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House Select Committee
on the recent Australian Bushfires

Response to the inquiry into the recent Australian bushfires

Dear Members of the Committee,

In response to the House Select Committee's inquiry into the recent Australian bushfires, Bombardier Amphibious Aircraft has called upon years of aerial firefighting experience supplemented with the Canadian forest fire management expertise to assist in putting together a comprehensive response. The following pages discuss the points below in order to provide the Committee with proven concrete options that could help it formulate recommendations for a truly adapted firefighting system in Australia:

- Integrated Fire Management System
- Aggressive Initial Attack
- Scooping Technology and the Bombardier 415 aircraft
- Optimal mix of assets
- National Interagency Coordination Centre

Should the Members of the House Select Committee wish to obtain any additional information about these subjects, Bombardier Amphibious Aircraft would be honoured to provide more in depth details on issues of interest.

You have an important mandate and I wish you good luck in your deliberations,

Michel Bourgeois
President,
Amphibious Aircraft

Response to the inquiry into the recent Australian bushfires

Presented to the
House Select Committee on the Recent Australian Bushfires

By Bombardier Aerospace, Amphibious Aircraft

May 2003

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1. Executive Summary

The ACT, parts of the States of New South Wales, South Australia, Victoria and Tasmania are some of the most prone areas for bush fires in the world. Climate, vegetation types, drought, high winds, heavy fuel loads and periodic ENSO events, all contribute to a fire regime in which fire frequency and intensity are high. In the bushland-urban interface, where fire involves buildings and bushfire fuels simultaneously, the problem reaches crisis proportions. Events in recent history have been significant – Ash Wednesday 1983, Sydney Fires 1994 & 2001, and ACT fires in 2003. In response, Australia's State and local governments have developed, over the decades, coordination measures and fire management systems to cope with this significant issue.

In Australia, however, creeping urbanization and forest fragmentation present an unparalleled fire management challenge to governments, their dedicated emergency response and fire agencies.

Therefore, the need for an increased focus on innovative fire management becomes a priority. This response to the Terms of Reference for the House Select Committee on the recent Australian bushfires presents a number of key elements that can lead to positive change in this cycle of devastating bushland-urban interface fires. These elements should be implemented within the integrated fire management system, some of which already work well within in Australia:

- ***Initial Attack is key to efficient fire suppression (T.o.Ref.: b,c,g,h)***
  Priority fires in high value/high risk areas require rapid detection and aggressive initial attack with aerial delivery of appropriate suppressants following with proven ground crew extinction techniques. This response includes:
  - Early detection of small fires
  - Rapid aggressive first attack
  - Massive volumes of fire suppressants
  - Delivery by air
  - Sustained delivery volume
  - Integration with traditional resources
  - Overkill

- ***Scooping aircraft are proven and will work in Australia (T.o.Ref.: c,g)***
  Sufficient water-scooping sources are available in Australia. For instance, in the A.C.T., scoopable water sources are readily accessible to offer firefighting productivity in excess of 60,000 litres/hour per aircraft throughout the entire inhabited area. Being fast and autonomous, scooping aircraft can rapidly reach fires.
  A scooping aircraft like the Bombardier 415:
  - Is purposely designed for firefighting

- Can fly slower and are more manoeuvrable than conventional fixed-wing airtankers.
- Can fly at lower altitudes, in rougher terrain and under less favourable conditions of wind and visibility.
- Has demonstrated a high level of drop accuracy
- Can operate from much shorter runways than conventional airtankers and hence can typically be deployed closer to the fire.
- Requires less special equipment and ground personnel associated with the operation of the airtanker or helicopter aircraft
- Can move from fire to fire autonomously.

- ***Mix of Suppression Assets is critical to success (T.o.Ref.: h, c)***
  Successful initial attack requires the optimal mix of assets. Ground and air resources must be integrated and work together to be effective. The mix of suppression assets will vary depending on the need and the technology available. The backbone of the mix is the trained fire crews equipped with appropriate tools, applied to the fire edge. The mix can include:
  - Mobile pumps, hoses and hand tools
  - Fire pumpers/engines and burn out equipment
  - Large aircraft (fixed-wing and helicopters) – both land-filled and scooping aircraft
  - Small aircraft (fixed-wing and helicopters)

- ***Sharing high value assets is cost efficient (T.o.Ref.: h, c)***
  Quick access to adequate assets is paramount. No single fire agency has the resources needed for the worst fire events. National Interagency Coordination and Mutual Aid Protocols are needed to allow efficient movement of assets between Districts/States and across the nation. The advantages for Australia to pursue a coordination and sharing model are obvious:
  - Adequate, efficient and timely fire response
  - Resources of the country available to specific fire events
  - Fire losses and impacts reduced (public safety enhanced)
  - Extreme fire years and events can be managed
  - Standards developed
  - Early warning and data sharing
  - Enhanced fire management in the country
  - Reduced capital costs for individual fire agencies

2. Introduction – Challenges and Solutions

If the needs of each nation and of the world are to be met on a sustainable basis, the natural resource base of the Earth must be conserved and enhanced and public safety ensured. Today's forest fire management is more than the preservation of trees and bush land; it is a multi-dimensional, multi-science discipline. It defines the level of fire protection and integrates its management into public safety and sustainable forest policy. Australians know the role of fire in their environment and the impact it has on their daily lives. Fire is a major environmental factor in Australia, historically and now.

"Drought, dry seasons, and more than all, the deadliest weapon of the tyrant, the bush fire, reduces and selects the life of the country."
(W.H.L. Rawken, The Dominion of Australia, 1874)

Australia has been called the fire continent (Pyne 1995) because its vegetation has been shaped and continues to be shaped by fire. This plays a major role in the ecology of most bush land types and Australians have had to both live with and learn to manage devastating fires on a regular basis.

This submission attempts to shed light on innovative ways of managing wildfires based on Bombardier's more than 30 years of continuous involvement in the firefighting industry.

Fire in the urban-bush interface

3. Initial Attack is Key to Efficient Fire Suppression

The inescapable fact is that wildfires that can result in catastrophic consequences will occur in high risk, high priority areas under extreme weather and fuel conditions. In Australia, severe bushfires have occurred in the past and can be predicted to occur again. When such extreme conditions happen, a specific suppression response strategy is required. The "Initial Attack Concept" is a philosophy that has been proven, time and time again.

This is an efficient response strategy that includes the following:

- Early detection of small fires
- Rapid aggressive first attack
- Massive volumes of fire suppressants
- Delivery by air
- Sustained delivery volume
- Integration with traditional resources
- Overkill

The reason the Initial Attack Concept works is that the most effective resources are directed to knock down and to stop high value, high-risk fires at inception. It results in enhanced public safety and preservation of property and natural resources. In the larger picture, it is less expensive than marshalling people and equipment to deal with escaped fires. There are a number of components that must be present for the Initial Attack Concept to work.

Central Command and Control
This response strategy is built around a small, centralized organization that combines the features of a modern fire department with a military style command and control (incident command) structure. At the top of the chain of command is the single decision-maker responsible for monitoring the total fire situation and responsible for deploying optimum resources to manage the incident(s). Many Australian fire agencies do have this structure in place.

Fire Information System
Good decisions are based on real time and predicted data. Usually a computer based fire information system supports the decision-making. It uses fire danger rating systems to predict new fires, fire danger and fire behaviour by fuel type. It is also used for determining and tracking resource deployment. Sophisticated models exist to predict the potential for fires to start, spread and do damage. They can forecast accurately fire growth and the effectiveness of deployed assets. Australian fire agencies can improve results by ensuring they have the state of the art fire information systems in place including:

- Fire Danger Rating System
- Prediction of Fire Arrivals
- Prediction of Fire Behaviour
- Tracking of Occurrences
- Wildfire Threat Rating System

- Optimal Resource Allocation and Positioning Model
- Resource Readiness
- Resource Deployment Planning
- Communication Between Decision Centres
- Performance Evaluation
- Long Range Planning

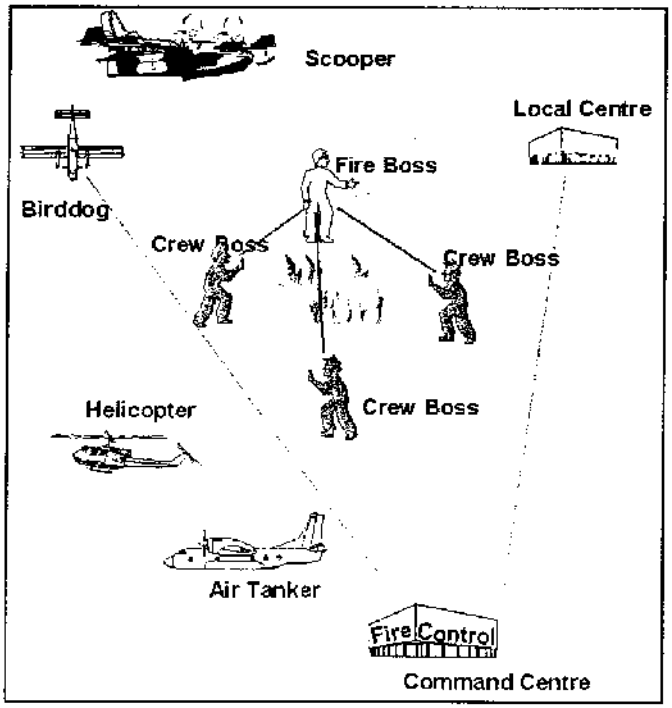
Rapid Detection
Successful fire attack depends on finding and reporting small fires as quickly as possible. Immediate and constant communications with fire centres is vital. Timing of detection is crucial if fires in high hazard and extreme risk areas are to be contained before outstripping available suppression resources and technology.

Aggressive Direct Initial Attack
Rapid aggressive initial attack using ground forces integrated with aerial delivery of suppressants completes the concept. Because fixed-wing aircraft can be rapidly deployed, they will generally be the first responders, knocking down the flame front with foam and allowing for ground forces to respond directly to the fire edge.

Aircraft are highly mobile and can be deployed from fire to fire on multiple fire start situations, buying time for the trained ground forces to arrive and begin to work. This technique is efficient within the volatile urban interface areas where early response with suppressants is so important.

Integration with Traditional Resources
An aggressive initial attack concept involves an integrated approach using a mix of suppression resources that can include helicopters, ground crews, fire engines and an array of other appropriate assets, in addition to scooping aircraft.

Initial Attack Strategy



The Role of Aircraft in Initial Attack

The response goal of most fire agencies is to arrive on the scene and take action within minutes of a fire report or discovery. Ground forces may be delayed by inadequate road structures, or by long distances. Firebombing fixed-wing and rotary-wing aircraft are now the de-facto "first responders" for bushland firefighters in most modern fire agencies around the globe [1]. Early dispatch of highly efficient firefighting aircraft with scooping technology makes a significant difference in time of high fire danger. One large fire controlled or prevented can justify the use of such massive response measures.

Helicopter - unloading initial attack fire crew

The increased hazard posed by a high-risk interface fire makes the use of aerial suppressants a real complement rather than a simple supplement to other traditional resources. There is a wide range of aircraft types available, each with its merits and drawbacks. Fixed-wing and rotary-wing fire bombing aircraft can work effectively together. Such aircraft can rapidly gain control of fires while they are still quite small. The optimal mix of air attack first responders depends on requirements in distance, payload, time at the scene and the availability of scoopable water. The most effective resource is the fixed-wing waterbomber as it can reach the fire quickly, even at long distances and provide the necessary massive volumes of water and foam to knock down and contain the fire in a direct attack.

