SCUBA DIVING OPERATIONS MANUAL

UNIVERSITY OF SYDNEY DIVING SAFETY COMMITTEE

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1. INTRODUCTION

The University of Sydney conducts Scientific Diving as a tool for teaching and scientific research. All scientific diving operations must be conducted according to AS/NZS 2299.2:2002 and WHS Regulation 2011.

This Manual outlines the procedures for conducting diving operations using compressed air, for scientific research or educational purposes under the auspices of The University of Sydney and defines the roles and responsibilities for those involved in diving operations. This Manual will be reviewed both periodically and as required.

Users of this manual should note the usage of the following terms:

must / shall: there are no circumstances under which this instruction may be ignored

should: normal diving practice requires that this instruction be obeyed but there may be circumstances in which it is appropriate for it to be relaxed

can / may: scientific diving may well benefit from using this technique

should consider: a helpful hint for scientific divers

2. REFERENCED DOCUMENTS

The following publications are referred to in this manual.
- AS/NZS 2299.2:2002 Scientific diving
- AS 2815.1-1992 Training and certification of occupational divers Part 1: SCUBA diving to 30m
- WHS Regulation 2011

This document should be read in conjunction with the University’s Fieldwork Safety Standards as they cover more general aspects of fieldwork that must also be taken into account when planning and carrying out scientific diving.

Copies of these and other referenced documents are available from the Diving Officer.

3. PERSONNEL & RESPONSIBILITIES

3.1 EMPLOYER

The employer shall:
- Install a management process to ensure that all scuba diving activities performed by staff, students, contractors, volunteers and visitors under the auspices of The University of Sydney comply with the under NSW Occupational Health and Safety Act 2000, AS 2299.2:2002 Scientific diving, WHS Regulation 2011 and this Diving Operations Manual and allocate necessary resources where applicable,
- Appoint and consider recommendations made by the Scientific Diving Advisory Committee, and
- Periodically review the management process regarding diving practices under their responsibility
- Appoint Diving Officer(s) with the responsibilities as set out under 3.3.

3.2 SCIENTIFIC DIVING ADVISORY COMMITTEE

The University of Sydney shall select and appoint a Scientific Diving Advisory Committee, known within the institution as the Diving Safety Committee.

The Diving Safety Committee should:
- review relevant legislation
- periodically review the scientific diving operations manual
- provide information, guidance and advice to Directors, Heads of Schools, Supervisors, principal researchers, employees, staff, students and visitors regarding diving policy and practice, recommend and disseminate modifications of policy and practice to all levels of University management, staff, students and visitors.
3.3 DIVING OFFICER

The University of Sydney shall appoint Diving Officer(s) who shall be experienced Scientific Diver(s) trained to a level equal to or exceeding that specified in AS2815.1 (Commercial Diver) and have a certificate to that effect issued by a relevant authority. They shall have at least 100 h of underwater diving experience and satisfy any other reasonable requirements as specified by the organization. The responsibilities of the Diving Officer are described in AS/NZ 2299.2:2002 and WHS Regulation 2011. The Diving Officer shall:

a) Have the power to restrict, prohibit or suspend any diving operations, program or practice which he or she considers unsafe;

b) Have the power to require such additional safety practices, procedures or equipment as he or she thinks necessary in any diving operation;

c) Assess diver's competencies and record the evidence used in the assessment;

d) Be familiar with any legislation and guidelines which may apply to the diving operations, including AS/NZ 2299.2:2002 and WHS Regulation 2011, this manual and ensure that any dive proposals that he/she approves comply with the requirements of this manual.

When approving dive proposals, The University of Sydney Diving Officer(s) shall ensure that the divers are trained and competent for the diving operation proposed, and have any extra training they may require prior to particular dives. The Diving Officer(s) may authorize a diver to dive on certain diving operations only, depending on the qualifications of the diver and relevant legislative requirements. When approving dive proposals the Diving Officer(s) will also consider the adequacy of the risk assessment and emergency plan for each dive proposal.

3.4 DIVE COORDINATOR

A dive coordinator appointed by the diving officer shall be present at all times while a diver is in the water or under pressure in a compression chamber. The dive coordinator shall be responsible for the safe conduct of diving and shall coordinate and direct the activity of the diving teams and ensure that all diving is carried out in accordance with AS/NZ2299.2:2002 and WHS Regulation 2011.

A dive coordinator shall have at least 15 hours experience as a scientific scuba diver and have experience in the diving, equipment and procedures used in the diving operation to be performed. They shall further:

a) Be appointed in writing at the discretion of the diving officer to supervise diving operations; and

b) Be able to recognize and manage diving emergencies and conduct pre-dive risk assessments

c) Satisfy any other reasonable requirements specified by the organization's Diving Officer.

d) Be familiar with this manual and ensure diving operations are carried out in accordance with its requirements

3.5 DIVE LEADER

- A dive leader is a person in charge of a specific part of a diving operation. A dive leader shall be-
- The dive coordinator or a person appointed by the dive coordinator; or
- A scientific diver or a visiting scientific diver with adequate knowledge and experience of the diving techniques and equipment to be used.

When a dive leader is the person in charge of a single group of divers who are diving in free-swimming SCUBA mode, that person shall take responsibility for any decisions required as the dive proceeds, in consultation with the dive coordinator where appropriate.

3.6 CLASSIFICATION AND COMPETENCY OF DIVERS

Every diver shall be classified as a restricted scientific diver, a scientific diver, visiting scientific diver or a visiting restricted scientific diver. All divers shall be made aware of their occupational health and safety responsibilities and the organization's relevant procedures, including this manual.

