

CHAPTER TEN

LIFTING/LOWERING SYSTEMS

INTRODUCTION

- 10.01** The rescue of a trapped or injured person in a vertical environment requires a high degree of skill and experience in ropework, knots, and vertical rescue equipment.
- 10.02 COMMON SCENARIOS**
- In very general terms, lifting/lowering systems will be required for the recovery of all trapped and/or injured persons in the following common situations:
- Lower casualty from high point to low level.
 - Lower rescuer from high point, collect casualty from mid-point and lower to low level.
 - Lower rescuer from high point, collect casualty at midpoint and recover to high point.
 - Lower rescuer from high point to low level, collect casualty and recover to high point.
- 10.03** The listing of these common scenarios highlights the requirement for an approach in which a lowering system can be rapidly converted for lifting, to reduce delay.

WARNING NOTE

In all circumstances, rescue systems must be reversible so that the direction of movement can be changed at any stage of the operation

INCORPORATION OF SAFETY BELAYS

- 10.04 REQUIREMENT**
- In certain circumstances, dictated either by service operational policy or by on-ground conditions, there will be a requirement to establish a belay or safety rope for the casualty and escort.
- 10.05 BACK-UP**
- The belay is for use only as a back-up in the event that the main hauling line becomes inoperative, or any element of the rescue system fails.
- 10.06** A belay should be anchored independently of the rescue system and controlled at all times so that there is a minimum of slack in the line.

LOWERING SYSTEMS

10.07 The rescuer can be lowered to the casualty location either directly by a hauling crew paying out rope (**direct lower**), or with the rope being controlled through an anchored in-line descender (**friction lower**).

10.08 DIRECT LOWER

This is a reversal of the basic hauling system shown in Figure 10:1. With this, the hauling system is set up in its entirety, the ascender brake is disarmed, and the crew pays out rope to lower the rescuer. This system allows for a very rapid change of direction by the arming of the ascender brake, and the crew change to a hauling action.

10.09 FRICTION LOWER

With an in-line descender suitably anchored, the rope can be controlled by a single person to lower the rescuer to the casualty location. The descender is then locked off, the ascender brake is set up and connected to the rope, and when the hauling system is in place, the in-line descender is removed from the rope but left connected to its anchor for rapid conversion to a lower. A safety belay can then be set up.

LIFTING SYSTEMS

10.10 Lifting or hauling systems can be set up either with or without some form of mechanical advantage. The decision on the most appropriate method of lifting a casualty and rescuer will primarily depend on the size of the hauling team available.

10.11 The most commonly used systems are:

- a. the basic hauling system; and
- b. the basic mechanical advantage system.

10.12 BASIC HAULING SYSTEM

This is a very simple direct lifting system. It can be set up as shown in Figure 10:1 with a direction-changing pulley where hauling crew work space is limited, or with the hauling crew in a direct line back from the cliff edge. A variable amount of force will be required to overcome the friction created by the edge roller and the pulley.

10.13 As illustrated in Figure 10:1, an ascender brake or Prusik Loop is attached to the rescue line between the edge roller and the redirection pulley. This serves as a safety brake to permit the haul team to rest, and to provide safety in the event of system failure.

10.14 The ascender is rigged on a short length of rescue rope from an anchored in-line descender (to provide reversibility of the safety system), and should be tensioned towards the edge roller with a length of shock cord to maintain clearance with the pulley. A Prusik Loop used for this purpose must be controlled by a rescuer.

