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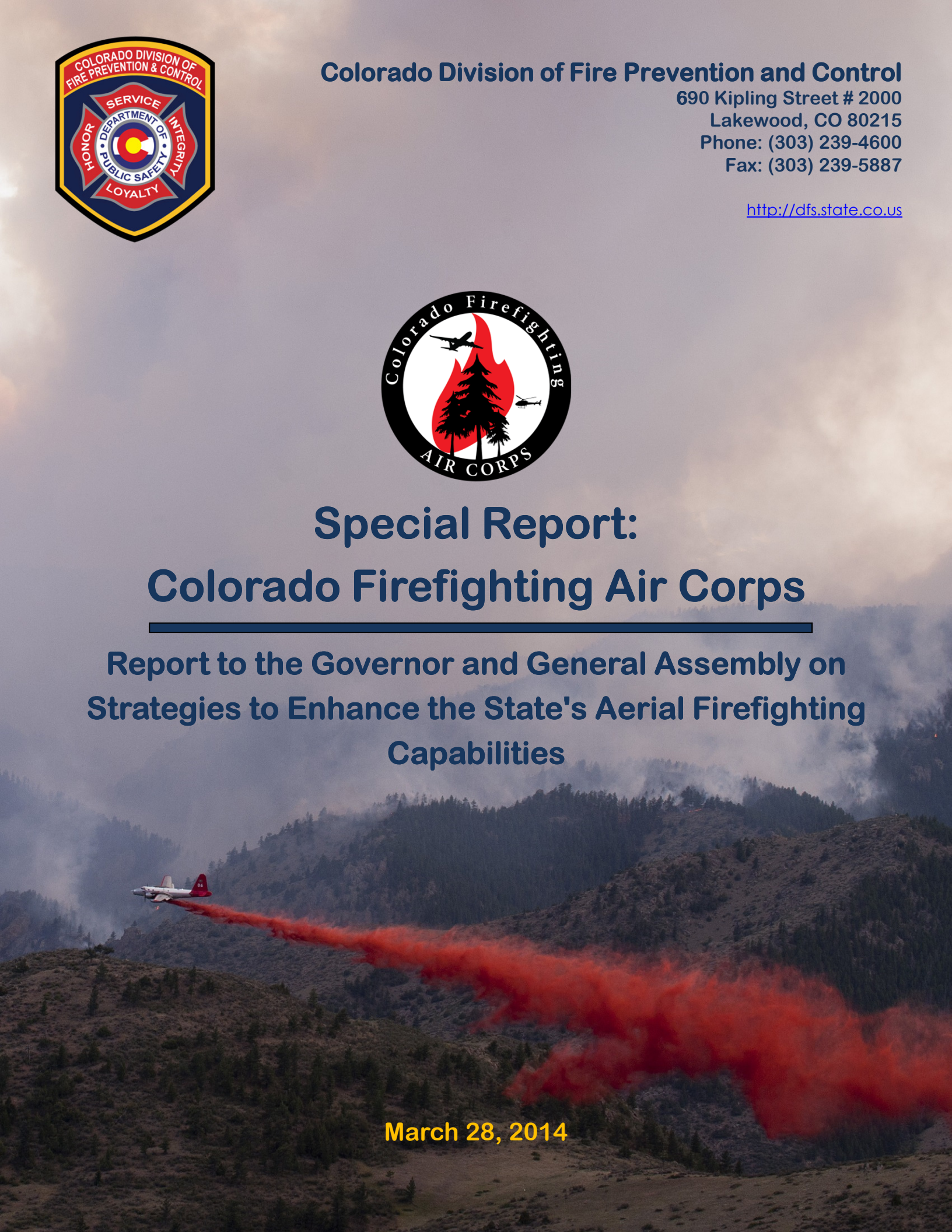
Special Report:
Colorado Firefighting Air Corps

Report to the Governor and General Assembly on Strategies to Enhance the State's Aerial Firefighting Capabilities



March 28, 2014

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March 28, 2014

John W. Hickenlooper
Governor of Colorado
136 State Capitol
Denver, CO 80203

Senator Morgan Carroll
President of the Colorado Senate
271 State Capitol
Denver, CO 80203

Representative Mark Ferrandino
Speaker of the Colorado House of Representatives
346 State Capitol
Denver, CO 80203

Governor Hickenlooper, President Carroll, and Speaker Ferrandino:

I am pleased to submit the final report of the special study concerning the Colorado Firefighting Air Corps (CFAC) within the Division of Fire Prevention and Control (DFPC) in the Colorado Department of Public Safety. Senate Bill 13-245 requires the DFPC to submit to the Joint Budget Committee and to the General Assembly a report concerning the efficacy of CFAC and strategies to enhance the state's aerial firefighting capabilities, prior to April 1, 2014. This report will include budget requests for CFAC and aerial firefighting if recommended by the DFPC.

To fulfill this mandate, I turned to the Advisory Committee to the Director of the Division of Fire Prevention and Control on Wildland Fire and Prescribed Fire Matters, which was created by Executive Order B 2013-001. An ad hoc "Fire Aviation Working Group", which included stakeholders as well as industry experts, was created under the Advisory Committee to focus on Colorado's aerial firefighting capabilities.

Early in the preparation of this report it was apparent that information that is critical for guiding policy, strategy, and decisions regarding the management of wildfire is not sufficient, accessible, or readily available. Thus, a key recommendation concerns the implementation of an integrated information management system to ensure the maximum effectiveness of current and future resources.

Recommendations concerning improvements in Colorado's aerial firefighting capabilities were not based exclusively on gaps in the federal interagency aviation system, but rather on DFPC's wildfire management goal, which is to:

> **"Keep all wildfires with values at risk smaller than 100 acres and to suppress all fires in Wildland Urban Interface (WUI) areas at less than ten acres, 98% of the time."**

Because DFPC's role is primarily to support local and county firefighting organizations, in order to achieve this wildfire management goal accomplishment of the following enabling goals will be necessary:

- Generate an incident assessment for every fire within 60 minutes of report or detection.

- Deliver the appropriate aviation suppression resources to every fire within 60 minutes of the request.

Key to achieving DFPC's wildfire management goal is developing the capability to detect fires earlier, locate them faster, provide the local Incident Commander with data needed to make informed decisions regarding suppression strategy, and then dispatch the appropriate aviation suppression resources expeditiously.

In order meet these wildfire management goals, the following improvements in Colorado's firefighting capabilities are recommended:

- Colorado should procure and train fire managers in the state to use an off-the-shelf wildfire information management system.

- In order achieve the goal of generating an incident assessment for every fire within 60 minutes of report or detection of a wildfire Colorado should procure and operate two fixed-wing multi-mission aircraft.

- In order achieve the goal of providing the appropriate aviation suppression resources to every fire within 60 minutes of the request Colorado should:
    - contract for the exclusive use of four Type 3 or larger rotor-wing aircraft; and
    - increase the exclusive use single engine air tankers (SEAT) contract to four aircraft.

- Instead of procuring state-owned air tankers, Colorado should identify and contract for the use of existing air tanker systems during the fire season. An exclusive use contract for two Type 2 or larger air tankers is recommended.

Other Recommendations

- DFPC should evaluate the benefits, opportunities, costs, and risks associated with implementing an "Agricultural Aircraft-Based Rapid Response Aerial Firefighting Program" for Colorado.

- DFPC should explore ways to further incorporate Colorado National Guard rotor-wing assets as a standing wildland firefighting resource for initial or extended attack.

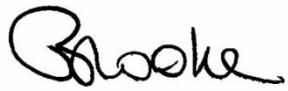
- DFPC should work to ensure all firefighters are provided the appropriate training, equipment and facilities necessary to successfully and safely meet the increasingly complicated and challenging wildfire and emergency response environment.

The improvements and capabilities recommended by this report will not ensure that Colorado will be free of wildfires. Even under the most highly effective wildland fire protection systems some fires will continue to escape control efforts. Under extreme weather conditions, such as those ignited during high wind events, or when resource availability is limited due to significant fire activity, a small percentage of wildland fires will become large and damaging. As a result, efforts must be taken to create homes and communities that can withstand such fires; develop policies and procedures to promote public and firefighter safety; and educate the public that wildland fire is a natural part of Colorado's landscape.

The improvements and capabilities recommended by this report will have a positive effect on wildfire suppression response and will improve Colorado's ability to act on fires in a more efficient, effective, and elegant manner. The recommendations in this report are likely to decrease the losses suffered as a result of wildfire in Colorado as well as the overall cost of fire suppression and post-fire recovery

I stand ready to answer any questions you may have concerning the recommendations contained in this report.

Respectfully Submitted,



Paul L. Cooke
Director

Special Report:
Colorado Firefighting Air Corps

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Cover Photo

High Park Fire – A fixed wing aircraft drops a load of fire retardant on a dozer line to prevent the fire from crossing into a residential area. (Official U.S. Army photo by Sgt. Jecca Geffre / June 19, 2012)

ACKNOWLEDGEMENTS

I wish to express my gratitude to the many individuals who made the production of this Report possible. There are so many to thank, and on a project of this scale there is significant risk of forgetting someone, so I will begin by apologizing if your name was inadvertently left off the list.

Next, I want to highlight the commitment that members of the "Advisory Committee to the Director of the Division of Fire Prevention and Control on Wildland Fire and Prescribed Fire Matters" and the ad hoc "Fire Aviation Working Group" made to this process.[1] The Advisory Committee and Working Group members, as well as other stakeholders attended several meetings and working group sessions, provided thoughtful comments, and engaged in spirited discussions over the last eight months.

I also wish to recognize the tireless efforts of DFPC staff members, specifically Jane Lopez, Deputy Section Chief – Wildland Fire Planning (Aviation and Prescribed Fire); Cliff White, DFPC Seat Manager; Rocco Snart, Acting Chief - DFPC Wildland Fire Section; and Vaughn Jones, Acting Deputy Section Chief – Wildland Fire Operations. Additionally, I want to thank Melissa Lineberger, DFPC Policy Analyst, for her work as the Editor of the Report.

The Advisory Committee and Working Group were fortunate to hear many presentations, including:[2]

USFS Aerial Firefighting Briefing & Strategic Management of Large Airtankers
Ron Hanks, National Aviation Operations and Quality Assurance
Kim Christensen, USFS Deputy Director of Operations

CAL-FIRE's Aviation Program
John Winder, Assistant Deputy Director for Fire Protection Operations, CAL-FIRE

Center of Excellence for Advanced Aerial Firefighting
Perspective of Dr. Tony Kern, former USFS National Aviation Director

Fire Aviation Alternatives
Perspective of Tom Landon, former USFS Regional Aviation Officer

DynCorp & Argon ST Aircraft Systems Presentation
Jeff Cavarra, Jason Rossbach, Scott Rauer, Scott Harvey, and Paul Wynns

[1] See Appendix D for list of members of the Advisory Committee to the Director of the Division of Fire Prevention and Control on Wildland Fire and Prescribed Fire Matters and the ad hoc "Fire Aviation Working Group".

[2] Many more presentations on particular products and services were attended to by DFPC management and staff.

Sierra Nevada Corporation Presentation
Caleb Freeman, Principal Engineer

Coulson Fire Aviation Presentation
Wayne Coulson, CEO

Helicopter Night Flying in Fire Suppression
Dennis Hulbert, Retired US Forest Service Regional Aviation Officer

10 Tanker Air Carrier (DC-10 Program Review)
John Gould, President, 10 Tanker Air Carrier, LLC.

State of Oregon Fire Aviation Program
Doug Grafe, Fire Operations Manager, Oregon Department of Forestry

State Fire Aviation & Interstate Fire Compacts
Dan Smith, Fire Director, National Association of State Foresters

The National Cohesive Wildland Fire Management Strategy: Western Regional Action Plan
Ann Walker, Western Governors' Association

Wildland Fire Information Management System
Brian Collins, Intterra Inc.

Beriev 200 (Be-200) Multipurpose Amphibious Jet
International Emergency Services, Inc.

Integrated Wildland Fire Mapping, Monitoring, and Modeling
Dr. Janice Coen & William Mahoney, National Center for Atmospheric Research

Preparation of this Report was also aided significantly from input by a number of subject matter experts, including:

Mike Amicarella, BIA Central Regional Aviation Manager
Glenn Barter, USFS Rocky Mountain Area Coordination Center
Scott Fisher, Chairman, Interagency Airtanker Board, USDA Forest Service
Caleb Freeman, Principal Engineer, Sierra Nevada Corporation
J. Kent Hamilton, Regional Aviation Safety Manager, USFS Rocky Mountain Region
Ron Hanks, Federal Fire and Aviation Safety Team (FFAST)
Marsha Henderson, State Fire Operations, State of Alaska
Joel Kerley, National Aviation Manager, Bureau of Indian Affairs
Dr. Tony Kern, CEO, Convergent Performance
Jim Lawson, USFS Helicopter Operations Specialist

Sandra LaFarr, USFS Regional Aviation Officer
Thomas Landon, CEO, Landon's Landing LLC, USFS (ret)
Brooke Malcolm, U.S. Fish and Wildlife Service – Region 6
Marco Perea, BLM Fire Management Specialist, RMACC
William B. Scott, CEO, Scott Systems, LLC
Mark Sirangelo, Chief Innovation Officer, Office of Governor Hickenlooper
Lt. Col. Luke Thompson, Chief of Aerial Firefighting, US Air Force Reserve
John Winder, Assistant Deputy Director for Fire Protection Operations, CAL-FIRE (ret)
Michael Yadon, FedEx Corporation
Douglas Young, Senior Policy Director, Office of Governor Hickenlooper
Eric Zanotto, District FMO, Pike and San Isabel National Forest

Finally, I am especially grateful for the participation of the Western Governors' Association, and, in particular, Ann Walker, Forest & Rangeland Health Program Manager, who attended many meetings, consulted with DFPC staff, and helped organize several of the presentations.

Without the assistance of each of these individuals and sponsoring organizations, we could not have met our statutory obligations.

Sincerely,

Paul L. Cooke, Director
Colorado Division of Fire Prevention and Control

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Introduction

The objective of wildfire management is protecting people, property, and the environment. All wildfire fighting authorities do their best to achieve these goals with the resources available. Nevertheless, improvements are always sought, especially after every devastating wildfire.

One such significant improvement that is the focus of this report regards early wildfire identification and initial attack. Although this report will extensively examine the full range of aerial firefighting resources—their utility, availability, viability, and costs—the primary recommendations will involve developing new and improved processes, integrating them in support of risk-informed decision making, and backing these with the aerial firefighting resources needed for an aggressive initial attack strategy. This has the potential to improve natural resource and community protection, reduce firefighter exposure, and potentially decrease suppression costs by stopping small fires before they can become devastating catastrophic wildfires.

Under the traditional approach to wildfire management, a local dispatch center receives a report of smoke. The dispatch center notifies the jurisdictional authority, which in turn, mobilizes firefighting resources to look for the source of the smoke. Even when there is a distinct column of smoke visible from the ground, countless hours can be spent pinpointing the location. Even more time is spent making an assessment of the fire to develop a suppression strategy.

What if, following notification of the jurisdictional authority, an order was made to launch Colorado's remote sensing fixed wing aircraft? The aircraft would be on site within approximately 30 minutes of launch and would employ thermal imaging sensors to survey the reported area. The fire would be located and mapped, and this information would be loaded in real time to the state's wildfire information management system. Within an hour of the first report of smoke the local incident commander would have access to a map of the fire, ingress and egress paths, fuels involved, fire behavior, values at risk, weather forecast, and other data needed to make informed decisions regarding the appropriate management response.

What if the appropriate management response is full suppression, but the fire is in a remote area with difficult access? What if the local incident commander could call for the state's contracted aviation resources, a helicopter, single engine air tanker, or large air tanker, with much greater confidence in their availability to be promptly over the fire?

What if all this can happen while the fire is small and still manageable? What if we can prevent the next mega fire that would otherwise result in lives lost, property destroyed, precious watershed damaged, and millions of dollars in suppression costs? This is the vision for the Colorado Firefighting Air Corps (CFAC).

Executive Summary

This report constitutes the analysis called for in Senate Bill 13-245. As such, it:

- Provides information on Colorado's current wildfire structure and resources, with emphasis on aerial firefighting resources;
- Examines the opportunities, challenges and costs associated with various options to augment those resources;
- Presents the case for the most effective use of aerial firefighting resources; and
- Makes recommendations regarding aerial firefighting resources.

Principal Finding:

The success of the Colorado's wildland fire management program depends upon aggressive initial attack and response in order to keep fires that threaten lives, property, or natural resources small.

Recommendation: *To accomplish this, Colorado should:*

- focus attention and efforts on initial attack—the most critical time to generate an informed and effective suppression response is the first few hours of a fire;
- develop the means to ensure that existing suppression resources are being used to their maximum effectiveness while ensuring responder safety; and
- increase the likelihood that a fire is suppressed in the first hours of its existence by providing quick responses with appropriate resources.

Wildfire Information Management System Finding:

Critical information needed for guiding policy, strategy, and decisions regarding the management of wildfire in Colorado are not sufficient or readily available.

Recommendation: *To address this finding, Colorado should:*

- develop and implement a state-wide information management system that provides shared, collaborative, real-time information amongst all participants in Colorado's wildfire management system as immediate availability of information is critical to ensuring that Colorado's currently-available resources are most effectively utilized.

Early Detection and Remote Sensing Finding:

Colorado has not developed the capability to actively detect small fires before they grow into large incidents that affect life, property, and resources.

Recommendation: *To address this finding, Colorado should:*

- develop early detection and remote sensing capabilities by securing aircraft equipped with modern fire-detecting sensors that should be operated to actively identify and locate small fires in high-risk wildland and wildland urban interface areas.

Initial Attack Focus Finding:

Colorado does not have the ability to deliver appropriate aviation resources in a timely fashion to support local suppression response to small fires while they are still small.

Recommendation: *To address this finding, Colorado should:*

- contract for four multi-mission rotor-wing aircraft to facilitate the initial attack response in Colorado's rugged and remote locations; and
- increase the number of Single Engine Air Tankers (SEATs) under the operational control of the state from two to four.

Large Fixed-Wing Air Tankers Finding:

A gap exists between the needs of Colorado and the available large air tanker resources provided by the federal government.

Recommendation: *To address this finding, Colorado should:*

- contract for two fixed wing large air tankers; and[1]
- monitor the U.S. Forest Service's (USFS) implementation of its plan to significantly augment the current air tanker capability in 3-5 years.

Procurement of large air tankers by means other than contracting is not recommended unless the modernization and augmentation of the federal air tanker fleet does not occur as planned, and Colorado's large air tanker needs cannot be sufficiently met.

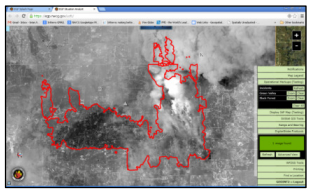
In making this recommendation many options for Large Air Tankers (LATs) were considered, including:

- Acquiring and converting surplus military aircraft through the Federal Excess Personal Property (FEPP) Program (see discussion on page 27)
- Converting donated civilian aircraft for use as air tankers (see discussion on page 30)
- Joint Procurement and Operation of Aircraft Fleet by Western States, through acquisition or contracting (see discussion on page 52)

[1] The contingency, if the State is unable to contract for two qualified large air tankers, is to contract for two helitankers, or a combination of one fixed-wing air tanker and one helitanker.

Summary of Recommendations to Address Findings

The recommended improvements and the estimated annualized costs to implement the improvements (excluding long-term operation and maintenance)[2] in 2014 are:

	**Wildfire Information Management System** Procure a state-wide license and provide training (See page 38)	$100,000
	**Multi-Mission Fixed Wing Aircraft** Procure two aircraft and operate in 2014 (See page 40)	$11.7 million
	**Multi-Mission Rotor Wing Aircraft** Contract for four Type III or larger rotor wing aircraft (See page 46)	$4.7 million
	**Single Engine Air Tankers (SEATs)** Contract for four exclusive use SEATs (See page 47)	$3.1 million
	**Large Fixed-Wing Air Tankers** Contract for two exclusive use large air tankers[3] (See page 47)	$11.9 million
	**Other Direct and Indirect Expenses** Additional insurance, airport fees, hanger leases, tanker base costs, personnel, supplies and equipment, etc.	$2.1 million
	Total estimated cost for program implementation in 2014:	**$33.6 million**

[2] These are estimated annualized costs for the specified improvements based on information provided by potential vendors. A detailed budget request will be submitted as a separate document.

[3] The contingency, if the State is unable to contract for two qualified large air tankers, is to contract for two helitankers, or a combination of one fixed-wing air tanker and one helitanker.

Other Recommendations

- Evaluate the benefits, opportunities, costs, and risks associated with implementing an "Agricultural Aircraft-Based Rapid Response Aerial Firefighting Program" for Colorado (see discussion on page 25).