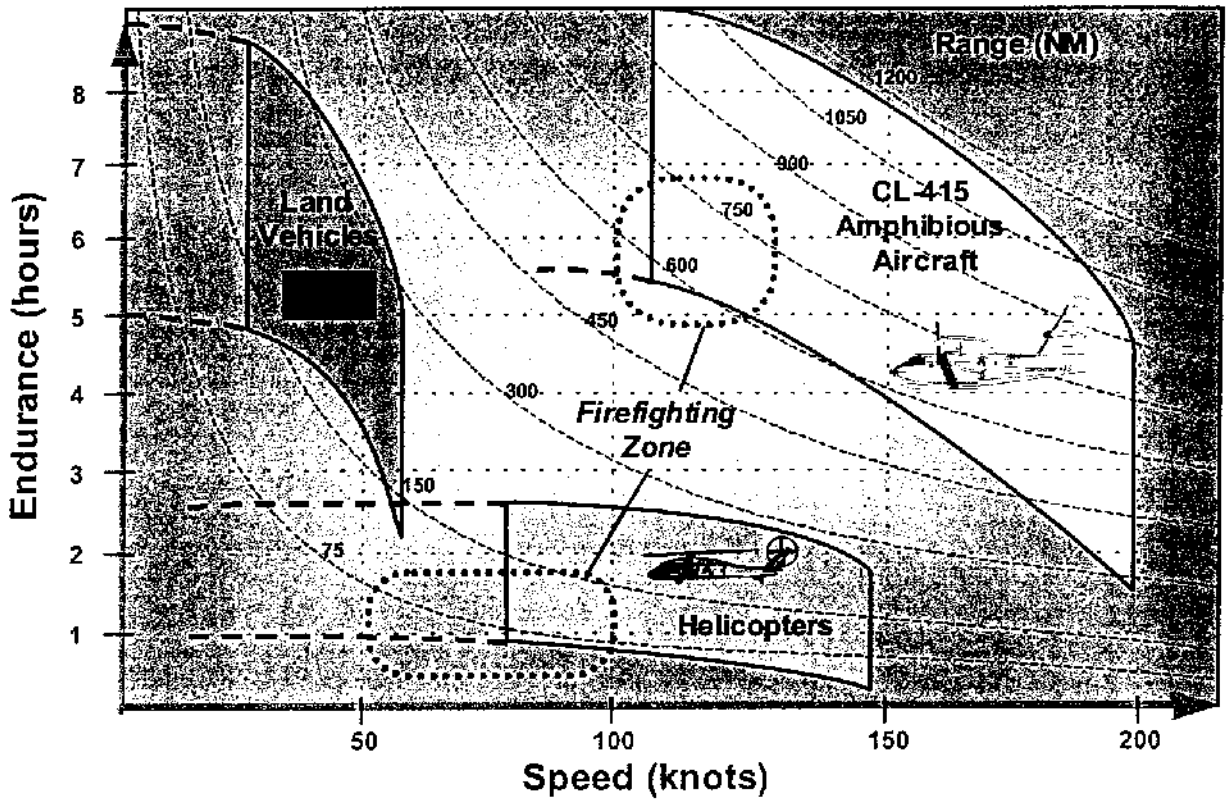
When initial attack is not implemented, the aircraft can then be used to apply suppressants directly on, or in advance of the flame front to assist and protect the ground firefighting crews, help citizen trapped by the flames and protect threatened infrastructure. In the bushland/urban interface, some specialized aircraft are ideal tools

[1] Goodman J.F. and MacAuley A. J. 2000.

because they are able to operate in high winds and accurately deliver large quantities of suppressants on a sustained basis.

As the following graphic shows, fixed-wing aircraft and helicopters have very different operational capabilities. Being built more complex, rotary-wing aircraft can typically fly for up to two (2) hours and displace themselves at speeds of around 90 to 120 knots. On the other hand, fixed-wing aircraft can typically exceed six (6) flight hours in endurance and transit to target areas at more than 180 knots. For local intervention, helicopters are efficient tools to bring personnel and bring water on small fires with precision. However, to adequately perform initial attack in vast regions in countries such as Australia or Canada, fixed-wing aircraft are required.

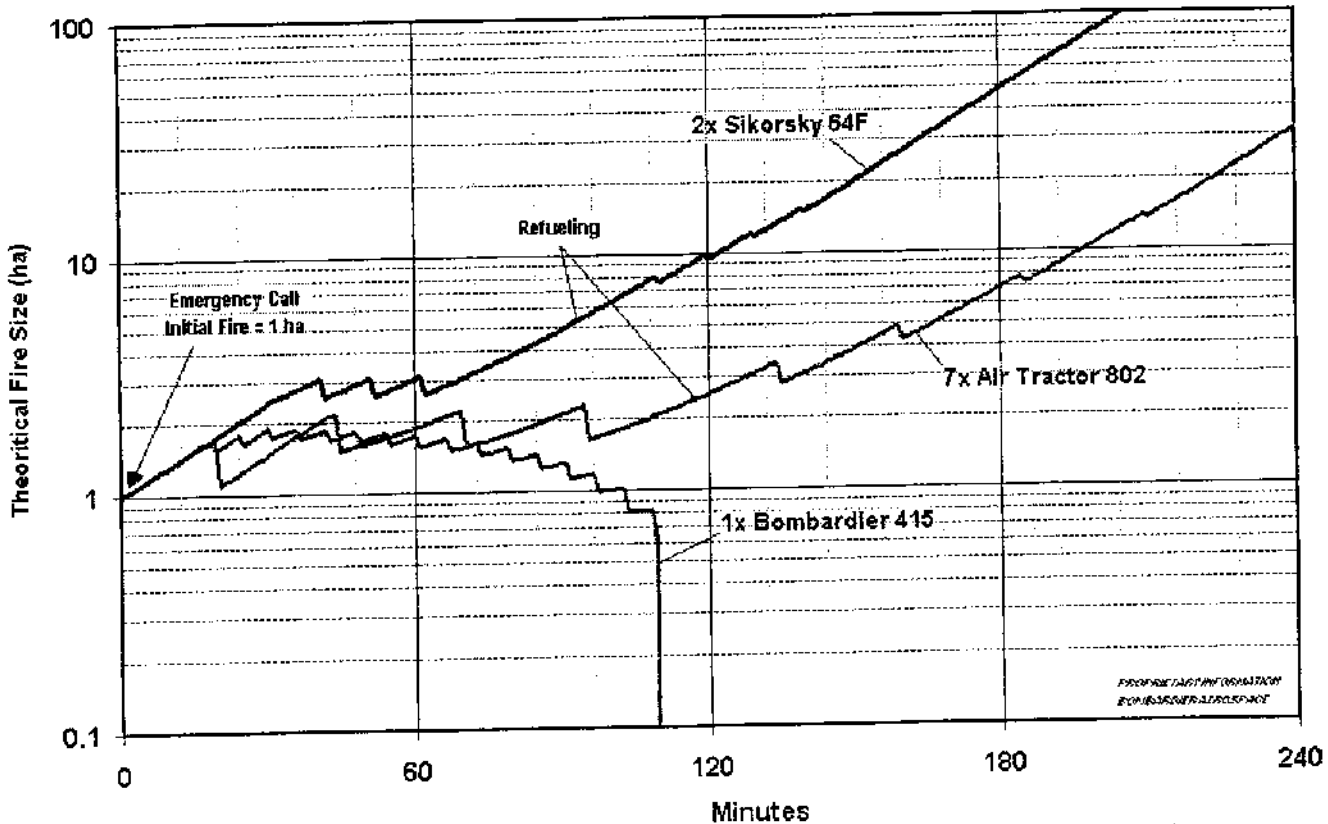
Intervention Vehicle Operational Capabilities



Attacking a fire while it is small implies getting to it quickly. Once there, both massive and sustained attack is necessary to keep the fire small for ground crews to extinguish. The following theoretical fire growth model highlights the importance of having these two points together by demonstrating that both speed and endurance are essential to be truly effective in aerial firefighting.

As can be seen in this theoretical model, the Air Tractor 802 is fast, but needs to refuel after 2 hours, where the fire then have the opportunity to get larger and escape to aerial control. The Sikorsky 64 drops a lot of water when working, but takes time to get to the fire (slower flight speed) and needs to refuel after 1.3 hour. Again, the late arrival on site and the need to refuel quickly enables the fire to gain in size and intensity and hence escape to aerial control. This model has been put together to better understand the impact of early arrival on site and sustained & massive attack of a fire.

Fire Size vs. Time



Assumptions: 1800ft alt.; 31.4C, 8 hours working day, 4-hour section shown; Main base to fire & refueling distance: CL-415: 40nm, S-64F & AT-802: 15nm; Aircraft endurance: CL-415: 4hr, S-64: 1.3hr, AT-802: 2hr; Water to fire distance: CL-415: 5nm, S-64F: 2.5nm, AT-802: 15nm; Tank size (litres): CL-415: 6100, S-64F: 9000, S-64E: 6000, AT-802: 3030; All aircraft dropping water. Fire area increasing 3.00% its size per minute; 1500 litres of water help control 0.05 (1/20) hectare of burning area. Ground crew arrives at fire 30 minutes following emergency call. If fire is smaller than 20 ha, ground crew are able to control 1.5 ha/hr.

Overkill

The last consideration for those high-risk interface fires is the concept of "overkill". This is where, if available, more resources are deployed than would normally be dispatched. The option of aborting some of the assets if the fire responds to the first attack is always available. Many agencies use this concept as a cost effective measure on high-risk fires.

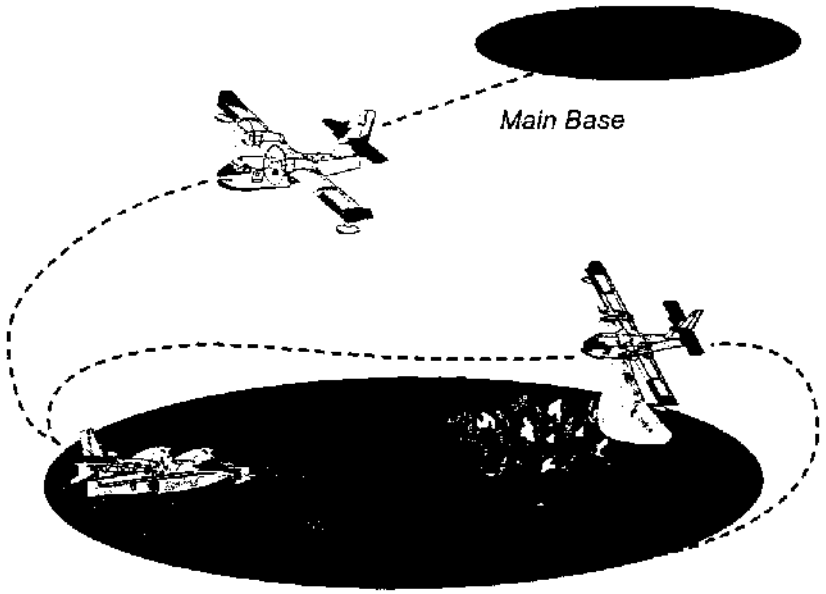
In summary, aggressive air attack, within the Initial Attack Concept, reduces risk factors and provides a strategy to control and suppress bushfires. This results in:

- Fewer escaped fires
- Fewer large fires
- More knock down of flame fronts
- Average fire size reduced over time
- Increased volumes of suppressants delivered per unit of time
- Initial attack times reduced

4. Scooping Technology Is Proven And It Will Work In Australia

The relative effectiveness of the different types of firefighting aircraft varies with the task at hand and the conditions under which it is being performed. Typically, scooping aircraft will out-produce their land-based counterparts in volume of suppressant dropped on the fire because they get their water supply from nearby sources without flight interruption rather than having to return to a distant base, stop and reload. Additionally, unlike large fixed-wing airtankers, medium-sized scoopers can place their load accurately where it is needed. Helicopters, which also use the local area water-loading concept, typically with smaller loads, may have relatively high productivity for short periods of time, but that is largely offset by slower flight speeds and limited endurance.