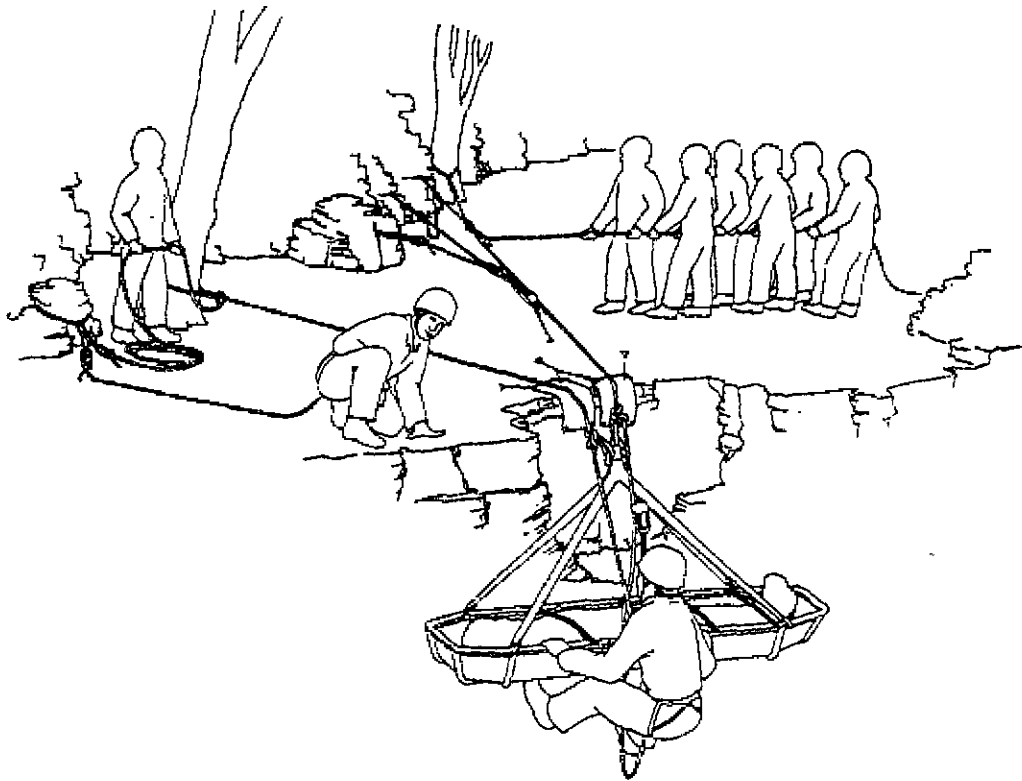
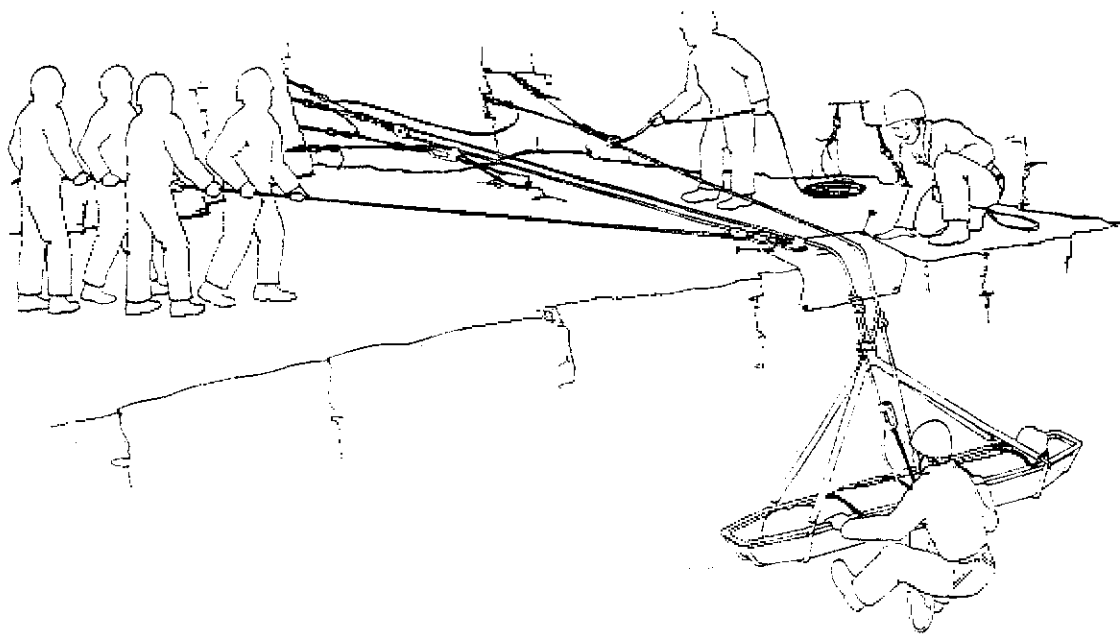


