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October 13, 2016

TO: EACH SUPERVISOR

FROM: DARYL L. OSBY, FIRE CHIEF

CONSOLIDATED FIRE PROTECTION DISTRICT OF LOS ANGELES COUNTY (DISTRICT) ANALYSIS OF CURRENT WILDLAND FIREFIGHTING AIRCRAFT PROGRAM

The purpose of this communiqué is to apprise your Honorable Board on the status of the District's comprehensive assessment of its current aircraft program as requested by Supervisor Michael D. Antonovich, via Board Motion, on Tuesday, July 26, 2016.

Attached is the District's completed *Analysis of Current Wildland Firefighting Aircraft Program and Other Aircraft Types* (Attachment A). The purpose of this analysis was to evaluate and provide strategic replacement and expansion recommendations for the District's aircraft program related to effective wildland fire suppression while maintaining full capability to complete all other aviation-related missions.

This assessment is consistent with the District's Strategic Plan Goal No. 1, Fiscal Sustainability, by "ensuring we provide the best possible value for the taxpayers' dollar by continuously evaluating the use of funds and resources, as well as legal risk."

Significant analysis highlights and recommendations include:

- Continuation of dialogue with local municipalities and adjoining counties to identify cost sharing and economies of scale opportunities for shared aircraft usage.
- Continuation of collaboration with key State and Federal agencies to develop innovative 21st century solutions to augment initial attack response and coverage during a year-round fire season.

- Reevaluation of the annual 120-day contract with Erickson for use of the S-64 Helitanker to determine if the $3.2 million allocation can be spent more effectively.

- Continuation of the lease for the CL-415 SuperScoopers from the Government of Quebec as the most cost-effective approach to augmenting the District's aircraft program.

- Modification of the CL-415 SuperScooper lease contract to bring the aircraft to the District beginning in July to address the year-round fire season as a result of impacts from climate change.

- The CL-415 SuperScooper is no longer in production. Bombardier, the original manufacturer of the aircraft, recently sold its production rights to Viking Air who has no immediate plans or capability to restart the production line.

- Due to the high capital and staff costs associated with the CL-415 program, ownership – if new aircraft were available for purchase – is not economically feasible at this time.

- The S70i Firehawk helicopter surpassed all six evaluated aircraft and achieved a positive rating in all comparative capability assessments (high production rate, night flying capability, accuracy of drops, response speed, multi-mission capability, acquisition availability, and operating cost) to support initial and early extended attack phases of wildland fires. Sikorsky has indicated they have six to eight aircraft available for immediate acquisition and can offer substantial cost savings to the District for the purchase of multiple aircraft versus purchase of excess /retired military aircraft (see Attachment B).

In addition, the District also contracted with Conklin & de Decker Aviation Associates, Inc., to complete the attached *Fleet Analysis* (Attachment C) for the Air Operations Section. Based on the findings and recommendations of both analyses, the District recommends the continued annual lease of two or more CL-415 SuperScoopers combined with the purchase of S70i Firehawks to create a well-balanced and blended approach to aerial firefighting challenges.

Over the course of the next 120 days, the District will collaborate with the Chief Executive Office to proceed with Phase II of the comprehensive assessment. Phase II will include:

- Development of a helicopter replacement and financial plan to augment the CL-415 SuperScooper lease, expand the District's existing fleet of S70a Firehawk helicopters with new and more capable aircraft, and improve infrastructure and aviation safety systems.

- The financial plan will include an assessment of alternative sources of funding (i.e., cost offset, Measure B funding and grants) available for helicopter purchases and low-interest financing.

- A progress report on the aforementioned recommendations.

The Phase II report will be provided to your Board in 120 days.

If you have any questions, please contact me at (323) 881-6180, or your staff may contact Chief Deputy David R. Richardson Jr., Emergency Operations, at (323) 881-6178.

DLO:heo

Attachments

c: Sachi Hamai
Sheila Williams
Lori Glasgow
Each Board Deputy

Los Angeles County Fire Department:

Analysis of Current Wildland Firefighting Aircraft Program & Other Aircraft Types

[redacted]

Introduction

Recent fire activity in Calabasas, San Gabriel Canyon and Santa Clarita has sparked a great deal of public debate regarding whether the Los Angeles County Fire Department (LACFD) has year-round access to the right type and combination of aerial firefighting resources to meet the highly visible mission demand of effective wildland fire suppression. In addition, questions have been raised as to why the Department leases certain aircraft instead of purchasing the resource for year-around use. This document will address these concerns in detail. Additionally, this document will:

- Provide a cost and operational analysis related to the options of purchasing, leasing or partnering with other public entities for the operation of SuperScooper, rotary and fixed wing aircraft;

- Analyze the availability of SuperScooper aircraft in the southern hemisphere, and explore the possibilities of developing partnerships with military, private sector and/or government entities that operate such aircraft;

- Explore other types of aircraft and provide recommendations on leasing or purchasing such aircraft, including the DC10;

- Provide an overview of our current relationship with the Los Angeles City Fire Department (LAFD), California Department of Forestry & Fire Protection (Cal Fire) and the United States Forest Service, U.S. Department of Agriculture (USFS) related to aircraft usage and availability for direct protection areas (DPA) and mutual threat zones;

- Provide an update on the completion of the Conklin & de Decker report "Aircraft Fleet Analysis," which provides a comprehensive assessment of the Department's current aircraft program.

Wildland Fire Suppression Responsibility

Geographically, the County of Los Angeles covers 4,058 sq. miles (4,751 sq. miles inclusive of waterways) (1). Over half of this area, 2,067 sq. miles, is deemed to be Very High Fire Hazard Severity Zone (VHFHSZ) (see map) (2). Areas identified as VHFHSZ are where wildfires typically start and where they grow into destructive fires that threaten lives and property (3).

Responsibility for managing wildland fire prevention and fire suppression activities in VHFHSZ areas in Los Angeles County is divided between three primary entities based on legislated areas of responsibility. These areas of responsibilities are as follows:

- 51% Federal Responsibility Areas (FRA) including: 1,058 sq. miles
    - U.S. Forest Service (USFS);
    - National Park Service (NPS);
    - Bureau of Land Management (BLM);
    - U.S. Department of Defense (DOD).
- 30% State Responsibility Areas (SRA) – Unincorporated lands 613 sq. miles
- 19% Local Responsibility Area (LRA) - Incorporated cities 396 sq. miles

LACFD is directly responsible for wildfire prevention and suppression on approximately 15% of the total VHFHSZ land in Los Angeles County. Through a long-standing agreement with Cal Fire, LACFD additionally provides contracted fire prevention, investigation and initial attack (first two hours) fire suppression services to the State for all SRA land in the County, including an additional 30% of VHFHSZ area. Finally, LACFD has the legislative responsibility to provide structure protection for buildings located within the FRA.

This summary of land responsibilities is an important foundation for understanding the wildfire management obligations of each involved agency in both financial and operational terms.