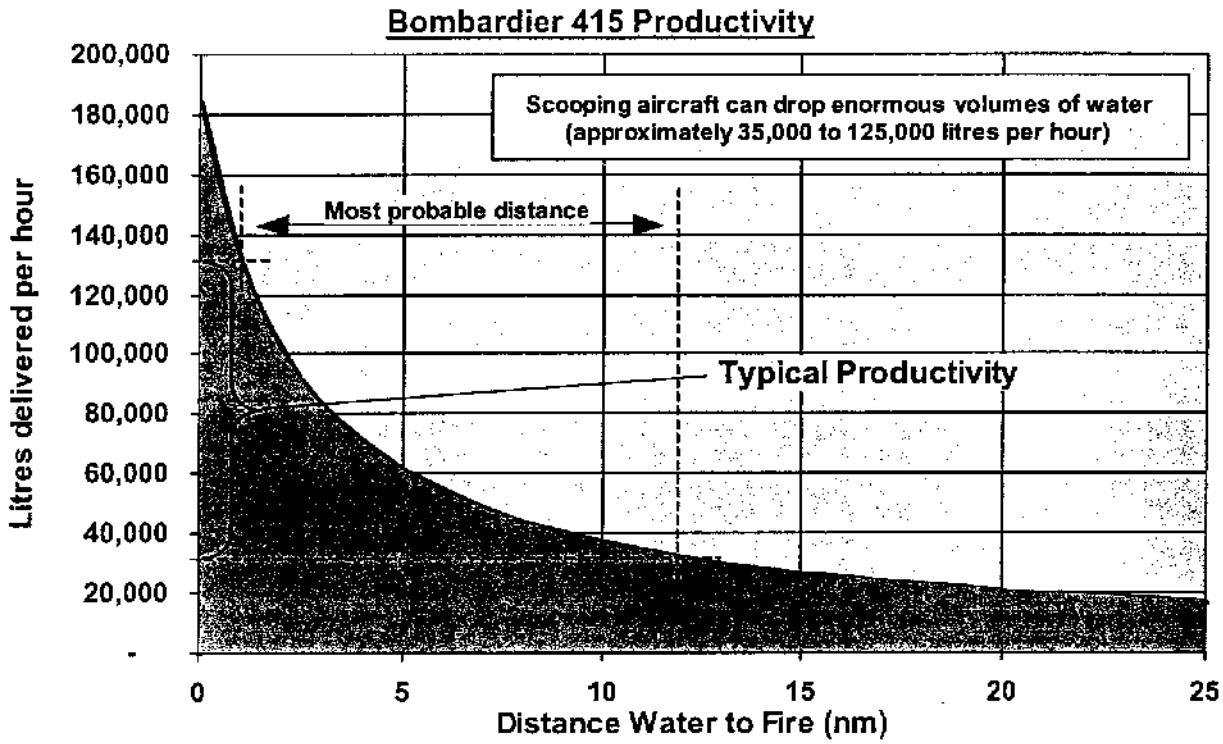
Scooping Aircraft Operation Concept



Aircraft reloads from nearby water source and returns to the fire

Scooping aircraft are especially effective in initial attack. In addition to being able to attack the fire quickly and repeatedly, they can attack several fires on a single mission, shuttling non-stop between water and fires for up to four hours (4) at a time, scooping and dropping thousands of litres of water and foam in the process. If the water source is reasonably close to the fire, they can make many more drops in a day than any land-based airtanker.

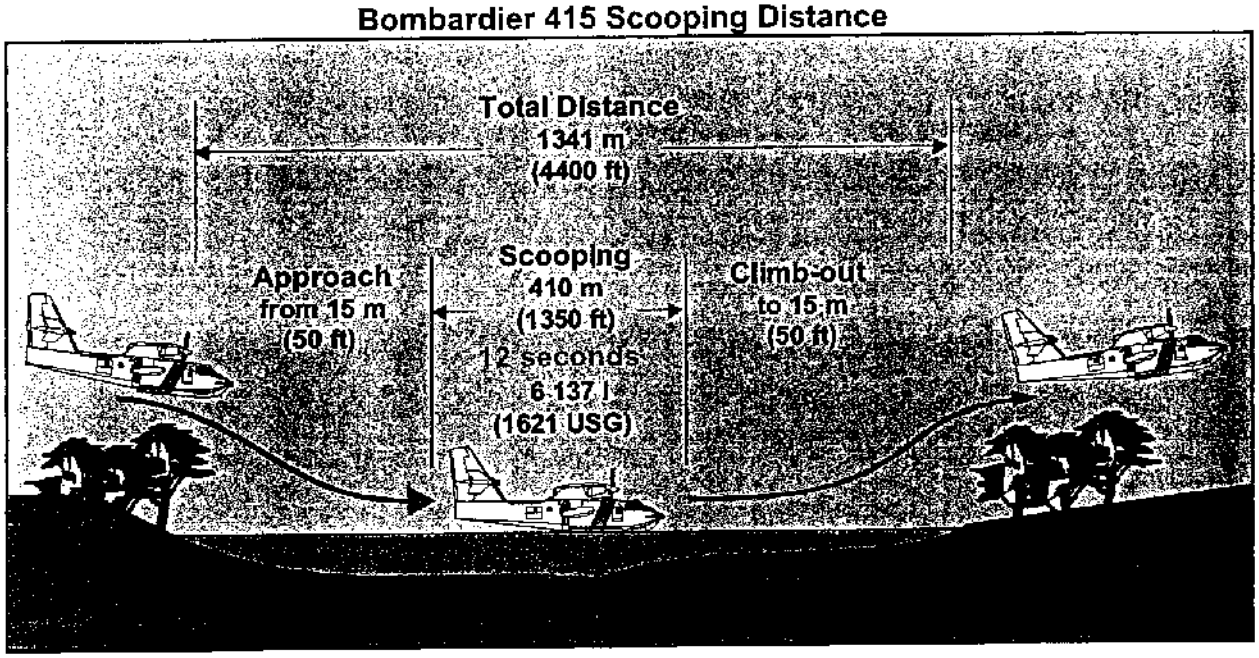
The following chart shows the amount of water delivered by one Bombardier 415 aircraft to a fire in relation with the distance between the fire and an adequate source of water. Since forested area and inhabited regions are usually located near or close to bodies of water such as rivers, lakes, water reservoirs or the sea, typical distance between a fire and scoopable water typically varies from around 2 to 12 nautical miles (3.7 to 22 km). Consequently, scooping aircraft can provide very high productivity.



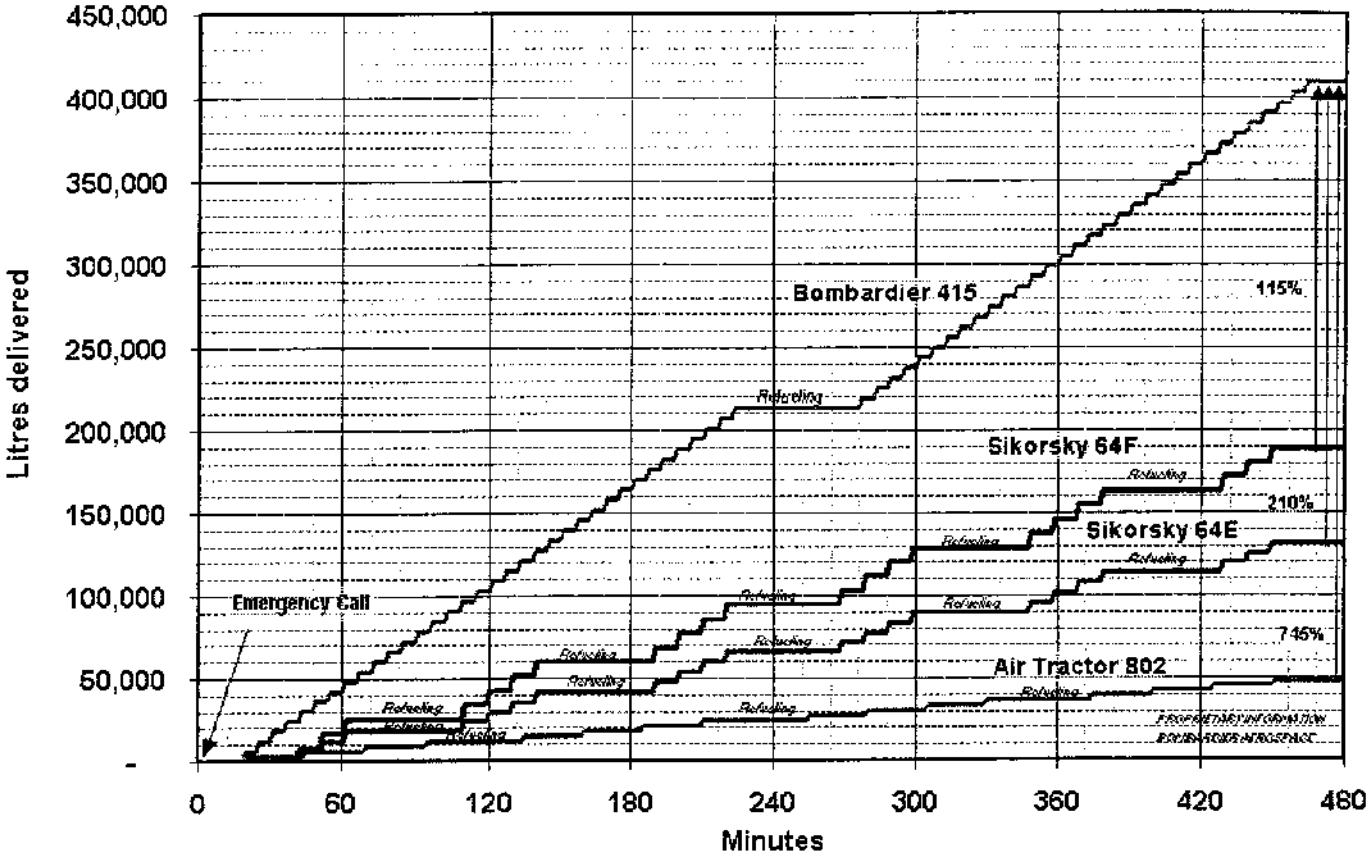
A scooping aircraft is able to drop water continuously on a target for long periods of time. Other conventional aircraft & helicopters lose productivity while frequently reloading at the base or refuelling. The following step-chart graphically shows the cumulative amount of water delivered to a target for various types of firefighting aircraft in an 8-hour working period. Scooping aircraft show a clear advantage in amount of suppressant delivered as the distance between the refuelling point and the fire increase. In a large country such as Australia, large distances and few roads in remote areas make scooping aircraft an ideal tool to perform aggressive initial attack.

Scooping is performed by the aircraft skimming on the surface of a body of water. Using two small retractable scoops (see annex 7), the aircraft is able to take its full load of water (6137 litres or ~6 tons for the Bombardier 415) in 12 seconds. The actual scooping distance on the water is ~410 meters. Should it be a wining river, a small lake or reservoir, or simply the sea, the aircraft requires a strip at least 90 meters wide and 1341 meters long (not necessarily strait) to safely perform scooping.