3.6.1 Scientific Scuba Diver

- In order to carry out scientific diving using scuba a scientific diver shall have:
  - A statement of attainment for a specified VET course for general diving work that includes the type of general diving work to be carried out by the person, or
  - A certificate for general diving work, issued by a training organisation that mentions the subject areas covered in AS/NZS4005.2:2000 (Training and certification of recreational divers – Recreational SCUBA dive supervisor).
1. All divers must have, through training, qualification or experience, acquired sound knowledge and skill in relation to the following:
   a. The application of diving physics
   b. The use, inspection and maintenance of diving equipment (including emergency equipment) and air supply of the type to be used in the proposed general diving work,
   c. The use of decompression tables or dive computers,
   d. Dive planning,
   e. Ways of communicating with another diver and with persons at the surface during general diving work,
   f. How to safely carry out general diving work of the type proposed to be carried out,
   g. Diving physiology and first aid, and
2. Have at least 15 hours of underwater diving experience after certification, and
3. Demonstrate competency and satisfactory performance in diving theory and diving practical units as specified in AS/NZ 2299.2:2002, and
4. Be familiar with the pre-dive plan before diving, and
5. Dive in accordance with the pre-dive plan, and
6. Act as a buddy diver during the dive to others in his or her designated buddy group, unless diving alone in tethered SCUBA mode. Free-swimming buddy divers shall maintain effective two-way communication with each other at all times while in the water and be able to render assistance, and
7. Be on the Dive Register of his/her institution with a current diving medical, and

3.6.2 Restricted Scientific Diver
This category is specifically for persons who are involved in research requiring diving but who have limited diving experience and are deemed by the diving officer of their host institution not to have experience equivalent to a scientific diver.

As a minimum, a restricted scientific diver should–
   a) Be 18 years of age;
   b) A statement of attainment for a specified VET course for general diving work that includes the type of general diving work to be carried out by the person, or
   c) A certificate for general diving work, issued by a training organisation that mentions the subject areas covered in AS/NZS4005.2:2000 (Training and certification of recreational divers – Recreational SCUBA dive supervisor).

1. All divers must have, through training, qualification or experience, acquired sound knowledge and skill in relation to the following:
   a. The application of diving physics
   b. The use, inspection and maintenance of diving equipment (including emergency equipment) and air supply of the type to be used in the proposed general diving work,
   c. The use of decompression tables or dive computers,
   d. Dive planning,
   e. Ways of communicating with another diver and with persons at the surface during general diving work,
   f. How to safely carry out general diving work of the type proposed to be carried out,
   g. Diving physiology and first aid, and
2. Have at least 15 hours of underwater diving experience after certification, and
3. Only dive when conditions are suitable for untethered SCUBA mode, and
4. Not dive deeper than 18 m depth, and
5. Not act as a standby diver or a dive leader, and
6. Not use powered tools or lift bags.

3.6.3 Visiting Scientific Diver and Visiting Restricted Scientific Diver (Limited Scientific Diving)

1) A person who is not permanently resident in Australia must not carry out limited scientific diving work unless the person has:
   a. The training qualification or experience referred to in clause 3.6.1 (c), and
b. Relevant diving experience, including relevant diving experience obtained outside Australia.

2) In this clause, a person has relevant diving experience if the person has logged at least 60 hours of which at least 8 hours and 20 minutes were spent diving between 10 meters above and any depth below the maximum depth at which the limited scientific diving work is to be carried out.

3.7 DIVER'S ATTENDANT
3.7.1 Availability and knowledge
Dive teams shall have a diver's attendant who is competent to administer cardiopulmonary resuscitation (CPR) and oxygen resuscitation and have a working knowledge of the following:

a) Diving and the requirements of underwater work.
b) Signals in use, in particular, the systems of hand and rope signals to be used in the diving operations.
c) Decompression procedures.
d) Diving equipment in use, including ancillary fittings such as pressure gauges, compressors and filters.
e) The diver's attendant shall not be engaged in any task other than that of diver's attendant while the dive team is in the water or under pressure.

3.7.2 Duties
The diver's attendant, or other person nominated by the dive coordinator, shall

a) Record the time of descent and surfacing of each diver;
b) Maintain a constant vigil during a dive for divers surfacing at a distance from the boat or other dive control position;
c) Assist in the recovery of divers and all equipment and samples from the water;
d) Ensure that the dive flag is deployed;
e) If tending a diver's lifeline, maintain the ability to communicate with the diver by means of that lifeline.

3.8 STANDBY DIVER
3.8.1 General
The standby diver shall be present whenever a single diver is underwater in tethered mode, and shall be a qualified diver and located on the surface, dressed and equipped to enable immediate entry into the water for the purpose of providing aid or assistance to a distressed diver. The dive profile of the standby diver shall be planned to allow all necessary assistance to be given to a distressed diver without the standby diver incurring a decompression commitment. The only exceptions to this shall be:

a) In an emergency; or
b) When the depth of the water is such that the standby diver will automatically incur a decompression commitment.

NOTE: The surface standby diver may perform certain minor duties (e.g. tending the lifeline) provided the safety of the diver in the water is not compromised in any way.

3.8.2 Two divers in the water
Where two divers are in the water at the same time, one may act as standby diver for the other provided that both divers have no decompression commitment and maintain visual contact with, and direct access to, each other. That is, the buddy diver may act as the standby diver.

3.9 HEALTH, FITNESS AND FIRST AID
3.9.1 Health and fitness
All divers must be certified as medically fit to dive in accordance with the requirements of AS/NZS 2299.1:1999 (see Appendix J for a comprehensive list of Medical Practitioners within the Sydney Metropolitan area, trained specifically to perform Occupational Diving Medicals). A certificate of fitness to dive shall have been issued within 12 months prior to diving by a medical practitioner appropriately trained in underwater medicine. All divers involved in diving shall also ensure that they are fit to dive. Fitness should be maintained by exercise and regular diving. Where a diver has not dived for a period of time exceeding six months, the diver shall carry out a check out dive or program of dives with the diving officer or the diving officer's delegate qualified to undertake such an evaluation.
3.9.2 First Aid for Diving Teams
All divers and attendants should be trained in first aid so that, as a minimum, they are able to-
(a) Control bleeding;
(b) Administer 100% oxygen to spontaneously breathing patients and oxygen-enriched resuscitation to non-
breathing patients using the oxygen resuscitation equipment at the dive site;
(c) Care for an unconscious patient; and
(d) Carry out cardiopulmonary resuscitation.

