



Survival



CIVIL AVIATION AUTHORITY
OF NEW ZEALAND

Te Mana Rererangi Tūmatanui o Aotearoa

An airliners' passage through the sky is closely monitored, very well defined, and its ETA calculated precisely. So any deviation from the flight planned route will be quickly noticed, and should something serious happen, it will be immediately noticed.

In General Aviation things are not quite so rigid, and for many, that's the way they like it.

In the General Aviation arena, should something go wrong, it will probably take

longer to establish that it has, and the information available will invariably be more general. It will take longer for the search to start; the search area is likely to be bigger; and most importantly, the time it takes to find you will be greater.

Wouldn't you like to make it as easy and as quick as possible to be found alive?



The Power of Being Prepared

All you need to survive after an accident is a bit of gear and maybe some training, right? Actually, the one thing that will help you the most in a survival situation is a positive mental attitude.

A positive mental attitude is not just a case of sticking your chin out and saying, “We’ll be fine, trust me”. It’s the result of having put in enough thought, training, and preparation, so that when you are confronted with a survival situation, you have a good idea of how to handle it.

In the ideal survival scenario, everyone would have a positive mental attitude. Nothing is ever ideal, however, and you may be the only positive one, but it will have a positive effect on your passengers as they see you handling the situation well.

Deal With It

As the pilot, it’s possible that something you did, contributed to you finding yourself in this survival situation. Don’t dwell on the things you could have done better, just get on and deal with the situation at hand.

Handling a bad situation well is a great way to help redeem yourself. Concentrate on what needs to be done now to produce the best possible outcome.

Contents

The Power of Being Prepared	3
Survival Kit Contents	6
The Rule of Threes	10
Surviving in New Zealand’s Environments	16
Cell Net and Satellite Communication and Distress Signalling Devices.....	29
Survival Priorities	31

Acknowledgement:

The CAA gratefully acknowledges the work of Grant Gillespie in the production of this booklet.

CAA Web Site

See the CAA web site for Civil Aviation Rules, Advisory Circulars, Airworthiness Directives, forms, and more safety publications.

www.caa.govt.nz

Priorities of Survival

Every task you carry out in a survival situation is a priority, but some things are more important than others.

Experience over many years, and in many environments, has shown that there is a definite order of priorities.



Priorities of Survival

1. Protection

- First Aid
- Clothing
- Shelter
- Fire

2. Location

Immediate aids (ELT or beacon) and improvised (signal fires, etc)

3. Water

4. Food

This structured list should form your action plan – in a survival situation, write it down and record your actions in a running log.

Survival Training

You can have a positive mental attitude by thinking about your actions in advance. Consider some training, talk through how to handle a variety of situations with experienced people, and practice some of the things that might be expected of you in those situations.

Survival training closes the loop by making you prepared for what happens after the aircraft comes to a stop.

Some things your training should cover:

- How do you transition everyone from “we’ll just land here until the cloud clears” to “looks like we’ll be staying the night”.
- How do you stop people from getting cold?
- What is the difference between being cold and becoming hypothermic?
- What can you do when someone is hypothermic?
- Most of us can light a fire, but can you light a safe fire when it’s blowing and raining?



There are a number of organisations providing training courses, including The Mountain Safety Council and Search and Rescue Institute New Zealand. See *Resources* section page 30.

So, if you have a survival kit under the seat but have never even looked at it, get it out, familiarise yourself with it, attend some training and give yourself the greatest advantage possible.

You can have a positive mental attitude by thinking about your actions in advance.

Survival Kit Contents

There are many variables to consider when making up a survival kit.

The amount of equipment needs to be appropriate for the maximum number of occupants of the aircraft, including infants.

The weight and physical size of the kit is relevant. If you are going to keep your kit permanently in the aircraft, this will need to be included in the aircraft weight and your centre of gravity calculations.

If your kit's not enough for an overnight stay, then you'll probably wish it were. A second night would seem unlikely, but not impossible, especially if you are caught out in bad weather. Three nights is probably stretching it. Considerations for this length of enforced stay need to be carefully balanced against the practicalities of what can be carried, and the likelihood of ever needing it.

It is important to have just enough of what would be really useful if you were to find yourself dumped in the middle of nowhere, to help stop the situation from deteriorating further for perhaps a day or two.

Your survival kit should be designed to cover your needs for most of the flying that you do. If you do something different, such as a long over-water flight, you will need to consider what additions you might need to make for that, such as a life raft.

Consider how you will gain access to the kit after a forced landing.

Some overall compromises will have to be made, so it's best to figure out how much space and weight you have available before buying any equipment. Make up a list of what you think you should be carrying, then prioritise it in order of importance. Start from the top of the list and work down until your weight or space available is used up. See our list on page 9.

99.9% of the time a survival kit is no more than additional weight in an aircraft.

First Aid

While most light aircraft are not required to carry a first aid kit, fire axe, or fire extinguisher, these are sensible items to carry.

Your first aid kit should be able to cover the number of potential occupants, and there is no reason why you cannot add useful items to a standard kit, like additional survival blankets for example.

One addition worth considering is a first aid handbook. Most first aid courses come with a manual that might be





ideal, and a lot of first aid kits have a small booklet included.

An alternative is the New Zealand Mountain Safety Council Outdoors First Aid Manual (www.mountainsafety.org.nz). Although written for trampers, it is orientated for those needing to provide first aid in the remote outdoors. Also available are pamphlets on recognising and treating hypothermia.

For those who may need reassurance, or a kick start, when faced with a real first aid situation, these publications would be ideal. They are also a good back up if you become injured and need others to help you.