Figure 10:1
Basic Hauling System with Redirection Pulley

- 10.15 A communicator and/or team leader should be located as shown in Figure 10:1, on a safety line near the cliff edge but outside any danger zone.
- 10.16 The advantages and disadvantages of the basic hauling system are:
- a. **Advantages:**
 - (1) Simple in operation.
 - (2) Minimum equipment.
 - (3) Adequate haulage method.
 - b. **Disadvantages:**
 - (1) Limited control.
 - (2) 1:1 pull.
 - (3) Large manpower resource required.
 - (4) Considerable cleared working area in which to operate safely.
- 10.17 **BASIC MECHANICAL ADVANTAGE SYSTEM**
- The 'Z' pulley system shown in Figure 10:2 is the most commonly used and provides a theoretical mechanical advantage of 3:1.



10.24 HAULING OPERATION CALLS

Suggested calls for hauling operations are:

Call	Called by
HAULING TEAM READY?	Rescuer
READY	Team leader
UP	Rescuer
DOWN	Rescuer
STOP	Anyone
CLEAR	Rescuer

- 10.25** The use of hand signals should always be considered as an option for circumstances where voice or whistle calls will not be workable.

CLIFF MACHINES AND RESCUE DERRICKS

- 10.26** Devices such as the Larkin Rescue Frame and the Crux 2000 are now readily available and in common usage with rescue teams. All machines or derricks of this type are designed to provide edge clearance and high pulley attachment points at the working edge.
- 10.27** Due to the range of equipment available on the market, personnel should be trained in the use of the particular device used within their service.

CONCLUSION

- 10.28** It must be understood that this chapter deals only with the basic lifting/lowering systems in common usage with Australian rescue teams. The application of more advanced systems and problem solving techniques will depend on the individual level of knowledge and experience, developed through practice, producing safe and competent personnel.

CHAPTER ELEVEN

STRETCHER OPERATIONS

INTRODUCTION

- 11.01 The recovery of an injured person from a vertical environment requires the bringing together of a wide range of rescue skills with the use of rescue stretchers. **Where any doubt exists as to casualty injuries, a stretcher must be used.**

BASIC PRINCIPLES

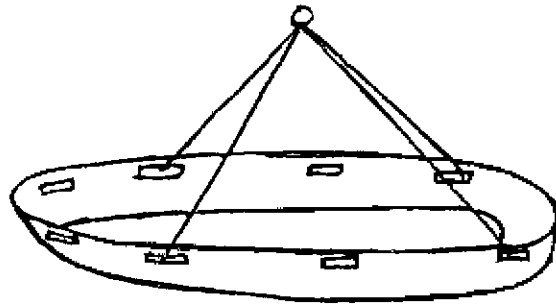
- 11.02 The following principles should be observed in all vertical rescue stretcher operations:
- a. The approach to a casualty should always be made carefully and to one side to avoid the risk of causing further injury.
 - b. Stretcher rescues should be effected using lifting/lowering systems. **Absell rescues of stretchers are not recommended.**
 - c. Wherever possible, the casualty should be protected with a helmet and some form of eye protection.
 - d. A rescuer should escort the stretcher. This person should be rigged on an ascent rig on a rope tether forming part of the stretcher rope system.
 - e. All components of the rescue system must be rigged with due regard to the loads which must be sustained.