Bombardier 415 Scooping Distance



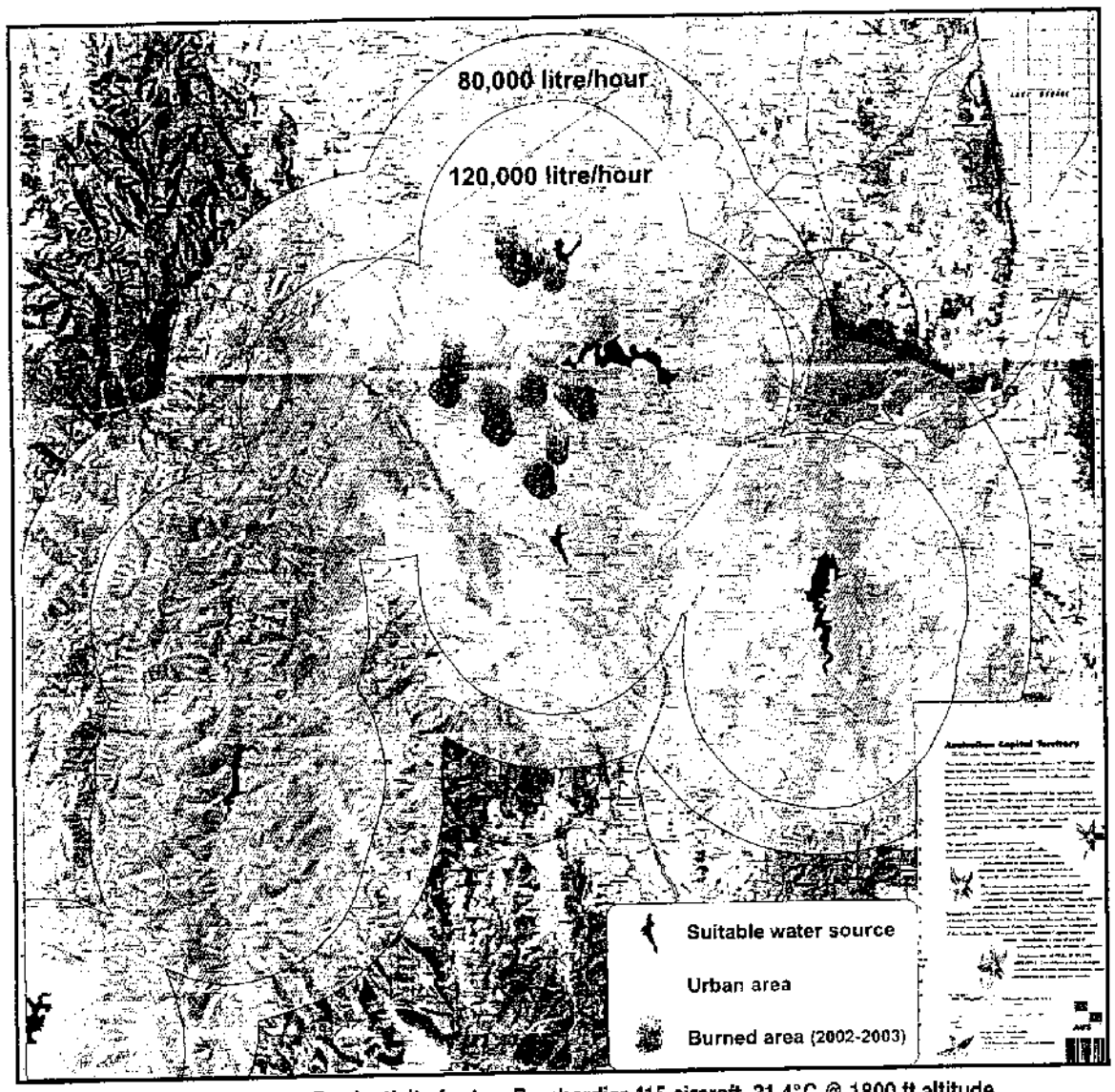
Firefighting Productivity



Assumptions: 1800ft alt.; 31.4C; 8 hours working day; Main base to fire & refueling distance: CL-415: 40nm, S-64E&F & AT-802: 15nm; Aircraft endurance: CL-415: 4hr, S-64E&F: 1.3hr, AT-802: 2hr; Water to fire distance: CL-415: 5nm, S-64: 2.5nm, AT-802: 15nm; Tank size (litres): CL-415: 6100, S-64F: 9000, S-64E: 6000, AT-802: 3030.

Scooping aircraft such as the Bombardier 415 can fly slower and are generally more manoeuvrable than conventional fixed-wing airtankers. They can fly at lower altitudes, in rougher terrain and under less favourable conditions of wind and visibility. These characteristics combine to provide a high level of drop accuracy. Scooping aircraft are normally dispatched to the fire unloaded, which means they can operate from much shorter runways than conventional airtankers and hence can typically be deployed closer to the fire. Special equipment for retardant mixing or loading and the ground personnel associated with the operation of the airtanker or helicopter are not required with scooping aircraft. Fixed-wing scooping aircraft can move from fire to fire with concern only for aircraft fuel.

Even in dry environments such as Australia, sufficient water-scooping sources are available. For example, in the A.C.T., scoopable water sources are readily accessible to offer firefighting productivities in excess of 60,000 litres/hour per aircraft throughout the entire inhabited area (see following map).



Performance assumptions: Productivity for two Bombardier 415 aircraft, 31.4°C @ 1800 ft altitude

Coverage area for a minimum firefighting productivity of **120,000 litres / hour*** Water-to-fire distance <= 9.6 km

Coverage area for a minimum firefighting productivity of **80,000 litres / hour*** Water-to-fire distance <= 14.4 km

5. The Bombardier 415 in Aerial Firefighting

The Bombardier 415 a medium-sized amphibious scooping aircraft, is the modern version of its predecessor the CL-215, and is purposely designed as the optimal size of fixed-wing aircraft to perform firefighting missions. As one major requirement of efficient aerial attack is to rapidly and aggressively hit fires in otherwise inaccessible areas, the aircraft was designed to be fully independent, very productive, and highly manoeuvrable.

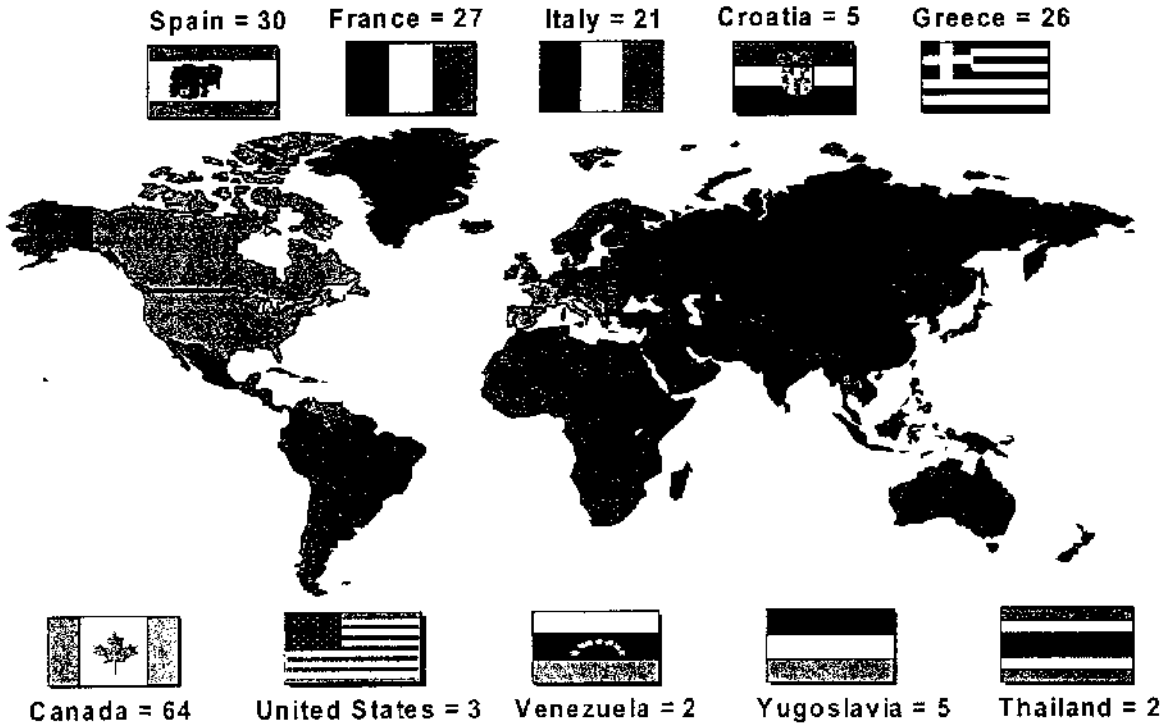
Design Characteristics

The Bombardier 415 excels in the role associated with high risk, high intensity fires. It was designed to meet these criteria.

- Rapid dispatch capability – Aircraft in the air quickly (within 5-7 minutes of call)
- High speed – Aircraft reaches attacks fires rapidly (up to 190 knots
- Massive attack – Delivers large quantity of water repeatedly (up to 180,000 litres/hr)
- Sustained attack – Can work for more than four (4) hours before refuelling
- Flexible basing opportunities – operates autonomously from short runways, or water

Since 1966, Bombardier / Canadair Inc. has delivered amphibious aircraft worldwide for the unique purpose of aerial firefighting. Since then, these aircraft have proven their efficiency and are now the backbone of an effective initial attack strategy for numerous firefighting agencies. This strategy and aircraft have demonstrated year after year their value in combating fires in the most extreme conditions.

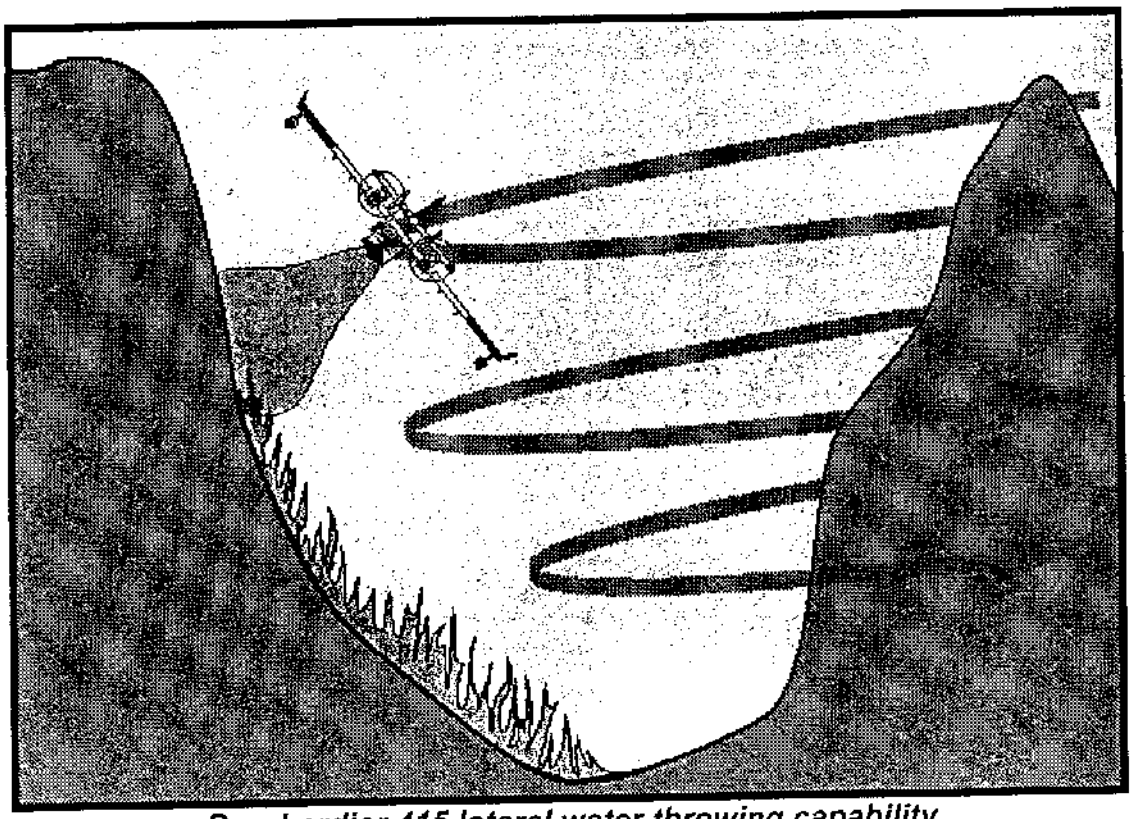
CL-215, CL-215T & CL-415 Delivered Worldwide



Operations in Mountainous Terrain

The wing of the aircraft is a high lift aerofoil with large flaps and flight control surfaces allowing low stall speeds and higher safety margins during the drop sequence. This agility is particularly important in rough terrain conditions where low-level turbulence is common. In addition to the above, the basic structure of the aircraft is stressed to a higher manoeuvre load factor than most transport category aircraft (3.25 'g' instead of 2.5 'g'). The aerodynamic and structural attributes of the Bombardier 415 allow it to fly with full water loads and at low drop speeds. Its tight turning radius can be as low as about seven wingspans of the aircraft.

More than 30 years of experience in mountainous areas of the north Mediterranean countries of Spain, France, Italy, former Yugoslavia, Croatia and Greece have proven that the Bombardier 415 scooping aircraft is very effective in controlling forest fires through Initial Attack. These aircraft have also operated in the Andes of Argentina, Rockies of Western Canada and mountains of Mexico. In all cases it has been found that the aircraft can operate in conditions and locations where other types cannot. Bombardier aircraft have established some remarkable records of performance on fires. A former Yugoslav CL-215 made 225 separate drops on fires in one day; dropping over 1.2 million litres of water and controlling a series of fires that threatened lives and property on the island of Hvar.