- Explore ways to further incorporate Colorado National Guard rotor-wing assets as a standing wildland firefighting resource for initial or extended attack.

- Work to ensure all firefighters are provided the appropriate training, equipment and facilities necessary to successfully and safely meet the increasingly complicated and challenging wildfire and emergency response environment.

The improvements and capabilities recommended by this report will not ensure that Colorado will be free of wildfires, but they will improve our ability to protect people, property, and the environment from the ever-increasing toll that wildfires bring. The recommendations in this report will also likely decrease the overall cost of fire suppression and post-fire recovery.

In addition to the likely decrease in fire suppression costs, opportunities exist to reduce the estimated cost of implementing the improvements and capabilities recommended by this report. These options and opportunities are discussed beginning on page 51.

Background

In 2013, the General Assembly passed and the Governor signed Senate Bill 13-245 which establishes the Colorado Firefighting Air Corps (CFAC) within the Division of Fire Prevention and Control (DFPC) in the Colorado Department of Public Safety. The CFAC is comprised of aircraft, personnel, facilities, and equipment necessary to conduct aerial firefighting. The law authorizes the DFPC to purchase and retrofit firefighting aircraft or to contract for such aircraft and supporting services. If the CFAC acquires aircraft, the director of DFPC must establish reimbursement rates for CFAC assets made available to assist the aerial firefighting efforts of other jurisdictions.

The law also creates the Colorado Firefighting Air Corps Fund to receive grants, reimbursements, and funding from other sources, as well as state appropriations. The fund is continuously appropriated and may be used for CFAC operational expenditures. However, in 2013 the General Assembly made no appropriation to the fund, so the acquisition and operation of aircraft is not possible until funding is allocated.

The law also directs the DFPC to submit by April 1, 2014, a report to the Joint Budget Committee and the General Assembly concerning the efficacy of CFAC and strategies to enhance the state's aerial firefighting capabilities. This report satisfies that requirement and includes recommended budget requests for CFAC and aerial firefighting.[4]

Wildfire in Colorado

Forest Conditions

Colorado's wildfire threats are increasing and becoming ~~a~~ more complex warranting coordinated assessment, planning, and response. A century of aggressive fire suppression, combined with cycles of drought, insects and disease, and changing land management practices, has left many of Colorado's forests unnaturally dense and ready to burn.

Wildland-Urban Interface (WUI) Challenges

As Colorado grows, its urban areas are rapidly expanding into the fire-prone lands in the WUI. According to Headwaters Economics, Colorado already has over 1.1 million acres in the WUI, 80 percent of which remains undeveloped.[5] As more development occurs, the WUI will continue grow. A Colorado State University study projects that the state's WUI areas will increase to 2.2 million acres by 2030.[6] This movement of urban and suburban residents into the WUI

[4] C.R.S. 24-33.5-1228 (4).

[5] Headwaters Economics, The Rising Cost of Wildfire Protection (2013)

[6] Colorado State Forest Service, Colorado Statewide Forest Resource Assessment: A Foundation for Strategic Discussion and Implementation of Forest Management in Colorado.

significantly increases the values at risk from wildland fire – the most critical of these being human life.

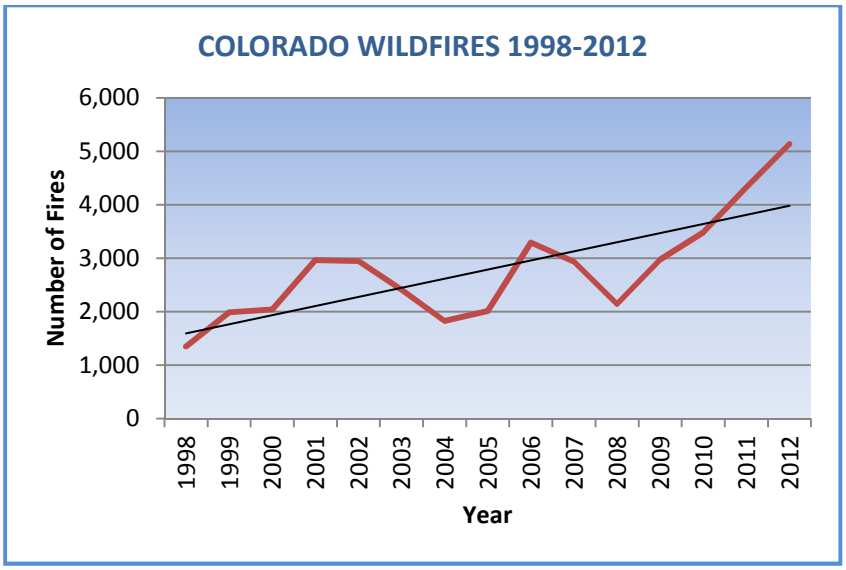


FIGURE 1 – COLORADO WILDFIRES, 1998-2012

Colorado's Fire History and Future

Since the 1990s, the number, intensity, and complexity of wildfires in Colorado have been growing exponentially, and experts predict that it will continue to worsen. In the 1960s, the average annual number of wildfires in Colorado was 457, and these fires burned an average of 8,170 acres annually. By the 1990s the average number of fires and acres burned had more than doubled to about 1,300 fires with 22,000 acres burned. Between the 1990s and the 2000s, the average number of fires and acres burned more than doubled again.

In 2012 alone, Colorado fire departments reported 6,459 wildland fires through the National Fire Incident Reporting System (NFIRS). These fires destroyed more than 648 structures, killed 6 civilians, burned more than 259,451 acres and caused at least $538 million in property losses.

Scientists project that, by 2050, the area burned each year by increasingly severe wildfires will at least double to around 20 million acres nationwide. Some regions, including Colorado, are expected to face up to a fivefold increase in acres burned if drought and weather trends continue on the current trajectory.[7]

[7] Effects of Climatic Variability and Change on Forest Ecosystems: A Comprehensive Science Synthesis for the U.S. Forest Sector, USDA Forest Service, General Technical Report PNW-GTR-870, December 2012.

Lengthening of Colorado's Wildfire Seasons

Colorado does not have a set wildfire season, which means wildfire potential can exist year-round. However, there are certain time frames that could be considered peak periods because of spikes in wildfire activity.

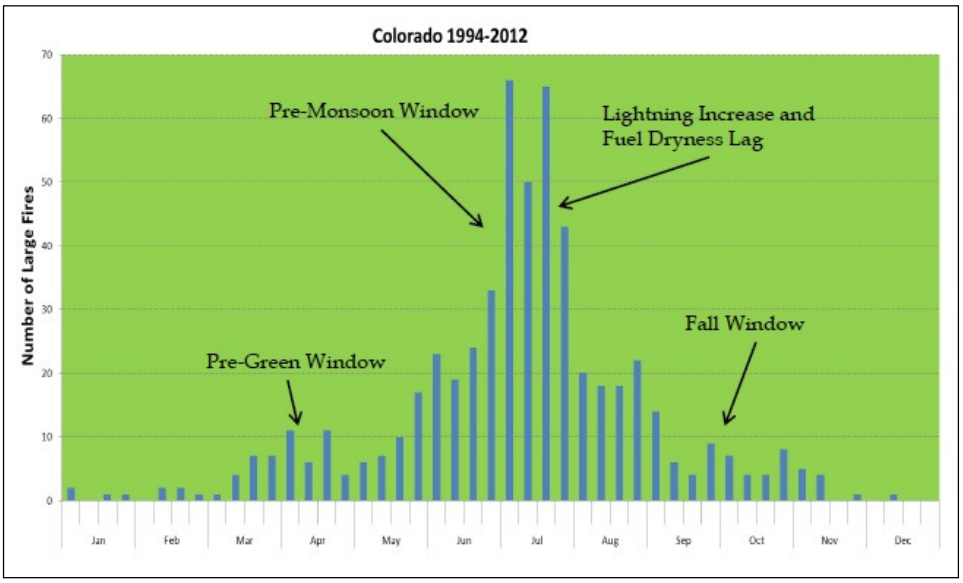


FIGURE 2 – COLORADO'S WILDFIRE SEASONS

The first peak period generally runs from late-February to mid-May. Sometimes called a Spring Wildfire Season (or early shoulder season), the period is characterized by wind-driven fires burning in cured grasses from the previous year. The driving force for these wildfires are the frequent frontal passages that come in from the west, bringing with them strong winds and dry air that can produce large, fast-moving wildfire. This season usually ends during green up, when the new grasses are emerging, actively growing and shrubs and trees are also beginning to put on the new year's growth.

During summer in Colorado, high temperatures and low humidity can create drier conditions that fuel wildfires. The second peak period – the Summer Wildfire Season – is typically a 6 to 7 week window from June to early July, although it may continue into August for portions of Northwest Colorado. These summer wildfires often are driven by an abundance of critically dry, curing or dead vegetation that serves as fuel for the fires.

This period is characterized by smaller but higher-intensity fires burning in timber and brush, when vegetation becomes critically dry. However, drought is also a strong contributor to the beginning part of the summer season, and when coupled with persistent frontal winds from the waning spring weather patterns, leads to the larger or mega-fires experienced in June. Strong winds often associated with dry thunderstorms, have likewise sparked or contributed to large or mega-wildfires during the Summer Wildfire Season. The onset and strength of the Monsoon can affect the length of this season.

The Fall Wildfire Season (or late-shoulder season) follows the Southwest Monsoon in late September to early November. The strength of the Southwest Monsoon is critical to determining the onset and severity of the Fall Wildfire Season. Like the Spring Wildfire Season, the late shoulder season is characterized by wind-driven fires; however, these fires are typically shorter duration due to shorter day length, cooler temperatures and moist fall weather patterns.

In general, Colorado sees short periods of increased fire occurrence throughout the year with just a few of the fires reaching a significant size or complexity. However, the drought conditions and fire activity experienced throughout 2012 — one of the worst wildfire seasons in state history — may be representative of a new normal. Experts warn that drought and the other causal factors could result in repeats of 2012 with widespread fire activity and extended, year-long wildfire seasons.

Increasing Wildfire Costs

Increasingly destructive wildfire seasons over the past ten years have caused devastating losses to Colorado and its residents. Between 2003 and 2012, there were a total of 258 large fires in Colorado.[8] These fires collectively burned 697,000 acres of land, and the cost to suppress these fires was approximately $287.6 million.

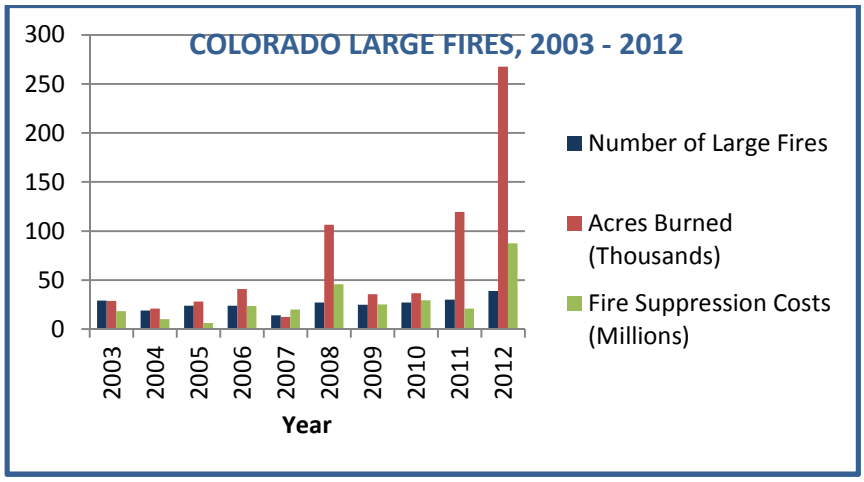


FIGURE 3 – COLORADO LARGE WILDFIRES, 2003-2012

In the "average year", there will be 30 large wildfires in Colorado that will destroy 113,000 acres of land and will result in $41.8 million in fire suppression expenses.[9] However, suppression

[8] This data is derived from ICS 209s on file. In some instances, the number of large fires in this summary is less than reported in the Annual Wildland Summary Report (AWSR) because 209s are not filed on all fires.

[9] Some of these fires will qualify for federal assistance through the Fire Management Assistance Grant (FMAG) program. When awarded, FMAGs provide for reimbursement of up to 75 percent of eligible fire suppression costs in the suppression of catastrophic wildfires.

costs are only a small portion of the true costs of a wildfire event. Property losses add significantly to the toll of wildfire.

The 2012 Wildfire Season took a devastating toll on Colorado residents, burning more than 600 homes and personal property. Damage estimates currently total $567.4 million from insurance claims.

The estimated insured losses make the Waldo Canyon Fire in Colorado Springs Colorado's most expensive wildfire with insurance costs totaling $453.7 million from 6,648 claims. The fire destroyed 346 homes. The High Park Fire near Fort Collins burned 259 homes, and based on the 1,293 insurance claims filed, the insurance costs are estimated at $113.7 million. These estimates do not include commercial losses.

Other direct costs of wildfire include rehabilitation costs, post-fire flooding, and watershed degradation costs. Costs that typically go unaccounted for are indirect costs, such as lost tax revenues, business revenues, and costs related to the loss of human life and ongoing health problems. A study on the true cost of wildfire in the western United States suggests that total wildfire costs can be as much as 30 times greater than direct suppression costs.[10]

Wildfire Impacts on Watershed

The forest floor consists of living and dead plants, litter and duff, and decomposing organic matter that serve as a sponge and filter where surface runoff is rare and soil erosion rates are low. Trees protect the surface from impacts of raindrops and their root systems provide soil stabilization. A main problem occurring after wildfires with areas of high severity is that the landscape is completely changed and the sponge and filter are no longer present to help prevent erosion and surface runoff. Surface runoff can cause loss of life, premature sedimentation accumulation in reservoirs, flooding, infrastructure damage, and damage to fisheries and wildlife habitats.

Mitigation to protect a community against these effects can cost millions of dollars. Further, fire can affect the presence of calcium and nitrogen in the water, as well increase the conductivity, turbidity, and temperature of affected watersheds.

Overall Finding:

As a result of Colorado's forest conditions, continued development in the WUI, the the lengthening of the fire season and increasing fire severity, and the growing costs to address these realities, there is a critical need to enhance the state's firefighting resources—especially appropriate and efficient aerial resources.

[10] The True Cost of Wildfire in the Western U.S., Dr. Lisa Dale, Western Forestry Leadership Coalition, April 2010.

Colorado's Wildfire Management Goals

Suppression costs escalate significantly as fire size increases.[11] A wildland fire becomes a local emergency before it evolves into a State, then regional, then national incident. Colorado's wildfire management program should continue to hold as a high priority the strengthening of first response firefighting forces to safely and effectively suppress wildland fires.

Fast, aggressive, initial attack on new fires (for fires where full suppression efforts is the appropriate management response) can reduce the number of mega fires that may burn hundreds of homes and cost the taxpayers tens of millions of dollars in suppression costs. The safety of firefighters and the public will continue to be the first priority in all fire management activity.

Primary Goal: Keep Fires Small

DFPC's goal for wildfire management is to keep all wildfires with values at risk smaller than 100 acres and to suppress all fires in Wildland Urban Interface (WUI) areas at less than ten acres, 98% of the time.

Enabling Goals

Because DFPC's role is primarily to support local and county firefighting organizations, in order to achieve this wildfire management goal, accomplishment of the following enabling goals will be necessary:

1. Generate an incident assessment for every fire within 60 minutes of report or detection.
2. Deliver the appropriate aviation suppression resources to every fire within 60 minutes of the request.
    a. Launch time – the time from notification at the base with all required information to when the aircraft physically launches should not exceed 15 minutes for helicopters, 20 minutes for SEATs, and 30 minutes for large air tankers (which allows for retardant loading).
    b. Response time – from launch time to arrival on the incident should not exceed 30 minutes whenever possible and weather permitting.

Aviation assets – will be strategically located based on preparedness levels, interagency situational awareness of fire activity, weather, National Fire Danger Rating System (NFDRS) indices, location of other aerial assets, etc.

[11] Based on Colorado's fire experience in 2012, the daily suppression cost of a fire that grows to over 100 acres escalates to $50,000 - $100,000. The daily cost continues to increase exponentially as the size of the fire grows and the complexity of the incident warrants specialized incident management resources. In 2012, fires managed by a Type 2 Incident Management Team (IMT) cost an average of $200,000 per day, and daily costs were about $550,000 per day for fires managed by Type 1 IMTs.

Challenges in Meeting these Goals

In order for Colorado to meet its wildfire management goals, we must overcome several challenges:

Information Availability

As was discussed earlier, risk drives all aspects of wildfire management. Risk is used to identify which areas should receive mitigation and where resources and apparatus should be pre-positioned and also to guide day-to-day decisions in suppression activities. Accurate identification and assessment of risk is key to wildfire management in Colorado. Some key capabilities that have been identified as necessary to provide timely and accurate information to wildfire managers are:

- An integrated system to gather information from disparate sources and present a complete picture of the wildfire situation in Colorado;
- An integrated resource management tool;
- The capability to predict and model the likely progress of an incident 12, 24, and 36 hours into the future;
- A consistent and integrated state-wide parcel level risk model;
- A tool to measure the effectiveness of mitigation efforts at reducing risk;
- A system to measure the effectiveness of suppression activities and strategies (especially the effectiveness of air tankers and retardant delivery);
- A means to study and apply lessons learned from previous incidents in guiding new wildfire management policies and strategies;
- An integrated tool to facilitate and standardize incident management across the state to communicate to incident responders the plans and tactics of the incident manager
- A strategy and policy that actively guides the escalation of incidents when they grow beyond the capabilities of the managing organization;
- A tool to track the location and ensure communication with active wildfire management crews to aid in ensuring firefighter safety; and
- A regional management tool that presents a comprehensive view of all wildfire incidents active in the state including:
    - Fire location
    - Fire perimeter
    - Active fire intensity
    - Fire history
    - Terrain
    - Fuel data
    - Fire behavior prediction and growth potential
    - Predicted weather
    - Threatened civilians and firefighters
    - Threatened structures

- Threatened watersheds
- Location and type of critical infrastructure
- Safety risks (e.g. propane tanks, power lines, natural gas wells)

During the preparation of this report, it became apparent that the information that is critical for guiding policy, strategy, and decisions regarding the management of wildfire is not sufficient, accessible, or readily available.[12]

Finding:

An integrated wildfire information management system is a key capability that is required to ensure the maximum effectiveness of current and future resources.

Early Detection and Remote Sensing Capability

Colorado has not developed the capability to actively detect small fires before they grow into large incidents that affect life, property, and resources. Fires are typically detected using public interaction via traditional emergency management systems (e.g. 911 calls). Even after detection, locating the fire often takes hours or days, allowing time for the situation to develop into an unmanageable one. Initial responders often spend hours or days "chasing smoke" in an attempt to pinpoint the location of a fire. These hours are when the fire is easiest to suppress.

Colorado has not developed the capability to predict and proactively search for new wildfire starts. Colorado does not have the capability to survey large areas of high-risk wildland to detect, locate, and inform local fire managers of small fires.

When a fire is detected, Colorado does not have the capability to generate real-time information required by local organizations to efficiently determine the appropriate management response, which may range from management of the fire for resource benefit to a full-out suppression effort. Some examples of this required information are: location, perimeter, terrain, fuel, and other situational parameters. During the suppression effort, this same information is also unavailable to the incident commander and state fire management officers who use this information to ensure that the incident is being managed effectively. This information would also be used to escalate the incident when required.

[12] According to the U.S. Government Accountability Office, the USFS and DOI have undertaken nine major firefighting aircraft studies since 1995 but those efforts have all been hampered by limited information and collaboration. "Specifically, the studies and strategy documents did not incorporate information on the performance and effectiveness of firefighting aircraft, primarily because neither agency collected such data". This same issue hampered DFPC's ability to study Colorado's fire aviation needs.

Initial Attack Assets

Colorado does not have the ability to deliver an appropriate and timely suppression response to small fires while they are still small. Colorado's rugged terrain and the large distances that separate responders from the incidents allow the fires time to develop into situations that are difficult or impossible to manage. California's suppression response is an effective model that can be tailored to Colorado's needs and improved upon using the application of risk identification and information management.[13]

Difficult Terrain

Colorado presents a unique challenge to aviation. High altitudes and hot temperatures often result in extremely high density altitudes that reduce aircraft performance to unacceptable or unsafe levels. These conditions limit the aircraft that would be effective tools in suppressing Colorado's wildfires at high altitudes.

Consistent Risk Management Strategy

Colorado does not employ a consistent risk management strategy. **Timely and detailed information is not gathered by all wildland management organizations in the state and integrated into a comprehensive risk model.** This inconsistent approach to risk identification and assessment does not allow the state to accurately determine the most efficient application of resources and funding to reduce the risk of wildfire in Colorado. Standards and expectations for data collection, communication, mitigation effectiveness, and information accessibility do not exist. Incentives for participation in risk reduction efforts do not exist. Without an integrated and consistent approach, Colorado will not effectively identify and manage wildfires across the state.