Division of Responsibility For Wildfire Suppression

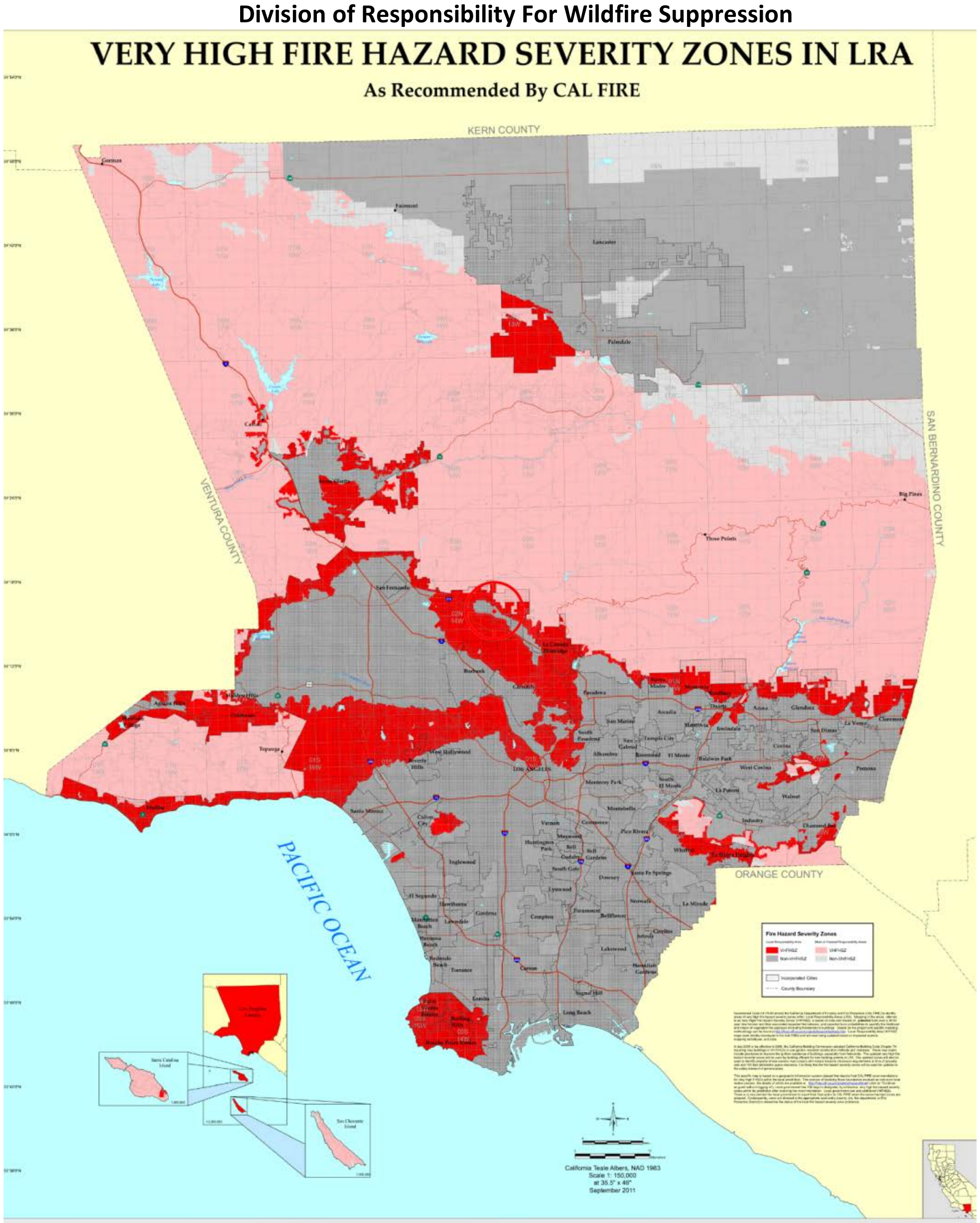


Figure 1 Red = LRA VHFHSZ Pink=SRA & FRA VHFHSZ (2)

Initial Attack Responsibilities

LACFD ground and air resources are currently configured to provide an extremely robust initial attack response to reported wildland fires in the previously mentioned LRA and SRA portions of the County. Through agreements, LACFD air and ground resources also respond to reported wildland fires in those VHFHSZ areas that border other entities, such as the USFS, LAFD, etc. Additionally, LACFD responds resources when structures are threatened on FRA lands.

These resources, including aircraft, respond en masse to "blitz" the fire quickly and to prevent it from growing beyond the control of local resources. Despite the size of LACFD, it only has the depth of resources to sustain this blitz for 24-36 hours before other jurisdictional responsibilities, such as Emergency Medical Services (EMS), structure fires, urban station coverage, etc., are negatively impacted. During the initial response/attack phase, LACFD is successful in containing more than 95% of all fires in wildland areas and limiting growth to less than 10 acres.

Extended Attack Responsibilities

In those instances in which LACFD is unsuccessful in containing wildland fires in the first few hours and significant growth occurs, additional augmentation of resources is required to support continuous operations. For these types of incidents, LACFD collaborates with CAL-OES (California's statewide mutual aid system), Cal Fire and/or the USFS (depending on land responsibility SRA/FRA) to access additional resources to effectively sustain fire control efforts. These partner agencies have access to a much larger pool of agency and contract resources to draw from. This augmentation is critical because it provides LACFD both re-enforcements to help fight the active fire, and it also allows LACFD to reset (and rehabilitate) its resources and return to daily operation status in preparation for the next significant initial attack fire.

Air Operation Resources

The Air Operations Section of the Los Angeles County Fire Department (LACFD) is specifically tasked with performing five core missions that in turn directly support the Department's overarching mission of saving lives and protecting property.

1. Aerial Firefighting (Accurately Dropping Water on Fires)
2. EMS Treatment and Transportation
3. Technical Rescue (Hoist, Swift-water, Large Animal, etc.)
4. Command, Control & Coordination (Aerial Supervision)
5. Logistical Support (Crew/Equipment Transport, Mapping, Recon & Admin. Flights)

The responsibility to successfully fulfill each of these missions exists 365 days a year and touches nearly every community in the county from Catalina to Wrightwood, from Malibu to Claremont and from Palos Verdes to Lancaster. The 62 dedicated men and women that make up the staff of the Air Operations Section rely on a combination of resources, aircraft, equipment and facilities, to consistently accomplish these challenging missions.

The most complex of these five missions for LACFD is the provision of aerial firefighting capability to effectively address the initial attack challenges facing the organization. Over the past three decades, the Department has successfully developed a robust and scalable aircraft deployment model that effectively addresses this central mission through the blending of owned, leased and shared resources.

Through the flexibility afforded by leasing and partnering, LACFD has been able to add resources during historically high periods of wildland fire danger, such as the fall months due to Santa Ana winds. However, with the continuation of the current five year drought, LACFD now faces these challenges on a year round basis. One such example was the destructive Colby Fire, which started on January 16, 2014. Despite the full use of local, regional and contract aircraft (SuperScoopers), this out-of-season fire destroyed 15 structures and consumed more than 1,900 acres.

County Owned Aircraft

Until recently, LACFD operated a fleet of nine multi-mission aircraft each capable of performing all required LACFD aviation missions, including aerial firefighting. With the loss of Copter 10 on August 16, 2015, following a destructive landing, the fleet was reduced in size to eight aircraft.

LACFD staffs three aircraft daily and deploys them to strategic locations in Malibu, Pomona and Lancaster. Year-round, the standard aircraft response for a wildland fire includes two LACFD helicopters and one LAFD aircraft. During periods of high wildland fire danger, LACFD strives to staff at least two of the three S70 Firehawks, and when possible all three. However, due to the aging of the fleet and the loss of Copter 10, LACFD has been faced with a fleet availability of just 55% (4), which has limited the ability to staff two or more S70s Firehawks.

Aircraft	Model	Type/Gallons	Year	Age	Total Hours	Ave Annual Hours
Copter 10 (Surveyed 2015)	Bell 412	Type 2 / 360 gal.	1981	34.00	8929	262.6
Copter 11	Bell 412EP	Type 2 / 360 gal.	2006	9.00	2411	267.9
Copter 12	Bell 412EP	Type 2 / 360 gal.	2007	8.00	2142	267.8
Copter 14	Bell 412EP	Type 2 / 360 gal.	12/2005	10.00	2748	274.8
Copter 15	Sikorsky S70-A	Type 1 / 1000 gal.	11/2004	11.00	3084	280.4
Copter 16	Sikorsky S70-A	Type 1 / 1000 gal.	12/1998	17.00	4237	249.2
Copter 17	Bell 412HP	Type 2 / 360 gal.	1992	23.00	8218	357.3
Copter 18	Bell 412HP	Type 2 / 360 gal.	1992	23.00	7526	327.2
Copter 19	Sikorsky S70-A	Type 1 / 1000 gal.	12/2000	15.00	4478	298.5
Yearly Averages Firefighting Helicopter Typing: ▪ Type 1 – 700 or more gallons & 15 or more passengers ▪ Type 2 – 300 to 699 gallons & 9-14 passengers ▪ Type 3 – 100 to 299 gallons & 4-8 passengers				**16.67**	**4863.67**	**287.3**

The anticipated effective lifespan for the aircraft in LACFD's current fleet is based on several factors including age, flight hours, utilization, maintenance thresholds, obsolescence of components (such as avionics & flight control systems) and trade in considerations. Historically, the smaller Bell 412 aircraft have remained in the fleet for 25 or more years. LACFD currently has two aircraft (Copt 17 & 18) that are approaching this threshold. These aircraft are still functional and remain valuable to the current fleet. However, with the acquisition of new aircraft, these will be the first to be replaced.