NOTES:
1) The above requirements are usually met by a first aid course leading to certification, incorporating or
supplemented by an oxygen administration course.
2) It may in some circumstances be possible to make adequate provision for the delivery of emergency
first aid with not all personnel being trained, provided that no less than two persons are trained and
available to ensure first aid will be available if required.

4. ORGANISATION, PLANNING AND RECORDS

4.1 GENERAL
Diving procedures must be carried out according to the provisions of AS/NZS 2299.2:2002, WHS Regulations 2011
and this manual. Many scientific locations are remote from search and rescue, medical and recompression facilities
and risk assessment and planning must take this into account.

4.2 ACTION PLAN
All diving must be in accordance with the following action plan. More detailed guidance on the processes of hazard
identification, risk assessment and risk control can be found in Appendix A.

4.2.1 Diver Registration
All staff, students, contractors, visitors and volunteers who are required to scuba dive in diving operations
conducted by The University of Sydney must register and be approved for diving by the Diving Officer. Each diver
will be approved as a scientific diver, a restricted scientific diver, visiting scientific diver or a visiting restricted
scientific diver.

4.2.2 Dive Proposal
The following must be approved by the Diving Officer before every diving operation:
(a) Dive Proposal - details of location of diving operations and dive team
(b) Pre-dive plan and safety checklist - identify possible hazards and precautions to be taken
(c) Emergency Plan - identify emergency facilities and procedures

4.2.3 On-Site Pre-Dive Plan and Safety Checklist
At the dive site before every dive, the dive coordinator, divers, divers’ attendants and any non-diving support
personnel shall discuss in detail and agree upon the pre-dive plan and update the risk assessment. The on-site
pre-dive plan and safety checklist must be lodged with the Diving Officer on return to The University of Sydney.

4.2.4 Diver’s Record and Employer’s Record of Dives
All divers shall keep and maintain a permanent record of all diving undertaken for the duration of the diver’s
working life. At the end of a diving operation the Dive Coordinator shall deposit with the Diving Officer, a copy of
each diver’s log for dives conducted during that diving operation.

The diver's permanent record of diving usually takes the form of a logbook, which shall include:
 a) The diver's photograph
 b) Next of kin information
 c) Diver's name, current address, date of birth and signature
 d) A record of medical examinations conducted for the purpose of scientific diving;
 e) A record of diving activity undertaken and,
 f) A record of accidents and incidents including decompression treatment(s).
The logbook shall be presented at each diving medical examination. The diver's record of dive (including a brief summary of any incidents or accidents) should be entered into this permanent record of diving at the completion of each dive, and signed by the Dive Coordinator for verification.

4.3 DIVING PROCEDURES

4.3.1 Restrictions on diving operations
Diving operations shall only be carried out when:
- The dive does not involve planned decompression stops
- The maximum depth does not exceed 30 metres
- The dive does not involve “Cave diving” as defined by the Cave Diving Association of Australia (http://www.cavedivers.com.au/)

4.3.2 Dive Teams
Dive teams must include a Dive Coordinator and should comprise
- Two divers and a competent boat person or shore watch (diver’s attendant) OR
- Three divers and a competent boat person or shore watch (diver’s attendant) OR
- More than three divers grouped into buddy pairs (preferably) or trios, but no more, and one competent boat person or shore watch (diver’s attendant) OR
  - When diving in “Sheltered conditions”, divers are permitted to dive without a shore watch (i.e. in a team of two divers).

Note: Sheltered conditions are defined as:
1. Depth less than 10 metres,
2. Visibility greater than 4 metres,
3. Wave height less than 0.5 metre,
4. Current nil to slight,
5. Daylight hours, and
6. Carry a surface marker buoy whilst at pressure.

4.3.3 Dive Leader
Before the divers enter the water, one member of each group of divers shall be designated by the Dive Coordinator as the underwater dive leader of that group. Prior to the dive, the Dive Leader should confirm the means to be used by the group for summoning attention and recalling divers to the surface, such as banging on the tank with the knife. The Dive Leader should also confirm that any diver feeling distressed or uncomfortable may terminate the dive at any time.

4.3.4 Night dives
In addition to normal diving procedures, the following procedures must be followed for a night dive:
- The entry and exit points shall be adequately and distinctively illuminated
- Every diver shall carry at least two lights, one of which may be a chemically-activated light stick.

Consideration should be given to the use of other safety measures according to circumstances.

4.3.5 Blue water diving for tracking particles
These procedures are not appropriate for open ocean blue water diving, but are to be applied to blue water diving in waters 20-30 m deep over the continental shelf. For open ocean blue water diving, the use of a mother ship for coordination must be considered and appropriate procedures developed in conjunction with the Diving Officer.

Diving will be conducted from a small, outboard-powered boat, with a dive team comprising two divers and one boat operator. The operator will circle the divers’ bubbles at idle speed at a radius of 20-30 m. A dive flag is displayed throughout. If the boat operator loses sight of the divers’ bubbles, he/she motors at idle speed into the wind constantly scanning the area until the diver’s surface. The boat operator keeps track of vessels in the vicinity, and wards off any vessels approaching too close to the divers.