Resource Availability

The type and quantity of firefighting resources available in Colorado, particularly federal resources, varies considerably based on time of year, national and Geographic Area Preparedness Levels,[14] and actual wildfire activity. For example, during the early and late shoulder seasons in Colorado, there are very few handcrews and aircraft available, as these periods are outside the traditional federal wildfire resource contracting period. During the Summer Wildfire Season, Colorado will compete with other states in the Geographic Area as well as other Geographic Areas for resources based upon preparedness levels, and actual wildfire activity.

[13] See page 53 for a description of California's wildfire management system and aviation resources.

[14] Preparedness Levels are dictated by burning conditions, fire activity, and resource availability (see Glossary).

Large Air Tanker Employment and Availability

Large air tankers (LATs) are only one part of a multi-faceted aerial firefighting fleet, but they are critical to aerial firefighting support. LATs are particularly important in building and/or reinforcing fire line in heavy fuels and closed-canopy fires. LATs are most effective when engaged in initial attack operations that are well supported by ground personnel and equipment. There are some occasions and situations where LATs are effective on extended attack fires. It is uncommon for LATs to be justifiable resources for the initial attack response of small wildfires. Colorado currently relies on the federal interagency system for all large air tanker resources.

The reduction in the size of the federal large air tanker fleet from 44 LATs available in the 2002 fire season to the current level of 11-12 has had significant impact on both availability and total suppressant/retardant delivery capability. To some extent, the use of helicopters and SEATs has mitigated this situation, but total fleet capacity has diminished as has the capacity to build and/or support fire line in heavy fuels and closed-canopy fires.

In February, 2013, "Fire Aviation" reported that data released by the National Interagency Fire Center about the 2012 wildfire season "reveals that almost half, or 48 percent, of the national requests for large air tankers could not be filled. [15] Of the 914 requests, 438 were rejected as "unable to fill" (UTF), meaning no air tankers were available to respond to the fire; 67 were canceled for various reasons."[16]

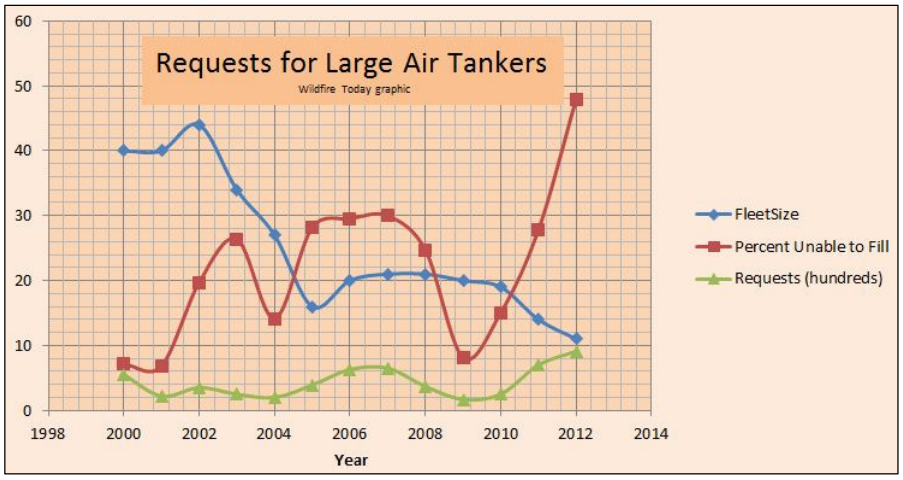


FIGURE 4 – REQUESTS FOR LARGE AIR TANKERS

[15] *Almost Half of Requests for Air Tankers Were Not Filled In 2012*. Fire Aviation, February 24, 2013 at: http://fireaviation.com/2013/02/24/almost-half-of-requests-for-air-tankers-were-not-filled-in-2012/

[16] On February 18, 2014, the National Interagency Fire Center released its data for 2013 which reflects the large air tanker UTF rate fell to 21 percent.

Overall Finding:

Incident Commanders are frequently confronted with an incident that warrants tools and resources that are not available. Often, requests for specific resources are not made because of knowledge or presumption that none are available. Without dedicated, consistently available resources controlled by the state of Colorado, effective suppression tools will not be available or requested.

Colorado's Current Firefighting System

Organization

Colorado's structure for combatting wildland fires is a cooperative, interagency system involving local, county, state, and federal agencies. Wildland fire protection responsibilities on non-federal lands in Colorado follow a hierarchy of local jurisdiction, to the county sheriff, and finally to the State of Colorado. DFPC is the lead state agency for wildland fire management.

The fire chief of the fire department in each fire protection district is responsible for the management of wildland fires that occur within the boundaries of his or her district as long as those fires are within the capability of the fire district to control or extinguish.

- When wildland fires exceed the capability of the local fire department to control or extinguish the fire chief may (with concurrence from the sheriff) transfer responsibility for the fire to the county sheriff. The sheriff is responsible for all wildland fires that occur outside the boundaries of a municipality or fire protection district.

- When wildland fires exceed the capability of the county to control or extinguish, DFPC may assist the sheriff in controlling or extinguishing such fires and may assume (with concurrence of the sheriff) command of such incidents.

DFPC's Wildland Fire Management Program

Wildland fire management service, support, and programs are implemented and delivered to counties and fire districts through DFPC's Wildland Fire Management Section. The immediate field response to requests for assistance with wildfires comes from the DFPC Fire Management Officer (FMO). DFPC has 9 Regional FMOs to cover the State's All-Hazard Regions, with 2 Area FMO positions serving in supervisory and backfill roles.

Wildfire Emergency Response Fund

The Wildfire Emergency Response Fund (WERF) was created to assist local jurisdictions with initial attack wildland fire response on state and private lands within the state of Colorado. Any County Sheriff, municipal fire department, or fire protection district within Colorado may

request WERF as the official Requesting Agency. If funds are available, WERF will reimburse the cost of eligible wildland firefighting resources to the Requesting Agency. Eligible costs under Sec. 24-33.5-1226, C.R.S., include:

a) The first aerial tanker flight or the first hour of a firefighting helicopter to a wildfire; and
b) The employment of wildfire hand crews to fight a wildfire for the first two days of a wildfire.

As a result of legislation passed in 2013 (SB13-270), the governor may authorize DFPC to increase the use of The Wildfire Emergency Response Fund to provide funding or reimbursement for additional aerial tanker flights or additional usage of wildfire hand crews to fight a wildfire.

Colorado's Current Firefighting Capability

The vast majority of Colorado's firefighting resources are owned and operated by local fire departments (fire protection districts, municipal fire departments, non-governmental volunteer fire departments, etc.). County Sheriffs and county governments also own and operate firefighting equipment or equipment that can be called upon for wildland fires, such as dozers and water tenders.

The focus of this report is Colorado's aerial firefighting capabilities. Thus, the discussion that follows concerning the state's current firefighting capability primarily examines aviation resources. A description of other (non-aviation) wildland firefighting resources is included as Appendix E.

Utility of Wildfire Aviation

Aviation, just like a chainsaw, is a tool for firefighters to employ during the suppression of a wildfire. Although aircraft are often used to fight wildfires, aircraft alone cannot put them out. Firefighters rely on planes and helicopters to:

- Deliver equipment and supplies;
- Deploy smokejumpers and rappellers to a fire;
- Transport firefighters;
- Provide reconnaissance of new fires, fire locations, and fire behavior;
- Drop fire retardant or water to slow down a fire so firefighters can contain it; and
- Ignite backfires and prescribed fires.

Ultimately, the goal of suppressing a fire is achieved by removing the source of fuel, rearranging fuel, or removing heat sources. Aviation can aid in this effort by applying suppressants and retardants that reduce the ability of the fire to consume the fuel, thus slowing the fire's progress.

During high wind and extreme weather conditions, aviation is often not a usable tool. Unfortunately, these same weather events are often the cause of Colorado's worst wildfire incidents. During unfavorable weather conditions, some fire aviation is not allowed to operate. High winds and/or low-visibility will keep air tankers and rotor-wing aircraft grounded for safety reasons. Higher altitude aircraft used for surveillance or remote detection may be able to operate on high wind and low visibility days, but may have visible obstructions or weather diversions that reduce their effectiveness.[17] Many of the memorable and devastating wildfire incidents in recent years occurred during extreme wind events. These incidents were small and manageable before the weather-induced changes removed any capability for suppression or management. In many cases, these adverse weather conditions were predicted.

Finding:

These situations justify and validate the need to establish a risk model that encompasses all of the aspects of wildfire management and to apply the appropriate resources in the light of this identified risk. If appropriate risk is identified during the time the incident is manageable, the incident can be contained.

Current Wildfire Aviation Resources in Colorado

Colorado's wildfire aviation capabilities are currently provided by the federal government with the exception of Colorado's Single Engine Air Tanker (SEAT) aircraft and rotor-wing assets provided by the Colorado National Guard in some instances.

No local agency owns firefighting aircraft, but at least one (Douglas County) contracts for the exclusive use of a Type 2 helicopter during the Summer Wildfire Season.

Requesting Federally Managed Aircraft to Fight Colorado's Wildfires

The federal aviation capabilities are administered through the interagency dispatch system by the National Interagency Fire Center (NIFC), located in Boise, ID.

The Resource Ordering and Status System (ROSS) is the tool through which federal aviation assets are requested. Generally speaking, the interagency dispatch system allows 48 hours for requests to be filled. The federal definition of "availability" is defined by this 48-hour window. If a request is not filled within this time, it is deemed to be unavailable and is canceled. It is also

[17] Moderate to high winds and turbulent conditions affect flight safety and water/retardant drop effectiveness. A number of factors including terrain, fuel type, target location, resources at risk, cross- winds, etc., must be considered. However, heavy air tanker drops are generally ineffective in winds over 20-25 knots. SEAT operations are generally ineffective in wind over 15-20 knots and Helitanker drops are generally ineffective in winds over 25-30 knots.

worth noting that the available data did not include the large fire seasons of 2012 and 2013 which may influence the availability numbers.[18]

The DFPC has extracted data in an attempt to document the requests that originated in Colorado compared to the requests fulfilled. The data available in the ROSS system does not completely describe the need within the State, or the ability of the federal wildfire management organization to meet the State's needs. **This shortage of data is a product of the nature of the ROSS program and is representative of the hurdles that must be overcome when attempting to generate conclusions or recommendations without available and effective wildfire information management systems.**

Initial Attack Limitations of Federal Resources

Federal resources are rarely requested during the first few hours after a fire is detected. This is often because the fire's location, size, terrain, and risk have yet to be defined or communicated. Often, firefighters spend a significant amount of time 'chasing smoke' during these first few hours.

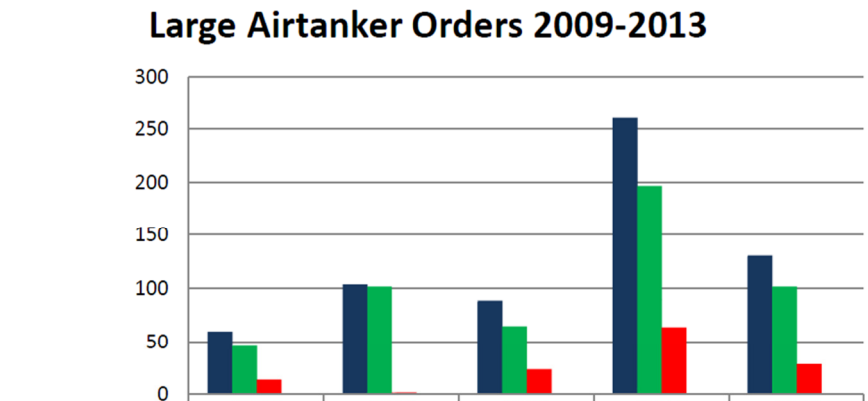
Data regarding the size or complexity of the incident at the time of the aviation request was not available for this report. The ability of the federal wildfire aviation system to provide support with aerially delivered resources in the first hours of an incident is not documented. Often, local organizations in Colorado will not make a request to the federal system because there is an anecdotal understanding that the needed resources would not be available within the needed time frame.

Wildfire managers in Colorado recognize that if wildfire effectiveness is to be improved, attention and efforts must be focused on initial attack response. In this context, initial attack is not defined as a 48 hour window, but as the first few hours immediately after detection of a fire.

Limited Availability of Federal Resources

During the 2009-2013 fire seasons, Colorado made many requests and received many filled orders from the federal wildfire aviation system. However, over the course of this period, twenty percent of the orders for large air tankers were not filled. This "unable-to-fill" rate increased to twenty-five percent over the last three years.

[18] Avid LLC, "AG-024B-C-12-0006 Final Report Firefighting Aircraft Study (FAS)", Feb 27, 2013. Note: A significant issue with the AVID report is that it only looks at fires and aviation responses between 2007 – 2011 and historical fire data was only available from 1992-2010 which made record matching only possible for 2007-2010 (page 80) and the strategy used completely ignores small fires (page 82). Since Colorado had some historically large fire in 2012 and 2013, the AVID report seems less relevant to Colorado's situation.



	2009	2010	2011	2012	2013
Ordered	60	104	89	261	131
Filled	46	102	65	197	102
Cancelled/UTF	14	2	24	64	29
% Cancelled/UTF	23%	2%	27%	25%	22%

"UTF" – Unable to fill

FIGURE 5 – LARGE AIR TANKER ORDERS, 2009-2013

Current Status of Federal Aerial Resources

During the course of preparing this report the status of the national large air tanker fleet and the plans to modernize and augment the fleet have changed significantly. When SB13-245 was making its way through the General Assembly, it appeared that the only way for Colorado to ensure that its needs for firefighting aircraft could be met was to acquire and operate large air tankers. At the time, the US Forest Service had just released its "Large Airtanker Modernization Strategy"[19] and it was unclear how and when needed improvements would be made to the national large air tanker fleet. In fact, because of this uncertainty, an early draft of this report recommended that Colorado acquire and operate its own fleet of large air tankers.

Additional Resources for 2014 Fire Season

At the time that this report is being published, the following is the information that was provided by the USFS concerning LAT's/VLAT that will be available during the 2014 Fire Season:

- 8 Legacy Air Tankers (7 P2V's and BAe146)
- 2 Next Generation Air Tankers[20]
- 1 VLAT (DC-10)

[19] Large Airtanker Modernization Stategy, USDA Forest Service, February 10, 2012.

[20] There are 7 Next Gen air tankers under contract to the USFS; however, only 2 of the 7 are actually available. The USFS hopes that at least 3 additional Next Gen air tankers will be available during the 2014 season, for a total of 5 of 7. See: 2014 US Forest Service Airtankers - Schedule of Items (Revised Feb. 28, 2014)

Additionally, the USFS will be able to access four CV-580s from Canada and eight MAFFS, if needed.

C-130H Acquisitions

The National Defense Authorization Act (NDAA) for 2014 contains provisions for the USFS to receive seven C-130H aircraft from the Coast Guard. However, it is unlikely that any of the C-130's that are being acquired from the Coast Guard will be available during the 2014 fire season. The USFS anticipates the first two C-130's will be available in 2015, although they are hoping it will be October/November 2014; three more in 2016, and the last 2 in 2017.

As an interesting aside, the NDAA:

- Requires the Coast Guard to transfer seven, HC-130H aircraft to the Air Force.
- Requires the Secretary of the Air Force to spend up to $130 million to upgrade those seven aircraft to make them suitable for Forest Service use a firefighting aircraft (roughly $18.6 million per plane).
- Requires the Forest Service to accept the upgraded HC-130H aircraft in lieu of exercising their right to take seven excess C-27J aircraft.
- Transfers 14 excess C-27J aircraft from DOD to the Coast Guard.
- Transfers up to 15 C-23 Sherpa aircraft from DOD to the Forest Service.

Before transferring the C-130Hs to the Forest Service, the Air Force would perform center and outer wingbox replacement modifications, progressive fuselage structural inspections, and configuration modifications necessary to convert each HC-130H aircraft as large air tanker wildfire suppression aircraft.

2014 Farm Bill Provision

A provision in the Farm Bill (H.R.2642) signed by the President on February 7, 2014 authorized the U.S. Forest Service to "establish a large airtanker and aerial asset lease program", allowing the agency to "enter into a multiyear lease contract for up to five aircraft that meet the criteria described in the Forest Service document entitled 'Large Airtanker Modernization Strategy' and dated February 10, 2012, for large airtankers". This provision was passed without an appropriation for the additional leases, so this may or may not ever translate into additional aircraft.

The State's Supplemental Resources

Colorado's Single Engine Air Tanker Program

For the past several years, in order to increase the likelihood that fire aviation resources are available when needed, the State has supplemented federal aviation resources by entering into exclusive-use contracts for Single Engine Air Tankers (SEATs).

SEATs have consistently proven to be very effective as initial attack firefighting resources. The SEATs' load (approximately 800 gallons) is smaller than the large air tankers' load, but their mobility, speed, and accuracy make them ideal for fighting fires in in lighter sage, brush, and grass type fuels.

FIGURE 6 – COLORADO'S SINGLE ENGINE AIR TANKER

For the 2013 fire season, DFPC entered into an exclusive-use contract for 2 SEATs for 120 days each. The contract provided for the addition of a third SEAT if needed. The actual number of contract days and flight hours was based on need (240 operational days between the 2 SEATs in 2013).

SEAT Program Costs

The cost of the SEAT contract for 2013 was $1.2 million. Salaries and operating costs added $700,000 to the cost of the fire aviation program, taking it to $1.9 million (or 58% of the total FY2014 Wildfire Preparedness Fund appropriation of $3.25 million).

National Guard Rotor-Wing Assets

The Colorado National Guard's rotor-wing assets are often requested in the initial attack phase of private, county, or state wildfires. These assets may include Type I, bucketed or tanked Chinooks and Blackhawks, and Type III Lakotas used for command and control. In recent years, hoist-capable Blackhawk helicopters have been made available for emergency extraction when firefighters are working in steep and inaccessible terrain.

During the past two fire seasons, the Colorado National Guard made six active flight missions on State Active Duty Status (SAD), one active flight mission on Immediate Response Authority (IRA) status and two medical support missions on stand-by status (SAD).

FIGURE 7 – COLORADO NATIONAL GUARD BLACKHAWK HELICOPTER[21]

The Colorado National Guard trains yearly with an interagency cadre including UFSF, BLM, DFPC, county, and fire protection district personnel to ensure appropriate communications and standard operating procedures are understood and followed.

Limitations

Because the National Guard assets are prioritized to other defense-related missions, they may not always be available to respond to Colorado's wildfire situation. While their capability is unquestionable, they are not dedicated, first and foremost, to Colorado's wildfire needs. As the political and military environment in which the National Guard operates continues to change, the DFPC is working to strengthen and streamline access to the Colorado National Guard's aerial assets.

Helicopter Hourly Rate Comparison

Hourly Emergency Rate CONG Helicopter		**Commercial Helicopter Hourly Rate**	
Aircraft	Rate	Aircraft	Rate
CH-47 Chinook	$8,736.03	BV-234 Chinook	$7,445.63
UH-60 Black Hawk	$4,845.33	S-70 BattleHawk	$3,791.49

[21] A Colorado National Guard Black Hawk helicopter performs water drops on the Black Forest fire, June 12, 2013, using Bambi Buckets®. Photo by Air Force Capt. Darin Overstreet.

Recommendations Regarding Aviation Resources

Fixed-Wing Large Air Tankers

The USFS is currently the only provider of large fixed-wing air tankers to Colorado. While a capability gap currently exists between the available air tanker resources and the needs of the state, the USFS is implementing a plan to address this.

The current plan is for the USFS to augment their existing fleet of air tankers with seven, C-130 aircraft. These aircraft will be revitalized and modified, and indications are at least two of them can most likely begin firefighting missions operations in the 2015 fire season. The aforementioned capability gap is expected to persist for 3-5 years.

The large capital investment cost of procuring, revitalizing, and modifying air tankers does not present a best-value approach to meet Colorado's wildfire management goals.[22] Additionally, if the aircraft systems are procured from the FEPP inventory, the modification and revitalization costs are not recoverable through cost-sharing agreements with federal agencies. Only direct operational costs are allowable to be recovered by the operating organization (e.g. DFPC).

Recommendation:

Instead of procuring state-owned air tankers, Colorado should identify and contract for the use of existing air tanker systems during the fire season to fill the temporary gap left by the federal resources. However, the USFS program to modernize and augment the federal air tanker fleet should be monitored to determine if it is occurring as planned. **If the modernization and augmentation of the federal air tanker fleet does not occur as planned and Colorado's large air tanker needs cannot be sufficiently met, additional consideration should be given to procuring state-owned air tankers.**

Multi-Mission Fixed-Wing Aircraft

These aircraft should be equipped with modern sensing, processing, and communication systems to allow for the gathering and dissemination of real-time wildfire information. The multi-mission aircraft should be integrated into the state's wildfire information management system to allow all data to be immediately available to wildfire managers across the state.