Bombardier 415 lateral water throwing capability

Operations In High Winds

The most dangerous fire conditions most often occur when high, dry winds are present. Most aircraft have limitations either specified in the Flight Manual or developed in practice, which limit their usefulness in fire operations. Operators of the CL-215 and Bombardier 415, which has a worldwide fleet total of over 600,000 flight hours in some of the worst flying conditions, have identified a guideline (not limitation) of 55 to 60 knots (102 to 111 km/hr) for aerial firefighting.

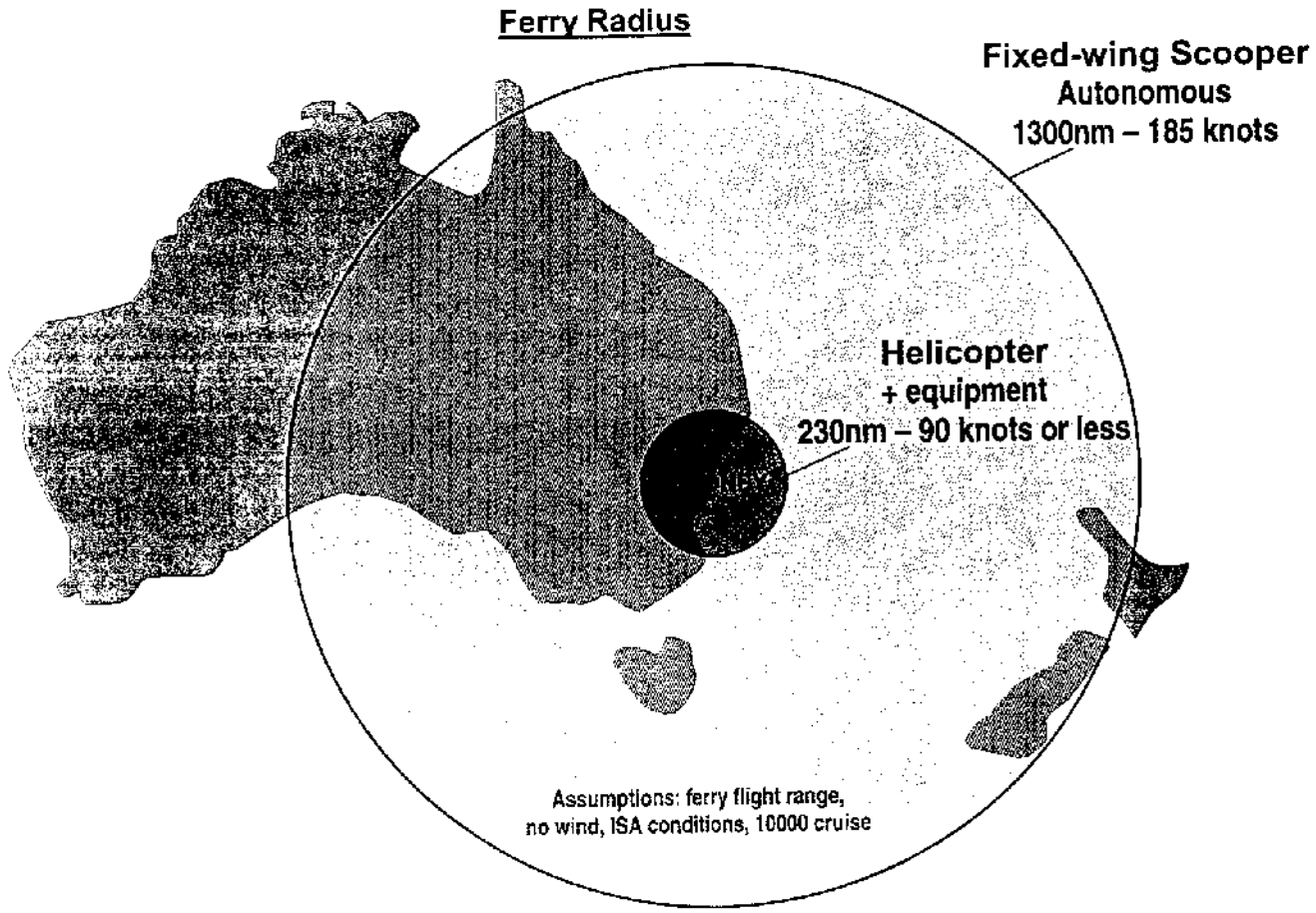
The Bombardier 415 operating in high wind and wave conditions

Relocation of Aerial Assets

Most aerial firefighting aircraft are usually maintained in a central location in order to be ready to be deployed either prior to, or as fires occur. When relocating aerial assets over very large areas such as Australia or Canada, it is important to remain efficient in minimizing the relocation time so that the aircraft can reach the emergency area quickly and start working on the fire without delay. Both large helicopters and scooping aircraft can be very efficient when called for a nearby fire. However, when hundreds or thousands of miles separate the location of the aircraft and that of the fire, aircraft speed and autonomy become a critical aspect.

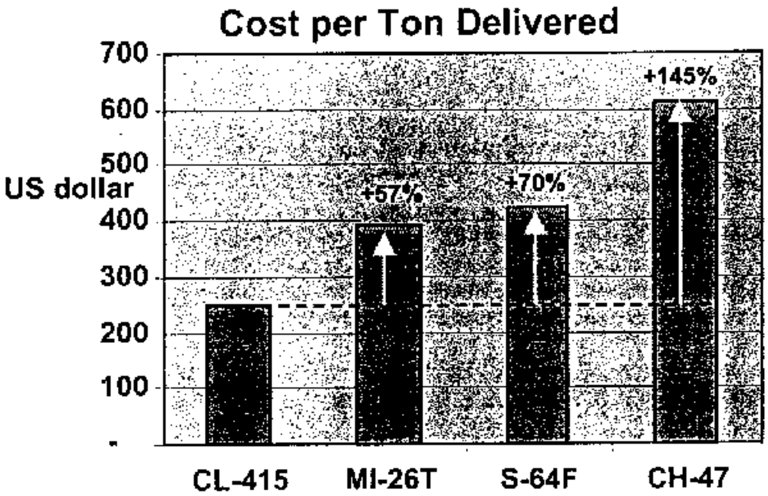
The dispatch time (time for the aircraft to be in the air) of the Bombardier 415 is typically 5 to 7 minutes. That of complex large helicopters can be around 15 minutes or more. Within hours, a Bombardier 415 can relocate throughout the country and immediately respond to an emergency, autonomously working for four (4) hours on a fire. To relocate a large helicopter and its critical maintenance equipment across Australia, could take days.

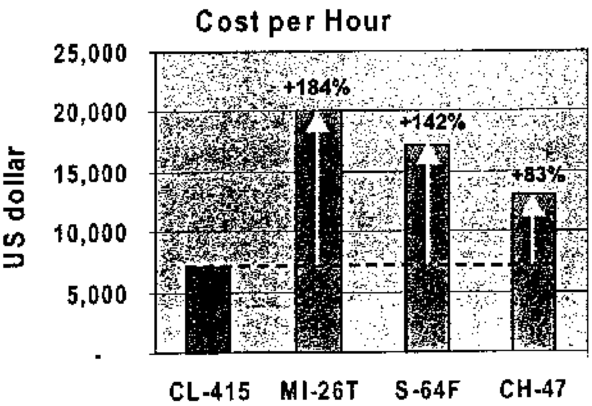
The map below represents the radius of action either a fixed-wing aircraft or a helicopter can perform easily. Because the fixed-wing aircraft has both speed and endurance as advantage over the helicopter, it is able to rapidly respond to emergencies over a much larger region. The Bombardier 415 would takes 3.4 hours to fly from Sydney to Adelaide against more than 8 hours for a heavy helicopter, and this, without considering the moving its essential maintenance equipment, refuelling trucks, maintenance team, etc.

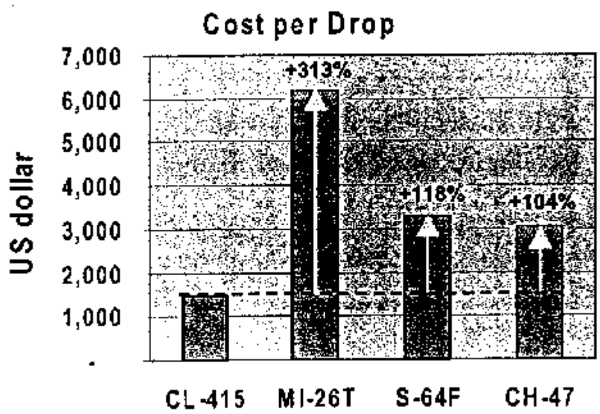


Cost Effectiveness

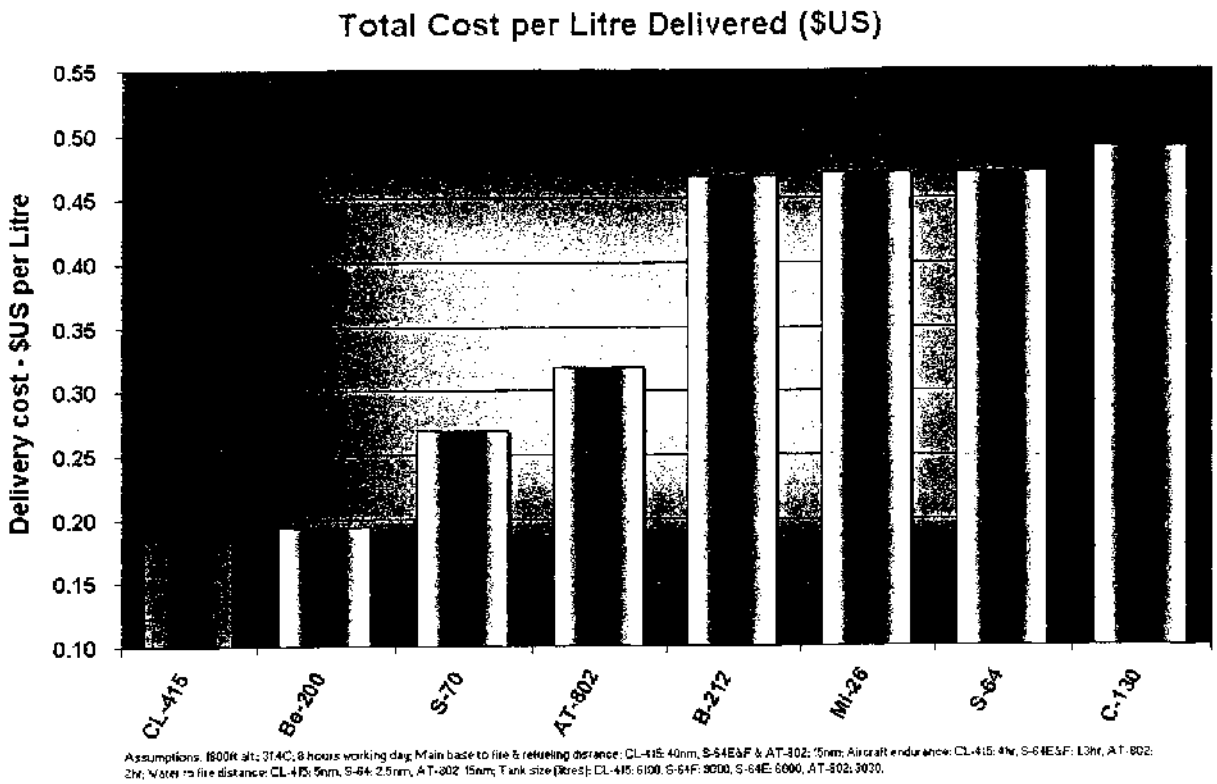
Compared to fixed-wing aircraft, helicopters require higher maintenance efforts to assure the high reliability levels expected by an aerial firefighter. As an independent Italian study confirms based on actual average costs and flight hours, large helicopters are substantially more expensive to operate than the Bombardier 415. It should be noted, for this discussion, that Italy operates fourteen (14) owned Bombardier 415 waterbombers and leases two (2) S-64 helicopters.