First Aid Training

There is no substitute for real first aid experience, but in lieu of that, a current first aid qualification is important.

All first aid courses will cover the basic safety, airway, breathing, circulation and major bleeding priorities. However, as help may be some time coming, and even then may not be in the form of a trained medic, some information/training on how to handle this situation could be an advantage. It would also be helpful to know how to improvise first aid items to supplement your first aid kit.

While you never know when you may need to provide help, you should be prepared for when you find yourself alone, or with a small group of people, in a remote location.

Consider how you will gain access to the kit after a forced landing.

As pilot-in-command, it is natural that others will look to you to provide help – so long as you are not badly injured yourself.

Fire Lighting

There are some very practical, and legal, considerations to be made when deciding to carry such things as matches, a lighter, or other potentially flammable items as part of a survival kit.

Book matches are not an option. They are hard to light, and if the book is compressed and rubbed between two surfaces, the matches can ignite. Waterproof matches can be handy but some types are difficult to light, so you need to try them out. Lighters need to be checked annually.

A short length of bicycle inner tube will light relatively easily in all conditions – even the wet, and will provide enough heat to get even damp wood burning. A short length of tube can easily be added to your kit, and can even be part of your personal survival kit, see page 8.

All inflammable items need to be stored either in a metal billy or in a small metal

container of their own. This will reduce the likelihood of them accidentally lighting, and if they do, then the container should be capable of containing the flame burst.

If you are carrying a cooker, it should be set up to run on your aircraft's fuel. The cooker itself should be stored empty and fume free along with a container to transfer fuel from the tanks to the cooker.

Flares and the like need to be stored appropriately, so think carefully before including these in your kit.

Personal Survival Items

You might like to consider a personal survival kit, one that you can carry in a pocket at all times. It should contain items that will enhance your survivability, but that are small and light to carry, and ideally the items will have more than one use. The container should be as big as your pocket allows and also able to be used for more than one purpose, like a metal can that can be used for boiling water or to signal aircraft/rescuers.

Personal survival kit contents could include:





Aircraft Survival Kit Contents

Item	Lowlands	Bush	Alpine	Marine
Standard Emergency Equipment				
Axe	✓	✓	✓	✓
Fire extinguisher	✓	✓	✓	✓
First Aid Kit				
Aircraft first aid kit	✓	✓	✓	✓
Basic first aid instruction manual, preferably with an outdoors orientation	✓	✓	✓	✓
Signalling				
Mirror or signal mirror	✓	✓	✓	✓
Satellite phone/Satellite tracking	✓	✓	✓	✓
ELT, EPIRB or PLB	✓	✓	✓	✓
Fire and Cooking				
Fire-lighting kit	✓	✓	✓	
Cooker			✓	
Billy (capacity 1 cup per pax)	✓	✓	✓	
Cups	✓	✓	✓	
Spoon	✓	✓	✓	
Clothing and Shelter				
Warm hats	✓	✓	✓	✓
Gloves	✓	✓	✓	
Warm socks	✓	✓	✓	
Wind/waterproof shell layer	✓	✓	✓	
Emergency shelter (Bothy Bag or similar)	✓	✓	✓	
Plastic bags (to put over gloves and socks)	✓	✓	✓	
Big plastic bags (to make rain ponchos)	✓	✓	✓	
Survival blankets (1 per pax, plus extras)	✓	✓	✓	✓
Duct tape	✓	✓	✓	
String/cord	✓	✓	✓	
Food and Hydration				
Water container	✓	✓	✓	
Barley Sugars	✓	✓	✓	✓
Nuts and raisins	✓	✓	✓	✓
Packet soups	✓	✓	✓	
Tea	✓	✓	✓	
Hot chocolate/Milo	✓	✓	✓	

Survival kits should be checked annually especially if batteries, fire lighting materials and food are included.

The Rule of Threes

Given the large number of environmental factors that will influence any survival situation, it's not possible to be precise about survival times. There are some rules of thumb, however, that will help put things in perspective.

How long can you survive without:

Air – 3 minutes

(drowning, carbon monoxide inhalation or major trauma)

Clothing and Shelter – 3 hours

(in extreme cold, due to hypothermia)

Rest – 30 hours

(depending on level of exertion)

Water – 3 days

(depending on temperature and activity level)

Food – 3 weeks

(unless you're burning calories flat out trying to keep warm)

Air

This is where your first aid training will come in to play. Once you have dealt with someone's lack of air, or other injuries, you can move on to the rest of the priorities.

Clothing

Clothing requires careful consideration. If you head off on your flight wearing the ideal set of clothing for a survival situation it is most likely you will end up really hot, quite uncomfortable, and eventually dehydrated.

Alternatively cotton shorts and a t-shirt will leave you very cold, should you have to spend a night outside. So ideally you should be dressed comfortably for your planned flight with some additional clothing handy, should you need it.

Cotton

Cotton is a poor insulator when wet, but will provide a minimal degree of protection against fire, as it doesn't melt and burn like synthetic fabric.

Fleece, Fiberpile, Polarfleece, Polypropylene

These all are made from synthetic material and will provide warmth even when wet. However, when heated by fire they will melt and burn. These items are useful once away from the aircraft, but not ideal to wear while flying.

Wool

Wool will keep you warm when wet, and doesn't burn when heated or in the presence of a flame.

Down

Down is a great insulator and has poor flammability, but is often encased in a nylon shell, which will melt and burn when sufficiently heated.

Fireproof Garments

Fireproof overalls and gloves are available, but can be expensive.

Sensible layering of cotton and wool can provide some degree of flame protection as well as being good practical flying apparel. Fleece or additional wool items can be set aside for additional warmth in emergency situations.