Recommendation:

In order achieve the goal of generating an incident assessment for every fire within 60 minutes of report or detection of a wildfire Colorado should procure and operate two fixed-wing multi-mission aircraft.

[22] See page 28 for an estimate of the costs of procuring, revitalizing, modifying, and operating federal surplus C-130s for use as air tankers.

Rotor-Wing Multi-Mission Aircraft

These aircraft should be capable of operating in Colorado's high altitude and hot temperature environments. The rotor-wing aircraft should be capable of delivering wildfire suppression personnel (helitack crews) to remote locations to facilitate initial attack missions. The rotor-wing aircraft should also be able to carry water or retardant to remote locations in order to support ground-based suppression teams.

Recommendation:

In order achieve the goal of providing the appropriate aviation suppression resources to every fire within 60 minutes of the request Colorado should procure and operate four multi-mission rotor-wing aircraft.

Single Engine Air Tankers (SEATs)

For the past several years, Colorado procured SEATs on an annual "exclusive-use" contract basis during the wildland fire season. Typically, the contract has been for two SEATs with an option for a third if needed.

SEATs are very effective in lighter fuel types such as grass and brush and are most effective during initial attack operations if used as a quick response resource. The efficiency and effectiveness of SEATs is increased if they are located in close proximity to the incident and integrated with ground resources as a support tool.

Recommendation:

In order achieve the goal of providing the appropriate aviation suppression resources to every fire within 60 minutes of the request and to increase the effectiveness of the SEAT program, it is recommended that Colorado increase the exclusive-use SEAT contract to four aircraft in 2014.

Agricultural Aircraft-Based Rapid Response Aerial Firefighting Program

Aerial application, or what was formerly referred to as crop dusting, involves spraying crops with crop protection products from an agricultural aircraft. Planting certain types of seed is also included in aerial application.

Agricultural aircraft are highly specialized, purpose-built aircraft. Today's agricultural aircraft is often powered by turbine engines and can carry as much as 800 gallons of crop protection product. The most common agricultural aircraft are fixed-wing, such as the Air Tractor, Cessna Ag-wagon, Piper PA-36 Pawnee Brave, and Rockwell Thrush Commander, but helicopters are

also used. Some aircraft, with proper equipment and trained pilots, serve double duty as water tankers in areas prone to wildfires. These aircraft are referred to as single engine air tankers (SEATs).

For example, the Air Tractor AT-802 is an agricultural aircraft that may also be adapted into fire-fighting versions. The AT-802 carries a chemical hopper between the engine firewall and the cockpit and another one under the belly. When properly adapted and a qualified pilot, it is considered a Type III SEAT.

Currently, most agricultural aircraft used for aerial application are configured for spray operations not firefighting, and the majority of the pilots of agricultural aircraft are not trained or qualified for aerial firefighting.

An effort was made to organize Colorado's agricultural aviation as a call-when-needed resource prior to the 2013 wildfire season, but such a program was never implemented.

Recommendation:

Evaluate the benefits, opportunities, costs, and risks associated with implementing an "Agricultural Aircraft-Based Rapid Response Aerial Firefighting Program" for Colorado.

At minimum, such a program would require:

- Creation of a state-level Single Engine Air Tanker (SEAT) training course for agricultural operators.
- Ensuring that pilots of double-duty agricultural aircraft are properly trained and qualified for aerial firefighting.
- Requiring that aircraft to be used for aerial firefighting are properly configured, including proper gatebox technology.[23]
- Developing a dispatch system that will allow for the rapid response of "approved" double-duty agricultural aircraft to state and local wildfires.

It is important to note that pilot and firefighter safety will be first and foremost in the development and implementation of any program. Safety will not be sacrificed for the sake of adding to the potential number of available SEATs.

[23] On April 15, 2008, an Air Tractor AT-602 single-engine air tanker crashed while fighting the TA25 wildfire, killing the pilot. According to the NTSB, among the factors contributing to the accident was the fact that it was improperly configured for the mission (because of its configuration with agricultural equipment installed). See NTSB Investigation Report DEN08GA076 at: http://www.ntsb.gov/aviationquery/brief2.aspx?ev_id=20080423X00534&ntsbno=DEN08GA076&akey=1

Other Aviation Options Examined

State Ownership of Large Air Tanker Fleet

DFPC surveyed the options available for Colorado's fixed-wing air tanker fleet. A broad range of options were considered including very large air tankers, amphibious aircraft, surplus military systems, and civilian aircraft.

Decision Model

A model reflecting Colorado's need for initial attack, high altitude, and hot conditions was constructed and submitted to industry for specific response (see Appendix G). This model was chosen to identify any shortcomings in aircraft performance when applied to Colorado's difficult mission. The air tanker industry was asked to provide the performance, fuel consumption, crew compliment, and retardant delivered for operating their solution in Colorado. This model will be used to evaluate the capability of each air tanker option and allow for direct value comparisons to support procurement decisions. The results of this survey will be presented in a separate analysis report.

Finding:

Preliminary results indicate there are only two surplus military aircraft options that are capable of meeting Colorado's needs and only one has a proven, fielded tanking and dispersal system. The other would require development of a custom solution at great expense.

Conversion of Surplus Military Aircraft

The following are surplus military aircraft that have been suggested for acquisition and conversion for a state fleet of large air tankers. There are issues and concerns with each option.

S-3 Viking

An air tanker modification of the U.S. Navy's S-3 Viking aircraft has been proposed. This proposed solution is a developmental solution that is not currently operating as an air tanker. The aircraft available would be surplus military equipment and would require significant modification. There is an outstanding question regarding the aircraft's climb performance in Colorado's high altitude and hot temperature environments. Additionally, a plan for the airworthiness and continued certification of this military derivative aircraft has yet to be explored.

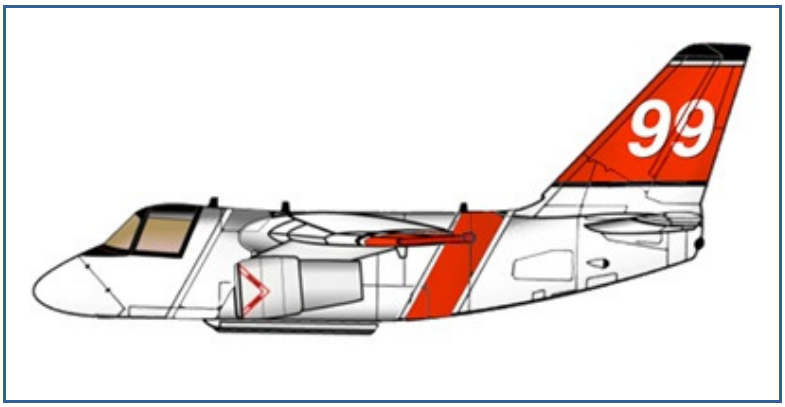


FIGURE 8 – S-3 VIKING

C-130

An air tanker modification exists for the C-130 airframe. This proposed solution presents a low-risk technical solution, but poses some challenges regarding aircraft procurement and airworthiness certification. The available aircraft would be surplus military equipment and would require a significant structural inspection program before operating in a firefighting mission. Any aircraft obtained from the federal surplus pools would be required to operate with a military airworthiness approval and sponsor. There currently exists one C-130 air tanker that operates under FAA approval.

FIGURE 9 – C-130 AIR TANKER

C-27J Spartan

One of the surplus military aircraft originally proposed as a candidate for conversion to a firefighting air tanker was the C-27J Spartan. In 2012, the Air Force announced that they were mothballing the entire fleet of 21, C-27Js to save money. Following this announcement, it was proposed that seven of these aircraft transfer from the Air Force to the U.S. Forest Service.

However, the National Defense Authorization Act for 2014 contains provisions for the Forest Service to receive seven C-130H aircraft in lieu of the C-27Js.

In November 2013, the Air Force transferred seven of the planes to U.S. Special Operations Command. The remaining 14, C-27Js are to be transferred to the Coast Guard, and the Coast Guard is to transfer seven of its C-130Hs to the Forest Service to be used as air tankers.

So, in spite of a USFS-commissioned study[24] that concluded that the C-27Js can be economically configured to operate as a medium-sized air tanker (carrying up to 1,850 gallons of retardant), there are none available for this purpose.

C-130 Procurement Cost Estimate[25]

If policy makers decide to seek to acquire federal surplus C-130 aircraft through the FEPP program (or other federal surplus program) for conversion to fixed-wing air tankers, the cost is expected to be:

Item	Year One Cost	Subsequent Yearly Cost
FEPP Procurement and Conversion of C-130s	$10.0 M each – Procurement of C-130 air tankers (x 3)[26]	$10.0 M each – Operations, maintenance, and required training (x 3)
Lead Planes[27]	$1.6 M – EU contract for three ATGS platforms	$1.6 M – EU contract for three ATGS platforms
Other Direct and Indirect Expenses	$1.2 M – Additional insurance, tanker base fees, and hanger leases	$1.2 M – Additional insurance, tanker base fees, and hanger leases
Totals	**$32.8 Million**	**$32.8 Million**

[24] C-27J Capabilities and Cost Analysis Report, Convergent Performance, LLC for the USDA Forest Service, n.d.

[25] Currently, there are no aircraft on the FEPP availability list that are suitable for conversion to air tankers. This includes both of the aircraft types identified in this report (C-130 and S-3 Viking), despite the widely-held belief that there are such aircraft available in the "military surplus" pipeline. Research continues on how to add surplus military aircraft to the FEPP availability list.

[26] The cost of converting one C-130 into an air tanker is approximately $10 to $13.5 million depending upon what work needs to be done. It is assumed that center wing boxes (CWB) would need to be replaced on any acquired C-130. The total cost of a CWB kit is approximately $7 million, including installation which takes about 10 months. In addition to replacing the CWBs, any acquired C-130s would need to receive programmed depot maintenance; a process that will take between 180 and 200 days and cost upwards to $3 million. Finally, the installation of the retardant tank system is approximately $3.5 million.

[27] A lead plane is required for air tanker pilots until they are qualified for Initial Attack (IA).

Note: If this option is decided upon, the cost of the EU (or CWN) contract for large and/or very large fixed wing air tankers would be eliminated once the FEPP aircraft are operational. It is anticipated that it would take until the 2016 fire season before Colorado-owned fixed-wing air tanker operations would replace the contracted assets.

Donated Commercial Aircraft

Opportunities may exist for the State to receive donated commercial aircraft for the purpose of converting them to use as firefighting air tankers. The state examined the process and cost involved in accepting donated MD-10s from FedEx. As no MD-10 has been converted and approved for firefighting purposes, the actual costs have not been determined. However, given that similar aircraft have been converted—such as the DC-10—it is possible to extrapolate the costs and processes encountered in that conversion to other donated aircraft.

Finding:

Donated civilian aircraft as potential candidates for firefighting air tankers present much the same issue as surplus military aircraft that do not already have a proven, fielded system; that being it could add significantly to both cost and time to implement. Additionally, the age and condition of the donated aircraft could cause significant inspections and revitalization.

In general, the time and costs involved in the inspection, revitalization, engineering, and conversion of an aircraft for use as an air tanker include:

Inspection and Repair

This is the estimated cost to bring the aircraft to a state of airworthiness. There will be considerable variability depending on aircraft type, age, condition and other factors (such as whether the aircraft was aircraft in storage or otherwise out of service). Depending upon what work needs to be completed; these costs could range from tens or hundreds of thousands of dollars, to several million dollars.

- All components must be inspected (engines, hydraulics, avionics, airframe, etc.). At minimum, the inspection and maintenance will require several weeks and hundreds of man hours. The estimated cost of the inspection is $75,000.

- Engine Overhaul. If an overhaul of the engines is needed, a decision must be made whether to replace them with used engines that are not run out. The overhaul of one engine can range from $2.5 to $4 million.

- Airframe Overhaul. If an overhaul of the airframe is needed, the cost can be as much as $1.5 million dollars.

- A new maintenance program will be required to be developed based on the proposed future use of the aircraft, which may have different inspection intervals than the original Type Certificate.

Engineering Costs

This is the cost of the engineering needed to modify the aircraft for a retardant tank, avionics, and related equipment in order to obtain a Supplemental Type Certificate (STC). Depending on the type of aircraft, age, condition and other factors, these one-time costs could be as much as $30-$40 million.

Conversion Costs

This is the cost to fabricate and install a retardant tank in the aircraft, to provide for modification and installation of avionics and other equipment. As with other costs, there is considerable variability depending on aircraft type, type and size of retardant tank, etc. It is estimated that the conversion costs could be as much as $10 million or more.[28]

Other Costs

Other non-operational costs include the cost and time involved in obtaining an STC[29], airworthiness certification, and approval by the Interagency Airtanker Board.

Other Issues

MD-10 Cockpit Upgrade. The MD-10 is retrofit cockpit upgrade to the DC-10 and a re-designation to MD-10. The upgrade included an Advanced Common Flightdeck (ACF) used on the MD-11. The new cockpit eliminated the need for the flight engineer position and allowed common type rating with the MD-11. This allows companies such as FedEx Express, which operate both the MD-10 and MD-11, to have a common pilot pool for both aircraft. However, according to 10 Tanker executives, with 9 years' experience with the DC-10, conducting firefighting missions with two crew members instead of three would compromise safety.

DC-10/MD-10 Pilots. Outside of those employed by 10 Tanker Air Carrier, there are few, if any, DC-10/MD-10 pilots with low level flying experience. Thus, it would be necessary for any pilot to serve as a co-pilot for 1-2 years in the co-pilot seat with an experienced pilot before becoming qualified for firefighting missions.

[28] As an example, according to 10 Tanker executives, they have budgeted $10 million dollars for the latest conversion, which is exclusive of the airframe cost or any engineering costs associated with the STC.

[29] The Supplemental Type Certificate (STC) application process through the FAA may take as long as 180-270 days due to the lack of funding within the agency to review the number of STC applications they receive.

Finding:

The large capital investment cost of procuring, revitalizing, and modifying donated aircraft for use as air tankers does not present a best-value approach to meet Colorado's wildfire management goals.

The 10 Tanker Air Carrier Experience

Because of the similarities between the MD-10 and the DC-10, DFPC inquired of 10 Tanker, the company that has converted DC-10s for firefighting use, the process they want through.

10 Tanker Air Carrier incorporated in 2002 to research, develop and operate fixed wing jet aircraft for aerial firefighting. Company personnel were assembled with an extensive history of heavy jet operations, modifications and ownership. After two years of research into aerial firefighting requirements and future direction, 10 Tanker selected the DC10 type for development.

FIGURE 10 – ONE OF TWO DC-10 AIRTANKERS CURRENTLY IN OPERATION

In 2006, following thousands of hours of engineering design and stress analysis, the first modified DC10 flew over one hundred flight hours in test flight profiles. This permitted the issuance of a multiple use Supplemental Type Certificate (STC) by the FAA.[30] 10 Tanker then obtained a 14 CFR Part 137 Operating Certificate for aerial firefighting and Interagency Airtanker Board (IAB) approval for agency use.[31]

[30] A multiple use STC from the FAA for modifications of DC10 aircraft to be used for the aerial dispersant of liquids was issued in March 2006. "Multiple use" means the STC may be applied to additional aircraft of the same type design. Thus 10 Tanker can produce additional DC10 tankers. Currently 10 Tanker Air Carrier has started the process of converting their third DC10 to use as an air tanker.

[31] Complete airworthiness requirements for air tankers are available in the USDA – Forest Service, Special Mission Airworthiness Assurance Guide, November 5, 2010.

Along the way, 10 Tanker Air Carrier:

- Spent approximately $100,000 to have Boeing Corp write the new maintenance program for their DC-10s.

- Invested about three years and $30 million for the engineering needed to modify the aircraft for a retardant tank, avionics, and related equipment in order to obtain a Supplemental Type Certificate (STC) and FAA Operating Certificate.

According to 10 Tanker executives, "One substantial cost that isn't referenced is the commitment to the organization required to operate an aircraft of this size." Prior to 2014, 10 Tanker operated two aircraft and had an organization of 15 people that were primarily flight and maintenance crews. 10 Tanker also supplemented their organization with seasonal contractors that also represented a substantial cost.

Finding:

If the decision is made to acquire and operate a state-owned fleet of fixed-wing air tankers, no options on aircraft types or procurement methods have been excluded. However, initial indications are the most suitable and cost-effective candidate aircraft would be military surplus C-130s obtained through the FEPP program.

Unmanned Systems for Remote Sensing and Persistent Monitoring

FIGURE 11 – NASA'S GLOBAL HAWK 872 DRONE

The use of unmanned systems for remote sensing and persistent monitoring of wide areas presents an attractive capability. The long endurance and wide-area surveillance capability of modern military systems will, one day, be a tremendous situational awareness tool for wildfire managers. Challenges exist that currently preclude the widespread adoption of unmanned systems for Colorado's information management problems. The FAA's guidance and path for unmanned system certification currently does not allow for persistent, widespread employment of unmanned systems in the national airspace. "Sense and avoid systems", airworthiness requirements guidance, and test and certification of unmanned systems are years away.

Additionally, the initial procurement cost of unmanned systems is larger than that of commercial-derivative aircraft that perform the same mission. The crew complement is not

reduced when using unmanned systems because pilot and sensor operator positions are relocated to the ground. Currently, no feasible systems are available to Colorado for continuous, state-wide adoption.

Other Recommendations Regarding Wildfire Goals

Provide a Wildfire Information Management System Tool

This tool should integrate with any available data source and provide real-time, collaborative information updates to all participants. The tool should be tailored to each individual's role in the wildfire management system while providing a near real-time common operating picture. For example, state aviation resource managers responsible for pre-positioning of air tankers should be presented with a different view than a county sheriff responsible for managing a grassland fire on Colorado's plains. However, the database that provides the information should be shared amongst all users.

This tool should record and display all of the available parameters for wildfire management, including:

- Parcel level risk assessment
- Regional risk assessments (state, fire management region, county, or other geographic boundaries)
- Resource availability and tasking
- Resource requests
- Active incidents
    - Risk assessment
    - Growth potential
    - Lives, structures, and resources threatened
    - Real-time suppression cost estimation
    - Location
    - Perimeter
    - Active hot spots
    - Assigned resources
    - Requested resources

The wildfire information management tool should integrate with federal systems to allow for simplified hand-offs of large incidents to Type I and Type II Incident Management Teams.

The participation of all local wildfire management organizations is critical to ensuring the maximum effectiveness of state-wide wildland risk mitigation and suppression efforts. A consistent, statewide, incentivized risk assessment and pre-planning strategy is needed to ensure that all local wildfire management organizations participate in the wildfire management process. This risk management strategy will be the core of all decisions related to wildland fires. This strategy should include existing risk models (e.g. CO-WRAP and others).

Recommendation:

An integrated and ubiquitous tool for all participants in wildfire management should be implemented in Colorado.

Risk Management and Pre-Planning Strategy

Colorado should develop and establish a state-wide, comprehensive, and integrated risk management strategy in 2014. The state should develop standards and expectations regarding wildfire management that can be considered for local adoption. The state should provide incentives for adoption of these tools to local wildfire management organizations. Furthermore, requests for fuel mitigation funding to the state should be evaluated using risk-based information generated and recorded in the state provided system. **The utility and full value of the information management, risk management, and pre-planning capabilities will only be realized if they are adopted by all wildfire organizations within the state.**

Recommendation:

All local wildfire management organizations should be encouraged to adopt tools, strategies, and policies set by state-developed risk management, incident pre-planning, and information management approaches.

Continued Effectiveness Monitoring

Continued operations of assets and resources should continue in 2015. Recommendations from this evaluation should be included in the 2015 plan. Operations should continue with constant system and process refinement.

Recommendation:

Evaluation of the effectiveness of the proposed 2014 components should be performed during the year and at the end of the fire season.

Finally, the cost and complexity of developing custom solutions to address the capability needs of the state should be avoided. Proven, fielded systems are available to fill all of the capability gaps in Colorado's wildfire management system.

Intended Effects of Recommendations

To illustrate the effects of the recommendations in this report, following are two real-world incidents that occurred in Colorado. The intent is not to comment on the decisions or effectiveness of the personnel or organizations involved in these incidents; rather, this report uses these incidents as examples of how the capabilities and tools recommended here may have facilitated a more effective response.

Waldo Canyon Fire

As many as seventeen hours elapsed from the first detection of smoke and the determination of the location of what would be named the Waldo Canyon Fire.[32] If the fire had been timely located and assessed, local fire management organizations would likely have been able to suppress the fire before it became a destructive, wind-driven event.