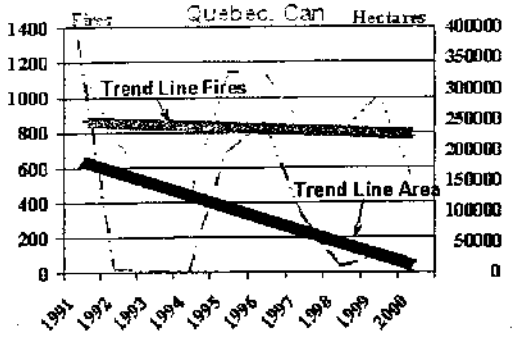


SOURCE: Cost reported by: ESTRATTO DA "VOLARE" MENSILE DI AVIAZIONE LUGLIO 2000: operations through Jan01 to Oct31 1999; 2227.4 lira/us$; www.incendi-boschivi.org/rass00/luglio/volarelug00.htm



Impressive Worldwide Experience

For more than 30 years now, Bombardier scooping aircraft have proven to be very effective around the world in successful operations amongst the most extreme fire conditions. Today, the Bombardier 415 has enabled numerous firefighting agencies to use aggressive direct initial attack in environments where harsh conditions and high value assets coexist. As shown in the following charts, the introduction of aggressive aerial initial attack has gradually reduced the average size of fires in all territories where the Bombardier 415 is being used. In each case, the total area burned decreased substantially when compared to the total number of fires. In annex 6, a detailed report on the Forest Fires in Southern Europe clearly shows this correlation.



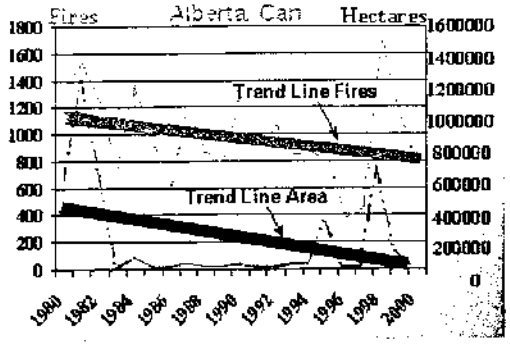


Figure 14. Number of forest fires in Spain (1980-2000)

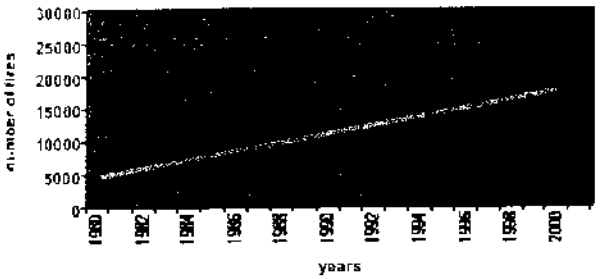


Fig. 5. Burnt wooded area in Spain (1980-2000)

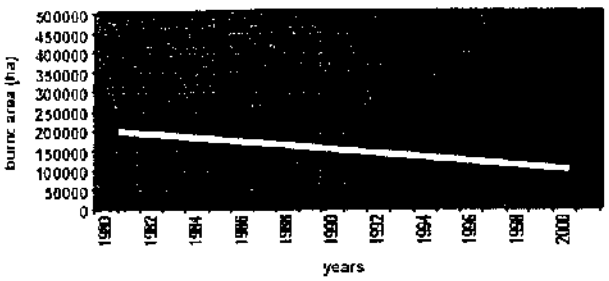


Figure 16. Number of forest fires in Italy (1980-2000)

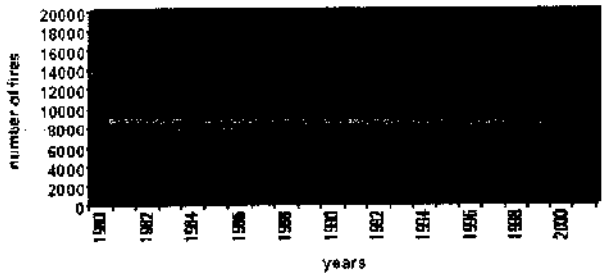


Fig. 7. Burnt wooded area in Italy (1980-2000)

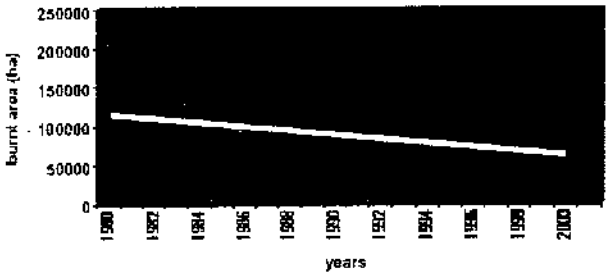


Figure 15. Number of forest fires in France (1980-2000)

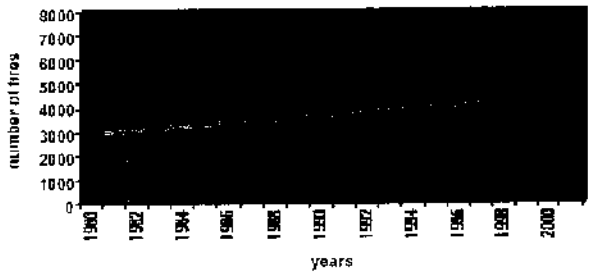
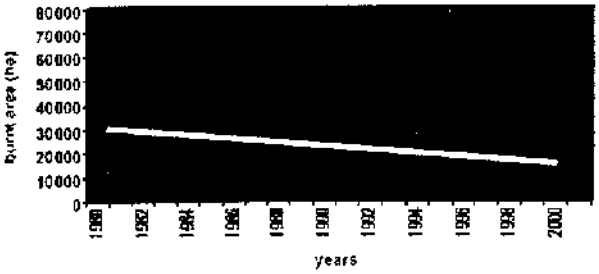


Fig. 6. Burnt wooded area in France (1980-2000)



Source: Forest Fires in Southern Europe (Annex 6)

The Bombardier 415 in the Australian Context

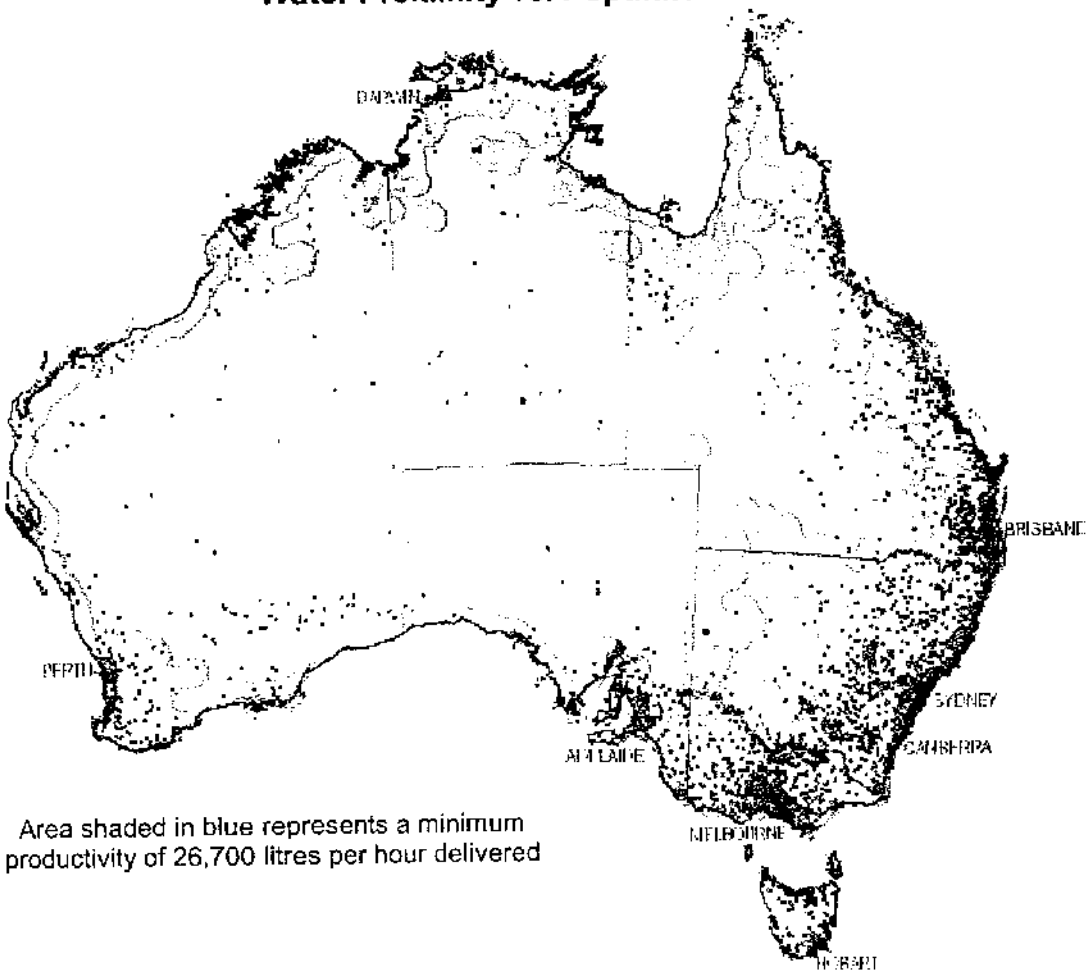
When discussing the role of the Bombardier 415 in the mix of assets, it is often said that Australian fire regimes and experience with high intensity fires are different than elsewhere in the world, and airborne suppressants are not effective. While Australian fire regimes are some of the most extreme anywhere, similar regimes are experienced in Mediterranean Europe (France, Spain, Greece) and Southern California where scooping aircraft are effectively used.

The Bombardier 415 waterbomber would be an important addition in Australia. As demonstrated over the last 30 years in similar fire regimes, it can deliver the suppressants quickly and effectively, while assisting and protecting ground crews, and even protecting structures from advancing fire lines. This aircraft buys time for the ground crews to reach the fire edge and begin direct work with pumps, hoses and hand tools. In the event that initial attack fails the Bombardier 415 has a role in indirect attack, continuing to apply large volumes of suppressants ahead of the fire edge, cooling the fuel and slowing the advancing flame front providing a safety net for ground crews.

The Bombardier 415 is one of the key components in the Initial Attack Concept. It will arrive on the scene before ground crews, knock down flame fronts to allow crews to work close-in, and "fire proof" structures by coating the exteriors with foam and water. Drop intensity can be tailored to meet specific needs; "it can be as gentle as rain or powerful enough to punch through deep forests".

It has been established by an independent Australian evaluation [2] that there is water for scooping in most of the fire prone areas of Australia. One exception is the State of Western Australia where, except for the coast, inland scoopable sites are scarce. The following water-proximity map depicts the extent of the area covered for a minimum of 26,700 litres of water/foam delivered per hour. As can be seen, the large majority of the populated area is covered. This map has been put together using the known water sources adequate for scooping. As seen everywhere else where scooping aircraft have later operated, many non-listed water sources can usually also be used, hence increasing the effective covered area.