CASUALTY PACKAGING/SECURING

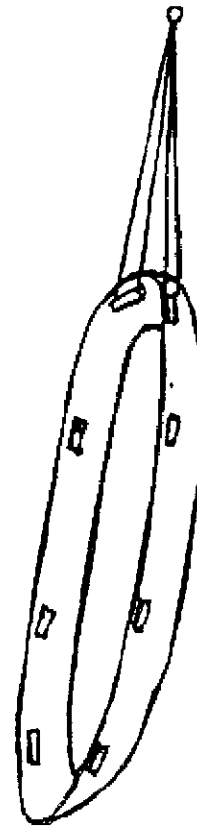
- 11.03 Regardless of the stretcher or recovery system, the casualty must be packaged and secured to the stretcher to prevent further injury.
- 11.04 **SECURING TO STRETCHERS**
- Chapter 5 of the *Australian Emergency Manual - Disaster Rescue* provides several options for the lashing of casualties to basket stretchers. These techniques are recommended for vertical operations.
- 11.05 Where other styles of rescue stretcher are used, casualties must be secured to the stretcher in the manner recommended by the manufacturer.

STRETCHER RIGGING

- 11.06 Depending on the injuries, terrain and conditions, a casualty can be recovered in a horizontal or vertical attitude (Figures 11:1.)
- 11.07 **PREFERRED METHOD**
- Wherever possible, it is recommended that casualties be recovered in a **horizontal attitude**, with the stretcher supported by a four point lifting bridle.



Horizontal



Vertical

Figure 11:1
Stretcher Attitudes

11.08 HORIZONTAL METHOD

When the casualty is secured to the stretcher, the rigging is carried out by:

- a. attaching a lifting harness or slings to four points of the stretcher so that it will adopt a horizontal position when suspended (Figure 11:2);
- b. locating the escort centrally beside the stretcher on an adjustable ascent rig which allows movement around the stretcher; and
- c. attaching an independent belay to the stretcher and escort (where required).