Problem: The difficulty in ascertaining the location allowed the fire time to grow unchecked.

FIGURE 12: The Waldo Canyon fire moving towards the Mountain Shadows area of Colorado Springs, 26 June 2012. Photo credit: Creative Commons.

Result: The Waldo Canyon Fire left two people dead, destroyed 346 homes, and burned 18,247 acres in the Pike National Forest and in Colorado Springs. It took firefighters 18 days to fully contain at a total estimated suppression cost of $16.7 million. The Waldo Canyon fire is the most expensive wildfire in Colorado state history to date with insurance costs totaling $453.7 million.

High Park Fire

The High Park Fire was caused by lightning and started in a difficult to access area above Buckhorn Road in Larimer County, Colorado. A smoke report in the vicinity was received on the afternoon of June 8, 2012. A fixed-wing detection aircraft flew the area but was unable to visually locate the fire. Smoke reports started coming in again early the next morning.

[32] On Friday, June 22, 2012, at approximately 7:49 pm, a resident in the Crystal Park area reported seeing smoke in the Waldo Canyon area. Fire resources from several agencies were dispatched to the area to conduct a smoke investigation. Those agencies worked together, searched the area and were unable to locate smoke that night. Since the investigation was challenged by the hours of darkness, it was determined that fire resources would return in the morning to follow up. On June 23, 2012 at approximately 6:48 am, firefighters were back in the area attempting to locate the source of the smoke. At 11:39 am crews were still in the area. At approximately 12:00 noon several reports of smoke began to come into the dispatch center. At approximately 12:20 pm the fire was located and additional resources were ordered, including a single engine air tanker.

On June 9th, responders spent the valuable time between the detection of smoke and arrival of the first ground firefighters focused on determining the location, access routes, and initial assessment of the fire.

The difficulty of locating the source of the smoke and then the travel time to the incident delayed the ability of the incident commander to generate a suppression strategy.

FIGURE 13: Emergency vehicles sit on a road in Redstone Canyon as the High Park Fire burns about 15 miles west of Fort Collins, Colo., June 17, 2012. (U.S. Army photo by Sgt. Jesica Geffre)

Problem: Effective tools were unavailable to locate the fire and communicate pertinent information and ground personnel had long transit times due to poor access; for these reasons, the fire grew into an event that exceeded the capability of the initial attack resources.

Result: The High Park fire burned over 87,284 acres, becoming the third-largest fire in recorded Colorado history by area burned. It destroyed at least 259 homes, killed one person, and resulted in an insured loss of $114 million. It took firefighters 21 days to fully contain the fire with an estimated suppression cost of $38.4 million.

Key to achieving DFPC's wildfire management goal is developing the capability to detect fires earlier and locate them faster and providing the local Incident Commander with data needed to make informed decisions regarding suppression strategy. The improvements recommended by this report will provide these capabilities.

Colorado's remote sensing fixed wing aircraft would be on site within approximately 30 minutes of launch and would employ thermal imaging sensors to survey the reported area. The fire would be located and mapped, and this information would be loaded in real time to the state's information management system. Within an hour of the first report of smoke, the local incident commander would have access to a map of the fire, ingress and egress paths, fuels involved, fire behavior, values at risk, weather forecast, and other data needed to make informed decisions regarding the appropriate management response.

When the appropriate management response is full suppression, DFPC should provide the local IC with the support (including aviation suppression resources) needed in a prompt and efficient manner.

Detailed Recommendations

Following is a detailed description of the recommended improvements in Colorado's wildfire management capabilities related to Colorado Firefighting Air Corps (C-FAC).

Information Management System

Several wildfire management and emergency response organizations have adopted an information management system. The Colorado Wildfire Risk Assessment Portal (CO-WRAP) is one example of a risk management tool intended to cover the entire state. This tool currently does not provide a parcel-level risk assessment, but does cover a wide area.

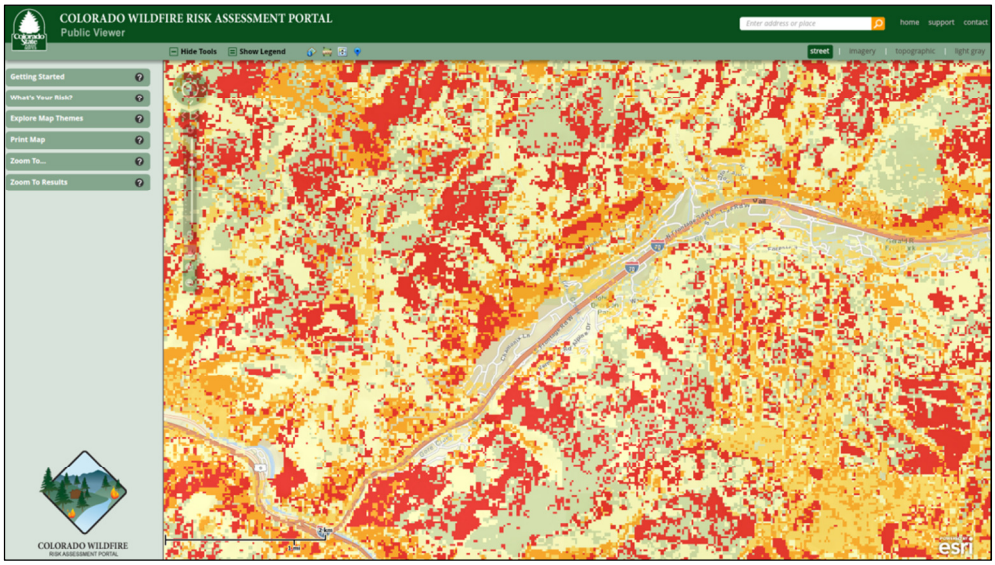


FIGURE 14 – COLORADO WILDFIRE RISK ASSESSMENT PORTAL (CO-WRAP)

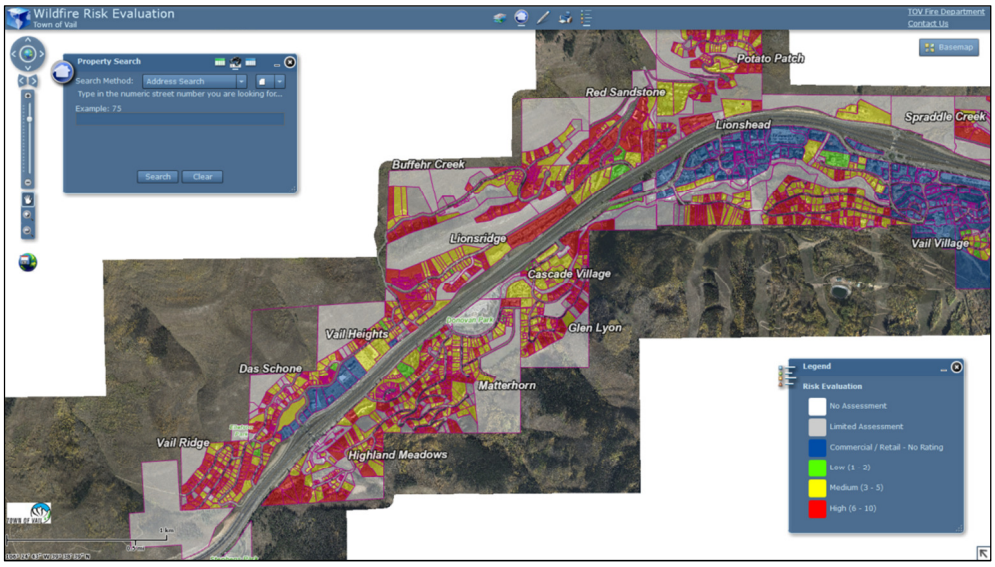


FIGURE 15 – WILDFIRE RISK EVALUATION, TOWN OF VAIL

The Town of Vail has generated a parcel-level Wildfire Risk Evaluation tool that is a good small-scale example of an integrated risk approach.

These tools should be combined into a larger risk model, similar to that created by Intterra, for local wildfire management organizations.

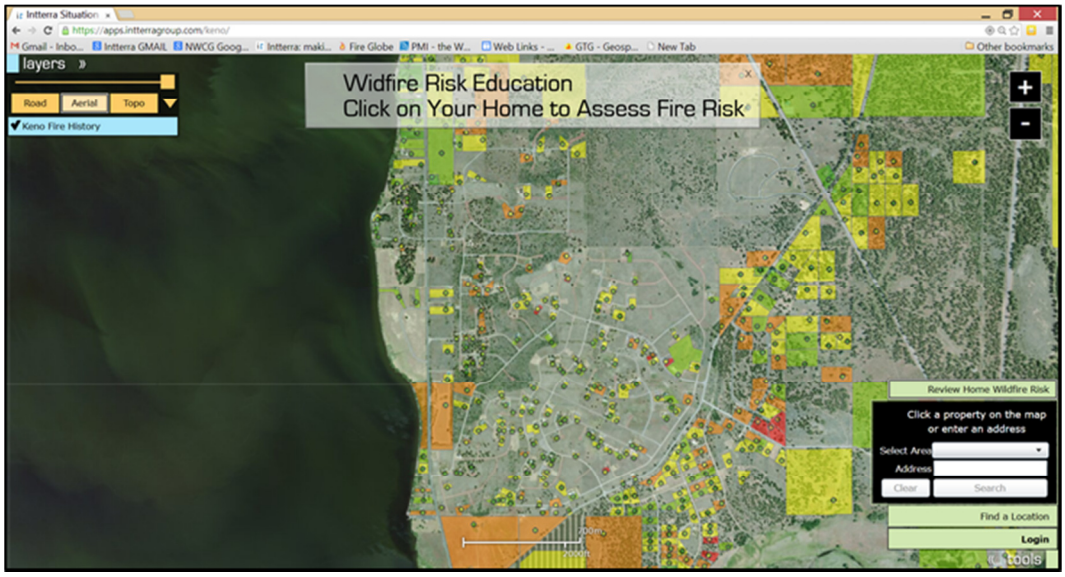


FIGURE 16 – INTTERRA'S INTEGRATED INFORMATION MANAGEMENT SYSTEM

Colorado's information management system must be designed and built specifically for wildland fire management. A web-based, cloud-hosted solution that offers multiple workflows and toolsets that are tailored to the individual needs of the user should be procured. Regional views should be made available to resource managers that facilitate the positioning and allocation of State-owned resources.

Incident-specific views should be made available to incident commanders or division chiefs to allow for the effective statusing, communication, and decision making capabilities. All workflows should present data that is collected in one central location. This data should be gathered from many sources and contain:

- All active incidents
- Real-time cost estimation
- Containment
- Terrain data
- Fuel data
- Parcel-level risk assessments
- Nearby people, structures, and watersheds
- Personnel locations
- Active fire information (perimeter, intensity map, division boundaries)
- Aviation locations (using the Automated Flight Following or AFF system)

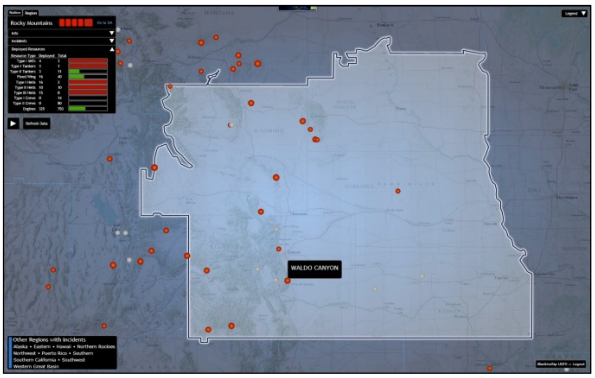


FIGURE 17 – REGIONAL WILDFIRE MANAGEMENT AND SITUATIONAL AWARENESS

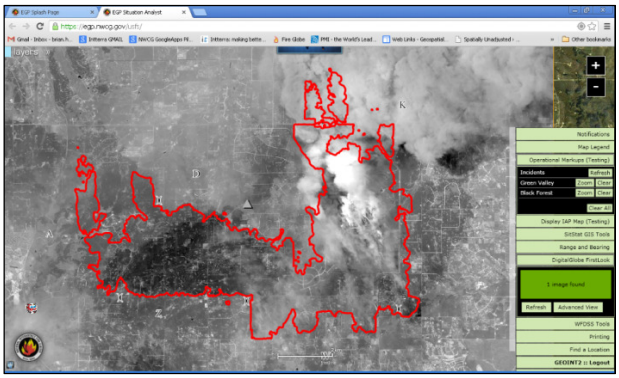


FIGURE 18 – INCIDENT MANAGEMENT TOOLS

Risk Management and Pre-Planning Strategy

All local wildfire management organizations should adopt state-established tools, strategies, policies for risk management, incident pre-planning, and information management. The state should develop standards and expectations against which local organizations should be evaluated. Incentives for adoption of these tools should be provided to local wildfire management organizations. Requests for fuel mitigation funding to the state should be evaluated using risk-based information generated and recorded in the state-provided system. The utility and value of the information management, risk management, and pre-planning capabilities will only be realized if they are adopted by all organizations within the state.

Multi-Mission Fixed-Wing Aircraft

Colorado should procure a fixed-wing aircraft system that would perform many functions associated with wildfire management. The tasking of the assets available to the DFPC would be based on an assessment of planned fire activity, risk modeling, and active incidents. The DFPC would be responsible to position and prioritize missions and requests for the multi-mission aircraft. The system would be equipped with modern sensing, information management, and communications capabilities.

<u>Capabilities</u>

- Airframe
  - Operating altitude – at least 29,000 ft
  - Endurance – 6+ hours
  - Minimum crew – 2 (pilot and sensor operator)
- Sensing
  - Wide-area fire detection and mapping
  - Day and night imaging capabilities
  - Thermal imaging capabilities
- Communication

  - Broadband data connection
  - Interagency approved communication systems
- Information Management
  - Geospatial management tools
    - Maps, perimeter generation, fire intensity, terrain information, annotation, fuel data, risk predictions, incident command data, personnel location
  - Integration with statewide information management tools

FIGURE 19 – PILATUS PC-12 (EXAMPLE)

Functions

- New start detection and location
- Geospatial product generation
  - Real-time fire perimeter generation
  - Real-time intensity location identification
  - Communication relay and gateway
- Retardant monitoring
  - Drop accuracy and retardant effectiveness
- Incident status reporting
- Evacuation monitoring
- Safety overwatch and response
- Prescribed burn monitoring and escape detection
- Fire behavior surveillance
- Firefighter and supply transport

Missions

Start Detection and Location

The multi-mission aircraft will be launched on wide-area start detection surveillance missions when high risk situations are identified or upon notification of a possible new fire start. In the case of notification of a possible new fire start, the objective would be to have the aircraft on site within 30 minutes of launch.[33] Using risk assessment products from the information management tools, critically high risk areas (e.g. dry weather, high fuel load, high winds, and recent lightning strikes) will be surveyed to detect, locate, and identify any newly initiated fires. Each detected fire will be triaged by the onboard crew to validate that the fire is indeed a potential threat and not a false alarm (i.e. campfire or other non-wildfire incident).

A report will be generated for each detected or located incident containing the following information:

- Location (latitude/longitude, county, fire protection district, and/or jurisdiction)
- Imagery (color or thermal)
- Fire intensity map
- Perimeter map
- Parcel identification
- Risk report (threatened structures, watersheds, and/or populations)
- Notes or comments

This report will be provided to a distribution list to include the responsible local organization, DFPC personnel, other state individuals, and federal agencies.

Incident Status Reporting

For active incidents, the multi-mission aircraft would be tasked with providing up-to-date information to incident commanders. This information is critical to successful decision making regarding the management of the incident. The multi-mission aircraft will be tasked with providing the following information:

- Active fire perimeter
- Fire intensity location
- Geo-referenced imagery (at the request of the IC)

This information would be transmitted, in real time, to the state's information management system. The information would be immediately available to any participant in the state system to include: the incident commander, responsible local fire management organization, local sheriff's office, responsible FMO, and DFPC personnel. During busy fire days, one multi-mission

[33] This objective is based on the coverage area of PC-12 or equivalent aircraft based in Denver and Gunnison for maximum coverage of the state. However, aviation assets will be strategically located based on preparedness levels, interagency situational awareness of fire activity, weather (lightening occurrence), National Fire Danger Rating System (NFDRS) indices, location of other aerial assets, etc.

aircraft would visit all active incidents within the state to provide regular updates to the collected information. Coordination with the local Incident Commander (IC) would ensure that the data products requested were relevant and applicable to the IC's intent.

Prescribed Burn Monitoring

During prescribed burn activity, the multi-mission aircraft would be employed to detect and locate any breaches in the prescribed burn area.

Evacuation Monitoring

During times of mandatory evacuations, the multi-mission aircraft would be positioned to ensure that the public is complying with the evacuation order. Using onboard sensors, unauthorized access to evacuation areas would be reported immediately to local authorities to ensure the safety and security of the evacuation area.

Safety Overwatch

When it is identified that firefighting or other personnel are at risk of harm from an active incident, the multi-function aircraft will be used to locate and vector the affected ground crews to safety. **Modern personnel location reporting systems would report the real-time location of all ground personnel.** The multi-mission aircraft would apply the information management tools to identify active fire perimeters, fire growth potential, weather patterns, egress paths, and potential risks and guide the crews to safety.

Retardant Requests and Monitoring

Large air tankers have proven their worth time and again, particularly in building and/or reinforcing fire line in heavy fuels and closed-canopy fires. However, with devastating wildfires and mega fires threatening more WUI communities throughout the U.S., there is a strong need to review the effectiveness of aerial firefighting strategies and tactics – and modernize them as indicated.

For the past 40+ years Incident Commanders in charge of fighting wildfires have deployed firefighting aircraft to build lines of retardant to slow the fire, while firefighters on the ground contain the fire with bulldozers and hand crews. The USFS maintains that retardant slurry is not effective or recommended for directly attacking the flames or the head of a wildfire; however, there is no real-world experiential data to support this claim.

During incidents where air tankers are requested, the multi-mission aircraft will be used to coordinate the request for retardant. The IC's intent will be communicated using machine-to-machine tools incorporated in the state's information management system. Before the application of retardant, a snapshot will be recorded of the intended application area to establish a baseline. After the retardant is applied, geo-referenced imagery will be collected to measure the accuracy of the retardant application. As the incident progresses, the retardant line will be monitored to measure the effectiveness of the retardant. This data will be recorded

and combined with many hundreds of retardant applications to develop models to predict and influence the future use of retardant application.[34]

Other Uses

In addition to the wildfire management related missions, the multi-mission aircraft would be useful for other Colorado State agencies:

The Colorado State Patrol currently operates 5 fixed wing aircraft: Beech King Air; Cessna 340; and three, Cessna 182's. These are piloted by 4 full-time and 1 part-time Level I Peace Officers. Besides use by the Governor and Lt. Governor and their staff, there is a high demand for aircraft time including the following:

- Traffic Compliance and general law enforcement
- Transportation of State employees for important functions, meetings, and emergencies
- Department of Corrections prisoner transports

Colorado Parks and Wildlife (CPW) owns and operates four Cessna 185 fixed wing aircraft (one in each Region of the state). These are used to radio-locate and/or observe wildlife, stocking fish into high-mountain lakes, and flying low-altitude transects, much of which is done in extreme terrain at high elevations. CPW has limited or no capability to assist other agencies with flight needs. In fact, they periodically pursue contracts with external vendors during times of the year when their fixed-wing flight needs exceed the capacity of their aircraft.

CPW has annual external contracts in place for helicopters for "survey" flights to observe and count wildlife and for "capture" flights to locate and net/dart wildlife to handle them as part of studies.

Other potential uses of the multi-mission aircraft include:

- Transportation of critical medical personnel, supplies, and equipment
- Colorado State Forest Service: insect damage and forest assessments
- Office of Emergency Management: disaster assessments/reconnaissance
- Department of Mineral and Geology: mine assessment/compliance
- Dam safety and inspections
- Environmental monitoring and compliance
- Search and rescue missions
- Avalanche control
- Emissions monitoring at oil and gas exploration and production sites

[34] DFPC believes there should be a study of the performance and effectiveness of firefighting aircraft utilizing "direct attack" and these should be combined with studies of the performance and effectiveness of various fire suppressants, such as gels.

Remote Sensing Aircraft - Fixed Wing vs. Rotor Wing

Rotor wing aircraft offer the unique capability to operate from locations other than airports with runways. The vertical takeoff and landing capability offers many advantages to the wildfire managers, but these traits are not beneficial to remote sensing and early detection missions. The parameters and intention of the mission should dictate the tools selected. One should not decide what mission is needed based on tool availability.

Speed - Turbo-prop fixed wing aircraft offer increased dash speed as compared to rotor-wing aircraft. Maximum cruise speed of high performance helicopters like the S-76 is approximately 150 knots. Fixed wing turbo-prop aircraft offer cruise speeds approaching 230 knots. When response time is essential, as in IA situations, this speed is a requirement.