Waterproof and Windproof Layers

Waterproof and windproof layers may be of only limited use around or in an aircraft, but if you do find yourself unexpectedly out in the weather they will be invaluable. A windproof layer over warm layers will help trap your body heat and stop the movement of air carrying the heat away from your body.

Some multi-person survival kits include one-piece coveralls, made from a paper-like nylon. These can be easily fitted over existing clothing layers and protect the wearer from the elements. They are usually fitted with a hood and elastic cuffs to reduce the loss of heat from around the body.

Given the relative expense of outdoor parkas and waterproof pants, especially in larger numbers, coveralls can be a good option. Their durability is limited, however, and after a day or so they become ineffective and will need to be replaced. They are a single use item, which you should try out first.

Shelter

There are three options for shelter: the existing aircraft, an emergency shelter carried in the aircraft, such as a Bothy Bag (see page 23), or a shelter constructed from the natural materials around you, such as a bush shelter or a snow mound.

Think seriously about carrying a lightweight emergency shelter such as a Bothy Bag as part of your kit, they are very easy to use, and they work everywhere – except under water.

Hypothermia

Hypothermia is the real long-term enemy – the one that probably won't go away. Once you have dealt with all the other survival priorities, hypothermia will be the remaining challenge. It will remain the challenge right up until help arrives, and in serious situations, well after help arrives too. You must be able to recognise hypothermia, and know how to treat someone who is developing it.

Hypothermia is the body's response to being cooled. Initially, you will start shivering – this is the body trying to generate warmth by muscle activity. As you continue to cool, in an attempt to preserve the core of your body from cooling, circulation to the extremities is reduced. Your hands and feet get cold because there is less warm blood flowing to them to keep them warm. With a restricted blood flow, the volume of blood needed is reduced, so your kidneys go to work and you will urinate the excess fluid.

As you continue to cool, you lose your ability to think rationally, your coordination decreases, you stop shivering, and vitally, your ability to hold down fluids is lost. This means that the best way of warming someone up, by giving them a hot drink, is gone. So the best remaining option is to use close body warmth, ie, surrounding them closely with other warm bodies, especially around the core or chest area. If cooling continues unchecked, consciousness is eventually lost and ultimately death will occur.



Critically, do not rub the limbs of someone who is seriously cold as all you will do is pump cold blood back into the cool core. The temperature drop to the core may just be the last straw. Additionally, do not give up on someone who is not responsive. Provided they are treated gently, kept as warm as possible, and treated appropriately by a trained medic or doctor, they may make a full recovery.

So the message is: don't let people get cold.

To help stave off hypothermia, you may want to get everyone to walk around the aircraft for ten minutes every half hour as a means of generating some warmth.

Essentially hypothermia is the real long-term enemy – the one that probably won't go away.

Search Action

If you have tackled the priorities above, now might be a good time to think about helping rescuers find you.

There is no point lighting a roaring bonfire in the middle of a remote valley as a signal fire if nobody knows you're overdue yet – but there is a lot of point in getting ready to light one. Thinking about what might be happening on the 'outside', and planning to respond accordingly, is a great way to ensure you are using your resources (including your energy) to the best possible effect.

Rest, Hydration and Food

While the rule of threes puts very different survival times on these three key components, the reality is that given the New Zealand climate, they are best viewed collectively, as each has a marked impact on the other two.

Surviving is like trying to get the best economy out of your car. You are trying to make the energy you have stored in your body, plus the additional energy available to you from food, last as long as possible. Burning energy as economically as possible is the best way to survive. Rushing around doing things that don't need to be done will just burn valuable energy.

We all have a certain amount of fat stored around our body. While this helps keep us warm, our bodies can also burn it to produce energy. However, it takes time for our body

to convert the fat, so to use this energy effectively, don't rush about. It is slow burn energy.

Things with lots of sugar in them produce lots of energy, but are quickly burnt, so tend to produce energy spikes, therefore, they are great if you need a boost to get something done, but once this energy is burnt you will be left feeling worse than before.

Rest

Take stock of the situation, considering all the options and decide on the best things to be doing.

Hydration

Unless it is a hot day, fluids are best provided warm. Cold water such as snow and glacier melt water can cause stomach cramps, and then vomiting if enough is drunk. Even if the fluid is not that cold, the body uses energy warming it to body temperature. Warm or hot water will help re-warm the body from the core out if needed, which is ideal. For those starting to suffer from hypothermia, giving them a hot drink is highly recommended (warm and sweet, but not coffee), provided they are able to swallow it themselves.

Boiling drinking water is a great way of keeping people occupied if you need to fill in time. The fire or cooker will need to be kept going and will provide a warm focus for all involved, with the promise of a nice warm drink at the end of the chore.



Food

Perhaps unexpectedly, food is a low priority during the early stages, but food is where energy comes from. If it's cold and your shelter and clothing are a bit deficient, people will be burning energy trying to keep warm, so food will be the best way to replace the energy being used.

So what sort of food should you be carrying?

- Something that will last a long time before it needs to be replaced.
- Something that can be eaten without any preparation.
- Something that can be mixed with hot water, if available.
- Something that can provide a moderate rate of energy release.

Some recommendations are:

*Barley sugars -
slow/medium release of energy if sucked,
faster if chewed.*

*Milo/hot chocolate -
hot sugary energy, good for re-warming
someone, it has a fast release of energy
so needs to be followed up with something
with a more moderate rate of energy release.*

*Tea -
adds flavour and tradition to hot water,
but no real energy value.*

*Packet soup -
lasts for years, has a slower release of
energy but quite warming if the water is hot.*

*Nuts and raisins -
last moderately well. Replace at least
two yearly. Medium release of energy.*

Surviving in New Zealand's Environments

The Lowlands

Most of our heavily populated areas are on the lowlands, and obviously that's where a large percentage of general aviation flying is carried out. So this is the terrain we should be prepared to look after ourselves in, and as it happens, the easiest option to be prepared for.