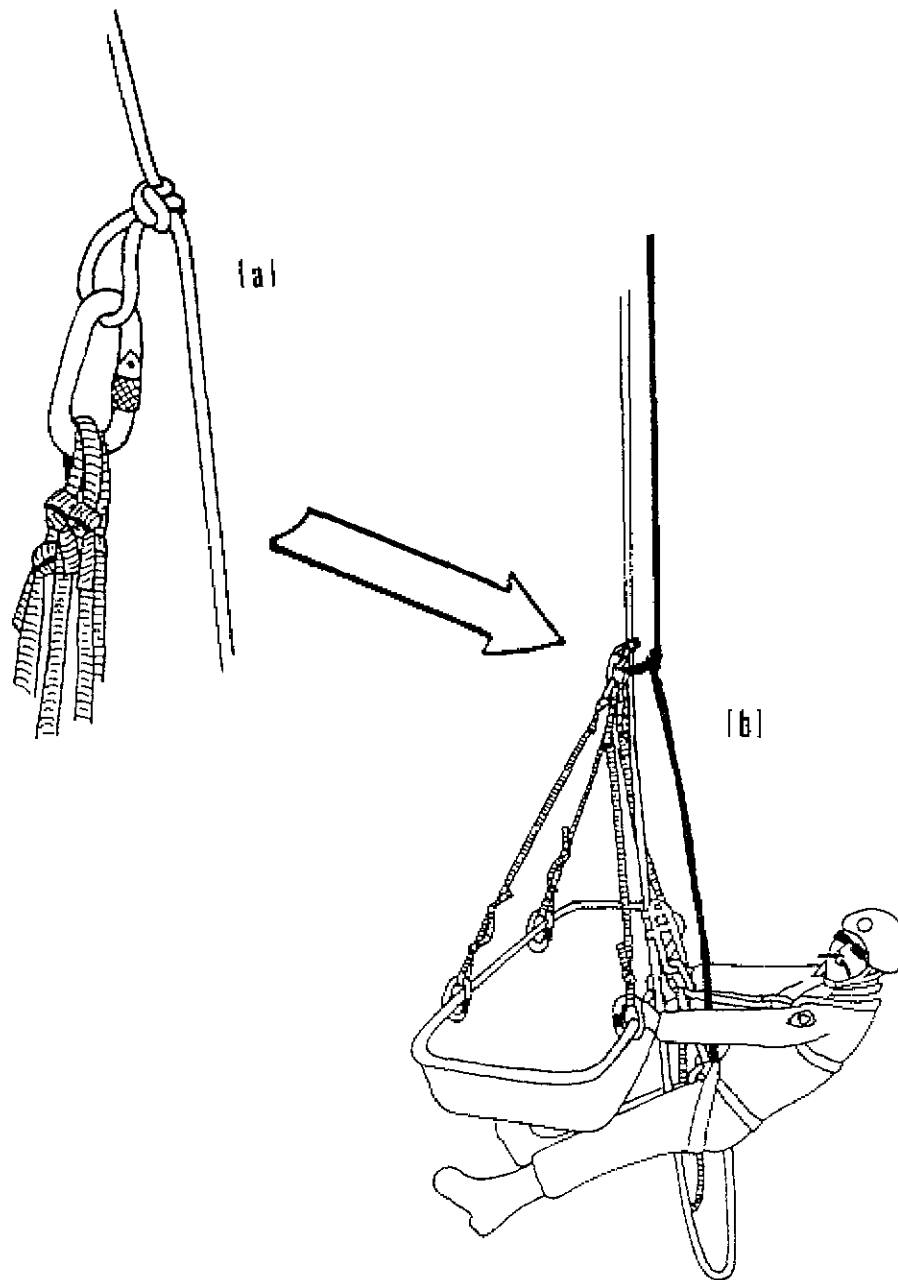


Figure 11:2
Horizontal Stretcher Rig

11.09 VERTICAL METHOD

When the casualty is secured in the stretcher, the rescue rope is attached to the head of the stretcher by means of a two leg lifting sling. Alternatively, for the basket stretcher, two tape slings can be used, or the rope tied directly to the stretcher.

- a. **Two Tape Slings** - Two tape slings of about three metres circumference can be used, one for each side of the stretcher as shown in Figure 11:3. Each sling is taken around the frame nearest the stretcher head, then braided around the top rail to distribute the load. The slings are then taken out at the stretcher head so that they meet at an angle of not more than 60 degrees and connected to an attachment karabiner.

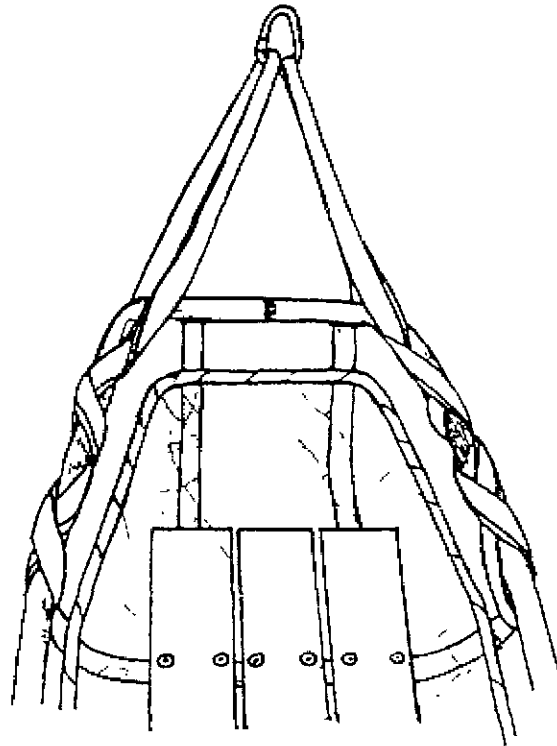


Figure 11:3
Braided Tape Sling Attachment

- b. **Direct Attachment:**
- (1) The direct rope attachment is rigged by taking the rope in through the head of the stretcher, and around the first frame and the top rail on one side. It is then taken around the top rail and the inward leg of rope to the first frame on the other side, then back out the head of the stretcher, resulting in a braided attachment which distributes the load. Refer to Figure 11:4.
 - (2) The rope is tied off using a pre-rigged Figure of Eight Loop so that the angle formed by the two legs of rope at the knot is not more than 60 degrees.