If conditions are such that the boat operator cannot easily keep track of the divers’ bubbles at the surface, one of the divers must be equipped with a light line attached to a small surface float to enable the boat operator to stay in the vicinity of the divers. In addition to normally-required dive gear, divers must be equipped with a dive computer and a compass.
4.3.6 Use of decompression tables
All dives including repetitive dives must be calculated using DCIEM tables (Canadian Defence and Civil Institute for Environmental Medicine). A copy of the DCIEM tables has been supplied to every Diving Coordinator; further copies are available on request. Divers should note that UDT, the licensee and manufacturer of DCIEM tables have recommended amendments covering the use of these tables (see Appendix B).

Maximum bottom times must be reduced according to Table 3.1 AS/NZS 2299.2:2002 if diving is conducted without a recompression chamber on site (see Appendix B). Dive computers may be used for the diver’s own information.

4.3.7 Safety stop
On each dive, divers should do a safety stop of at least 3-5 min at 3-6m depth.

4.3.8 Diving with other institutions and divers from other institutions
When a dive operation is conducted by The University of Sydney all divers must be registered with The University of Sydney and follow the procedures of AS/NZS 2299.2:2002, WHS Regulation 2011 and this manual.

When The University of Sydney divers participate in diving operations conducted by another institution, they must follow the procedures of AS/NZS 2299.2:2002, WHS Regulation 2011 this manual and the procedures of the institution conducting the dive operation. University of Sydney divers must provide the DSO with copies of the Dive Plan prepared by the other organisation. The responsibility of the DSO is to verify that the planned dives are compliant with this manual, AS/NZS 2299.2:2002 and WHS Regulation 2011. The DSO does not approve the dive per se, but may suggest amendments to bring the plan into compliance. It should be noted that the DSO may veto the participation of a University of Sydney diver in any diving project deemed to be less safe or not compliant with this manual.

When diving off of a chartered vessel or one owned by a collaborating institution, it is the USyd divers’ responsibility to check that the vessel is registered as a charter vessel (if appropriate), carries sufficient emergency equipment and an in date, working oxygen providing system. The USyd diver must also confirm that the skipper, or Diving Coordinator for the day, checks that the oxygen set is full and working before the vessel leaves the dock.

4.3.9 Incident Reporting
All unusual incidents, unexpected hazards, accidents and injuries will be reported as soon as possible to the relevant Diving Officer and to SH&W within the University. Where injuries occur or there are mechanical breakdowns or accidents that affect completion of the work, safe return of staff or students, or endanger life, these must be reported verbally as soon as practical to the contacts at the University. Less serious events shall be reported to the Diving Officer on return to the University.

The Dive Coordinator must investigate all incidents, hazards, injuries and breakdowns with the other people involved to determine the causes and any actions that may be taken to prevent a recurrence of the incident. Detailed guidance on the investigation of accidents and incidents can be found in Section 7 of AS/NZS 2299.2:2002.

When an event occurs which affects work or future work, a debriefing must be held soon after the return of the dive team, in accordance with procedures developed by the Department. The debriefing should cover issues such as the adequacy of the planning, risk assessment and preparation for the dive, any incidents which occurred and how they were managed and any lessons learned that could benefit future dives by members of the Department concerned or other Departments.

The University of Sydney requires that accidents and/or incidents are reported via RiskWare which may be found at https://riskware.sydney.edu.au/login.aspx?ReturnUrl=%2fdefault.aspx&cks=1.

The incident must also be reported to DAN using the incident report form in Appendix E.

4.3.10 Lost Diver Routine
In the unlikely event that a diver becomes separated from their buddy:
- The divers will do a 360° search for each other for a maximum of 1 minute looking for bubbles or visual sign of lost diver
- If lost diver is not located the searching diver will then return to surface at the correct ascent rate, still performing a 360° search on ascent
- Once on surface, deploy safety sausage, utilize whistle (or vocally question where diver is) and wait on surface for 4 minutes
- If lost diver is still missing, return to boat or shore and initiate emergency procedures, i.e. alert Diving Coordinator/shore attendant, contact DSO, contact emergency services.

4.3.11 Diving before or after travel.

a) Diving after Travel
The diver shall have had adequate rest before diving.
b) Travel after Diving
   a. Altitude exposure after diving is a potent precipitator of decompression illness. After a dive, a minimum delay time should be observed prior to exposure to altitudes (e.g. air travel and road travel over mountains) – see Appendix H for a list of the minimum delay times which should be observed relative to altitudes.

5. EQUIPMENT FOR DIVING

5.1 EQUIPMENT STANDARDS AND MAINTENANCE
Each member of the diving team must know the capabilities and limitations of any equipment used. The dive leader must select appropriate equipment, based on the work site conditions and the dive plan. Equipment must not be altered, modified, or changed in any way that might impair its safe and efficient operation.

All diving equipment, including cylinders, regulators and accessories necessary for the safe conduct of the diving operation must be:
- Of approved design, sound construction, adequate strength, free from any defect and maintained in a condition that will ensure its continued operation for the purpose and depths for which it was originally designed and subsequently used
- Examined, tested, overhauled and repaired in accordance with the manufacturer's recommendations and used in accordance with AS/NZS 2299.2:2002.

5.2 SERVICE AND MAINTENANCE OF EQUIPMENT
Regulators, buoyancy vests (where they serve as an alternative air supply), gauges and metering equipment shall be serviced according to manufacturer’s requirements. Any malfunction must be rectified without delay.

Records of maintenance and testing of The University of Sydney and personal equipment used in The University of Sydney diving operations will be kept by the Diving Officer for at least two years.