Site Selection

Site selection is the first and most important issue when planning an emergency landing, and your range of options will be greatly influenced by the availability of engine power and/or the presence of cloud.

Selecting a good landing site requires making choices based on the information available to you at the time. During any flight, being aware of the best forced landing options, and what the influence of the wind is likely to be, is very important, and will help greatly in making a safe landing.

Priorities

Once on the ground, and having come to a halt, remember you are still the pilot-in-command and you have responsibilities.

Double check the fuel and electrics are switched off, and vacate the aircraft to a safe area. Head upwind if there is any damage and the possibility of leaking fuel or of fire.

Then tend to your priorities.

1. First aid – have a good look at everyone, talk to them and apply your training as needed.
2. Ensure your ELT is activated and the aerial is still intact.
3. Depending on your circumstances concentrate on:
 - shelter if the weather is poor, or
 - signalling if the weather is suitably fine.

Clothing

Clothing will become important as the night cools down – so that jacket you threw in will be useful. Keeping everything dry is very important. Wet cotton loses a large amount of its warmth, and wet cotton exposed to the wind will chill your body down very quickly. Once cold, it is relatively difficult to get warm again, so aim to keep everyone warm right from the outset.



Shelter

Depending on the time of day, and the reason for your unplanned landing, you may need to prepare for an overnight stay, before it gets too late and starts cooling off.

The aircraft may be your best shelter option, though never ideal. If you can, remove the seats and put all the cushions on the floor to make the most of the space available. If the aircraft is too damaged to provide shelter, you will need to find natural shelter or make a shelter from what you have available – bits of aircraft, an emergency shelter, or a shelter made from vegetation.

Signalling

This can be in the form of a signal fire, signal mirror, silver survival blankets or, after checking it's safe, turning the electrics back on and trying the radios. Airliners usually have a spare radio tuned to 121.50 MHz, so this is worth a try if you see any flying overhead.

Once it starts to get dark, anti collision lights, if they are still working and it is safe to use the electrics, can be a good means of attracting attention.

Provided it's safe, a fire is a wonderful thing. It provides warmth, a signal, a means of drying wet clothing, a focus for passengers, and something constructive for them to do.

Provided you have an active ELT, PLB, a satellite tracking system, or have made an acknowledged MAYDAY call, you could assume (given suitable weather and daylight) that help will be on its way within hours. Doing everything to minimise the search time should be your focus.

Leaving the Aircraft

If there are signs of life nearby, you may elect to walk for help. Leave an obvious note listing your exact intentions and don't deviate from them. As a rule of thumb, to judge travel time on foot, one minute's flying at 120 knots will equate to roughly one hour's walking. So that farmhouse you passed about 10 minutes ago is far too far away to consider walking to at three o'clock in the afternoon. Usually you're much better to stay with the aircraft.

Rest

At the very least, sit down long enough to take stock of your situation, decide what options are available to you, and what the best course of action is. It is too easy to waste a lot of energy doing stuff that doesn't really help. Most people are not comfortable sitting still confronting their own reality, but if you can do it, a well-considered thought-through approach will get you a lot further than throwing all your energy into whatever thought crosses your mind at the time.

Unfortunately, sleep is not recommended for anyone who has been knocked unconscious, so these people will need to be kept restfully awake.

Hydration and Food

These will help with energy levels and morale, but depending on the amounts available, may need to be rationed.

The Bush

If you have to make a forced landing, and the only option you have is covered in bush or trees, then all other things being equal, avoid the trees.

Trees, bush, and scrub all have distinct colours and shades of green. Next time you're flying over some bush, take note of what makes the lower height scrub distinctive from the trees. If you know what your preferred ground cover looks like from above, it will allow you to identify it earlier and make better site selections.

Both wind and slope need to be taken into account when deciding to land up or down-valley. If the valley climbs any more than gently, then you should be landing uphill, even if you have to accept some tailwind.

In the Trees

If trees are your best (or only) option, then landing on top of the canopy, like it is the ground, seems to be the best advice.

If you end up hung up in the trees you may want to climb down. This can be

hazardous, so make sure you take everything you need with you.

Before you climb down, check the ELT is activated and its aerial is still intact. An active ELT signal can easily be heard on the aircraft's radio, somewhat regardless of the frequency selected.

If the aircraft comes down through the trees to the ground, at least you won't have to climb down, but it's likely there will be very little sign of your passage, so it's not going to be easy for rescuers to see you!

Shelter

When it comes to making a shelter in the trees or scrub, there are some distinct advantages. The vegetation will give you some natural shelter and help break the wind. Not being on snow is a huge warmth advantage, and materials for a fire will be relatively abundant.

If the aircraft is reasonably intact and safely sitting on the ground, this will be your best shelter option, but it will probably need to be made safer and more habitable. Disconnect the battery or at least make sure the master is turned off – this should not affect your ELT as it has its own battery.

Inside the aircraft, do what you can to reorganise seating to provide an insulated area to sit or lie on. Patch up any holes in the fuselage with survival blankets and

duct tape to keep the breeze and the rain out. Don't cover the aircraft with scrub in an attempt to make it warmer – you'll just make it harder to find.

If the aircraft is unsafe you will need to make or build an alternative shelter. There may be some natural shelter nearby you can use, like a rock overhang. However, if you need to move away from the aircraft to find shelter, make sure you leave clear evidence of which direction you went, and how far away you are. You have only done half your job if rescuers find the aircraft, but not you.