Procurement Cost - The simplicity and availability of fixed-wing aircraft results in reduced procurement cost.

Altitude - To successfully operate over the restricted airspace surrounding a wildfire in Colorado, altitudes of 25,000 feet must be reachable. Unpressurized rotor-wing aircraft are not able to attain these heights and would be required to operate in the congested and risky airspace occupied by air tankers, lead planes, and air attack aircraft. This increases risk and is unnecessary with modern, proven sensor systems. Further, to survey large areas of at-risk wildland, the aircraft is required to operate at significantly higher altitudes than is permitted by unpressurized, altitude-limited rotor wing aircraft.

Endurance - The higher fuel efficiency of fixed wing aircraft provide increased time-on-station as compared to rotor wing aircraft. Unrefueled flight endurance of 5+ hours is possible in fixed wing aircraft allowing the maximum efficiency of every flight hour.

Reliability - Fixed wing aircraft are much simpler mechanically than rotor wing aircraft. Maintenance inspections and down-time due to repairs are less than that of rotor wing aircraft.

Operating Cost - The increased maintenance and complexity of rotor wing aircraft increase the overall operating cost.

Proven Solutions - Military systems with similar requirements have been developed and proven using fixed wing platforms. Wide area, persistent surveillance missions are not assigned to rotor wing applications. Rather, turn-prop fixed wing aircraft are consistently relied upon for use in this type of mission scenario. There are many sensor, datalink, and console applications that can be leveraged from the commercial market to quickly and affordably provide the required capabilities.

Training and Certification - Operating outside the restricted airspace of a fire removes the requirement for pilots to be certified to operate in interagency incidents. This reduction in pilot

qualification increases the availability of pilots and reduces overall personnel cost. Certified pilots are more costly and require more training.

Rotor-Wing Multi-Mission Aircraft

In order achieve the goal of providing the appropriate aviation suppression resources to every fire within 60 minutes of the request, Colorado should procure and operate four multi-mission rotor-wing aircraft. These aircraft should be capable of operating in Colorado's high altitude and hot temperature environments. The rotor-wing aircraft should be capable of delivering wildfire suppression personnel to remote locations to facilitate initial attack missions. The ability to carry water or retardant to remote locations in order to support ground based suppression teams should also be provided. In order to reduce pilot training, maintenance training, spares, and support equipment costs, one airframe should be procured instead of multiple types of aircraft.

The utility of helicopters for fire suppression and other wildfire missions is well-documented. When water is available nearby, Type 1 helicopters can place more suppressant/retardant onto a wildfire quicker and with greater accuracy than LATS. However, the high altitude and hot temperature environment typical of Colorado's fire seasons create a challenging environment for rotor-wing aviation. There are few solutions for rotor-wing aircraft capable of effectively operating in these conditions with the multi-mission capabilities. Colorado should consider procuring or contracting one of the following airframes to ensure adequate performance in Colorado's demanding altitude and temperature conditions:

- Type 3/Light helicopters: Eurocopter, A-Star B3, or Bell L-4 with high altitude tail rotor kit
- Type 2/Medium helicopters: Bell 205++, Bell 214, or Bell 212 HP with Strake Kit.

FIGURE 20 – HIGH PERFORMANCE MULTI-MISSION HELICOPTER[35]

[35] Pictured: Kern County (California) Fire Department's Bell 205A++

Single Engine Air Tankers

Single Engine Air Tankers (SEATs) have consistently proven to be very effective as initial attack firefighting resources. In order to be truly effective, these aircraft need to be an integral part of the overall initial attack strategy. SEATs are very effective in lighter fuel types such as grass and brush and are most effective during initial attack operations if used as a quick response resource. The efficiency and effectiveness of SEATs is increased if they are located in close proximity to the incident and integrated with ground resources as a support tool.

For the past several years, Colorado procured SEATs on an annual "exclusive-use" contract basis during the wildland fire season. Typically, the contract has been for two SEATs with an option for a third if needed. The SEATs are relocated from base to base as the indices and/or fire activity increased in a particular region of the state.

In order achieve the goal of providing the appropriate aviation suppression resources to every fire within 60 minutes of the request, Colorado would need to increase the Exclusive-Use SEAT Contract to four aircraft for 2014.

Fixed-Wing Large Air Tankers

As recommended previously, instead of procuring state-owned air tankers, Colorado should identify and contract for the use of existing air tanker systems during the fire season to fill the temporary gap left by the federal resources. In order achieve the goal of providing the appropriate aviation suppression resources to every fire within 60 minutes of the request, Colorado would need to contract for two exclusive use large air tankers in 2014. [36]

FIGURE 21 – BAE-146 AIR TANKER (EXAMPLE)

[36] The contingency, if the State is unable to contract for two qualified large air tankers, is to contract for two helitankers, or a combination of one fixed-wing air tanker and one helitanker.

Program Structure

Contracting Model

Several options are possible to support the aircraft procurement and sustainment needs.

Operated (Government Owned – Government GO/GO)

In the GOGO contracting model, the State of Colorado would be responsible for all aspects of procurement, management, maintenance, and operation of any wildfire management systems. This requires significant increases in state employees and infrastructure and little flexibility in system operation. This model requires a large up-front purchase and continued operational cost.

Company Owned – Company Operated (CO/CO)

The COCO contract model requires the least overhead and supervision from the State of Colorado. This model generates a contract for the ownership, operation, and maintenance of any aviation resources and the contractor accepts all risks. This model requires the least up-front cost, but is the most expensive option when evaluated over a long-term. The large investment of special hardware that the contractor must make results in significant financial risk exposure to the contractor. The result of the increased financial risk is a more expensive yearly contract due to the amortization of the initial investment. This increased risk can be reduced by ensuring that the length of the contract is sufficient to amortize the initial investment.

Government Owned – Company Operated (GO/CO)

In the GOCO model, the state of Colorado would procure and own the large ticket items. The state would then contract with a company to provide for the maintenance, management, and operation of the state-owned aircraft systems. Since the GOCO model removes long-term investment cost recovery, the annual cost is reduced. Additionally, the overhead cost and additional personnel required to manage and maintain the aviation assets is transferred to a contractor.

Recommendation:

The GO/CO model presents the most attractive mix of affordability and efficiency. If the initial purchase cost of the airframes precludes this option, the CO/CO model is also a reasonable approach. It is recommended that the CO/CO contract be of sufficient length (i.e. 3-5 years) to give to the contractor confidence that their investment will be recovered.

It is not recommended to pursue the Government Operated model. The special skills, resources, and experience required to maintain, operate, and ensure airworthiness of complex aircraft systems is not typically found within state governments. Any FEPP or surplus military procurement solution would warrant a GO/CO models because it is not legal for a private or commercial organization to be in possession of US Government resources.

Infrastructure Requirements

To effectively operate and maintain a fleet of aircraft, Colorado would be required to invest in or contract for some infrastructure components. Aircraft hangars, ground support equipment, spare parts, and training for pilots and maintainers are all required costs to manage and operate aircraft. The total ownership cost is included in the cost/effectiveness evaluation model.

Schedule

0-6 Months After Program Initiation

- Procure and implement a Wildfire Information Management System
- Provide Wildfire Information Management System training for state and local fire managers
- Develop policy and procedures for aviation system requests, dispatch, funding, and application
- Develop and implement training courses for Wildfire Information Management tools for local and state wildfire managers
- Begin contract operations of fixed-wing air tankers
- Begin contract operations of rotor-wing aircraft
- Build an aircraft operation and maintenance system

6-18 Months After Program Initiation

- Fully-operational Wildfire Information Management System
- Continue training and adaption of the Wildfire Information Management System
- Begin operational employment of the multi-mission aircraft

18-36 Months After Program Initiation

- Continue training and adaptation of the Wildfire Information Management System
- Continue training and adaptation of the State’s aviation program

Cost Estimate

Cost estimation for the recommendations described in this report is highly dependent on external factors and has the potential to vary significantly. The recommended improvements and the estimated annualized costs to implement the improvements are: [37]

Item	Year One Cost	Subsequent Yearly Cost
Information Management System	$60k operational licenses $40k software development and integration	$60k operational licenses $40k software development and integration
Multi-Mission Fixed Wing Aircraft	$10.0 M – Aircraft procurement and modification of two aircraft systems[38] plus $1.7 M for operations, maintenance, and required training	$1.7 M – Operations, maintenance, and required training[39]
Single Engine Air Tankers	$3.1 M – EU contract for four SEATs	$3.1 M – EU contract for four SEATs
Multi-Mission Helicopters	$4.7 M – EU contract for four Type 3 or larger helicopters[40]	$4.7 M – EU contract for four Type 3 or larger helicopters
Large Air Tankers	$11.9 M – EU contract for two large air tankers	$11.9 M – EU contract for two large air tankers
Other Direct and Indirect Expenses[41]	$2.1 M	$2.1 M
Totals	**$33.6 Million**	**$23.6 Million**

[37] These are estimated annualized costs for the specified improvements based on information provided by potential vendors. A detailed budget request will be submitted as a separate document.

[38] It might be possible to enter into an exclusive use contract for Multi-Mission Fixed Wing Aircraft instead of acquiring the aircraft. The estimated annual cost of a for two large Multi-Mission Fixed Wing Aircraft ranges from $2.2 million to $4.0 million, depending upon the number of operating months and number of flight hours.

[39] This cost estimate assumes 360 flight hours per year. Missions tasked to particular incidents would be paid for by the incident.

[40] This cost estimate assumes 150 flight hours per year. Missions tasked to particular incidents would be paid for by the incident.

[41] Includes personnel costs, supplies, equipment, insurance, hanger leases, additional airport and air tanker base fees, vehicle leases, travel, per diem, training, etc.

The greatest challenge in predicting the cost of wildfire suppression activities is the cost sharing arrangement between local, state, and federal agencies. Colorado would be required to cover the daily availability and hourly operational costs for all contracted and owned resources on fires under the jurisdiction of the State. When incidents occur that request a Colorado-contracted resource, that particular incident would be charged a pre-determined cost for daily availability and hourly use. In busy fire seasons resulting in incidents frequently requesting state-owned resources, Colorado's portion of the cost sharing would be reduced. Conversely, a mild fire season (one with relatively few incidents) would result in Colorado burdening a larger share of the resource's cost as the time is not billable against an incident.

Call When Needed Contract for LATs

As an alternative to an Exclusive Use contract for large air tankers, Colorado could enter into a Call When Needed (CWN) contract for one or more large (or very large) air tankers. The downside to this approach is that the aircraft may not (and probably would not) be located in the State of Colorado and might not be available when it is needed. Further, the cost of a CWN contract is typically 50% more than an Exclusive Use Contract. An advantage to the CWN contracting approach is that the State only pays for what it uses, and theoretically, funding could come through Executive Orders for specific fire disasters and not from a standing appropriation.

The estimated annual cost of a CWN Contract for two large air tankers is $20.1 million.[42]

Total Budgetary Needs

Following are the total estimated program costs (annualized) for each of the options related to large air tanker acquisition:

Item	Year One Cost	Subsequent Yearly Cost
CFAC Aviation Program with EU Contract for LATs	$33.6 Million	$23.6 Million
CFAC Aviation Program with CWN Contract for LATs[43]	$21.7 Million	$11.7 Million
CFAC Aviation Program with Procurement of C-130s	$54.5 Million	$44.5 Million

[42] In order to provide an "apples-to-apples" comparison, the same number of months and flight hours were assumed for a CWN contract that were assumed for an EU contract. By comparison, the estimated annual cost of a CWN Contract for one Very Large Air Tanker (VLAT) is $10.4 million.

[43] These amounts do not include a contingency for CWN contracting for two large air tankers which could be as much as $20.1 million.

Other Opportunities

In addition to the likely avoidance of fire suppression costs, opportunities exist to reduce the estimated cost of implementing the improvements and capabilities recommended by this report.

Joint Procurement and Operation of Aircraft Fleet by Western States

Wildfire risk in all of the western states is increasing and becoming a more complex problem that warrants coordinated assessment, planning and response. All western states are adversely impacted by the reduction in the size and capability of the federal large air tanker fleet, although most western states have taken action to address their aviation needs.

A study by the National Association of State Foresters (NASF) identified that states operate 218 fixed wing aviation assets (not including tankers), of which about half are owned and operated by the states. For rotary-wing aircraft, contract, FEPP, and National Guard helicopters make up 77% of the 198 available aircraft. States reported access to 50 fixed wing air tankers, including single engine air tankers. Of those, seven were state-owned, 23 were FEPP aircraft (California), and 20 were contract air tankers.[44]

There are significant barriers that would need to be overcome before consideration could be given to joint procurement and operation of aircraft fleet by western states. These include the various state procurement laws and regulations and federal regulations governing aircraft acquired through the FEPP Program.[45] In the preparation of this report, there was little interest expressed by fire managers in the western states to pursue the joint acquisition and operation of an aircraft fleet.

The barriers to collaborating with other states in the contracting for the joint use of firefighting aircraft seem to be less onerous than joint ownership. However, there still seems to be little interest on the western states fire managers to pursue this course. There appears to be little incentive for a state to contribute to the cost of a multi-state exclusive use contract, if the potential exists that the aircraft will not be available when they need it.

While more work needs to be done, the concept of a multi-state (or western states) solution should not be discarded. There is currently a proposal for the Western Governors' Association (WGA) to empanel a "Western Aerial Wildfire Fighting Ad Hoc Committee" of interested western states to discuss ways to expand the range of aerial options at their disposal and share

[44] State Fire Suppression Capabilities: An Overview of Aviation Assets, National Association of State Foresters, September 18, 2011.

[45] Authorizing legislation in each of the respective states permitting the joint purchase and operation of aircraft would likely be necessary. Also, federal regulations do not permit FEPP equipment to be obtained jointly by multiple states. Thus, a joint procurement program would likely be limited to commercial aircraft, not federal surplus aircraft.

them regionally. It is proposed that the committee will report back to the Governors on their findings and recommendations by December 2014.

In the interim, there is interest by other western states in having access to resources that Colorado might acquire on a cost-reimbursement basis.

California and Oregon's State-Owned Fleets

The California Department of Forestry and Fire Protection (CAL FIRE) manages the most robust fire aviation program in the country. California first contracted for airtanker services with private aviation companies in 1958 and the CAL FIRE program has evolved over time to where it now includes 23 Grumman S-2T 1,200 gallon air tankers, 11 UH-1H Super Huey helicopters, and 14 OV-10A airtactical aircraft. From 13 air attack and nine helitack bases located statewide, CAL FIRE aircraft can reach most fires within 20 minutes.[46]

FIGURE 22: CAL FIRE S-2T AIR TANKER

CAL FIRE is responsible for fire protection within State Responsibility Areas (SRA). SRA is found in 56 of California's 58 counties and totals more than 31 million acres. In addition, CAL FIRE provides fire and related emergency services in 36 of the State's 58 counties via contracts with local governments. CAL FIRE's firefighters, fire engines, and aircraft respond to an average of more than 5,600 wildland fires each year. Those fires burn more than 172,000 acres annually.

CAL FIRE has adopted an aggressive initial attack strategy designed to suppress wildland fires in or threatening State Responsibility Areas. CAL FIRE's goal is to contain 95 percent of all wildfires to 10 acres or less. This is achieved through detection, ground attack, air attack and mutual aid using fire engines, fire crews, bulldozers, helicopters and fixed wing aircraft.

CAL FIRE's overall annual budget for aviation exceeds $65 million. The average annual budget of the CAL FIRE Aviation Management Program is nearly $20 million. A total of 18 CAL FIRE

[46] For more about CAL FIRE's aviation program, go to: http://calfire.ca.gov/fire_protection/fire_protection_air_program.php.

personnel oversee the program with an additional 130 contract employees providing mechanical, pilot and management services to the program.

CAL FIRE's current support contractors are DynCorp and Logistics Specialties Incorporated (LSI). DynCorp provides airtanker and airtactical plane pilot services, and all aircraft maintenance services. However, all CAL FIRE helicopters are flown by CAL FIRE pilots. LSI provides procurement and parts management services. Currently, CAL FIRE's aviation resources are not permitted to leave the state except for fires in border states that threaten California.

In comparison, the Oregon Department of Forestry (ODF) Fire Division has primary responsibility for approximately 16 million acres of private and public forestland. The acreage protected includes 3.5 million acres of wildland-urban interface areas.

In the typical year, there will be 920 wildland fires in areas where the ODF has jurisdiction. Like California, Oregon has adopted an aggressive fire management goal, which is to stop more than 94% of all fires at 10 acres or less.

The State of Oregon has addressed its fire aviation needs with the following mix of aircraft:

- 2 Large Air Tankers under Exclusive Use Contract
- 2 Single Engine Air Tankers under Exclusive Use Contract
- 8 Medium Helicopters (7 EU Contracts, 1 Agreement)
- 5 Light Helicopters (4 EU Contracts, 1 Agreement)
- 8 Fixed Wing Aircraft: 3 - EU Contracts, 2 - FEPP, 3 – State Owned

The cost of most of these aviation assets is included in ODF's annual budget of $42 million (exclusive of suppression and wildfire insurance costs).

Multi-State and Canadian Province Fire Protection Compacts

State forest fire programs are reinforced through forest fire compacts between the states. Established under the Weeks Law and other specific legislation enacted by Congress, state forest fire compacts reduce wildfire suppression costs for local, state and federal jurisdictions by allowing states to share personnel and equipment and by minimizing the firefighting burden on any single state during periods of high fire occurrence.

There are eight regional compacts across the United States, with 42 states participating in one or more compacts. All of the compacts outline how states will help one another with prevention and suppression operations; resources that can be shared between compacts; and cover billing, reimbursement, and liability.

Three of the compacts are international and include specific Canadian provinces. Three of the compacts include member states of the Western State Fire Managers (WSFM) and the Western Governors' Association (WGA).

- The Northwest Compact includes OR, WA, ID, MT, AK, and the Canadian provinces of British Columbia, Alberta, and the Yukon and Northwest Territories.
- The South Central Interstate Compact includes TX and OK.
- The Great Plains Interstate Compact includes ND, SD, CO, and WY.

Eight Western states are not currently members of a fire fighting compact – AZ, CA, KS, NE, NV, NM, UT and HI.

Canadian/United States Sharing Wildland Firefighting Resources

While states/provinces can share resources through the National Wildland Fire Resource Mobilization System and the United States/Canada Reciprocal Forest Firefighting Arrangement respectively, state-to-state/province mobilizations of resources can be completed in a much shorter timeframe through compact arrangements.

The Western Governors and Western Premiers recognized the need for improved cross-border sharing of firefighting resources years ago. In 2003, the Memorandum of Understanding (MOU) on Enhancing Cross Border Cooperation to Fight Wildland Fires was signed by the Western Governors and Western Premiers. This agreement focused on the need for well-coordinated cross border support.

Despite the 2003 MOU, cross-border mobilization of Canadian-U.S. resources continues to be problematic. Opportunities for Colorado to access Canadian air tankers in a timely manner though a fire protection compact are being evaluated.

Helicopters

The USFS, BLM, BIA and NPS currently contract with T-1, T-2 and T-3 helicopters in Colorado. All are subject to being mobilized out of state when fire behavior moderates and there is a documented need for that resource. Shared opportunities are limited in these cases. However, an opportunity exists with the USFS for the joint staffing of a Type 3 helicopter on the Arapahoe Roosevelt National Forest during the 2014 summer season.

Other opportunities may exist to share exclusive use or CWN contracts with Counties or other entities. Furthermore, there are several helicopter companies within the State to help facilitate additional shared opportunities.

Cost Recovery

Whether Colorado owns or contracts for aircraft, when not needed for missions in the state, they would be made available as a CWN resource to other states and to augment the federal fire aviation fleet.

Senate Bill 13-245 authorizes DFPC:

- To enter into agreements with federal agencies or other states for the provision of the CFAC firefighting aircraft when the aircraft are not being utilized for fires or other emergencies in Colorado.[47]

- To establish reimbursement rates for the direct and indirect costs of providing aircraft from the fleet that are requested through the interagency dispatch system or pursuant to an agreement.[48]

- Fulfill any of the duties related to the CFAC through the use of public-private partnerships with one or more private or public entities.[49] This provision seemingly would permit advertising on aircraft as a means to generate revenue, as was suggested by one of SB13-245's prime sponsors.

DFPC is also authorized to seek and accept gifts, grants, reimbursements, or donations from private or public sources to manage the CFAC.[50]

When an incident occurs in another state or on federal land in Colorado, the other entity could request a Colorado aviation resource, and the incident would be charged a predetermined cost for daily availability and hourly use.[51] The same is true if CFAC multi-mission aircraft are requested by other state agencies for purposes other than firefighting.

There are too many variables to determine with any accuracy how much revenue can be derived from making CFAC aircraft available as a contracted resource to other state agencies, other states, and to the federal government. However, any revenue will be used to offset program costs.