The LACFD fleet of three S70a Firehawks range in age from 12 and 18 years old. Many of the avionic and flight control systems associated with these aircraft are now facing obsolescence issues. In addition, the cost of maintaining these aircraft continues to increase with age and flight hours, specifically once the 5,100 flight hour threshold is crossed due to the mandatory replacement of costly life-limited components. Based on historical aircraft utilization, the combination of these factors supports a targeted lifespan of between 17-18 years for the S70a aircraft.

Shared Aircraft

LACFD has enjoyed a collaborative relationship with LAFD for more than a decade. One element of this relationship has been the integration of aircraft from each agency on wildland fire incidents. Each agency automatically provides the other with one aircraft on each wildland fire dispatch to help augment the response without completely draining resource availability County-wide.

County Leased Aircraft

Since the destructive Firestorms of 1993, LACFD has augmented its existing fleet of multi-mission helicopters with additional initial attack aircraft solely dedicated to wildland fire suppression operations. This combination of increased aerial assault capabilities have proven successful in terms of lives and property saved (4). Currently, LACFD has two annual exclusive use contracts: one with the Government of Quebec for a yearly period of 90 days for two CL-415 SuperScooper aircraft; and a second 120-day contract with Erickson Helicopters for a single S-64F Helitanker. These contracts generally start each year on August 15th and September 1st respectively. Depending upon aircraft availability, these contracts can be negotiated to start earlier and/or be extended longer if high risk wildland fire conditions exist. The challenge with these contracts is the lack of late-spring and early-summer availability of the SuperScoopers and the high cost associated with the Helitanker.

State & Federal Aircraft

When wildland fire threatens to escape initial attack containment efforts or when such efforts have failed to suppress the fire, the incident becomes an extended attack or large fire incident where State and federal helicopters and air-tankers can be requested. The cost associated with deploying these critical resources is generally the responsibility of the entity (or entities) that has the legal responsibility for the land the fire is on, i.e. LRA, SRA or FRA.

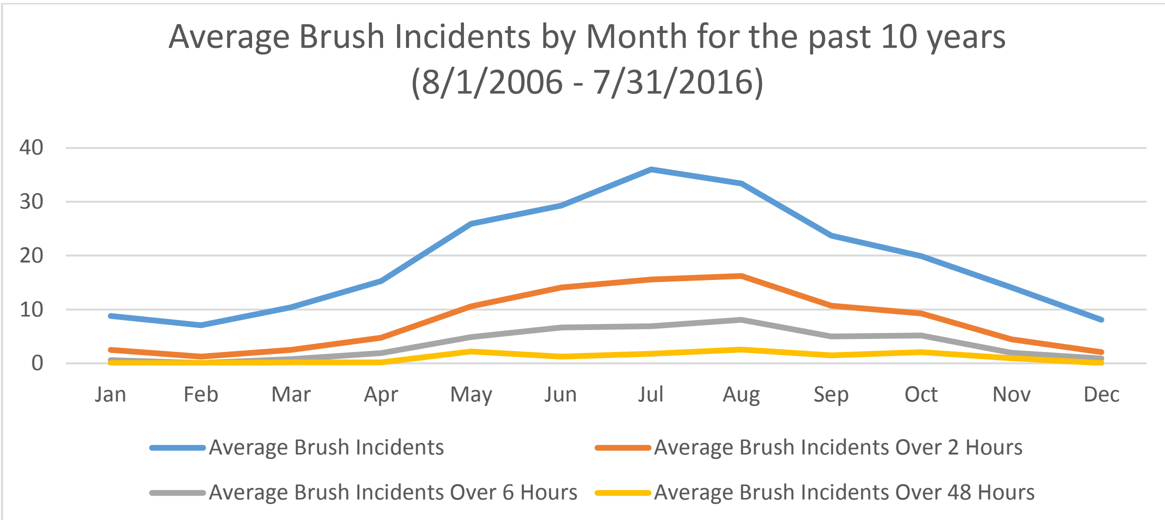
Cal Fire operates a fleet of 12 Bell medium water dropping helicopters and 22 S-2 medium air tankers statewide (5). The USFS operates dozens of large and medium helicopters on contract along with at least 21 fixed wing air tankers including BA146's, MD87's, P2V's and the DC10's, known as Very Large Air Tankers (VLAT) (6).

Through this blended approach of ownership, leasing and partnerships, LACFD has access to a large arsenal of various types of aircraft for wildland fires ranging from the small initial attack incident to larger extended attack fires, including large campaign incidents.

The Year Long Fire Season

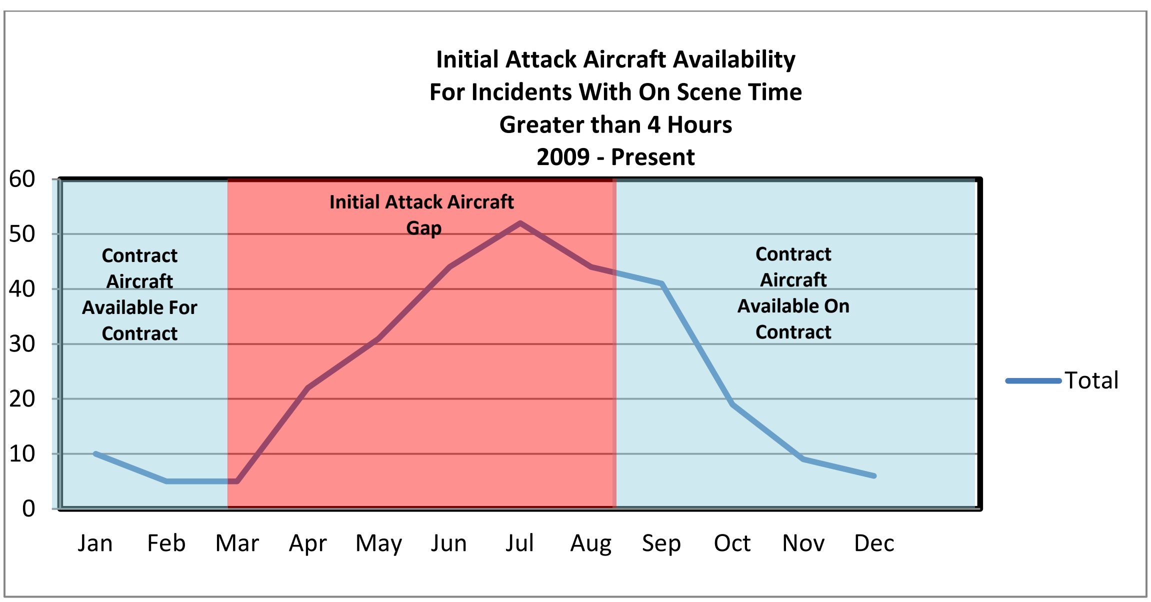
With the continuation of high temperatures, low humidity and severe drought conditions, Los Angeles County has experienced a noticeable shift in what once was commonly recognized at a standard May through November fire season. Response data (7) and recent fire history demonstrates that with the right daily conditions, significant wildland fires can occur during any month of the year.

In addition to an increase of out-of-season wildland fire activity, the associated difficulty in containing initial attack fires (resistance to control) during the months of April to August has consistently rivaled the challenges traditionally reserved for wind-driven fires predominately seen in the months of September through November. With the lack of significant rainfall associated with this drought, the normal fire-season-ending rain events are not occurring in the late fall, resulting in high risk wildland fire conditions consistently extending into January and February.



Initial Attack Aircraft Gap

With today's wildland fires demonstrating much greater resistance to control, and with the fire season greatly extended, approaches that were once successful are now proving to be less than reliable. As an example, the contracts for the SuperScoopers and Helitanker were originally designed to augment LACFD's aerial firefighting resources during the fall to address the historic threat posed by Santa Ana winds (4). Unfortunately, this approach is no longer harmonized with the threats facing LACFD year round, resulting in a substantial gap (7) in aerial firefighting capability.