5.3 PERSONAL DIVING EQUIPMENT
Each diver shall have the following equipment:

a) Open-circuit scuba, complete with cylinder and two demand regulators.
b) Face mask
c) Swimming fins
d) Snorkel for surface swimming
e) Weight belt or weight jacket with quick release closure
f) Submersible contents gauge for measuring remaining air pressure in cylinder
g) Wetsuit or protective clothing appropriate to the condition of work and the temperature of the water
h) Buoyancy compensator of an approved design that is inflatable orally and from a compressed air cylinder
i) Alternative air supply – which could comprise of; a spare second stage regulator such as an octopus regulator, a pony bottle, or a second stage regulator incorporated into the oral inflation hose of the buoyancy compensator
j) Watch or elapsed time indicator or dive computer
k) Depth gauge
l) Diver’s knife
m) Safety sausage
n) Shark shield
Note: In the notes section on fieldteq, a dive team must state the reasons for not using a shark shield

5.4 SAFETY EQUIPMENT FOR DIVING TEAM
The following equipment must be available at the dive site:

(a) Oxygen resuscitation equipment
(b) First aid equipment
(c) Dive flag
(d) Communications (mobile phone, satellite phone or radio)
(e) Copy of dive proposal and emergency procedure
APPENDIX A – HAZARD IDENTIFICATION AND RISK ASSESSMENT

Hazard identification and risk assessment should be performed at the dive proposal stage and as part of the pre-dive plan. Hazards that arise during a dive should be immediately brought to the attention of the Dive Coordinator so that the dive plan can be altered to ensure the health and safety of the divers or the dive aborted.

The following steps are used to manage work health and safety risks arising in scientific diving operations.

**Step 1** Identify hazards and hazardous tasks
**Step 2** Assess the nature of the risk created by those hazards and hazardous tasks
**Step 3** Assess the degree of exposure to the risks and the potential of the risks to cause injury or illness
**Step 4** Eliminate or control the risks
**Step 5** Review the adequacy and effectiveness of the adopted control measures.

Risk assessment of diving operations should identify and take into account the following:

- **Environmental conditions**, e.g.
  - strength and direction of wind and its potential influence on diving operations and emergency response capability
  - atmospheric temperature and humidity currents and tides
  - time of day
  - water temperature and visibility
  - underwater terrain
  - entrapment hazards
  - contaminants,
  - Isolation of the site, etc.

- **Task factors**, e.g. complexity, non-routine tasks may increase level of risk

- **Hyperbaric/Physiological factors**, e.g.
  - depth and duration of dive
  - frequency of diving, multiple ascents, repetitive diving, multi-day diving
  - breathing gas
  - exertion required to reach site and conduct tasks
  - immediate pre-dive fitness
  - altitude exposure
  - excessive noise, etc.

- **Factors relating to associated activities**, e.g. manual handling, boat handling and dive platforms, etc.

- **Emergency response factors**, e.g. location and availability of emergency facilities and systems, etc.

- **Other hazards that could be encountered during the diving operations**, e.g. dangerous marine animals, water inlets, shipping, use of hazardous substances, biological pollutants or explosives, etc.

Hazard identification and risk assessments should be documented using the forms in appendices B and C, together with any additional documentation relevant to the particular situation.

Risks in diving operations should be controlled in accordance with the hierarchy of controls i.e.

1. **Elimination** – if the risk cannot be adequately controlled, no diving should take place
2. **Substitution** – if an alternative method is available that entails less risk, it should be considered
3. **Design** – procedures and equipment should be designed to minimize risk
4. **Isolation** – divers and others should be separated from identified hazards if feasible
5. **Administrative** – covers many aspects of dive safety including adequate training, supervision and experience of the dive team members, adequate organization and planning of the dive and selection of appropriate means of communication to minimize risk; the dive plan should minimize the duration and degree of each diver’s exposure to risk
6. **Personal Protective Equipment** – appropriately designed and sized equipment provided, used and maintained and the limitations of the equipment understood in order to minimize risks to the dive team.

Further guidance on hazard identification, risk assessment and control can be found in Appendix G of AS/NZS 2299.2:2002
APPENDIX B - DECOMPRESSION PROCEDURES
Reduced Bottom Time Limits for Remote Locations

**TABLE 4.1**
TIME LIMITS FOR DIVES, DEPENDING ON LEVEL OF RECOMPRESSION CHAMBER SUPPORT

<table>
<thead>
<tr>
<th>Maximum dive depth m</th>
<th>Maximum bottom time, min</th>
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<tbody>
<tr>
<td></td>
<td>Column A (chamber within 2 h)</td>
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<tr>
<td>6</td>
<td>480</td>
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NOTE: For depths between 12 m and 30 m, the bottom time limits are based upon the DCIEM tables. Column A lists the ‘no-deco’ limits. Column B represents one repetitive group less than the ‘no-deco’ limits.

**TABLE 4.2**
LIMITS FOR REPETITIVE DIVES, DEPENDING ON LEVEL OF RECOMPRESSION CHAMBER SUPPORT (BASED ON DCIEM TABLES)

<table>
<thead>
<tr>
<th>Maximum dive depth m</th>
<th>Maximum repetitive group</th>
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<td>Column A (chamber within 2 h)</td>
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<tr>
<td>15 to 30</td>
<td>DCIEM no deco limits</td>
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</tbody>
</table>

**Amendments to DCIEM procedures**
(a) The rate of ascent should be 10 meters ± 3 meters per minute
(b) A 3 minute stop is recommended for all dives below 12 meters
(c) Repetitive dives should always be shallower than the previous dives
(d) A maximum depth of 27 meters is recommended for second dives and 15 meters for the third dive
(e) The group letter for each repetitive dive must be higher than the RG from the preceding dive. Otherwise add one letter to the preceding dive RG and use the higher RG letter. e.g. 1st dive RG = C, 2nd dive RG = D, 3rd dive RG = E
(f) If more than two dives a day are conducted on three consecutive days, diving should not be carried out on the fourth day.
APPENDIX C - NITROX DIVING

Nitrox is a combination of oxygen and nitrogen where the percentage of oxygen is increased from standard air, which is approximately 21% oxygen and 79% nitrogen. In Nitrox diving the mix of oxygen is from 22% to 40% in water depths less than 130fsw/40msw.