If you need to build shelter, pick a spot that offers as much natural shelter as possible. Cut, bend and break whatever you can to make it as comfortable, dry, and sheltered as possible. This may or may not include bits of the aircraft. One piece of equipment you will be pleased you have is the axe. Provided to help you exit the aircraft after an accident, the axe is a very handy bit of firewood gathering and shelter-building kit.

The other option for shelter, completely separate from the aircraft, is a Bothy Bag carried as part of your survival kit (see page 23).

Signalling

Make sure the ELT is activated, and the aerial is intact and attached. The less sky you can see, the less likely it is that a satellite is picking up the ELT signal.

Trees don't help, so do the best you can to enhance the situation. If the signal is only being received intermittently, then it will take longer to get an accurate set of coordinates for your location.

That being the case, rescue may take longer and may not even be today, so start planning for an overnight stay.

Consider what you can do to make it easier for searchers to find you.

One of the better options is a smoky fire. Don't light it until you are sure someone will see it, maybe wait until you hear an aircraft in the area. However, start gathering up all the materials you can to make your signal fire – dry wood to get a fire started, and green vegetation to make smoke.

Keep a pile of materials in reserve, so if you need to make a second or third attempt, you're not off scrounging for materials when you should be trying to send up big puffs of smoke.

If it's cold and there's plenty of firewood available and people to collect it, start a small fire to keep warm and give the group a focus. Have plenty of material on hand to quickly increase its size and to make smoke when you hear a searching aircraft. Fuel or oil from the aircraft can help get a fire going and producing good puffs of smoke. However, if there is any spilt fuel or fumes present, don't light a signal fire too near, or downwind of, the aircraft!

Alpine

Given the distinct problems with undertaking a forced landing onto snow or ice, it may be much simpler to avoid flying over areas that offer no other forced landing options.

The only landing sites in high alpine environments are on snow or ice – though snow will be smoother and relatively more forgiving than the rougher glacial ice. Just getting there, however, will not be easy, so your other options would need to be decidedly poor, before you choose this one.

If it is your only option, here are some of the challenges you will need to overcome.

Lighting

Snow is white and reflects light rather than absorbs it, so under a clear sky the snow surface will be reflecting a lot of light, and is usually termed 'bright'. Under such conditions it is near impossible to judge the distance above the surface without the aid of an object or mark on the surface to use as a reference. Without sunglasses it is pretty much impossible.

You may be lucky and be able to pick out tracks left by skiers or climbers, but it's more likely you will need to use a rock outcrop or an area of crevassing, to provide some reference. This is far from ideal, as glaciers are uneven and steep as they flow around rocks, so the landing

area, when you finally get to see it, may be extremely poor. You will need to carry excess speed and make your approach towards a large and suitable area beyond the reference – preferably up-slope.

This might allow you to get close enough to the surface to be able to see it by using your reference feature then flare along the surface, bleeding off speed until a suitable touchdown speed is reached, hopefully over the potentially suitable area.

Avoid landing among crevasses, these cracks in the ice can be over a hundred feet deep.

The other common type of snow surface lighting that will cause great difficulty is flat light. This occurs under cloud cover or an overcast sky. In this situation, rather than having the full power of the sun reflected right at you (bright out), the cloud diffuses the sunlight, and the snow surface takes on the same grey hue as the cloud. Snow and cloud can become indistinguishable.

The best option for dealing with this lighting is the same as for bright out. Unfortunately, it may be even harder to see the snow surface and your chances of success will be poor. Ground reference features appear to hover in space, and it becomes challenging to accept what you see. It is possible under extreme conditions to be unable to see the surface as you walk on it!

Surface

If by some chance you are able to overcome these challenges successfully, you will then be able to move on to the second real issue with landing on snow: the softness, or firmness, of the snow surface.

Aircraft with fixed undercarriage will have no problem stopping, provided the snow is soft, but the deceleration is likely to cause the aircraft to pitch nose over and come to rest lying on its back. Be prepared for this possibility and remember to brief your passengers before landing.

If retractable undercarriage is fitted, you could consider landing wheels-up.

Helicopters fitted with skids seem to do fine in snow, though if it's soft, there can be a tendency for the heels of the skids to sink in more than the toes, causing tail rotor strike, which is why some machines are fitted with snowshoes.

Firm or well-frozen snow surfaces can be as hard as polished concrete, so land upslope to have any chance of pulling up in a reasonable distance. If the slope is moderate and the surface firm there may be a tendency for the aircraft to slide off downhill as soon as it comes to rest.

After Landing

The first decision to make is to decide if you are now parked on a glacier or

just seasonal snow. Glaciers have crevasses, seasonal snow doesn't. If you're not sure or if it is a glacier, getting out of the aircraft and walking around is not recommended, due to the possibility of falling down snow covered crevasses. However, that risk also needs to be weighed up against any threat from the aircraft such as fire or it sliding off down the slope. Certainly minimising how much you walk around in the snow would be wise, and once some footsteps in the snow are established walking in those exact steps from then on, to minimise any further risk of stepping down a crevasse, is highly recommended.

The Cold

Given that you are now in snow, if you are not cold you soon will be. The reflected light of the sun does cause a huge amount of radiated warmth during the day but as soon as the sun disappears it is like walking into a freezer, so be prepared. Getting wet from the snow will spoil any insulation properties your clothing and footwear provide, so keeping dry is a high priority, especially if a night out is possible.

Once you have dealt with any first aid priorities and checked that your ELT is operating, the next task is to maximise your shelter and warmth options.