When challenging fires occur in the spring and early summer, (April to August), the arsenal of contract aircraft (SuperScoopers and Helitanker) are not on contract, and in the case of the SuperScooper not yet available. LACFD must rely on its internal fleet of firefighting helicopters and mutual aid aircraft from partner agencies (LAFD, Cal Fire, USFS), when available, to contain these often explosive fires. To close this gap, a cost and operational analysis was conducted to determine the most effective way to adjust LACFD's blend of owned, leased and shared resources.

Additional Aircraft Acquisition Options

Prior to analyzing various aircraft available to LACFD for acquisition, it is first important to define the desired capabilities for additional firefighting aircraft to support LACFD during the initial attack and early extended attack phases of wildland fires. These desired capabilities include:

1. High Production Rate – Ability to deliver a large quantity of water/retardant during the initial attack and early extended attack phases of a fire from available water sources in Los Angeles County
2. Night Flying Capability – Ability to fight fire & perform other LACFD aviation missions during hours of darkness
3. Accuracy of Drops – Ability to deliver payloads on target and in direct support of ground crews in varied terrain
4. Response Speed – Ability to mobilize rapidly (take-off) and fly with high enough speed to reach all parts of the County quickly
5. Multi-Mission Capability – Ability to perform more than one of the five core LACFD missions
6. Acquisition Availability – LACFD's ability to acquire the resource when it is needed
7. Operating Cost – Ability to meet many or all of these desired capabilities at a reasonable cost

Based on this list of desired capabilities, six different aircraft were analyzed, three rotary wing and three fixed wing; and a detailed summary was completed (see Aircraft Capabilities Acquisition Chart).

Air Tractor 802 Fire Boss

This small and economic fixed wing aircraft compared favorably against the many other aircraft from a cost standpoint (8). However, due to its low production rate of 3,250-3,900 gallons per hour (gph) and its lack of night flying and multi-mission capability, it did not finish in the top three. Nevertheless, this aircraft needs to be evaluated further to determine its feasibility for use in Los Angeles County with the limited number of open water sources available.

Bell 412 EPI

LACFD currently owns and operates five Bell 412 helicopters as part of its eight aircraft multi-mission fleet. This aircraft performs the majority of the required LACFD missions with efficiency and effectiveness. However, the Bell 412's strength lies in its adaptability and not its sheer firefighting capability as it has a limited production rate of 1,500-3,000 gph. To improve aerial firefighting capabilities, LACFD needs to consider other aircraft options in addition to the Bell 412.

Sikorsky S70i Firehawk

At the heart of LACFD's multi-mission deployment model are three Department owned Sikorsky S70a Firehawk helicopters. First developed by LACFD in partnership with Sikorsky in 1998, the S70a Firehawk has proven to be the single most effective multi-mission aircraft currently available. The newest model of this combat proven aircraft is the S70i Firehawk. With improvements in avionics, flight control systems, powertrain and maintenance monitoring systems, this aircraft is safer and even more operationally dominate than its predecessor.

In this evaluation, the S70i Firehawk out surpassed all other evaluated aircraft and achieved a positive rating in all nine comparative assessments. Most notably, the S70i Firehawk had a production rate that rivaled or exceeded all other aircraft, with the exception of the DC10. In addition, the S70i Firehawk can maintain its high water delivery rate through the night when other aircraft are grounded.

LACFD's ability to consistently deploy four or even five S70 Firehawks during periods of elevated fire danger will serve to close the "initial attack aircraft gap" previously discussed. Sikorsky has indicated they have several (6-8) aircraft available for immediate acquisition and they have offered LACFD an estimated 25% reduction in price for a timely purchase of multiple aircraft.

CL-415 SuperScooper

Over the past 23 years, two Quebec based SuperScooper (CL-215 & CL-415) amphibious aircraft have augmented LACFD's aerial firefighting capability during the fall of each year. These highly visible and well-branded aircraft have won the hearts of both the public and the media, capturing attention whenever they are called into action. For LACFD, the fondness for the Quebec leased CL-415 is not based on branding; it is based on capabilities and demonstrated performance.

In comparison to most other firefighting aircraft, the CL-415's strengths stand out; the CL-415 delivers a tremendous payload of water (between 1400-1600 gal), it flies at 160-180 knots ensuring they arrive quickly County-wide; it can "load & return" much quicker than other non-amphibious air tankers; and finally the CL-415 is affordable when referencing our ongoing partnership with the government of Quebec. For example, the cost associated with using the Quebec leased CL-415s for a four hour initial attack fire is $20,317 (9). When compared to other contract options such as Aero-Flite, at $95,481 (6) for the same scenario, the affordability of the Quebec based CL-415 SuperScoopers is clearly demonstrated.

Many people have questioned why LACFD doesn't purchase two or more CL-415s to provide enhanced aerial response capability year round. The answer contains two parts; one, the CL-415 is no longer in production. Bombardier, the original manufacturer of the aircraft, recently sold its production rights to Viking Air (10) who has no immediate plans or capability to restart the production line for new aircraft; and second, cost. Due to the high capital and staffing costs associated with CL-415 ownership and the comparatively low utilization rate by LACFD, estimated at 100 hours per year per aircraft, ownership, even if new aircraft were available, creates significant financial concern.

Operationally, the continued utilization of two or more CL-415s from Quebec, starting as early each summer as possible (July or August), will address the earlier start to the fire season as a result of impacts from climate change. This, combined with other aircraft augmentation, such as additional S70i Firehawks, creates a well-balanced and blended approach to the aerial firefighting challenges facing LACFD.

Erickson S-64 Helitanker

LACFD's relationship with Erickson has existed for over a decade through an exclusive use contract (11) for one S-64 Helitanker for 120 days each year. The contract was designed to augment LACFD's aerial resources during the fall months due to the historic threat posed by Santa Ana winds. Currently, LAFD also contracts with Erickson for an S-64 making two or more of these aircraft available from August to the beginning of December each year.

As is indicated in the summary chart, the S-64 delivers a high production rate, which can be valuable during large fires. However, this aircraft comes with a steep cost. For the past six years, LACFD has had an average utilization rate of just 32 hours per year for the S-64, at a contract cost of more than $3.2 million per year.

An important finding in both the Conklin & de Decker report and in the Aircraft Capabilities Summary chart is that the S70i Firehawk can compete and even outperform the S-64 Helitanker in aerial firefighting capability, and additionally perform every other mission required by LACFD. In addition, the S70 Firehawk can do this at night. For these reasons, and based on the potential availability of the LAFD leased S-64, LACFD needs to determine when and if the continued utilization of the Erickson S-64 Helitanker contract makes sense.

McDonnell Douglas DC-10

Despite the DC-10's imposing size and overwhelming capacity to deliver large quantities of retardant, this analysis quickly concluded that the DC-10 is not ideally suited for the initial attack requirements of LACFD. Operationally, the DC-10 is a strategic aircraft and is not designed to work tactically, in close proximity with ground resources, nor does it meet the requirements of rapid response. More importantly, the DC-10 is exceptionally expensive. The cost for four drops of retardant over a four hour period is approximately $245,000 (6). This aircraft and the retardant it carries are designed to support fires that have escaped initial attack containment efforts and threaten to be or have become extended attack or large fires. When these situations exist, LACFD can access this resource from both Cal Fire and the USFS, generally at no cost to LACFD.