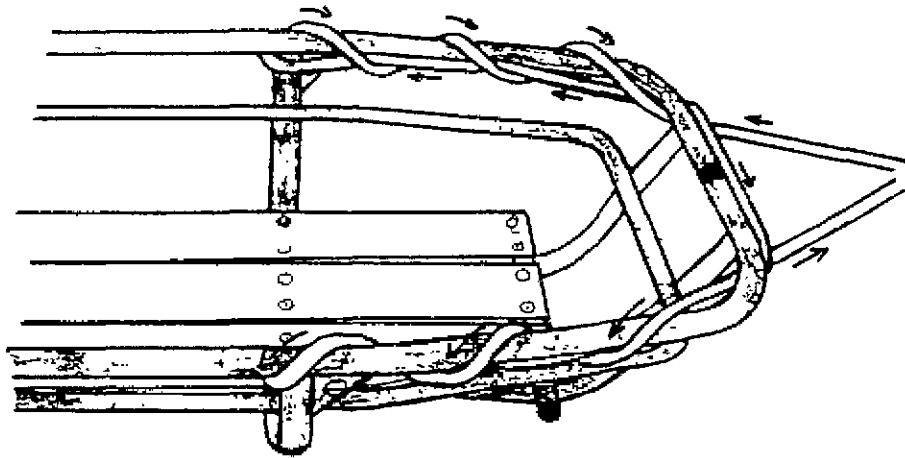


Figure 11:4
Direct Rope Attachment to Stretcher

- (3) The escort is initially located at the foot of the stretcher attached by an ascent rig to a rope tether which allows movement up and down the stretcher as required.
- (4) Where required, an independent belay is then attached to the stretcher and escort.

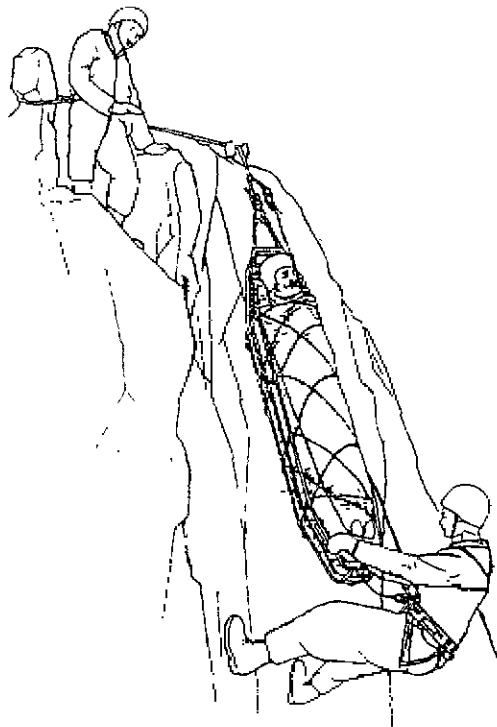


Figure 11:5
Vertical Stretcher Rig

TESTING THE RIG

- 11.10 The rescue system should be tested under load whenever safe and practical to allow for final adjustment.

