. Do you anticipate strong currents ? YES /NO

(Divers should be able to swim comfortably against any current or a drift dive should be conducted)

If yes, what precautions will you take?

.....
.....

5. Are you planning repetitive dives? YES/NO

If yes, what precautions will you take?

.....
.....
.....

Dive Proposal approved by Diving Officer Date.....

Employer's Record Submitted Date.....

(Signature of Dive Officer)

2 copies:

-COPY FOR DIVE TEAM

-COPY TO BE RETAINED BY DIVING OFFICER

Emergency phone number: 000

Divers Emergency Service (DES) : 1-800-088-200 (in Australia)
61 8 8212 9242 (International)

Dive Site: If you are diving at one site, what are the directions to the site for Emergency Services?

.....
.....
.....

Where is/are the evacuation points/s

.....
.....

Where is/are the nearest hospital/s to all your proposed dive site(s)?

.....
.....

Where is the nearest recompression chamber?

Murdoch University contact number in case of emergency

.....

Do you have oxygen and a first aid kit at the dive site? Yes/No

Communications with dive team : Mobile

Satellite phone

Boat Radio VHF /HF /27Mhz (circle type of radio)

Does the boat have EBIRB? Yes / No

Form 5 - DIVE COORDINATOR'S LOG SHEET

This form must be submitted to the University Dive Officer (Giuseppe Paccani, Loneragan Building Room 4.34A) for approval within 24 hours of return from any field trip involving diving.

For each day's diving, details of every dive must be recorded for each diver.

NB: Any dive after a surface interval of greater than 15 minutes must be deemed a new dive. Rep. Gp based on DCIEM tables.

Day & Date: _____ Site(s): _____ Dive Supervisor(s): _____

Divers: _____ Surface support: _____

Dive 1:	Time in	Time out	Total time	Air in	Air out	Max Depth	Safety St	Surf Int.	Rep GP	Rep Factor

Comments: _____

Dive 2:	Time in	Time out	Total time	Air in	Air out	Max Depth	Safety St	Surf Int.	Rep GP	Rep Factor

Comments: _____

Dive 3:	Time in	Time out	Total time	Air in	Air out	Max Depth	Safety St	Surf Int.	Rep GP	Rep Factor

Comments: _____

Dive 4:	Time in	Time out	Total time	Air in	Air out	Max Depth	Safety St	Surf Int.	Rep GP	Rep Factor

Comments: _____

Dive Coordinator Signature: _____ Date submitted: _____

Comments: _____

Dive Officer Signature: _____

Form 6 – Sample Diver’s Log Form

Dive Log

Dive number.....

Employer/Organization:
.....

Date of Dive:

Site & Location:.....

Current: Visibility:

Water Temperature:

Type of Dive: SCUBA SSBA Snorkel
 Shore Jetty Boat

Breathing Medium: Air Gas mix (details)

Work/Training description:
.....
.....

Comments (including any unusual aspects of dive, medical incidents, etc.):
.....
.....

Left surface: Left bottom: Arrived surface: Left water:

Bottom Time: **Total Dive Time:** **Total in Water Time:**

Cumulative Dive Time: **Cumulative in Water Time:**

Decompression (including safety stops):

Dive depth:

Diver signature

Validated

Dive Coordinator
(signature)

University Dive Officer
(signature/stamp)

Form 7 – Diving Accident Report Form

Diver Emergency Service – Australia	1800 088 200
– International	+61 8 8363 5312
Fremantle Hospital (hyperbaric chamber)	(08) 9431 3333 (24 hours)

Name of diver(s): _____

Date: _____ Location: _____

Type of injury or illness suspected: _____

Signs and symptoms:

(time) _____

(time) _____

(time) _____

(time) _____

If suspected dive medical illness or injury:

(time) _____

If suspected decompression illness or arterial gas embolism

1. Do 5-minute neurological examination

(time) _____

2. Telephone or radio for advice

(time) Doctor's name: _____

3. Advice given:

(time) _____

Other first aid provided: _____

Remember:

- Follow the diving emergency procedures
- Contact the University Dive Officer

Form 7 – Diving Accident Report Form

Diver Emergency Service – Australia	1800 088 200
– International	+61 8 8363 5312
Fremantle Hospital (hyperbaric chamber)	(08) 9431 3333 (24 hours)

Name of diver(s): _____

Date: _____ Location: _____

Type of injury or illness suspected: _____

Signs and symptoms:

(time) _____

(time) _____

(time) _____

(time) _____

If suspected dive medical illness or injury:

(time) _____

If suspected decompression illness or arterial gas embolism

1. Do 5-minute neurological examination

(time) _____

2. Telephone or radio for advice

(time) Doctor's name: _____

3. Advice given:

(time) _____

Other first aid provided: _____

Remember:

- Follow the diving emergency procedures
- Contact the University Dive Officer