FIREFIGHTING AIRCRAFT CAPABILITIES COMPARISON

Aircraft Type \ Mission Type	FIREFIGHTING	GROUND FILL	SNORKEL FILL	NIGHT FLYING	CREW TRANPORT	EMERGENCY MEDICAL	HOIST RESCUE	COMMAND & CONTROL	LOGISTICAL SUPPORT	DROPS NEAR CREWS	MANEUVERABLE IN STEEP TERRAIN
Sikorsky S70a Firehawk	Very Effective	Very Effective	Very Effective	Very Effective	Very Effective	Very Effective	Very Effective	Very Effective	Very Effective	Very Effective	Very Effective
Bell 412	Very Effective	Very Effective	Very Effective	Very Effective	Very Effective	Very Effective	Very Effective	Very Effective	Very Effective	Very Effective	Very Effective
CL-415 Superscooper	Very Effective	Not Effective	Not Effective	Not Effective	Not Effective	Not Effective	Not Effective	Not Effective	Not Effective	Somewhat Effective	Somewhat Effective
Fire Boss AT802	Very Effective	Not Effective	Not Effective	Not Effective	Not Effective	Not Effective	Not Effective	Somewhat Effective	Not Effective	Very Effective	Somewhat Effective
Sikorsky S-64 Skycrane	Very Effective	Very Effective	Very Effective	Not Effective	Not Effective	Not Effective	Not Effective	Not Effective	Not Effective	Not Effective	Very Effective
VLAT DC 10	Very Effective	Very Effective	Not Effective	Not Effective	Not Effective	Not Effective	Not Effective	Not Effective	Not Effective	Not Effective	Not Effective

LEGEND	
Very Effective	(green)
Somewhat Effective	(yellow)
Not Effective	(red)

Partnerships with Other Agencies

LACFD has pre-established mutual threat zones (MTZ) with neighboring agencies including LAFD, Orange County Fire Authority (OCFA), and Ventura County Fire Department (VCFD). These areas receive a first alarm assignment on all brush fire responses. If LACFD responds to a brush fire outside of a MTZ, LAFD will provide one of the three helicopters on the response during daylight hours year round. LACFD will provide one helicopter, four camp crews, one superintendent and one battalion chief to a brush fire in LAFD area outside a MTZ. Both agencies currently have contract aircraft and have mutually agreed to share those resources with each other to the mutual benefit of each agency if those resources are not already committed to another incident.

LACFD serves as one of six Contract Counties for CAL FIRE, providing wildland fire protection in State Responsibility areas within their jurisdictions. LACFD responds up to a second alarm response and additional resources are requested and approved through South Operations in Riverside, California, or through an Agency Representative that responds to the scene. These resources include a variety of aircraft including the McDonnell Douglas DC-10 (VLAT) and a broad base of mobile logistical support for large scale incidents. The availability and utilization of Cal Fire S-2T air tankers, with a tank capacity of 1,200 gallons of retardant (5), is one sound option for improving LACFD aerial firefighting capabilities from May to August.

The USFS (Angeles National Forest) is another one of our partner agencies. LACFD responds mutually with throughout the County on forest borders within an initial action zone (IAZ). Close coordination with dispatch centers ensures common communication plans. Within the IAZ, both agencies respond to first alarm brush fire assignments, including aircraft. Both agencies assist each other within a mutually agreed upon annual operating plan (AOP). LACFD additionally has the responsibility within the forest for the protection of structures in the event of fire as well as medical and trauma emergency response. If the ANF requests assistance from LACFD within their lands outside of the IAZ, they compensate the County for those resources under an established assistance by hire agreement.

Cl-415 Availability from the Southern Hemisphere

In researching the various countries that currently operate the CL-415 (and CL-215) aircraft, it was determined that none are from the Southern Hemisphere. Currently, approximately 90+ CL-415s are being operated worldwide in 11 countries including (10); Canada, Croatia, France, Greece, Italy, Malaysia, Morocco, Spain and the United States (Aero-Flite).

Conklin & de Decker Fleet Analysis Report

The completed Conklin & de Decker report (Attachment C) was submitted to LACFD on September 13, 2016. The report focused on addressing the following four issues:

1. Identify the effect of any FAA regulations related to the LACFD's helicopter EMS mission regarding public aircraft.
2. Compare operating costs between the annually contracted Erickson S-64 Aircrane and the S-70 Firehawk.

3. Analyze acquisition and maintenance costs, including maintenance, for two options regarding the Sikorsky S-70 fleet. These two options are to retain the current S-70A helicopters or to obtain new S-70i helicopters.
4. Perform a fleet review that compared performance parameters for candidate helicopters and recommended fleet size for the S-70 helicopters.

Based on the review of several LACFD subject matter experts, the report has effectively addressed each of these issues and now provides LACFD the much needed technical guidance for replacing and rebuilding the aircraft fleet.

Recommendations

The subject matter presented in this document is broad in scope and technical in detail. However, based on both analytical findings and professional experience many concrete findings have been determined.

To answer the introductory question posed at the start of this document, the following recommendations are being made to ensure LACFD has the adequate year-round aerial firefighting resources to meet the demand of effective wildland fire suppression while maintaining full capability to complete all other aviation mission demands. These recommendations are:

- Identify a target capability of staffing five S70 Firehawk helicopters on high fire danger days to ensure a rapid and robust day & night aerial response and building a fleet inventory that can support this level of commitment consistently;

- Take advantage of the availability and substantial cost savings offered by Sikorsky and systematically replace and augment the existing fleet of S70a Firehawk helicopters with new and more capable S70i aircraft at a total mission-ready cost of $15.8 million (inclusive of 25% discount) per aircraft (see Attachment B);

- Commit to improving the infrastructure (hangar and support facilities) and aviation safety systems, at an estimated cost of $15-20 million, to ensure appropriate support for the current air fleet and the proposed enhanced fleet discussed above;

- Continue our longstanding and cost-effective partnership with the Government of Quebec to ensure future access to the CL-415 SuperScoopers;

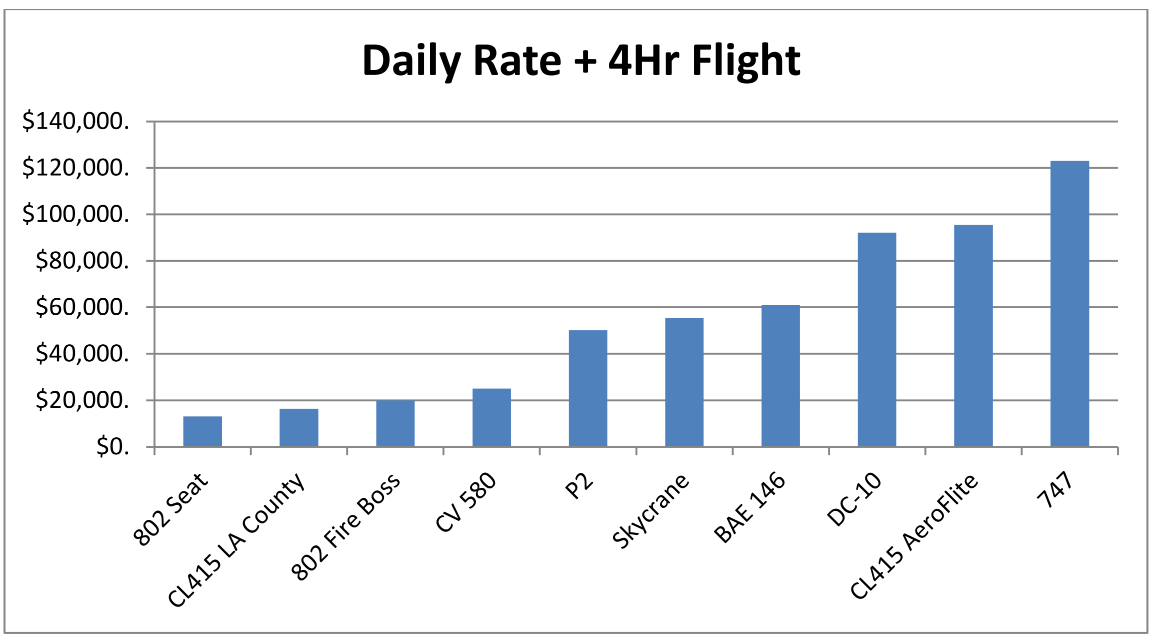
- Revisit the current annual 120-day exclusive use contract with Erickson for the S-64 Helitanker and determine if the allocated $3.2 million can be spent more effectively toward the S70 replacement and enhancement recommendation;

- Continue to partner with Cal Fire to improve air tanker coverage on initial dispatch for wildland fires occurring during the targeted gap months of May to August and beyond. Continue discussion with this strong partner on developing basing location options for tankers and aerial supervision within Los Angeles County, such as Van Nuys;

- Improve strategies to address drought impacted water sources by increasing the use of temporary portable water source facilities.