Nitrox divers have less nitrogen in their tanks than air divers. For an equivalent dive they absorb less nitrogen into their bodies and are less exposed to Decompression Sickness (DCS). Using Standard Air Dive Tables on Nitrox gives increased physiological safety, especially for people who are more at risk from DCS. The increased risk factors include: obesity, illness, older age, fatigue, heavy exertion during and or after a dive, are reduced by the use of Nitrox. Divers can benefit through increased bottom time and shorter surface intervals if they are not affected by such risk factors.

Diving cylinders used for Nitrox are defined with a Green band and labeling these are only used for Nitrox, this is to avoid a person using a tank thinking it is air when it is Nitrox or using a Nitrox tank thinking it is for air. This sort of mistake can result in a diver extending the no decompression limits thinking he is using Nitrox or, alternately, thinking he has air; the diver exposes himself to central nervous system (CNS) oxygen toxicity with Nitrox. Regulators using less than 39% oxygen can be used for air or Nitrox diving. Divers must check their own Nitrox fills with an oxygen analyzer and sign off on the fill log at the fill facility. Cylinders are tagged describing fill pressure, oxygen, analysis date, maximum oxygen depth, name of user and cylinder number.

A standard Nitrox course will equip a diver with the understanding and training to use this gas mix to increase safety margins, while working to air dive tables. It can increase dive times and shorten dive time intervals. If you do not understand any/some of the text below, you should not use nitrox.

Additional procedures for University of Sydney divers using EANx (nitrox)

1. Nitrox qualification cards must be shown to the DSO and copies retained. The qualification card (or supplementary information) must stipulate the gas mixes and maximum depth the qualification relates to.
2. In mixed teams of nitrox and air divers, observe the MOD of the richest mix and the decompression schedules of the air diver.
3. All nitrox divers must analyse their own gases and sign (i) the gas analysis sheet of the gas vendor, (ii) the analysis label on the cylinder and (iii) the dive plan log sheet (next to the percentage mix). The analyser must be clearly labeled with its oxygen sensor/cell’s expiry date. University of Sydney teams wishing to use nitrox must provide information on their analyser and the age of the oxygen sensor cell.
4. There are two possible ways of using nitrox.
   (i) The first is to use the extra oxygen (and reduced nitrogen to extend bottom times. In this scenario, use the table given as appendix F.1 to calculate the equivalent air depth of your gas mixture, and then calculate the decompression schedule from DCIEM tables as for any air dive.
   (ii) The second is to use the nitrox as an added safety factor by only running air schedules as if the divers were using air. In this case, divers must observe the MOD of the richest nitrox gas.
5. The European Scientific Diving Committee recommends a maximal oxygen partial pressure of 1.2 bar. Whilst the recreational and technical agencies permit a working partial pressure of 1.4 bar, University of Sydney divers should not plan for an exposure greater than 1.2 bar.
6. In all cases, dive coordinators must indicate the CNS oxygen loading (as a percentage) and UPTD (as UPTD units) on the Dive Plan (appendix B); these can be determined from the table given as Appendix F.2. Note that the NOAA oxygen exposure table assumes a half-life decay for surface credit; that is the CNS exposure reduces by a half every 90 minutes on the surface and this should be used in calculating the CNS oxygen toxicity for second and subsequent dives within a given series. CNS exposure should NOT exceed 80%. A diver should not incur more than a maximum of 300 UPTDs per 24hr period. Track each phase of the dive individually and add together, noting that UPTDs accumulate throughout a sequence of diving and UPTDs do not reduce until a sequence of diving is stopped.

Information sourced from Technical Diving International and the BS-AC
### APPENDIX C.1 - EQUIVALENT AIR DEPTH TABLES AND PARTIAL PRESSURES OF OXYGEN FOR GIVEN DEPTHS

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</table>

These tables allow the calculation of Unit Pulmonary Toxicity Dose (UPTD) or % Central Nervous System dose. Find the ppO2 level in the left hand column and look up the associated Oxygen toxicity dose in the appropriate exposure time column. For exposure times not shown in the table, split the exposure time into unit times shown above and add the indicated doses to find the total dose.

e.g. for a 33 minute exposure at 1.20

ppO2 read:  
1.20 for 1.00 min 1.32 0.48  
1.20 for 2.00 min 2.64 0.96  
1.20 for 30.00 min 39.60 16.4  

33.00 min 43.56 UPTD 17.84 %CNS

For EANx dives with a PPQ2 < 0.65, CNS and UPTD should be calculated using the 0.65 values.
APPENDIX D - AUSTRALIAN MUSEUM PROCEDURES FOR BLUE WATER DIVING FOR FISH LARVAE BEHAVIOURAL STUDIES

These procedures are not appropriate for true blue water diving (open ocean), but are to be applied to blue water diving in waters 20-40 m deep over the continental shelf. For open ocean blue water diving, the use of a mother ship for coordination must be considered and appropriate procedures developed in conjunction with the Diving Officer. Procedures developed for blue-water diving by zooplankton biologists involving a shot line, tethers between divers and the line, and a ‘look-out’ diver are inappropriate for a research protocol that requires the divers be free to follow a released larva.

Equipment
In addition to normally-required dive gear, divers must be equipped with a dive computer and an orange ‘safety sausage’. If conditions are such that the boat operator cannot easily keep track of the diver’s bubbles at the surface, one of the divers must be equipped with a light line attached to a small surface float to enable the boat operator to stay in the vicinity of the divers. A ‘shot line’ is not used because the divers are following a released fish. Divers have a compass, and a hand-held flow meter.