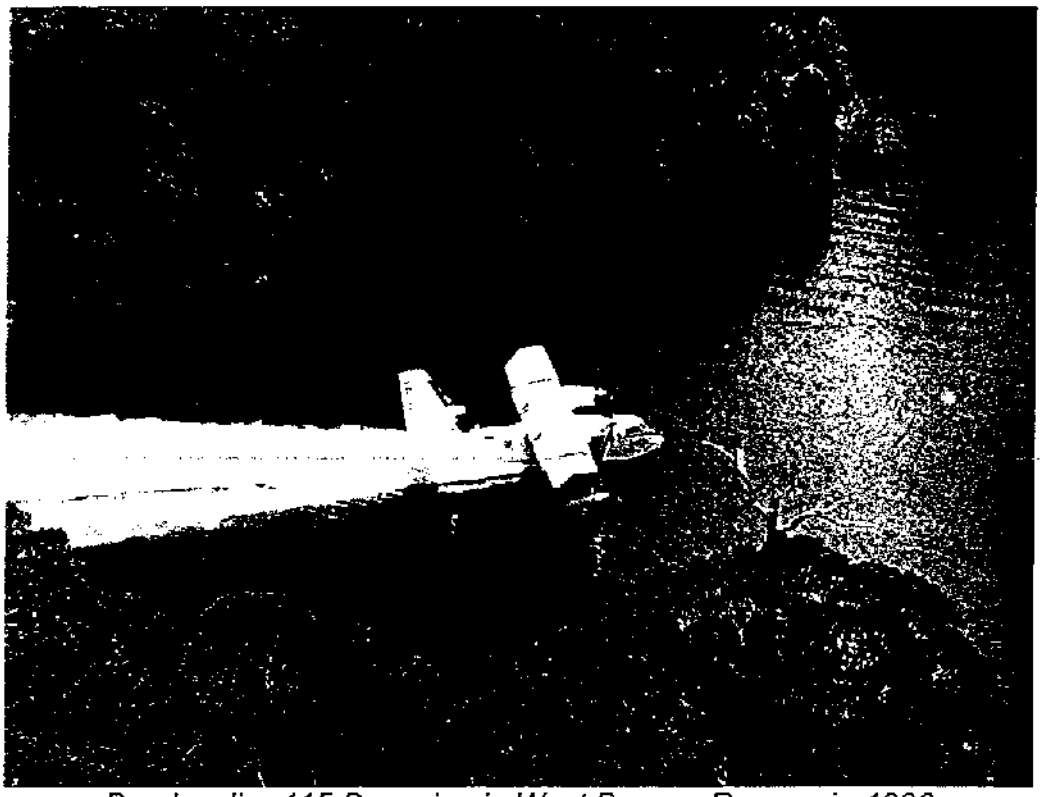
Water Proximity vs. Populated Area



Area shaded in blue represents a minimum productivity of 26,700 litres per hour delivered

Assumptions: Performance for two Bombardier 415 scooping aircraft for a distance from known scoopable water sources of 32 NM (59.3 km) represents ~4.4 drops per hour or ~26,700 litres per hour.

[2] Australian Fire Authorities Council (AFAC), CL-415 Evaluation – Annex 1



Bombardier 415 Scooping in West Barwon Reservoir, 1996

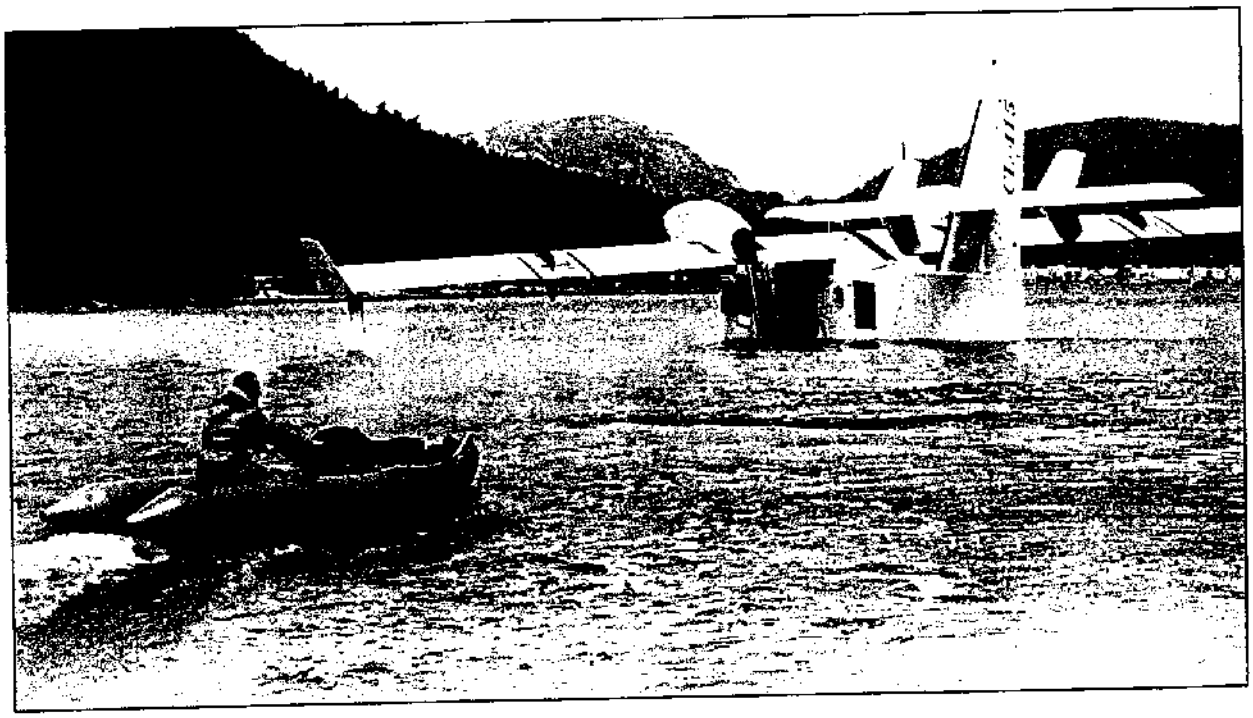
Bombardier 415 effect of foam penetration on Australian vegetation – AFAC report

The New Multi-purpose Bombardier 415MP

While the Bombardier 415 can perform excellent firefighting during the fire season, it can also perform a variety of other missions the rest of the year. The amphibious characteristics and unique capabilities of the Bombardier 415 make it an ideal candidate for missions such as Coastal Patrol, fisheries and environment protection and Search and Rescue (SAR). This new variant has 3 interchangeable interior/mission configurations. It has been designed with Quick-Change philosophy which will allow the aircraft to rapidly change roles from Firefighting to SAR to Utility Transport, or vice versa, in less than 1 hour. These new capabilities make the Bombardier 415MP a truly multipurpose aircraft. It can be used year round by various government agencies, giving operators more flexibility in their utilization of assets.

Search and Rescue (SAR)

In the SAR role a suite of equipment specifically designed for coastal patrol has been added. This equipment will permit agencies to perform missions such as fisheries control, pollution surveillance, search and rescue and other activities in territorial waters. The sensors include SLAR (Side Looking Airborne Radar), a FLIR (Forward Looking Infrared) Camera, a Weather Radar as well as still and video cameras. The signals from the sensors are processed by the integrated computer and GIS (Geographic Information System) allowing recording and reporting of data by the Mission Operator and Observer as the aircraft patrols. It is also able to communicate directly with ships and Mission Command Centres.

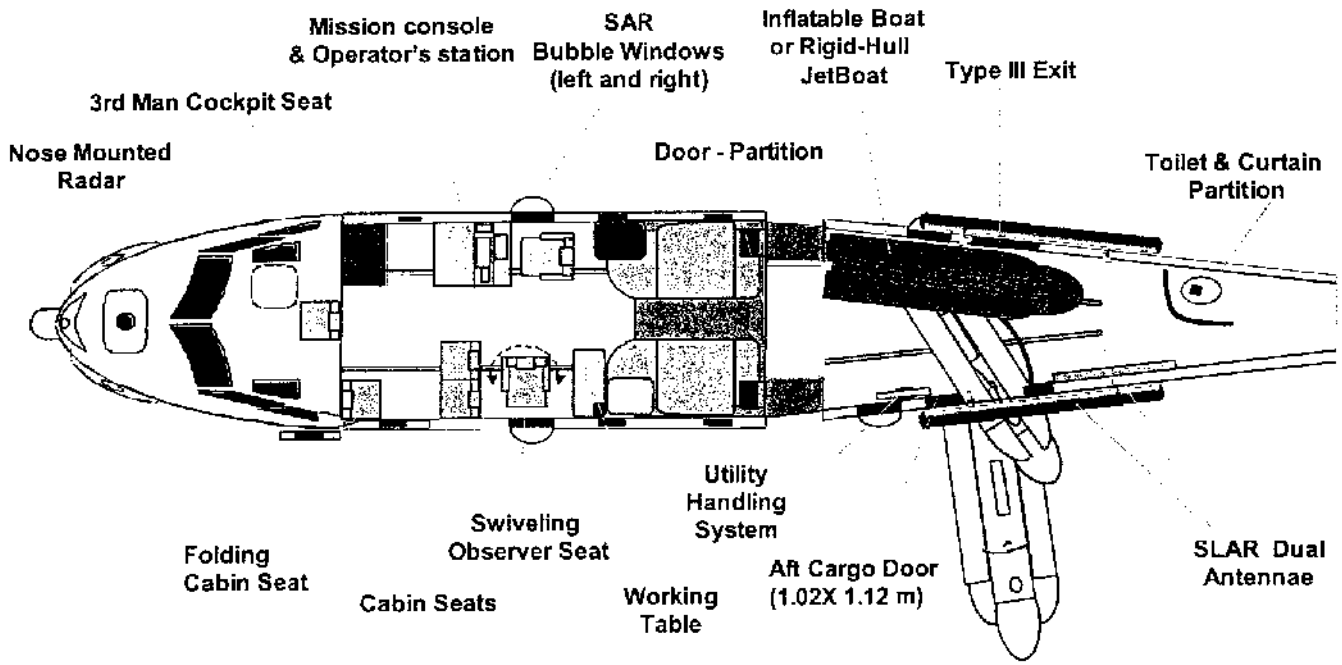


Bombardier Jet Boat (BJB)
To complement this equipment, a special folding rigid hull boat has been purposely designed to be carried on board the aircraft and be deployed for direct on-water intervention.

Utility Transport, Paradrop, Medevac
The Utility configuration of the Bombardier 415MP has seating for up to11 people, firefighters or parajumpers. The Medevac configuration includes 6 stretchers for the rescue of persons.

The Following Bombardier 415MP interior layout includes internal water tanks to perform firefighting (centre of aircraft), a mission console and observer seats to perform various patrol and search & rescue missions, and a rear cargo area where a rigid-hull boat, benches or stretchers can be installed.

CL-415MP Interior Layout



6. Mix of Suppression Assets is Critical to Success

No single firefighting tool or technique is sufficient to manage wildfires in a complex and unpredictable environment. Suppression assets required depend on the individual circumstances of the situation. Fire weather, both current and predicted, fuel loading, fire priority, water and road accessibility are some of the key factors that determine the optimal mix of assets that may be necessary to contain a new fire.

Ground and air resources must be integrated and work together to be effective. The mix of suppression assets will vary depending on the need and the technology available. The base of the mix is the trained fire crews equipped with appropriate tools, applied to the fire edge. In the end people put out fires!

The tools in the mix can include the following:

- Mobile pumps, hoses and hand tools
- Fire pumpers/engines and burn out equipment
- Large aircraft (fixed-wing and helicopters) – both land-filled and scooping aircraft
- Small aircraft (fixed-wing and helicopters)

The mix of assets depends on the suppression objectives and strategies that have been developed in the long-range plans. As well, the establishment of priorities (higher versus lower value and risk), will dictate the dispatch mix decisions. Not all fires require an immediate response and not all fires are harmful or a risk to public safety. Those high priority fires that are such risks need to be managed with the initial attack concept, using an appropriate mix of available assets.

There is a role for a mix of aircraft types including small and large helicopters and fixed-wing waterbombers. While scooping aircraft such as the Bombardier 415 are the backbone of many modern firefighting organisations, large helicopters, although limited in time on scene, can play a key role in the mix of equipment available for initial attack.

7. Sharing High Value Assets is Cost Efficient

Firefighting in an extreme fire regime environment is complex and expensive. High value assets (aircraft, fire engines, specialized vehicles) and well-trained fire personnel require substantial initial capital investment and continuous costly maintenance. It is the experience of forest fire agencies around the world that no single fire agency can acquire and maintain all of the necessary equipment required for the most difficult fire season. Usually, an agency will plan to capitalize its assets to cope with 7 out of 10 fires seasons [3]. Additionally, no single fire agency can manage large fire events alone.