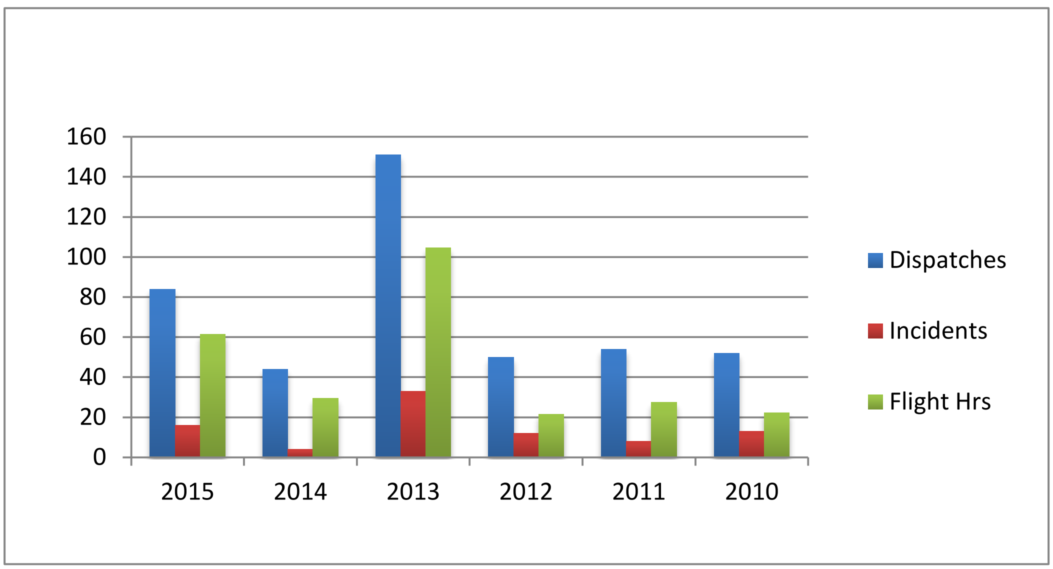
CHARTS AND TABLES

OPERATIONAL COSTS	BELL 412 COUNTY OWNED	SIKORSKY S70 COUNTY OWNED	ONE CL415 SUPER SCOOPER COUNTY OWNED (HYPOTHETICAL)	TWO CL415 SUPERSCOOPERS COUNTY OWNED (HYPOTHETICAL)	TWO CL415 SUPERSCOOPERS LEASED 365 DAYS (HYPOTHETICAL)
AIRCRAFT ACQUISTION (Includes Tax)	$13,620,000	$15,800,000	$32,700,000	$65,400,000	$0
Annual Cost (10 Years @ 9% Interest)	$1,664,820	$1,931,289	$3,997,034	$7,994,068	$0
(These figures are for comparison only)					
Cost of Ownership - Based On Utilization	300 Hours / Year	300 Hours / Year	100 Hours / Year	100 Hours / Year / A/C	100 Hours / Year / A/C
Hourly Rate	$5,549	$6,438	$39,970	$79,941	$2,158
Daily Rate					$24,002
PERSONNEL COSTS					
Additional Pilots	Existing Pilots	Existing Pilots	4	8	0
Annual Cost (SEB=$207,000 each)			$828,000	$1,656,000	$0
Additional Mechanics	Existing Mechanics	Existing Mechanics	2	4	0
Annual Cost (SEB=$135,000 each)			$270,000	$540,000	$0
Additional Annual Cost of Personnel			$1,098,000	$2,196,000	$0
(SEB = Salary & Employee Benefits)					
TOTAL ANNUAL AIRCRAFT & PERSONNEL COST	$1,664,820	$1,931,289	$5,095,034	$10,190,068	$9,192,330
PROJECTED AIRCRAFT/PERSONNEL COST / HR. Based on Historic Utilization	$5,549	$6,438	$50,950	$101,901	$91,923



Helitanker Six Year Summary						
Year	*Dispatches*	*Incidents*	*Days*	*Flight Hours*	*Gallons*	*Drops*
2015	77	8	120	14.9	95,400	53
2014	51	2	120	6.5	16,200	9
2013	104	20	135	49.4	608,400	338
2012	71	23	120	58.4	334,600	186
2011	68	15	127	41.3	318,600	177
2010	66	11	120	21.3	117,000	65
Total	437	79	742	191.8	1,490,200	828
Average	73	13	124	32	248367	138

SuperScooper Six Year Summary						
Year	*Dispatches*	*Incidents*	*Days*	*Flight Hours*	*Gallons*	*Drops*
2015	84	16	149	61.4	240,000	150
2014	44	4	118	29.5	38,400	24
2013	151	33	227	104.6	766,400	479
2012	50	12	98	21.6	217,600	136
2011	54	8	110	27.4	180,080	113
2010	52	13	105	22.3	147,200	92
Total	435	86	807	266.8	1,589,680	994
Average	73	14	135	44	264947	166



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AIRCRAFT CAPABILITIES & ACQUISITION SUMMARY

High Level Capabilities Comparison	AT802 Fire Boss 	Bell 412 EPI 	Sikorsky S70i Firehawk 	CL-415 SuperScooper 	Erickson S-64 Helitanker 	McDonnell Douglas DC 10 VLAT 
High Production Rate Ability to Deliver 5,000 gph or More During the Initial Attack & Early Extended Attack From Available L.A. County Water Sources (GPH = Gallons / Hour)	NO 3,250-3,900 gph (5-6 Lake Fills Per Hr.) (Average 650 gals/load)	NO 1,500-3,000 gph (5-10 Ground Fills Per Hr.) (Average 300 gals/load)	YES 6,000-9,600 gph (7.5-12 Snorkel Fills Per Hr.) (Average 800 gals/load)	YES 7,000 - 8,400 gph (5-6 Lake Fills Per Hr.) (Average 1,400 gals/load)	YES 7,200 - 10,800 gph (4-6 Lake Fills Per Hr.) (Average 1,800 gals/load)	YES 11,,700 gph (1 Ground Fill Per Hr.) (Average 11,700 gals/load)
Night Flying Capability Ability to Fight Fire & Perform Other Missions During Hours of Darkness	NO	YES	YES	NO	NO	NO
Accuracy of Drops Near Crews Ability to Deliver Payload On Target in Direct Support of Crews in Varied Terrain	YES Accurate Makes Drops at 80 knots	YES Very Accurate & Able to Maneuver in Canyons, Drainages and Steep Terrain	YES Very Accurate & Able to Maneuver in Canyons, Drainages and Steep Terrain	YES Accurate In Flat or Rolling Terrain Difficult in Steep Terrain	NO Drops Can Be Accurate But Cannot Be Made Near Personnel	NO Indirect Drops Are Made In Advance of the Fire Drops Cannot Be Made Near Crews
Speed of Response For Initial Attack Ability to Respond Rapidly (Take-Off) and Reach All Parts of the County Quickly	FAST Aircraft Can Be Based In Strategic Locations, Responses Quickly & Flies At 150 Knots	FAST Aircraft is Base In Strategic Locations, Responses Quickly & Flies At 120 Knots	FAST Aircraft Can Be Based In Strategic Locations, Responses Quickly & Flies At 150 Knots	FAST Aircraft Responds Quickly & Flies at 160-180 Knots	SLOW Aircraft Has A Slow Start Up and Flies at 90 Knots	SLOW Aircraft Has A Very Slow Mobilization Time But Flies Extremely Fast At 500 Knots
Multi-Mission Capability Ability to Perform More Than One of the Five Core LAC Aviation Missions	NO Aircraft Performs Only The Aerial Firefighting Mission	YES Aircraft Performs All LAC Missions Effectively	YES Aircraft Performs All LAC Missions Effectively	NO Aircraft Performs Only The Aerial Firefighting Mission	NO Aircraft Performs Only The Aerial Firefighting Mission	NO Aircraft Performs Only The Aerial Firefighting Mission
Acquisition Cost New Aircraft Cost - Mission Ready	$4.0 Mil	$13.6 Mil	$15.8 Mil	$32.7 Mil	$35.0 Mil	$80.0 Mil+
Acquisition Availability LAC's Ability to Acquire the Resource When Needed Through Purchasing, Leasing or Contracting	CONTRACT YES PURCHASE YES Vendors Exist That Have Solicited Offers To Buy Or Lease This Aircraft	LEASE YES PURCHASE YES Bell Can Provide This Aircraft Through Direct Purchase or Leasing	LEASE YES PURCHASE YES Sikorsky Can Provide This Aircraft Through Direct Purchase or Leasing	CONTRACT YES PURCHASE NO Aircraft Is Not In Production & Is Not Available For Sale Aircraft Can Be Leased From Both Govt of Quebec & Aero-Flite	CONTRACT YES PURCHASE YES These Aircraft Can Be Purchased Through Erickson Aircraft Can Be Leased/Contracted From Vendor	CONTRACT YES PURCHASE NO Custom Aircraft That Is Not In Production - Cost Would Be Extreme. This Aircraft Can Be Leased on Contract With 10 Tanker Company
Operating Cost Ability to Meet Many or All of These Desired Capabilities at a Reasonable Cost	CONTRACT $ PURCHASE $	LEASE $$ PURCHASE $$	LEASE $$ PURCHASE $$	QUEBEC CONTRACT $$ AERO-FLITE CONTRACT $$$$$	CONTRACT $$$$ PURCHASE $$$$	CONTRACT $$$$$
Incident Cost Summary Daily Rate + 4 Hours of Flight Rate	$20,000	$14,800	$26,800	Quebec Contract: $16,317 $4,000 Fuel Aero-Flite Contract: $95,481	$55,540.00	$92,150.00 $40,800 Fuel $117,000 Retardant
Total Cost for 4 Hrs of Fire Suppression	$20,000	$14,800	$26,800	$20,317 (Quebec) $95,481 (Aero-Flite)	$55,540	$245,950.00