Boat operation
Diving is conducted from a small, outboard-powered boat, with a dive team comprising two divers and one boat operator. The operator circles the divers' bubbles at idle speed at a radius of 20-30 m. The boat operator monitors geographic position, and supplies the divers with new fish for release as needed. A dive flag is displayed throughout. If the boat operator loses sight of the divers’ bubbles, he/she motors at idle speed into the wind constantly scanning the area until the diver’s surface. The boat operator keeps track of vessels in the vicinity, and wards off any vessels approaching too close to the divers.
APPENDIX E - DAN DIVING INJURY REPORT FORM

DIVING INCIDENT REPORT
DAN is a non-profit dive safety organisation whose aim is to sponsor data collection and research into diving incidents, and their prevention. To support this research, DAN collects and analyses information about diving incidents. DAN SEAP undertakes to hold the names and contacts of individuals involved as confidential.

INFORMATION ABOUT THE INCIDENT
Date: 
Time: 
Nearest Town: 
Country: 

BRIEF DESCRIPTION OF INCIDENT

TYPE OF INCIDENT
Decompression Illness
Drowning / near drowning
Trauma
Other:

DETAILS OF INJURED PERSON
Name:
Contacts:
Age / Birthdate:
Gender:

Certification Level
Not known
In Training Open Water
Advanced
Divemaster
Instructor
Technical
Commercial

Experience:
Years diving:
Total no. of dives:
Total dives in last 12 months:

Outcome:
Fatal
Non-Fatal

REPORTED BY:
Name:
Contact Ph:
Email:
# Appendix F – Registered Occupational Diving Medics in Metropolitan Sydney

SOUTH PACIFIC UNDERWATER MEDICINE SOCIETY.
Registered Occupational Diving Medics.

<table>
<thead>
<tr>
<th>Name</th>
<th>Address</th>
<th>Phone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr Priti Bhatt</td>
<td>Suite 506, Level 5, 74 Pitt Street, Sydney</td>
<td>02 9965 3723</td>
</tr>
<tr>
<td>Dr Susan Willis</td>
<td>University Health Service, University of Sydney, SYDNEY</td>
<td>02 9351 3484</td>
</tr>
</tbody>
</table>
APPENDIX G – DIVING PROCEDURES AND EMERGENCY ACTION PLAN FOR INCIDENTS INVOLVING LOSS OF LIFE (POTENTIAL OR ACTUAL) OR SEVERE INJURY

GENERAL PROCEDURES:
- “RESCUER” must not put themselves in danger
- Maintain airway, Administer 100% oxygen
- Administer First Aid
- Remove casualty from danger if safe to do so
- Seek Medical / Rescue Assistance

The exact order of these will vary with the incident, and the resources available.

1. DURING DIVING OPERATIONS:

**Shore Diving:**
(a) If a participant shows signs or symptoms of decompression illness or has had ANY ABNORMAL ASCENT (missed decompression stops or fast ascents): Place casualty on 100% oxygen immediately and seek medical advice immediately.
(b) If casualty is unconscious call for an ambulance (000) first, then contact Hyperbaric Units (Divers Emergency Service (1800 088 200)).
(c) If casualty is conscious contact Divers Emergency Service (1800 088 200) and follow instructions. Rescue Divers and those with more advanced rescue and/or first aid qualifications to manage the incident. Diving incident slate to be written immediately. Only when situation is stable and/or emergency services have taken over should University Risk Management Office (02 9385 1565 - during office hours) be notified and the University Security Service (02 9385 6666 – after hours). Effective management of the situation will involve delegation.

**Boat Diving:**
(d) If a diver shows signs or symptoms of decompression illness or has had ANY ABNORMAL ASCENT (i.e. rapid ascent), place casualty on 100% oxygen immediately and request advice/assistance.
(e) Contacts: Coastguard on VHF Ch16 and follow instructions, if radio is not answered try mobile phone, follow action as in 1(a-c), if phone is not answered then proceed to nearest safe haven and repeatedly try to contact Coastguard (marine radio or phone). Rescue Divers and those with more advanced rescue and/or first aid qualifications to manage the incident. A Diving Incident slate should be written immediately. Only when situation is stable and/or emergency services have taken over should University Risk Management Office (02 9385 1565 - during office hours) be notified and the University Security Service (02 9385 6666 - after hours). Effective management of the situation will involve delegation. If signs or symptoms appear on land (up to 24hours post-diving), follow action as if shore diving.

REQUIRED SAFETY EQUIPMENT:
- First Aid Kits
- Medical grade oxygen cylinder and giving sets (ensure that enough oxygen is available to transport diver to Emergency Services (boat dive), or utilise until Emergency Services arrive (shore dive).
- VHF radio charged and working (boat dive)
- Flares (boat dive)
- Knowledge of nearest emergency phone or possession of a mobile phone.

EVACUATION:
In the event of any registered diver being evacuated to a hospital or hyperbaric chamber, he or she should where possible, be accompanied by the diving coordinator, or other diver not in need of treatment, the destination noted and passed to the University contact person and DSO. If this is not possible, then the diving coordinator or an uninjured diver MUST ensure that they have a record of where the casualty goes.

POST INCIDENT:
- Thank Emergency services.
- Diving Officer to be notified.
- Incident (University and DAN) reports to be completed.
- DAN incident form sent to DAN headquarters.
- Diving Officer to review incident.
### Recommended Delay Before Exposure to Altitude

<table>
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<tr>
<th>Altitude (meters)</th>
<th>Minimum delay before travel to altitude (hours)</th>
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<tbody>
<tr>
<td></td>
<td>Category of dive (see legend)</td>
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<tr>
<td>0 - 150</td>
<td>Nil</td>
</tr>
<tr>
<td>150 – 600</td>
<td>Nil</td>
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<tr>
<td>600 – 2 400</td>
<td>12</td>
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<tr>
<td>Greater than 2 400</td>
<td>24</td>
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</table>

**LEGEND:**

Category 1 = A single dive to ≤50% of the DCIEM no-decompression limit or two short dives within 18 h with a total, combined bottom time of ≤50% of the no-decompression limit for the depth of the deeper dive. No decompression diving or repetitive dives in previous few days.