Shelter

There are three options – none are ideal, but given your circumstances the choice of which to pursue should be fairly obvious.

The first option is to use the aircraft, and provided it is basically intact and a safe place to be, that would be your best bet. The downside is that metal, fabric, or even composite, are poor insulators, so the cold of the snow and the night air will be transmitted through the aircraft's skin to you.

Perhaps surprisingly at night, the air temperature can be considerably lower than the snow temperature, especially in winter, so one option is to pile snow up against the sides of the fuselage to improve the insulation. Of course you don't want to make finding the aircraft harder, so don't bury it.

Inside, make sure everyone is fully clothed and insulated on seat cushions to keep them off cold outside surfaces. Huddling together helps prevent heat loss too as the area of skin exposed to lower air temperatures is lessened. Survival blankets are very useful, both to wrap people in, and to double glaze aircraft windows by taping blankets to the aircraft lining.

Survival blankets also make reasonable reflectors to signal searching aircraft. Their multiple uses and light weight, mean they are an important item to carry a good supply of.

The second shelter option is required if you have damaged the aircraft to such a



Digging a snow cave

point that it can no longer be of use, or it is sitting in a position that makes it dangerous to use. To cover this eventuality carry a Bothy Bag. This is essentially a tent without poles. It can be easily used to throw over a partly damaged aircraft for shelter, or can be used on its own as the people in it provide the 'poles'.

Bothy Bags

Bothy Bags are basically a brightly coloured round tent, with no poles or door. The roof is a circle of lightweight nylon attached to a 1.5 m high strip of nylon, that acts as the wall. Passengers are grouped together facing inward in a tight circle. The bag gets thrown over their heads and everyone grabs the bottom of the nylon wall and sits down on it. With backs facing outward they become the supporting wall and the temperature inside soon rises a degree or two.

People can be grouped around an injured person and achieve instant shelter for them. The nice thing about these bags is that they can be used anywhere, except the marine environment.



Bivouac Bags



Snow Mounds or Caves

The last option for shelter in the alpine environment is to build either a snow mound or dig a snow cave. However, you are in trouble if you are only dressed in cotton clothing, as it will soon become wet and lose its insulation properties, and of course if you don't have a snow shovel, or the snow is well compacted and can't be dug easily, then this just isn't going to work for you.

The remaining issue with this option is that it takes quite a lot of shovelling to make a shelter for even four people – perhaps four

hours at least. In the meantime you are getting wet and cold in your cotton shirt and pants, and everyone else is just plain getting cold. Realistically, the snow mound or snow cave option, while it can provide the warmest shelter, will probably make you hypothermic once you stop digging and remain wet in your cotton clothing. You will burn up a lot of energy digging, which you would have been better using to keep warm and dry by some other means. So this option is the last resort, and even then, only if you are prepared for it and the snow is favourable.

Making a snow mound



Marine

The marine environment is one of the hardest to survive in. More than any other survival situation, it relies heavily on preflight preparation.

There are five main problem areas when it comes to surviving a ditching: successfully ditching the aircraft in the water, getting out of the aircraft – along with all the survival equipment you may need, staying afloat, staying alive, and getting rescued.

Your preparation needs to include a thorough passenger briefing, before you leave the ground, covering:

- where the exits are,
- how to open them,
- what order you want them to exit in,
- location of the survival gear/life raft, and
- how to don and operate the life jackets.

If you are going to carry specialised marine survival equipment, like a life raft, you must know how to find it after the ditching, and how use it and get everybody in it. Practising in a swimming pool is invaluable, as it is much harder than it looks.

Ditching

If the water is glassy calm you will have trouble seeing the surface and judging your height above it. Just like flat light and bright light on snow, you will need to find some form of reference point to help you. A boat or even a bit of land would be ideal, but a slight ripple on the water or cloud shadow can help.

On the other hand, if there are swells you might want to land parallel to the biggest swells, just after the peak and as into wind as possible.

In both cases, try to reduce your speed as much as possible before touchdown, without stalling the aircraft onto the water.

Getting Out of the Aircraft

When it comes to successfully getting out of the aircraft, one of the most important aspects will be the adequate preparation of yourself, the aircraft, and its contents.

Before touchdown, open or unlock doors and hatches, to prevent them being jammed and stopping your evacuation.

Get rid of, or safely stow, as many loose articles as you can. When water (inevitably) enters the cabin, loose articles form a veritable soup that can be very disorienting, and hinder your exit.



Perhaps surprisingly, don't remove your seat belt as soon as you can. If you keep it on, you won't get so disorientated inside the cabin, and once you have one hand firmly on a grab handle or something similar near the door, then undo your seatbelt and pull yourself out the door.

Wear appropriate clothing – not too bulky, neutrally or slightly positively buoyant (if you are too buoyant then getting out may be difficult, particularly if the aircraft is upside down).

If you are not already wearing your life jacket, trying to put it on while still strapped into the aircraft, and trying to fly it, will be almost impossible. So put it on before you leave the ground.

Do NOT inflate your lifejacket until you are clear of the aircraft.

The chances of panic are high – you need to be prepared to help your passengers, and to keep calm yourself.

To give yourself the best chance possible of safely getting out of a ditched aircraft, you need to have thought about it, and even rehearsed it as a dry run first.

Staying Afloat

So here is the challenge: Stand up right now and head to the nearest swimming

pool. Don't bother getting changed, go straight to the deep end of the pool. Take your life jacket if you carry one flying, put it on if you wear it flying. Otherwise just leave it in its pouch.

Throw your life jacket in the pool and jump in after it. Decide what clothes you want to keep on, then put the life jacket on, and decide if you are going to swim to the shore or wait for the rescue helicopter.