ESCORTING THE STRETCHER

- 11.11 The role of the escort is to monitor and reassure the casualty and to manoeuvre the stretcher over difficult ground.
- 11.12 This role requires skill, strength and regular practice, and requires that the escort be fully rigged with an ascent system on a rope tether attached to the rescue rope.
- 11.13 The ascent system provides the degree of mobility which the escort requires to properly assist and support the casualty at all times.
- 11.14 **TWO ESCORT METHOD**
- To meet the needs of the casualty or terrain, two escorts can be rigged, each on a rope tether from the stretcher attachment point to accompany the stretcher. They should position themselves one at each end of the stretcher
- 11.15 The decision to rig for two stretcher escorts must be made, weighing the advantages of additional casualty support and stretcher mobility against the increased load to be moved by the hauling crew.
- 11.16 **UNESCORTED STRETCHERS**
- The rescue situation may be such that an escort can not accompany the stretcher. In all such cases, a stretcher guide rope must be rigged and controlled from below.
- 11.17 The decision to recover a stretcher casualty without an escort must be made with a careful assessment of the condition and needs of the casualty, and should be considered as the least preferred option.

CROSSING EDGES

- 11.18 **MACHINES/DERRICKS**
- Cliff machines or rescue derricks are specifically designed to help alleviate the difficulties involved in negotiating an edge. The use of these devices in all vertical rescue stretcher operations is highly recommended. (Refer paragraphs 10.26 and 10.27)
- 11.19 **PIGTAILS**
- Where a cliff machine or derrick is not available, it is recommended that an additional rope (a 'pigtail') be set up over the edge from a secure anchor point so that it hangs beside the main rescue rope.
- 11.20 On reaching the edge with the stretcher, the escort transfers his/her ascent rig (and weight) from the stretcher tether to the pigtail. From this position on the extra rope, and with the hauling load greatly reduced, the escort can help the belayed communicator to lift the stretcher over the edge while the hauling crew take in the rope.

CONCLUSION

- 11.21 Due to the dangerous nature and high degree of skill required for stretcher operations, the need for on-going training and safety management can not be over-emphasised.

CHAPTER TWELVE

OPERATIONAL MANAGEMENT

INTRODUCTION

12.01 This chapter is concerned only with the aspects of on-site operational management.

12.02 SEARCH AND RESCUE PROCEDURES

In keeping with standard search and rescue procedures described in the *Australian Emergency Manual - Land Search Operations*, a rescue operation should be based on the 'LAST' sequence as follows:

a. Locate:

- (1) Pin-point the location of the casualty.
- (2) Make contact with the casualty.
- (3) Conduct the reconnaissance and appreciation processes.
- (4) Develop the rescue plan.
- (5) Brief the team.

b. Access:

- (1) Urgent initial access to the casualty.
- (2) Continue reconnaissance and appreciation.
- (3) SITREP to team leader.
- (4) Update rescue plan.
- (5) Maintain contact and reassure casualty.

c. Stabilise:

- (1) Secure the casualty to prevent further harm and render life saving first aid.
- (2) Update information to team leader.
- (3) Package casualty for evacuation.
- (4) Prepare for evacuation.
- (5) Final briefing for team.

d. Transport:

- (1) Rescue system in place.
- (2) Conduct final safety checks.
- (3) Evacuate casualty to safety.
- (4) Debrief casualty if appropriate.
- (5) Recover and check equipment.
- (6) De-brief rescue team.

COMMAND AND CONTROL

12.03 TEAM LEADER

The rescue operation will be carried out under the command of the team leader. The team leader must direct the rescue team to a safe and rapid recovery of the casualty.

12.04 STRETCHER ESCORT

During the evacuation stage, the stretcher escort will give movement commands which the team leader will ensure are executed.

12.05 SAFETY OFFICER

The Safety Officer must oversee the operation. He or she is responsible for ensuring that all aspects of the operation are carried out safely.

LEGAL ASPECTS

12.06 OPERATIONS LOG AND RECORDS

An operational log must be maintained throughout the rescue activity.

12.07

Where there is a possibility that a Coronial investigation or civil action may ensue, accurate and detailed records must be kept. This is the responsibility of the Police, however local arrangements should be made to ensure this takes place.

12.08 PHOTOGRAPHS

Wherever possible, and at the discretion of Police in attendance, photographs should be taken to depict the situation.