[47] Section 24-33.5-1228 (2)(b)(I), C.R.S.

[48] Section 24-33.5-1228 (2)(b)(II), C.R.S.

[49] Section 24-33.5-1228 (2)(c), C.R.S.

[50] Section 24-33.5-1228 (3)(a), C.R.S.

[51] When FEPP aircraft are used, it is only permissible to recover the direct cost of operating the equipment. Use rates shall not include depreciation, amortization, modification, profit, risk, start-up, or replacement costs. See the criteria to acquire FEPP aircraft at: http://www.fs.fed.us/fire/partners/fepp/desk_guide/fepp.html#99.

Program Concerns and Risks

Aircraft Procurement

The initial airworthiness of the selected aircraft is a critical issue that must be monitored and managed closely. Aircraft already under management by the FAA (civilian aircraft) have established and proven methods for airworthiness certification. Military aircraft, however, pose some potential challenges and opportunities. Aircraft that do not possess a FAA airworthiness certificate are not certifiable under FAA rules. The aircraft operated in military environments were not constructed to FAA standards, and were not operated in accordance with FAA guidelines. Colorado could work to move the aircraft to a FAA certified status, or operate the aircraft using airworthiness approval and jurisdiction provided by the United States Air Force. There may be significant challenges that would be experienced when moving the aircraft from a military environment into the FAA arena that would cause additional cost and schedule delays. Aircraft repairs, maintenance, and operational history all play key parts in determining the appropriate path for aircraft certification. Specifically, the S-3 Viking is likely not FAA certifiable and the surplus C-130 aircraft are in military configurations.

Just as the initial determination for airworthiness is critical to program success, continued airworthiness is critical to the long-term ability of Colorado to continue safe aircraft operations. Repairs, inspections, and maintenance schedules for FAA certified aircraft are established and controlled using 'normal' FAA practices. The military variants, while equally thorough and established, are not governed by the FAA regulations and will require significant federal government involvement and support that can add cost and complexity.

Ultimately, airworthiness determination should be addressed by the FAA or by a military airworthiness organization. It is highly recommended that industry representatives with experience and intimacy with both FAA and military airworthiness regulations be heavily consulted to ensure a successful program.

Training

It is critical that wide-spread adoption of state-provided tools and resources occur to maximize the effectiveness of Colorado's wildfire managers. If procurement, training, or adoption of the wildfire information management tool is delayed, there will be a direct impact on improvement of the wildfire management system.

Continued Presence of Destructive Fires

The improvements and capabilities recommended by this report will not ensure that Colorado will be free of wildfires. It will, however, affect the suppression response and improve Colorado's ability to act on fires in a more efficient, effective, and elegant manner. Accomplishing the DFPC's wildfire management goals will not prevent wind-driven mega-fires. It will, however, ensure that the suppression response is as safe and effective as possible.

Even under the most highly effective wildland fire protection systems some fires will continue to escape control efforts. Under extreme weather conditions, such as those ignited during high wind events, or when resource availability is limited due to significant fire activity, a small percentage of wildland fires will become large and damaging. As a result, efforts must be taken to create homes and communities that can withstand such fires; develop policies and procedures to promote public and firefighter safety; and educate the public that wildland fire is a natural part of Colorado's landscape.

Limitations

Airplanes and helicopters are critical tools in managing wildfires; but aircraft alone cannot put them out. Fixed-wing air tankers and helicopters must be integrated with ground resources to contain wildfires. While the capabilities recommended by this report will improve overall response effectiveness, deficiencies in fire suppression capacity will remain. Some of the most significant needs that will remain are handcrews in the shoulder seasons and overhead (supervisory and incident management) personnel. While outside the scope of this report, it is important that solutions to filling these gaps are also identified.

APPENDIX A – GLOSSARY OF TERMINOLOGY

Abort	To jettison a load of water or retardant from an aircraft or terminate a preplanned aircraft maneuver.
Acceptable Fire Risk	The potential fire loss a community is willing to accept rather than provide resources to reduce such losses.
Aerial Detection	A system for, or the act of, discovering, locating, and reporting fires from aircraft.
Aerial Ignition	Ignition of fuels by dropping incendiary devices or materials from aircraft.
Aerial Ignition Device (AID)	Inclusive term applied to equipment designed to ignite wildland fuels from an aircraft.
Air Attack	The deployment of fixed-wing or rotary aircraft on a wildland fire, to drop retardant or extinguishing agents, shuttle and deploy crews and supplies, or perform aerial reconnaissance of the overall fire situation.
Air Operations Branch Director (AOBD)	This ICS position is responsible for management of an incident's air operations and reports to the Operations Section Chief.
Air Support Group Supervisor (ASGS)	This ICS position is responsible for overseeing logistical support and management of helibase and helispot operations and temporary fixed-wing base(s) and reports to the Air Operations Branch Director. This position also maintains liaison with air tanker and fixed-wing bases supporting incident operations.
Air Tactical Group Supervisor (ATGS)	This ICS position is responsible for directing and coordinating airborne aircraft operations and management of an incident's airspace and reports to the Air Operations Branch Director.
Air Tanker/Fixed-Wing Coordinator (ATCO)	This ICS position is responsible for coordinating air tanker and fixed-wing operations over an incident and reports to the Air Tactical Group Supervisor.
Air Tanker	An air tanker is defined as an aerial delivery system that includes the aircraft configured for the dispensing of fire retardant or fire suppressant material. The term applies to both fixed-wing aircraft and helicopters used for this purpose.
Allowable Payload	The amount of weight that is available for passengers and/or cargo. On the load

	calculation form it is the operating weight subtracted from the selected weight.
Appropriate Management Response (AMR)	Any specific action suitable to meet fire management unit objectives. Typically, the AMR ranges across a spectrum of tactical options (from monitoring to intensive management actions).
Bambi Bucket ®	A collapsible bucket slung below a helicopter. Used to dip water from a variety of sources for fire suppression.
Bucket Drops	The dropping of fire retardants or suppressants from specially-designed buckets slung below a helicopter.
Containment	The status of a wildfire suppression action signifying that a control line has been completed around the fire, and any associated spot fires, which can reasonably be expected to stop the fire's spread.
Control Line	An inclusive term for all constructed or natural barriers and treated fire edges used to control a fire.
Controlled	The completion of control line around a fire, any spot fires therefrom, and any interior islands to be saved; burned out any unburned area adjacent to the fire side of the control lines; and cool down all hot spots that are immediate threats to the control line, until the lines can reasonably be expected to hold under the foreseeable conditions.
Crown Fire	A fire that advances from top to top of trees or shrubs more or less independent of a surface fire. Crown fires are sometimes classed as running or dependent to distinguish the degree of independence from the surface fire.
Density Altitude	Pressure altitude corrected for temperature deviations from standard atmosphere. Used as an index to aircraft performance characteristics such as take-off distance and rate of climb. Density altitude bears the same relation to pressure altitude as true altitude does to indicated altitude.
Detection	The act or system of discovering and locating fires.

Direct Attack	Any treatment applied directly to burning fuel such as wetting, smothering, or chemically quenching the fire or by physically separating the burning from unburned fuel.
Discovery Time	Elapsed time from start of fire (known or estimated) until the time of the first discovery that results directly in fire suppression action.
Drop Pattern	The distribution of an aerially delivered retardant drop on the target area in terms of its length, width, and momentum (velocity x mass) as it approaches the ground. The latter determines the relative coverage level of the fire retardant on fuels within the pattern.
Drop Zone (DZ)	Target area for air tankers, helitankers, cargo dropping.
Empty Weight	Weight of an aircraft/engine including the structure, powerplant, all fixed equipment, all fixed ballast, unusable fuel, undrainable oil, and total quantity of hydraulic fluid.
Extended Attack	Suppression activity for a wildfire that has not been contained or controlled by initial attack or contingency forces and for which more firefighting resources are arriving, en route, or being ordered by the initial attack incident commander. Extended attack implies that the complexity level of the incident will increase beyond the capabilities of initial attack incident command.
Extinguishing Agent	Substance used to put out a fire by cooling the burning material, blocking the supply of oxygen, or chemically inhibiting combustion.
Federal Aviation Administration (FAA) Airworthiness Certificate	An airworthiness certificate is an FAA document which grants authorization to operate an aircraft in flight.
Fire Danger Rating System	The complete program necessary to produce and apply fire danger ratings, including data collection, data processing, fire danger modeling, communications, and data storage. See also: National Fire Danger Rating System.
Fire Hazard Index	A numerical rating for specific fuel types, indicating the relative probability of fires starting and spreading, and the probable degree of resistance to control; similar to

	burning index, but without effects of wind speed.
Forward Looking Infrared (FLIR)	Hand held or aircraft mounted device designed to detect heat differentials and display their images on a video screen. FLIRs have thermal resolution similar to IR line scanners, but their spatial resolution is substantially less; commonly used to detect hot spots and flareups obscured by smoke, evaluate the effectiveness of firing operations, or detect areas needing mopup.
Geographic Area / Geographic Area Coordination Center (GACC)	The United States is divided into 11 geographic areas. If a wildland fire grows to the point where local personnel and equipment are insufficient, the local dispatch center will contact the Geographic Area Coordination Center for assistance. The GACC provides coordination, mobilization, and demobilization of emergency management resources within a specific geographic coordinating area. Colorado is in the Rocky Mountain geographic area and the GACC is the Rocky Mountain Area Coordination Center (RMACC).
Gross Weight	Total allowable weight of a loaded aircraft for takeoff or landing, adjusted for altitude differences.
Haines Index	An atmospheric index used to indicate the potential for wildfire growth by measuring the stability and dryness of the air over a fire.
Hand Crew	A number of individuals that have been organized and trained and are supervised principally for operational assignments on an incident.
Hazard Assessment	Assess hazards to determine risks. Assess the impact of each hazard in terms of potential loss, cost, or strategic degradation based on probability and severity.
Helibase Manager (HEB1 or HEB2)	This ICS position is responsible for controlling helicopter take-offs and landings at a helibase, managing helibase assigned helicopters, supplies, fire retardant mixing and loading and reports to the Air Support Group Supervisor.

Helicopter Boss (HELB)	An individual assigned to an agency helicopter to supervise assigned crew members, oversee the loading and unloading of personnel and/or cargo, and ensure that agency policies and procedures governing helicopter operations are followed.
Helicopter Coordinator (HLCO)	This ICS position is responsible for coordinating tactical and logistical helicopter missions at the incident and reports to the Air Tactical Group Supervisor. This position can be airborne or ground-based with one or more assigned to an incident, depending on the number and type of missions to be accomplished.
Helicopter Crewmember (HECM)	An individual assigned to an agency or call-when-needed helicopter to support helicopter operations.
Helicopter Manager (HCWN)	An individual assigned to a call-when-needed (CWN) helicopter to serve as helicopter boss, administer contracts, and verify CWN helicopter and pilot qualifications.
Helitack Crew	A crew of firefighters specially trained and certified in the tactical and logistical use of helicopters for fire suppression.
Helitack	The utilization of helicopters to transport crews, equipment, and fire retardants or suppressants to the fireline during the initial stages of a fire. The term also refers to the crew that performs helicopter management and attack activities.
Helitanker	A helicopter equipped with a fixed tank capable of delivering a minimum of 1,100 gallons of water, foam, or retardant.
Incident Command System (ICS)	A standardized on-scene emergency management concept specifically designed to allow its user(s) to adopt an integrated organizational structure equal to the complexity and demands of single or multiple incidents, without being hindered by jurisdictional boundaries.
Incident Commander (IC)	This ICS position is responsible for overall management of the incident and reports to the Agency Administrator for the agency

	having incident jurisdiction. This position may have one or more deputies assigned from the same agency or from an assisting agency(s).
Incident Management Team	The incident commander and appropriate general and command staff personnel assigned to an incident.
Incident Objectives	Statements of guidance and direction necessary for the selection of appropriate strategy(s), and the tactical direction of resources. Incident objectives are based upon agency administrator's direction and constraints. Incident objectives must be achievable and measurable, yet flexible enough to allow for strategic and tactical alternatives.
Initial Attack (IA)	A planned response to a wildfire given the wildfire's potential fire behavior. The objective of initial attack is to stop the fire and put it out in a manner consistent with firefighter and public safety and values to be protected.
Initial Attack Fire	Fire that is generally contained by the attack units first dispatched, without a significant augmentation of reinforcements, within two hours after initial attack, and full control is expected within the first burning period.
Instrument Flight Rules Conditions (IFR)	Weather conditions below the minimum for flight under Visual Flight Rules and therefore requiring the observance of instruments inside the aircraft for controlling flight; generally considered to be less than 1000' AGL and 3 miles distant.
Interagency Airtanker Board (IAB)	The Interagency Airtanker Board (IAB) is the evaluation and approval authority for fixed-wing aircraft and helicopters used as air tankers intended for interagency use in the service of the cooperating state and federal fire suppression agencies.
Internal Payload	Allowable aircraft cabin load, in pounds, with full fuel and pilot in calm air at standard atmosphere.
Jettison	Disposing of cargo, fuel, water or retardant overboard to lighten an aircraft or to improve its stability.

Knot (kt)	The knot is a unit of speed equal to one nautical mile per hour. 1 knot = 1.15077945 miles per hour (mph).
Lead Plane	Aircraft with pilot used to make trial runs over the target area to check wind, smoke conditions, topography and to lead air tankers to targets and supervise their drops.
Modular Airborne Firefighting System (MAFFS)	A manufactured unit consisting of five interconnecting tanks, a control pallet, and a nozzle pallet, with a capacity of 3,000 gallons, designed to be rapidly mounted inside an unmodified C-130 (Hercules) cargo aircraft for use in cascading retardant chemicals on wildfires.
National Fire Danger Rating System (NFDRS)	A uniform fire danger rating system that focuses on the environmental factors that control the moisture content of fuels.
National Interagency Coordination Center (NICC)	Coordinates allocation of resources to one or more coordination centers or major fires within the nation. Located at the National Interagency Fire Center (NIFC) in Boise, Idaho.
National Wildfire Coordinating Group (NWCG)	A group formed under the direction of the Secretaries of the Interior and Agriculture to improve the coordination and effectiveness of wildland fire activities and provide a forum to discuss, recommend appropriate action, or resolve issues and problems of substantive nature.
Night (Aviation)	The time between the end of evening civil twilight and the beginning of morning civil twilight, as published in the American Air Almanac, converted to local time.
NWCG Standard	A defined behavior, action, process, or equipment type, agreed upon by the National Wildfire Coordinating Group for wildland fire performance, and is necessary to meet consistent, interagency fire management activities.
Operating Weight	For helicopters, the equipped weight plus weight of the crew and fuel.
Pattern	The distribution of an aerially delivered retardant drop on the target area in terms of its length, width, and momentum (velocity x

	mass) as it approaches the ground. The latter determines the relative coverage level of the fire retardant on fuel within the pattern. Synonym: Drop Pattern
Payload	Weight of passengers and/or cargo being carried by an aircraft.
Performance Chart	A chart, table, or graph provided by the manufacturer for use in determining an aspect of helicopter and fixed-wing aircraft performance.
Preparedness Level	The National Multi-Agency Coordination Group (NMAC) establishes National Preparedness Levels throughout the calendar year to help assure that wildland firefighting resources are ready to respond to new incidents. Geographic Area Preparedness Levels are established by the Geographic Area Coordination Centers (GACC). Preparedness Levels are dictated by burning conditions, fire activity, and especially resource availability. The five Preparedness Levels range from 1 to 5, with 5 being the highest level. Each Preparedness Level has specific management directions.
Procure	All activities involved in the acquisition, revitalization, modification, and certification of a system. This is intended to include the airframe selection, inspection, tanker modification, and airworthiness certification required to begin operations of a system.
Public Aircraft	Aircraft used only in the service of a government or a political subdivision. It does not include any government-owned aircraft engaged in carrying persons for commercial purposes.
Reconnaissance (RECON)	To examine a fire area to obtain information about current and probable fire behavior and other related fire suppression information.
Resource Order	The form used by dispatchers, service personnel, and logistics coordinators to document the request, ordering or release of resources, and the tracking of those resources on an incident.

Resource Ordering and Status System (ROSS)	A national system that provides automated support to interagency and agency dispatch and coordination offices. The system will provide current status of resources available to support all-risk activities; enable dispatch offices to exchange and track resource ordering information electronically; enable dispatch offices to rapidly and reliably exchange mission-critical emergency electronic messages.
Restricted Category	Aircraft that is generally used for cargo, retardant dropping, agricultural operations, survey work and other specific projects, and may not transport passengers.
Retardant Coverage	Area of fuel covered and degree of coverage on the fuel by a fire retardant, usually expressed in terms of gallons per hundred square feet (liters per square meter).
Retardant Drop	Fire retardant cascaded from an air tanker or helitanker.
Retardant	A substance or chemical agent which reduces the flammability of combustibles.
Risk Management	A continuous process that provides a systematic method for identifying and managing the risks associated with any operation.
Situational Awareness (SA)	An on-going process of gathering information by observation and by communication with others. This information is integrated to create an individual's perception of a given situation.
Smokejumper	A specifically trained and certified firefighter who travels to wildland fires by aircraft and parachutes to the fire.
Supplemental Type Certificate (STC)	A supplemental type certificate (STC) is a type certificate (TC) issued when an applicant has received FAA approval to modify an aircraft from its original design. The STC, which incorporates by reference the related TC, approves not only the modification but also how that modification affects the original design.
United States Forest Service (USFS)	The United States Forest Service is an agency of the U.S. Department of Agriculture that

	administers the nation's 155 national forests and 20 national grasslands, which encompass 193 million acres.
Wildfire Suppression	An appropriate management response to wildfire, escaped wildland fire use or prescribed fire that results in curtailment of fire spread and eliminates all identified threats from the particular fire.
Wildfire	An unplanned, unwanted wildland fire including unauthorized human-caused fires, escaped wildland fire use events, escaped prescribed fire projects, and all other wildland fires where the objective is to put the fire out.
Wildland Urban Interface (WUI)	The line, area, or zone where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuels.
Wind-Driven Wildland Fire	A wildland fire that is controlled by a strong persistent wind.

NATIONAL PREPAREDNESS LEVEL DEFINITIONS

The National Multi-Agency Coordination Group (NMAC) establishes National Preparedness Levels throughout the calendar year to help assure that wildland firefighting resources are ready to respond to new incidents. Preparedness Levels are dictated by burning conditions, fire activity, and especially resource availability. The five Preparedness Levels range from I to V, with V being the highest level. Each Preparedness Level has specific management directions.

Note: Geographic Area Preparedness Levels are established by the Geographic Area Coordination Centers (GACC). Geographic Area preparedness level criteria may vary from the national criteria.

Preparedness Level 1

Description: Minimal large fire activity nationally. Most Geographic Areas have low to moderate fire danger. There is little or no commitment of National Resources.

Preparedness Level 2

Description: Several Geographic Areas are experiencing high to extreme fire danger. Wildland fire activity is increasing, and large fires are occurring in one (1) or more Geographic Areas. Minimal mobilization of resources from other Geographic Areas is occurring. There is moderate commitment of National Resources with the potential to mobilize additional resources from other Geographic Areas.

Preparedness Level 3

Description: Two (2) or more Geographic Areas are experiencing wildland or prescribed fire activities requiring a major commitment of National Resources. Additional resources are being ordered and mobilized through NICC. Type 1 and 2 Incident Management Teams are committed in two (2) or more Geographic Areas and crew commitment nationally is at 50%.

Preparedness Level 4

Description: Three (3) or more Geographic Areas are experiencing incidents requiring Type 1 and 2 Incident Management Teams. Competition exists for resources between Geographic Areas. Nationally, 60% of Type 1 and 2 Incident Management Teams and crews are committed.

Preparedness Level 5

Description: Geographic Areas are experiencing major incidents which have the potential to exhaust all agency fire resources. Eighty percent (80%) of Type 1 and Type 2 Incident Management Teams and crews are committed, as well as the majority of other National Resources.

Preparedness Level 5 to 4

Description: Competition for resources has significantly decreased. No critical fire weather events are forecasted for the next twenty-four (24) hours, and moderating weather conditions are forecasted for the next three (3) to five (5) days.

Preparedness Level 4 to 3

Description: Significant demobilization is occurring. Crews are being released daily and sent to home units. Fifty percent (50%) of total crew capability is available for new fires. All ground DoD resources have been released. Moderating conditions are forecasted for the next twenty four (24) hours, and higher humidity and lower temperatures are forecasted for the major fire areas.

Preparedness Level 3 to 2

Description: The majority of large fires are contained. Initial attack resources are again available. Geographic Area crew availability is at or above the 50% level. There is no competition for resources between Geographic Areas. Large fire areas are expected to receive precipitation, with associated higher humidity and lower temperatures.