LOS ANGELES COUNTY FIRE DEPARTMENT
Analysis of Excess/Retired Military Aircraft

Background

In 2014, the U.S. Department of Defense (DOD) started the process of divesting its aging fleet of UH60A helicopters. The UH60A is the military version of the S70A Firehawk aircraft used by the Los Angeles County Fire Department (LACFD). The first round of divestiture saw 112 UH60A aircraft auctioned off to private operators at prices as low as a few hundred thousand dollars. When aircraft such as these are transferred to public safety agencies under programs such as the Federal Excess Property Program (FEPP), the purchase cost is generally free.

When considering the capital cost to procure new aircraft, the prospect of acquiring used aircraft for free can sound enticing. However, free is not truly free.

The UH60A aircraft in discussion are being released by the DOD for the simple reason that they have outlived their effective lifespan. These aircraft were manufactured in the early 1980s and many have been exposed to the rigors of years of hard use in extreme environments under active combat conditions. They are simply worn out.

With old aircraft come many challenges, first of which are steep maintenance requirements. Airframe and component fatigue require increased parts replacement and ongoing service. The majority of the 112 aircraft recently auctioned by DOD will never fly, but instead will serve as a part supply for those deemed to be in the best condition.

Challenges

If LACFD were to commit to acquiring and operating military surplus UH60A helicopters, it would exacerbate the organization's challenges faced with its existing aging fleet. The most notable of these challenges are:

- Significant initial overhaul cost to bring surplus aircraft up to FAA and industry standards for the missions flown by LACFD, particularly EMS and aerial firefighting.

- Increasing cost of operation as aircraft climb past 5,100 flight hours.

- Decreasing support from the original equipment manufacturer (OEM) for parts and component overhaul support.

- Lack of a parts support program such as LACFD's current Total Assurance Program (TAP) with Sikorsky. This would require the establishment of a robust supply chain to ensure parts and services support.

- Lack of TAP would also require the development of a large and costly inventory of spare parts to ensure the timeliness of repairs and minimized downtime.

- Obsolesces of avionics, flight control systems and associated components.

- Antiquated systems and reduced systems capabilities. These older aircraft (35 years older) lack the technological advancements now available in modern aircraft, which increases flight safety, operational effectiveness, maintenance demands and overall operating costs.

Once you have tackled each of these challenges, you are still faced with the fact that your fleet of surplus aircraft is 35+ years old.

Recommendation

It is recommended to move toward the purchase of new yet discounted Sikorsky S70i aircraft versus addressing unknown challenges and escalated cost surrounding the refurbishment of excess/retired aircraft.

Aircraft Fleet Analysis

County of Los Angeles – Air Operations

Prepared for:

County of Los Angeles Fire Department
Air Operations
Pacoima, CA

September 13, 2016

Prepared by

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1006 North Bowen, Suite B
Arlington, TX 76012
817 277 6403

Introduction

The stated objective in the Request for Proposal by the Los Angeles County Fire Department's Air Operations Section (LACoFD Air Ops) was to complete a fleet analysis of the current aircraft and their missions by evaluating aircraft parts plans, reviewing options for budgetary stability, examining issues regarding mission readiness for the Sikorsky S-70 Firehawks, and analyzing of the number of each type of aircraft as applied to the mission demands and costs for various purchase options.

After the award of the contract, Conklin & de Decker and LACoFD Air Ops agreed on the following specific items to accomplish the objective.

- Identify the effect of any FAA regulations related to the County's HEMS mission regarding public aircraft.
- Compare operating costs between the annually contracted Erickson S-64 Aircrane and the S-70 Firehawk.
- Analyze acquisition and maintenance costs, including TAP, for three options regarding the Sikorsky S-70 (S-70) fleet. The three options were to retain the current S-70A helicopters, convert the S-70A airframe to S-70L version with enhanced avionics, and obtain new S-70i helicopters.
- Perform a fleet review that compared performance parameters for candidate helicopters and recommended fleet size for the S-70 helicopters.

Conklin & de Decker created a section for each item and analyzed the items separately. Each section consists of

- A restatement of the County's original issue, concern or question.
- Conklin & de Decker's proposed approach.
- A conclusion that summarizes the analysis and research.
- An analysis that explains the process and research to support the conclusion.

Listed below are the sections with the respective page numbering.

Section 1 – Public Aircraft, Helicopter Air Ambulance Operations

1.0 LACoFD Air Ops Original Request

In recent years the United States Congress, Federal Aviation Administration (FAA), and National Transportation Safety Board (NTSB) have passed legislation, issued regulations, and expressed concerns about the safety record and practices of aviation in general and certain aspects of helicopter operations. More specifically, the activity has focused on Helicopter Emergency Medical Services (HEMS) and Public Aircraft. Given the recent changes, LACoFD Air Ops asked Conklin & de Decker to research the following areas regarding its current fleet.

- Identify the effect of any FAA regulations related to the County's HEMS mission regarding public aircraft.

1.1 Conklin & de Decker Approach

This section of the report provides information regarding LACoFD Air Ops desire to understand the effects of recent congressional legislation and FAA activity regarding helicopter air ambulance and public aircraft operations. To understand this effect, our analysis was based on the following steps.

- Overview of Public Aircraft and Public Aircraft Operations.
- Overview of the FAA Modernization and Reform Act of 2012 (2012 Act) passed by Congress and how it applies to Public Aircraft and their related operations.
- Overview of the FAA's response to the 2012 Act. (Part 135 subpart L and Advisory Circular 135-14B).
- Applicability of Congress' 2012 Act and FAA's final rule (Part 135 subpart L) and Advisory Circular (135-14B to Public Aircraft Operations).
- LACOFD AIR OPS considerations for its aviation unit and current fleet regarding the 2012 Act, FAA's final rule, and Advisory Circular.

1.2 Summary

In recent years, the safety record of the helicopter industry, and more specifically helicopter air ambulance operations, has received increased attention from various entities in or peripheral to the industry. This attention has initiated legislation, regulations, guidance, and discussion with the intention to improve the safety in helicopter operations by mitigating certain risk factors.

Congress passed the FAA Modernization and Reform Act of 2012 with a major emphasis on safety in general and an entire section on helicopter air ambulance operations. The FAA reinforced the legislation with two significant documents, a final rule for Part 135 operations issued in 2014 and an Advisory Circular issued in 2014 to clarify and provide guidance for mitigating operational risks with the intention of improving safety. Prior to and during this activity from Congress and the FAA, other organizations, primarily led by the NTSB, expressed their concern for safety of operations as well. Safety of helicopter operations appeared on the NTSB Most Wanted List in both 2014 and 2015. The 2015 item was specifically focused on public aircraft operations.