How far will you be able to swim or how long can you tread water for? 50 m, 100 m, 500 m, 1 km or maybe even 5 km can all be a long way for those who are not swimming fit. Now halve that distance, because swimming in a pool is much easier than in open water.

If you cannot swim well, your chances of survival without a lifejacket are poor.

Beware of using other forms of buoyancy aids, such as wetsuits or drysuits. They may well keep you afloat, and warmer than you would otherwise be, but you can't control the buoyancy. You do not want to be too buoyant until you are safely out of the aircraft.

A life raft is quite literally a lifesaver. It can help to keep you afloat, but more importantly it can keep you out of the water and reduce the effects of hypothermia.

Staying Alive

Hypothermia is by far the biggest killer in water survival situations. The following table (contained in Advisory Circular AC 125-2) gives an indication of approximate survival times for someone immersed in water without some form of protective clothing.

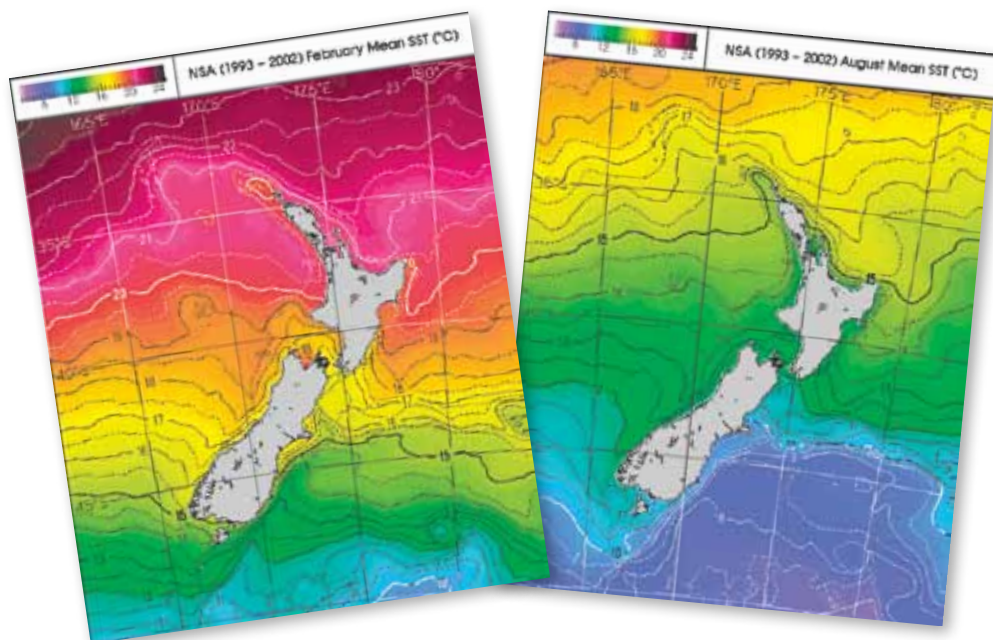
Water Temperature	Time to Exhaustion or Unconsciousness	Survival Time
21–27 °C	3–12 hours	3 hours–indefinitely
16–21 °C	2–7 hours	2–40 hours
10–16 °C	1–2 hours	1–6 hours
4–10 °C	30–60 minutes	1–3 hours
0–4 °C	15–30 minutes	30–90 minutes
<0 °C	Under 15 minutes	Less than 45 minutes

The maps below show the average sea surface temperature in New Zealand for summer and winter.

In summer, a person in the water in the North Island has a reasonable chance of surviving a few hours. Survival time progressively reduces as you move further south. In the lower South Island your time of useful activity – the ability to do things to save yourself – is likely to be less than two hours, and you will be dead in six.

In winter, the situation is much worse.

Survival time will be affected by factors such as your size and age, fitness level, clothing, amount you have to exert yourself to stay afloat, wind, and water conditions – you won't last long in strong winds with breaking waves. Children are particularly vulnerable.



If you have a life raft, and have managed to get into it, your problems are not over. You can still suffer from wind-chill. Almost everyone in a raft in open sea eventually becomes seasick – the onset can be very rapid, and seasickness can be very debilitating. It also exacerbates hypothermia and dehydration. Sunburn can also be a problem.

You may have been fortunate enough to ditch close to shore where you can get out of the water safely, without being injured by surf, rocks, reefs, etc. Another good option would be to ditch near any convenient boat. Most of the time, however, you will be too far from shore to make it, either paddling a raft or swimming. Unless you are a fit and experienced ocean swimmer, even a kilometre is likely out of reach, and will just

exhaust you and reduce survival time. Stay with your raft and stay together.

If you don't have a raft, then huddle closely together to preserve warmth, putting any children in the middle of the group. Minimise movement and activity – it might make you feel warmer, but it is burning valuable energy that you will need to stay alive until help arrives.

If you are on your own, then the technique is to huddle up with yourself, cross your legs and pull your knees up towards your chest. Keep your arms against your sides and folded in front of you. The big heat loss areas are your head, so keep it out of the water, your armpits, so keep your arms at your side, and your groin so keep your legs folded.



Huddle and hold

Getting Rescued

Your chances of surviving for long in New Zealand waters, particularly without a life raft, are small. For most of the year, surviving overnight would be unlikely. That means you need to be rescued before dark. Flying over a large body of water without active flight following is asking for trouble. It may be a good idea to only fly those routes in the morning, to ensure that if someone is looking for you they can find you before darkness falls.