For more detailed information refer to the National Interagency Mobilization Guide at: www.nifc.gov/nicc/mobguide/index.html. See Chapter 20.

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Chris Jennings, Fire Chief	Timberline Fire Protection District
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Ann Walker, Program Manager	Western Governors' Association
Dave Zader, Wildland Fire Administrator	City of Boulder Fire Department

[1] These individuals are in addition to the members of the DFPC Wildfire Advisory Committee

STATE AND LOCAL WILDLAND FIREFIGHTING RESOURCES (NON-AVIATION)

Colorado's structure for combatting wildland fires is a cooperative, interagency system involving local, county, state, and federal agencies. Wildland fire protection responsibilities on non-federal lands in Colorado follow a hierarchy of local jurisdiction, to the county sheriff, and finally to the State of Colorado. DFPC is the lead state agency for wildland fire management.

Locally Managed Resources

The vast majority of Colorado's firefighting resources are owned and operated by local fire departments (fire protection districts, municipal fire departments, non-governmental volunteer fire departments, etc.). County Sheriffs and county governments also own and operate firefighting equipment or equipment that can be called upon for wildland fires, such as dozers and water tenders.

Currently, there are nearly 1,500 engines and brush trucks operated by local agencies that are listed in the State's resource inventory database (WebEOC). The table below depicts the local firefighting resources by kind and type that are listed in WebEOC:

FIGURE E1 – LOCAL RESOURCES LISTED IN WEBEOC

Category Type	Type 1	Type 2	Type 3	Type 4	Type 5	Type 6	Type 7
ATV	4	3	7	0	2	0	6
Brush Patrol Unit	1	7	18	9	160	218	8
Crew Carrier	1	5	8	1	2	0	2
Engine	521	107	115	56	138	125	1
Hand Crew	3	15	2	0	1	0	0
Water Tender	163	171	46	8	3	10	0
Track Dozer	0	1	1	0	0	0	0
Total:	**693**	**309**	**197**	**74**	**306**	**353**	**17**

These equipment numbers represent only a percentage of the total that local jurisdictions own and operate, as not all jurisdictions submit their resource information to CDEM.

DFPC's Wildland Fire Management Program

Wildland fire management service, support, and programs are implemented and delivered to counties and fire districts primarily through the wildfire operations staff, consisting of the Deputy Section Chief of Wildfire Operations and the Area and Regional Fire Management Officers (FMOs).

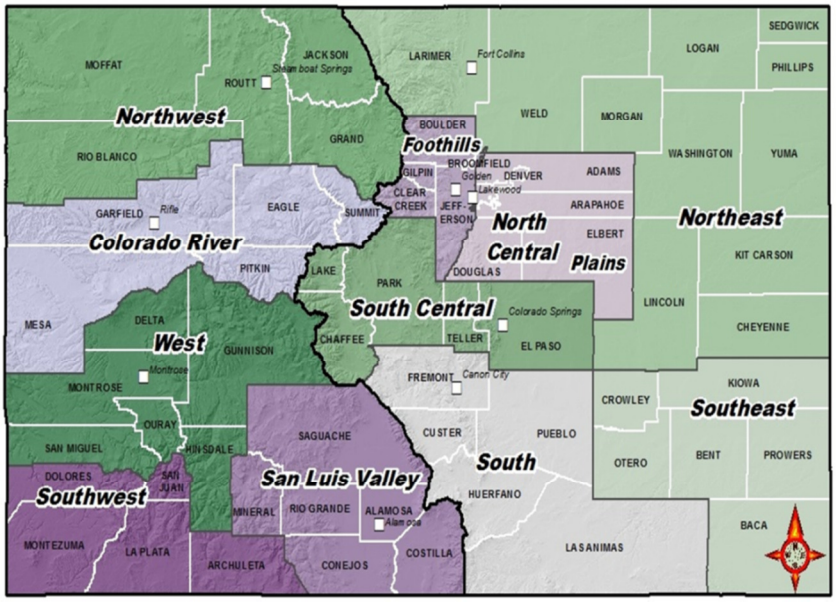


FIGURE E2 – COLORADO'S FIRE MANAGEMENT REGIONS

Under DFPC, the immediate field response to requests for assistance with wildfires comes from the FMO. DFPC has 9 Regional FMOs to cover the State's All-Hazard Regions, with 2 Area FMO positions serving in supervisory and backfill roles. Because of its geographic size, the Northwest All-Hazards Region was divided into two Fire Management Regions; the Northwest Fire Management Region and the Colorado River Fire Management Region, each with an assigned Regional FMO.

Additionally, the North Central Region exceeds the capability of one FMO due to the number, severity, and complexity of wildfires and has been divided into two Fire Management Regions; the Plains and Foothills Regions.

DFPC Engine Program

The DFPC Engine Program provides assistance to local jurisdictions when local firefighting resources are overburdened due to number, complexity, or duration of fires. When areas of the state are under high or extreme fire danger, DFPC Engines may be pre-positioned on "severity" assignments for the purpose of supplementing local resources for quick initial attack.

Also in "shoulder seasons," when state and federal handcrews are virtually non-existent, the engine crews can be pulled together to form a handcrew or the overhead for cooperator handcrews. Over the past several years, the DFPC Engine Program has proven to be a valuable force multiplier in situations when other resources have been stretched thin.

While suppression is the most visible function of the program, the engine crews also provide a wide range of forestry and fire related services including critical wildland fire training to local jurisdictions. The engine crews also provide valuable fuels reduction services. In conjunction

with the Division of Natural Resources (DNR) and the Colorado State Forest Service (CSFS), the crews work on state lands to reduce hazardous fuels and increase forest health. This is done through various methods including general thinning, chipping, pile burning and broadcast burning.

FIGURE E3 – DFPC TYPE 4 ENGINE

FIGURE E4 – DFPC TYPE 6 ENGINE

DFPC currently maintains nine Type 6 Engines and four Type 4 Engines.[1] In order to make the most of existing resources and provide assistance to local entities in wildland firefighting, DFPC has implemented alternative staffing models, such as engines jointly staffed by DFPC and local personnel. Under this program, DFPC provides an engine and an engine captain, while the local jurisdiction provides two firefighters to staff the engine. These jointly staffed engines are available for initial attack in the local jurisdiction and mutual aid response area, are dispatched to state responsibility fires. The benefit of the jointly staffed engine program is it provides for the immediate response of an engine to state and local wildfires for approximately one-third of the personnel costs to the state.

DFPC also maintains several engines that are staffed through cooperative agreements. While not fully staffed on a daily basis, these engines can be quickly staffed when needed for fire responses.

Federal Excess Personal Property (FEPP) Engine Program

This DFPC program is responsible for building and maintaining a fleet of Federal Excess Personal Property (FEPP) engines that are placed with local jurisdictions across the State of Colorado to increase local capability to respond to wildfires and other emergencies.[2] Currently, there are 118 FEPP engines under agreements across the state and the Fire Equipment Shop builds an average of 10 such engines each year to maintain and expand the fleet.

[1] The State Engine Program currently consists of three staffed engines; one of which is jointly staffed between DFPC and a local fire department. The program will increase by one additional fully-staffed engine and five jointly staffed engines effective May 1, 2014.

[2] The Federal Excess Personal Property Program was enacted by Congress under the Federal Property and Administrative Services Act of 1949 and the Cooperative Forestry Assistance Act of 1978. The Act directs the Secretary of Agriculture to encourage the use of FEPP to assist in reducing state fire budgets by loaning federally-owned property to state foresters and their cooperators.

FIGURE E5 – COLORADO'S FEPP ENGINES

Colorado Department of Corrections: State Wildland Inmate Fire Team (SWIFT)

Following the 2000 Fire Season, Colorado Corrections Industries (CCi) began forming a wildland fire team to provide hand crew support and assistance on wildland fires within Colorado. CCi currently operates four, 20 member State Wildland Inmate Fire Team (SWIFT) crews, housed at various correctional facilities in Colorado. Currently, the base locations are at the Four Mile Correctional Center in Canon City, the Rifle Correctional Center in Rifle and the Buena Vista Correctional Center in Buena Vista, Colorado.

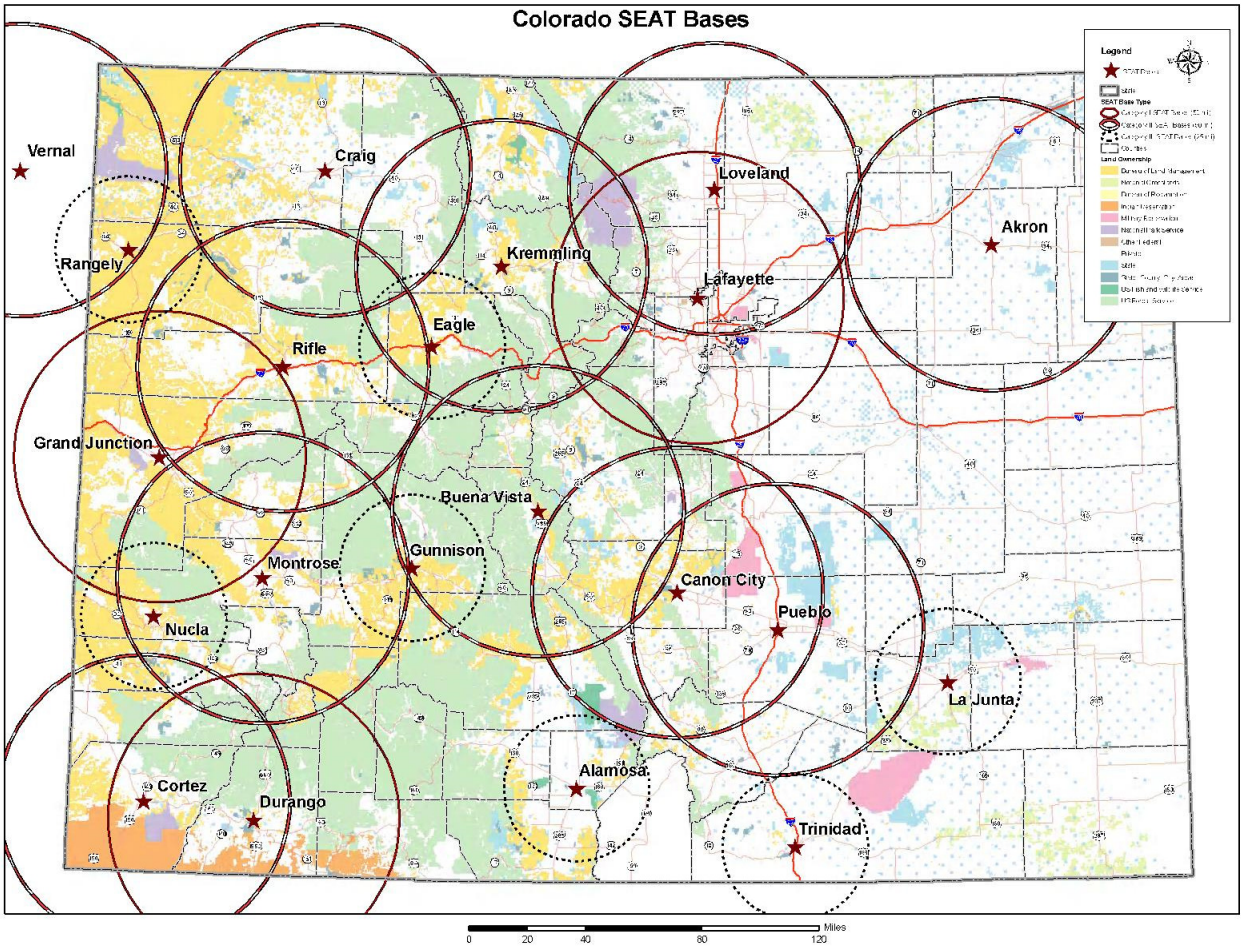
FIGURE E6 – The Buena Vista SWIFT Crew on the Hewlett Fire (May 17, 2012)

COLORADO SINGLE-ENGINE AIR TANKER (SEAT) BASES

A SEAT re-load network has been developed to service Interagency areas within Colorado. The system consists of Category I - II bases spread throughout Colorado and in association with base networks in Utah and Wyoming (see Exhibit 1 for SEAT base locations).

The system allows for aircraft to transition effectively from incident to incident within a specific area for retardant re-load, in order to minimize turnaround times. The network has been standardized where possible to ensure base utilization is simplistic, user friendly and economical for all interagency partners.

Exhibit 1
Category I, II, and III SEAT Bases



*Note: Montrose, Kremmling, and Buena Vista are no longer viable bases (map is being updated)

Colorado Interagency Approved SEAT Bases

Category I Bases – Established full-service (Interagency) or bulk account bases (USFS). Personnel are in place and continually staff aviation operations.

APPENDIX F – COLORADO SINGLE-ENGINE AIR TANKER BASES

Category 1 Bases in Colorado are:

- Durango Air Tanker Base
- JEFFCO Air Tanker Base
- Grand Junction Air Tanker Base

Category II Bases – Airports in which portable and semi-portable equipment are in place for the duration of the fire season. Agreements as to location and duration are established with the hosting airport. Personnel are either in place or on-call to support immediate operations under the provisions of the Interagency SEAT Loader Qualifications Program.

Category II	Airport Name	3 Letter Designator
Ft Collins	Ft. Collins/Loveland	FNL
Craig	Craig-Moffat	CAG
Cortez	Cortez/Montezuma	CEZ
Rifle	Garfield Co.	RIL
Canon City	Fremont Co.	1V6
Vernal	Vernal Regional	VEL
Kremmling	McElroy Field	20V
Pueblo	Pueblo Memorial	PUB
Akron	CO Plaines Regional	AKO
Alamosa	San Luis Valley	0V2

Category III Bases – Airports in which agreements are in place to support the parking of mobile equipment for periodic use as fire severity necessitates. Personnel are not identified with the base, but with the equipment that would be mobilized to the locale.

Category III	Airport Name	3 Letter Designator
Rangely	Rangely Airport	4VO
Meeker	Meeker Airport	EEO
Eagle	Eagle Co.	EGE
Gunnison	Gunnison/Crested Butte	GUC
Nucla	Hopkins Field	6V6
La Junta	La Junta Municipal	LHX

FIXED WING AIR TANKER REQUEST FOR INFORMATION

The Colorado Division of Fire Prevention and Control (DFPC) is creating a report to be provided to the Colorado General Assembly. This report will contain a recommendation regarding the decision to procure and operate aerial retardant delivery aircraft by the state of Colorado. In order to formulate this recommendation, it is necessary to request information from the wildfire aviation community. Notwithstanding the existence of aircraft performance data and previous comparison studies, we have outstanding questions related to mission performance at Colorado's high and hot environment.

The information requested by this request for information is intended to be used in determining the efficacy of available air tanker solutions in support of the aforementioned report. This request is related to the exchange of information only, and is not to be considered a request for quotation or a contractual obligation. The data will be used and presented in public documents and should not contain company sensitive, or proprietary information.

Mission Assumption

The mission profile identified in this request is designed to be:

- Representative of the initial attack (IA) nature of the Colorado air tanker mission
- Representative of the high density altitude conditions anticipated in Colorado
- Representative of the high tempo operations anticipated in Colorado

It is understood that this is only one mission scenario that could be used to analyze the efficacy and cost parameters for wildfire aviation applications in Colorado. This scenario was chosen to ensure that the performance characteristics of the solutions are evaluated against the possibility of fighting fires in Colorado's high and hot environment.

Mission Profile

The tanker shall be airborne within 20 minutes of mission notification.

The flight profile and parameters for the mission are:

Tanker shall depart from KBJC.

The tanker shall arrive at a wildfire incident at Colorado Forest State Park located within 1 nautical mile of 40° 29.454'N, 105° 54.767'W (approximately 50.0 NM)

The tanker shall loiter over the wildfire incident for 20 minutes before beginning the retardant drop sequence.

The tanker shall apply retardant at the target location in one drop event.

The tanker shall return and land at KBJC.

After completion of the mission the tanker shall land with at least 45 minutes of IFR reserve fuel at normal cruise power.

The weather conditions at KBJC shall be assumed to be:

Temperature: 95 degrees F
Equivalent Sea Level Barometric Pressure: 29.92 in Hg
Winds: 0 mph
Clouds: Partly Cloudy
Precipitation: None
Relative Humidity: 0.16
Dew Point: 42.8 degrees F
Visibility: 80.0 miles

The weather conditions at the wildfire incident shall be assumed to be:

Temperature: 86 degrees F at ground level (approximately 10,500 ft)
Equivalent Sea Level Barometric Pressure: 29.92 in Hg
Winds: 0 mph
Clouds: Clear
Precipitation: None
Relative Humidity: 0.13
Dew Point: 30.2 degrees F
Visibility: 10.0 miles

The tanker shall execute the described mission scenario as many times as possible within one crew duty day as specified in the Interagency Guidelines.

The tanker shall execute the described mission scenario twenty times each calendar month during the fire season.

The tanker shall not conduct night operations as prescribed by exiting interagency operational and safety guidelines.

The fire season is assumed to occupy the months of May through September.

The retardant shall be assumed to have a density of 8.33 pounds per gallon.

Respondent Products

(R-01) Respondent shall provide a description and timeline of the tasks to be accomplished after mission notification and before aircraft launch. A quick response capability is the desire of the DFPC.

(R-02) Respondent shall indicate whether the aircraft is effectively operable without a lead plane.

(R-03) Respondent shall indicate if the proposed aircraft is approved for operations by the interagency air tanker board. If the aircraft is not approved by the interagency air tanker board, the respondent shall indicate if the proposed aircraft meets the interagency air tanker board requirements.

(R-04) Respondent shall provide the expected tank capacity for takeoff from KBJC as specified in the mission profile, considering aircraft performance limitations.

(R-05) Respondent shall provide retardant coverage level data for a typical drop. If coverage level data has not been collected, a prediction of coverage level shall be provided.

(R-06) Respondent shall complete the following chart that outlines parameters and timelines for the mission described.

Response Chart											
Parameter	Gross Aircraft Weight (pounds)										
	Onboard Retardant Weight (pounds)										
	Onboard Retardant Quantity (gallons)										
	Onboard Fuel Quantity (pounds)										
	Altitude (ft MSL)	5673	5673								
	Time Since Mission Notification (minutes)	0	20								
		Mission Notification	Takeoff	Top of Climb	End of transit to incident	Bottom of descent	End of loiter	After retardant application	Top of climb	End of transit to KBJC	Land
		Mission Event									

(R-07) Respondent shall describe the proposed aircraft (dimensioned line drawing, nomenclature, and basic characteristics).

(R-08) Respondent shall provide aircraft basic empty weight.

(R-09) Respondent shall provide the aircraft maximum zero fuel weight.

(R-10) Respondent shall provide the aircraft maximum take off weight with retardant.

(R-11) Respondent shall provide the aircraft maximum take off weight without retardant.

(R-12) Respondent shall provide the aircraft maximum landing weight.

(R-13) Respondent shall provide the expected aircraft climb performance charts for all engines operating condition, and one engine inoperative condition if applicable.

(R-14) Respondent shall submit a maintenance plan for the aircraft.

(R-14-01) The maintenance plan shall identify and describe maintenance actions required to ensure the aircraft meets the fire season requirements.

(R-14-02) The maintenance plan shall cover a three year span of aircraft operations.

(R-15) Respondent shall provide the service ceiling of the aircraft as a function of gross weight.

(R-16) Respondent shall define the minimum crew required to meet the mission as described above within the limits of the interagency safety limitations.

(R-17) Respondent shall identify the expected time required for airframe revitalization, if required. This is intended to include activities required to return an aircraft to service after storage, any structural inspection program, or other activities required to re-establish basic aircraft airworthiness.

(R-18) Respondent shall identify the expected time required for air tanker modifications, if required.

ICS Type Specifications for Helicopters[1]

Capability	Type 1	Type 2	Type 3
Useful Load @ 59◦ F. @ Sea Level	5,000	2,500	1,200
Passenger Seats (unless FAA Restricted Category)	15 or more	9-14	4-8
Retardant or Water Carrying Capability (Gallons)	700	300	100
Maximum Gross Takeoff/Landing Weight (Lbs)	12,501+	6,000 - 12,500	Up to 6,000

Helicopter Examples

Type 1 Helicopter

Sikorsky S-70 “Firehawk”

Type 2 Helicopter

UH-1H "Super Huey"

Type 3 Helicopter

Bell 407

Minimum Daily Staffing Requirements

Staffing Requirement	Type 1	Type 2	Type 3
Standard Category	Manager plus four Helicopter Crewmembers	Manager plus three Helicopter Crewmembers	Manager plus two Helicopter Crewmembers
Restricted Category	Manager Only	Manager Only	Manager Only

[1] Chart 6-1, Interagency Helicopter Operations Guide, February 2013

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