Sharing high value assets can allow deployment of necessary resources, such as the Bombardier 415, to ensure fire containment for public safety and to minimize losses and impacts. Diminishing budgets and increased expectations of fire services require new and more diverse cooperative approaches. The Australian fire agencies and their national association (AFAC) are to be commended for initiating a process to establish a national fire coordination centre to serve the bushfire agencies in the country. This is an innovative and necessary initiative that when fully developed will allow the coordination and sharing of fire resources across Australia.

There is a Canadian example that demonstrates how sharing assets can work. The Canadian Interagency Forest Fire Centre (CIFFC), located in Winnipeg is a federally incorporated cooperative venture owned and funded by federal, provincial and territorial governments as a not for profit company. The funding formula is simple – 1/3 by the Federal Government and the remainder based on the area of forested land within each jurisdiction. The budget is modest - $500,000 - $600,000 Canadian annually and is staffed by 4 full time specialists. This case study is appropriate in the sense that both countries have significant forest fire regimes and also both have a similar confederation of government with the States (Provinces) primarily responsible for natural resources management including forest fire management.

Prior to CIFFC there were no formal resource sharing arrangements or standardization of suppression equipment or training in Canada. Sharing was done on an ad hoc basis between neighbours. It was not until following an extreme fire season in 1980 that agencies conceded there were severe shortages of water bombing aircraft, helicopters, and other suppression equipment available to the areas affected. There were similar shortages of trained fire crews and fire overhead personnel. The experience illustrated:

- Insufficient regional resources to combat large/multiple fire outbreaks
- No national intelligence system to support rapid deployment of available assistance
- No regional or national equipment reserves; and
- No formal mechanisms for inter-provincial sharing of resources

To address this situation CIFFC was created and started operation in the 1982 fire season. CIFFC is established and governed by the Operation Agreement and Corporation Bylaws, agreed to by all member governments and its work is facilitated by

[3] Canadian Interagency Forest Fire Centre.

the "Mutual Aid Resources Sharing Agreement, Manual of Administration and Manual of Operations.

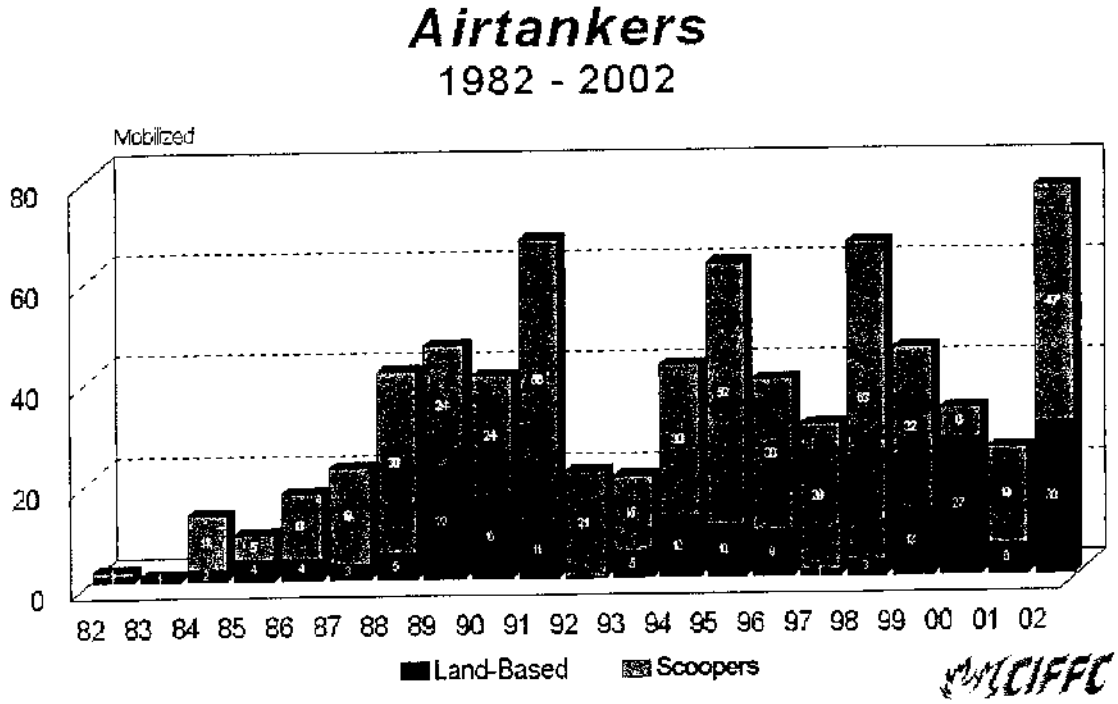
The Mission of CIFFC is to facilitate interagency cooperation in bushland fire management within Canada and internationally, minimizing fire management costs and losses throughout Canada, and supporting sustainable development of Canada's forests. It also will enhance Canada's ability to export fire management technology.

The goals are based on delivering services in a cost-effective, proactive and consultative manner, including:

- Exchanges of information
- Promote cooperation between members
- Foster development of national standards
- Market services and technology
- Communicate fire issues to all stakeholders

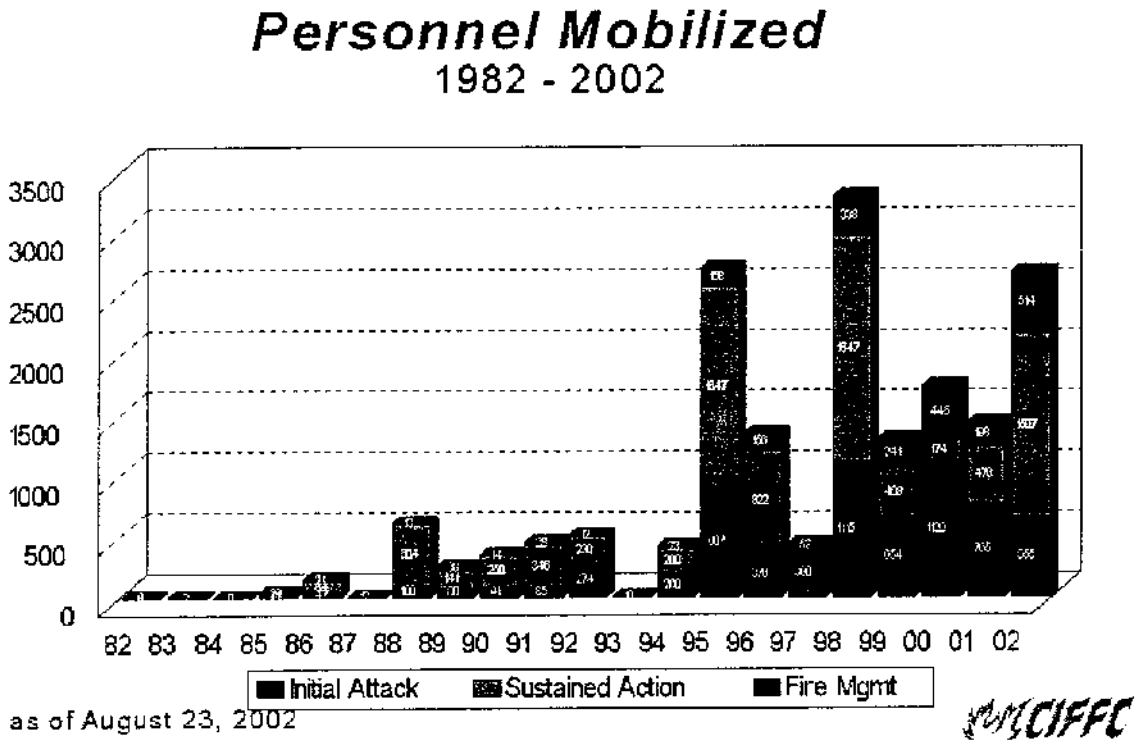
To facilitate mutual aid and resource sharing with the United States a separate protocol is in place providing for operational guidelines and the easy flow of resources across the international border.

CIFFC does not own equipment. CIFFC coordinates the resources of its members. All of the aircraft are owned or leased by member agencies and are available to CIFFC to coordinate and facilitate their sharing wherever needed in the country.



as of July 18, 2002

The mobilization of resources has increased year over year, partly due to frequent severe fire seasons and partly due to the maturing of the centre and its members. An analysis in 1998 estimated Canada's savings with resource coordination and sharing exceeded $500 Million Canadian that fire season.



The advantages for Australia to pursue a similar coordination and sharing model are obvious:

- Adequate, efficient and timely fire response
- Resources of the country available to specific fire events
- Fire losses and impacts reduced (public safety enhanced)
- Extreme fire years and events can be managed
- Standards developed
- Early warning and data sharing
- Enhanced fire management in the country
- Reduced capital costs for individual fire agencies

In summary, CIFFC is a success story that now routinely coordinates the movement of equipment and fire personnel, facilitates sharing of resources with the USA and other countries, monitors early warning, develops standards, shares data with members and the public and facilitates international aid.

8. Conclusion

The introduction of the scooping technology in the concept of Initial Attack has revolutionized the way several governments in North America and Europe effectively deal with extreme urban interface and bush fire situations. Comprehensive prediction and detection of fires combined with rapid dispatch of highly effective firefighting aircraft have proven the validity of the concept of aggressive aerial "Initial Direct Attack".

The Bombardier 415, a modern fixed-wing amphibious aircraft specifically designed for the purpose of aerial firefighting, has been the cornerstone in this new philosophy. Its unique attributes enhance its performance in harsh environments where efficiency and reliability are critical. The Bombardier 415's high endurance, higher speed, outstanding manoeuvrability in mountainous terrain and capability to accurately deliver large quantities of water or foam up to thirty (30) times an hour make it a truly unique asset essential to modern firefighting agencies.

Even in dry environments such as Australia, there are sufficient water-scooping sources available for the Bombardier 415 to operate efficiently. A fast and autonomous aircraft such as the Bombardier 415 can rapidly reach fires in remote mountainous areas and combat them before they reach catastrophic dimensions, even in high winds situations. Thanks to its versatility, the Bombardier 415 can be shared among several organizations and for roles other than firefighting such as: Utility Transport, Search and Rescue (SAR), Disaster relief, Logistics support, Oil Spill control, Fisheries Protection, Border Security, Maritime Intervention and Coastal Patrol.

Today, cost-effective use of public money is of paramount importance to Governments. Various structured financing alternatives exist to offer the Government flexible and cost-effective financing solutions for costly assets. For example, operating leases offer a unique way for the Government to benefit from the use of a group of assets without the burden of having the assets increase the capital budget requirements. Financing structures make sense to the Government as they provide private-sector financing solutions while benefiting from the Government's credit rating.

Bombardier Structured Finance [4] has been providing financing solutions to Bombardier's customers for more than 15 years. They have arranged financing for billions of dollars worth of assets to both private parties (airlines, private operators) and to Governments/Public sector. Currently, Bombardier is offering Governments innovative solutions to finance the acquisition of new CL-415 aircraft and will be more than ready to help Australia craft the right financing package to assist in acquiring Bombardier assets for its firefighting needs.

[4] The primary role of Structured Finance within the Aerospace Group is to facilitate the financing of Bombardier manufactured aircraft. We do not act as a funding source, but rather act to secure the most advantageous pricing and loan or lease structure for Bombardier's customers utilizing our established network of third party financing sources. Structured Finance does not charge a fee to the customer for its services. Our motivation is to develop a comprehensive financial structure that best suits the customer's needs while also being acceptable to potential financiers. Once your company has decided upon its target for its financing needs, Bombardier Structured Finance is highly confident that it can match your requirements with the appropriate source.

Annexes

1. AFAC – CL – 415 Evaluation Report 1996 – Executive Summary

2. AFAC – CL – 415 Evaluation Report 1996 – Conclusions

3. Report on Canadair CL – 415 Fire Bombing Aircraft, by S.A. Country Fire Service, 1996 – Demonstration of Fire Bombing a Dwelling in an Australian Bushland Setting. David Cout Manager Air Operations

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5. Hirsch, Kelvin – Canada's Wildland/Urban Interface: Challenges and Solutions – Article in Initial Attack Publication 2001

6. Forest Fires in Southern Europe, report no. 1 – Environment and Geo-Information Unit – Joint Research Centre, European Commission – July 2001

7. Bombardier 415 Water Scooping System – Illustration

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