Assuming someone is looking for you – how will they find you? It helps if they know exactly where to look. There are four tools to help you here:

- Accurate position reporting and distress call locations (a GPS position or radial and bearing will be much better than “mid Cook Strait”).
- Radar monitoring (Don’t forget to squawk 7700).
- Flight tracking (such as Spidertracks or TracPlus).
- A marine-capable ELT either in your lifejacket or life raft.

An ELT will provide a direction finding equipped aircraft with a way of finding your exact location – the other methods will show roughly where you ditched, which will almost certainly not be where you are now – in strongly tidal areas you may have drifted many miles by the time rescue vessels and aircraft get to your area.

Spotting floating survivors in the water is extremely difficult, particularly in anything other than a flat calm sea. A location aid such as smoke or flares, mirror, radar reflector (for rafts), water dye, and brightly coloured clothing will all be helpful.

Remember also that ELT’s don’t work so well underwater. So if you are definitely going to have to ditch, and can manually activate the ELT in advance, then do so.

Ditching scenarios would seem the ideal situation for carrying a secondary portable ELT, marinised PLB, or EPIRB which can be activated once safely clear of a submerging aircraft. Keep it in a watertight container and keep it handy. Maybe attach a string to the box so once activated it can be tied to you, your raft, or your group of passengers, and left to bob around on the surface sending out its call for help.

For most of the year, for most people,
surviving overnight would be unlikely.



Cell Net and Satellite Communication and Distress Signalling Devices

The whole range of satellite and cell net communication and emergency alerting devices all rely on a communications network to transmit messages.

Most of us are aware of the limitations of cellphone network coverage, and that this is likely to be poor in the mountains, especially if you are in a valley. However, modern cellphones do offer a number of attractive emergency beacon and position features, provided you are within network coverage at the time.

Perhaps more poorly understood (as we use it less), are the limitations of satellite coverage. Satellite coverage for communications is provided by a small number of geo-stationary satellites positioned above the equator, and a few polar orbiting satellites nearer to the poles. If you are out on the ocean, or on a mountaintop, with a good view of the whole sky, the chances there will be satellites in view all the time are high. If however, you are on a valley floor surrounded by mountains, and the amount of sky you can see is greatly reduced, then it is possible no satellites will be in view. Add in some trees and things will obviously get worse. As geo-stationary satellites are above the equator, the better your view to

the north, the better your chances of seeing one. The orbiting satellite coverage will come and go as they pass through the sky above you, so don't despair if no coverage is immediately available, you just may have to wait for a while.

These comings and goings, and your ability to see a geo-stationary satellite, can affect such things as satellite phone coverage and may, depending on your location, cause coverage to drop out as a satellite passes over the horizon. In a worst-case scenario, there may be no coverage at one particular time, however good coverage may be available a few minutes later as a satellite crosses the visible sky. If this is the case, remember it will disappear just as quickly, so don't waste time.

This coverage issue can also affect satellite-tracking technology, which is relying on satellite coverage to transmit your position to a land station. Most units hold on to points that cannot be successfully transmitted and then send them later on, when a satellite comes into view again, and thus fills in the missing points.

This works well, however, should you have an accident while out of view of any satellites then your last recorded position will be further away from where you really are. This is not a problem so long as this is realised when searching for an aircraft in terrain that may have precluded transmission of a point, or a series of points.

ELTs, PLBs and EPIRBs all have limitations too. While some are waterproof the signal won't transmit that well from underwater to the satellite. Even though constructed to withstand high G-loads, and if fitted to areas of an aircraft less likely to be damaged, there is no guarantee they will withstand a particular impact and if triggered by G-force

alone they may already be in a poor location for satellite coverage before they start transmitting. While the 406 MHz beacons provide a more accurate position than the old 121.5 MHz system, and are individually encoded to aircraft, positions can still be of an accuracy that requires some searching to finally pinpoint the target.

There are limitations to all the electronic communication and distress signalling devices available, which would make it prudent not to rely on them entirely. But there is a huge advantage in carrying any of these devices, should the day come that you need to be found.

Resources

St Johns First Aid
www.stjohn.org.nz

NZ Red Cross
www.redcross.org.nz

NZ Mountain Safety Council
www.mountainsafety.org.nz

**Search and Rescue Institute
New Zealand**
www.sarinz.com

**AC125-2 Ditching –
Techniques, Hazards, and Survival:
A Basis for Assessing Risk**
www.caa.govt.nz

Survival **Priorities**

Initial Checks

- Is the aircraft a safe place to be?
- Is the area around the aircraft safe?
- What are people's injuries and who needs help first?
Safety, Airway, Breathing, Circulation, Major Bleeding...
- Is the ELT beacon switched on and working?
Is the aerial still intact and attached?
- Is providing shelter or is preparing a means of signalling for help the next priority?

Preventing Hypothermia

Provide:

- Dry clothing.
- Shelter.
- Hot drinks and food.
- Exercise (produces four times the body heat than when at rest).

Treating Hypothermia

- Give warm drinks as long as they can be swallowed.
- Surround with other warm bodies.
- If shivering stops do not attempt to warm by rubbing limbs.

Remember:

- Remain in charge.
- Give people things to do that are useful and achievable.
- Cotton is only warm if dry.
- If using the aircraft for shelter, insulate it with seat cushions and survival blankets inside. If leaving the aircraft to seek shelter leave a clear record of you intentions and stick to them.
- Lots of warm drinks are more important than food.
- Be ready to help searching aircraft find you with radio, smoke, mirrors, colour or movement.

"Never give up"



PO Box 3555
Wellington 6140
Tel: +64 4 560 9400
Fax: +64 4 569 2024
Email: info@caa.govt.nz

Survival was published in January 2011.
See our web site, www.caa.govt.nz, for details of more safety publications.