Category 2 = Dives exceeding Category 1 but not included in Category 3, e.g. one or more dives to ≥50% of the no-decompression limits or a single decompression dive a day.

Category 3 = Repetitive deep diving over multiple days, multiple decompression dives on one day, extreme exposures; omitted decompression; or other adverse events.

**NOTES:**

1. The altitude referred to is the effective attitude. In pressurized aircraft the relevant environment is the effective altitude of the aircraft cabin and not the flying altitude. Commercial aircraft are usually pressurized to achieve an effective cabin altitude of 2400m or less.

2. The recommendations given in the above table are drawn from expert opinion regarding what would be safe for routine diving operations. The risk of decompression illness varies substantially with differing dive profiles, and data regarding risks associated with altitude exposure after diving is limited. Specialist advice is recommended whenever altitude exposure following diving is planned.

**SYDNEY METROPOLITAN AREA:**

The RTA (NSW) informed The University of Sydney Diving Officer (15.04.2005) that:

- Mount Ousley (Wollongong) is a maximum of 400 meters above sea level
- And Mount White (F3, near Gosford) is approximately 300 meters above sea level.
Appendix I – Definitions

Bottom time – the total time elapsed 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.

Caisson gauge – a pressure gauge specifically designed for the use inside pressure vessels.

Competent person – a person who has acquired, through training, qualifications or experience (or a combination of these), the knowledge and skills enabling that person to safely perform a specified task.

Compression (recompression) chamber (RCC) – 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.

CNS – exposure to high pressure oxygen leading to acute toxicity events. CNS is measured as a percentage of maximal exposure as given in the National Oceanographic and Atmospheric Administration tables.

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 barotraumas 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 in terms of maximum depth (MSW) and bottom time (minutes).

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 provided breathing gas to the diver via a mechanism which provides a flow of breathing gas when the diver inhales.

Dive coordinating position – a single, designated location on the surface, adjacent to where a diver enters the water, from which the diver’s safety is monitored.

Dive coordinator – a person who supervisors and coordinates any dive and is responsible for the dive team safety.

Dive leader – a person in charge of a specific part of a diving operation.

Dive plan – a procedure specific to a given diving operation.

Diver – a person who performs diving work underwater and who, for the purposes of this Diving Operations Manual, is trained and experienced in accordance with one of the categories mentioned within.

Diving officer – a person who has been nominated in writing by the employer and is ultimately responsible for all diving activities.

Diving program – one or more dives that are related by purpose, place or time to form a series.
Diving team – divers and support personnel operating together.

Diving work – work in which diving is conducted using underwater breathing apparatus, including work by the dive team in direct support of the diver.

Effective Bottom Time (EBT) – for a diver carrying out repetitive diving, the bottom time calculated after taking into consideration the residual nitrogen from previous dives.

Effective depth – for a dive at altitude, the depth of an equivalent dive at sea level.

Exceptional exposure dive – a dive where the maximum recommended dive time for a particular depth (shown by the limiting line in decompression tables) is exceeded by a diver at that depth.

Float line – a buoyant line connecting the diver to a highly visible float on the surface of the water enabling the approximate location of the diver to be known at all times.

Lazy shot – a rope running from the surface (dive coordinating position) to an attached weight, hanging free and positioned off the bottom or worksite. The rope is marked with depth graduations to facilitate decompression stops at the correct depth.

Lifeline – a line attached to a diver which is capable of being used to haul the diver to the surface.

Limiting line – a line shown in some decompression tables, which indicates time limits (bottom times) beyond which decompression schedules are less safe.

MOD: maximal depth for use of a nitrox mix, set by the partial pressure of oxygen at that depth. MOD limits for USyd divers is 1.2bar

Multi-place compression chamber – a hyperbaric chamber designed for occupancy by more than one person at a time.

Nitrox: A breathing gas mixture where the fraction of oxygen is elevated compared to air. Use of this gas (also called Enriched Air Nitrox – EANx) requires additional training.

Occupational diving – diving performed in the course of employment (irrespective of whether or not diving is the principle 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.

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.

Repetitive dive – any dive conducted within 18 h of a previous dive or that has a repetitive factor greater then 1.0 when calculated using DCIEM tables.

Repetitive factor – for DCIEM tables, a figure determined by the repetitive dive group and the length of the surface interval after a dive and used for repetitive diving.

Reserve air supply – that quantity of air that will enable a diver to return safely to the surface from the planned depth of the dive, completing any planned decompression stops.

Residual nitrogen – nitrogen that is still dissolved in a diver’s body tissues after the diver has surfaced.

Saturation – that condition where the person’s body tissues are totally saturated with the particular inert element of the breathing medium.
Scientific diving – diving performed for the purpose of professional scientific research, natural resource management or scientific research as an educational activity.

Self-contained underwater breathing apparatus (SCUBA) – open-circuit diving equipment which supplies the wearer with breathing gas from cylinders carried by the wearer.

Shot rope – a rope running from the surface (dive coordinating position) and fixed to the worksite or bottom with a weight or attachment. The role is marked with depth graduations to facilitate decompression stops at the correct depth.

Surface Interval (SI) – the time which a diver has spent on the surface following a dive, beginning as soon as the diver surfaces and ending upon commencement of the diver’s next descent.

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.

Tethered mode (in relation to SCUBA diving) – SCUBA diving in which a diver is secured by a lifeline and tended by a diver’s attendant, or is secured to a tended float line.

Therapeutic recompression tables – tables used for the treatment of decompression injury and other pressure-related injuries.

Visiting scientific diver – a trained, certified visiting diver from another country who performs tasks relevant to scientific diving in his or her own country, who has a current diving medical certification and who is allowed to dive under this Standard during his or her visit.