As mentioned, each effort identified safety in operations as a primary goal. The FAA Modernization and Reform Act of 2012 set the tone as to how or where organizations should focus to take the steps toward improved safety. Those areas included flight request and dispatch procedures, pilot training standards, and safety-enhancing technology and equipment. The NTSB 2014 Most Wanted List expounded upon the legislation by encouraging safety management systems that include sound risk management practices, developing flight risk evaluation programs and formalized dispatch and flight-following procedures, and ensuring pilots have access to training that includes scenarios such as inadvertent flight into instrument meteorological conditions and autorotation.

With the significant activity regarding safety in helicopter operations, LACoFD AirOps wanted to know if the FAA's changes (final for Part 135 subpart L and Advisory Circular affected 135-14B), created changes for public aircraft operations and, if not, what elements of the changes should be implemented to accomplish the overall goal of mitigating risks to improve safety in its operations.

Conklin & de Decker's research led to two conclusions and one recommendation.

- The legislation (2012 Act) passed by Congress and the final rule and Advisory Circular issued by the FAA did not change the oversight or regulations as it relates to LACoFD Air Ops public aircraft operations.
- The helicopters currently operated (Bell 412 and S-70A) and proposed to be operated (S-70i), either do currently or could meet the equipment requirements as identified in the Advisory Circular. We limited our review to helicopter equipment since the primary objective of the entire report is centered on the composition of the fleet. We did not expand the focus to include flight request and dispatch procedures and pilot training standards as outlined in the 2012 Act.
- We recommend LACoFD Air Ops conduct a review of its current processes and procedures as outlined in the Advisory Circular to identify opportunities for change to coincide with the intent of the recent changes in legislation and regulations in order to mitigate risks in operations that will lead to safety improvements.

1.3 Conklin & de Decker Analysis

The analysis in this section consists of five sections. Section 1.3.1 is a review of Public Aircraft and their related operations. Section 1.3.2 provides an overview of the FAA Modernization and Reform Act of 2012 passed by Congress and the effect the Act has on Public Aircraft. Section 1.3.3 reviews the FAA's response to the 2012 Act. Section 1.3.4 reviews how the 2012 Act and the FAA's final rule apply to Public Aircraft Operations. Section 1.3.5 Offers suggestions that LACoFD Air Ops may want to consider regarding the recent changes concerning safety and the mitigating risk in its operations.

1.3.1 Overview of Public Aircraft and Public Aircraft Operations (PAO).

Prior to establishing the applicability of the Reform Act and the FAA's Advisory Circular, it is relevant to define a public aircraft and what circumstances cause a public aircraft to move into civil operations.

- **What is a Public Aircraft?** Determining whether an aircraft is classified as Public Aircraft is defined by law in Title 49 of the United States Code (49 U.S.C.) § 40102 (a) (41), paragraph (C). In essence the relevant part of the paragraph for LACoFD Air Ops states that an aircraft owned and operated by a political subdivision of a state government is considered a public aircraft.

  While the classification of an aircraft, based on the type of the organization that operates it, is important, how the aircraft is used (mission) determines whether or not the operation will be required to operate under FAA regulations.

- **What are the mission limitations for a Public Aircraft?** According to Title 49 of the United States Code (49 U.S.C.) § 40125 (b) Aircraft Owned by Governments, an aircraft is not considered as a public aircraft operation if:

  - a mission is for commercial purposes; a mission for which compensation is received, or
  - the aircraft carries an individual that is other than a crewmember or a qualified non-crewmember,

  As it relates to compensation, if one government agency performs a mission in response to a significant and imminent threat for which private operators were not reasonably available, then an agency could be reimbursed for its costs to perform the mission.

  A "qualified non-crewmember" means an individual, other than a member of the crew, aboard an aircraft whose presence is required to perform, or is associated with the performance of, a governmental function. § 40125 (a) (2) defines governmental function as, "an activity undertaken by a government, such as national defense, intelligence missions, firefighting, search and rescue …"

  An Advisory Circular that was not issued, No: 00-1.1B section 5, paragraph o, offers insight as to how the FAA viewed Emergency Medical Services missions would fall within the "government function" by stating,

  > "The FAA considers emergency medical services similar to the 'search and rescue' function used as an example in the statute, and as falling within the statutory intent of governmental function. The

recipients of the service (in this case the accident victims) are considered to be 'qualified non-crewmembers' as they are individuals who are 'associated with the performance' of a governmental function."

- **What are the implications if the mission is not considered a PAO?** While a governmental agency may own and operate a public aircraft, the more important factor is the purpose of the mission. An aircraft can perform a public service operation in one circumstance but fall outside of the classification for another mission as defined by § 40125 (b).

  The mission's designation is important because it will determine if the operation falls under FAA regulations or not. A mission that is not considered as a PAO is classified as a civil mission and is subject to the regulations as administered by the FAA (e.g. Part 91, 135). If a mission is deemed to be a PAO, the only oversight by the FAA involves the national airspace system where public aircraft must comply with certain general operating rules applicable to all aircraft (e.g. minimum safe altitudes, operating near other aircraft, operating on or in the vicinity of an airport).

- **Summary** – By legal definition as established by Congress, LACoFD Air Ops operates public aircraft so long as it does not receive compensation for the performance of its missions and it does not carry individuals that are other than crew members or qualified non-crewmembers. If LACoFD Air Ops missions meet the intent of the law, then FAA regulations do not apply other than regulations that apply to the national airspace, which is applicable to all aircraft.

1.3.2 Overview of the FAA Modernization and Reform Act of 2012 (2012 Act) passed by Congress and how it applies to Public Aircraft and their related operations.

On February 14, 2012, Congress passed Public Law 112-95, FAA Modernization and Reform Act of 2012. Contained in the law are major categories dealing with funding for various FAA activities such as guidance for NextGen and air traffic modernization, environmental improvements, and safety. A primary purpose of the 2012 Act was to improve the safety of flight crewmembers, medical personnel, and passengers onboard helicopters.

A portion of the 2012 Act was passed to address increasing safety concerns involving air ambulance operations. Several parties -- the Federal Aviation Administration, National Transportation Safety Board (NTSB), air medical operators, and medical personnel -- involved with the air medical industry expressed concern with the increase in accidents and incidents in a rapidly growing industry as well as identifying areas to improve the safety record. The 2012 Act directed the FAA to establish standards for the industry within 180 days of its enactment.

The safety section, safety of air ambulance operations (Section 306), is potentially the area of interest for LACoFD Air Ops. This section is relevant, not because it is applicable to a PAO, but because it establishes guidelines for Part 135 air ambulance operations, which are designed to improve the safety of their operations. More specifically, Section 306 covers the following areas:

- Flight request and dispatch procedures,
- Pilot training standards,
- Safety-enhancing technology and equipment, and
- Other areas left to the FAA Administrator's discretion.

➢ In summary, the 2012 Act does not apply directly to LACoFD Air Ops because it does not specifically mention public aircraft or their related operations. However, the Act is worthy of further consideration as it addresses safety concerns associated with air ambulance operations, a type of mission performed frequently by LACoFD Air Ops.

1.3.3 Overview of the FAA's response to the 2012 Act. (Part 135 subpart L and Advisory Circular 135-14B).

As mentioned previously, one of the primary purposes for passing the 2012 Act was related to safety and improving the safety record of helicopter air ambulance (HAA) operations. As mandated by Congress through the 2012 Act, the FAA was tasked with implementing the objectives of the legislation.

In response, the FAA issued final rule Part 135 subpart L on February 21, 2014 and Advisory Circular 135-14B, Helicopter Air Ambulance Operations (HAA), on March 26, 2015.

➢ Part 135 subpart L, Helicopter Air Ambulance Equipment, Operations, and Training, addresses safety improvements for commercial helicopter operations through requirements for equipment, pilot testing, alternate airports, and increased weather minimums for all General Aviation (GA) helicopter operations.

➢ Advisory Circular 135-14B (AC) states that it, "…offers guidance and supports the final rule through the application of best practices which, when tailored to local and operational requirements and the appropriate scope and complexity of each organization, provide one of many possible ways to ensure safety and compliance with regulatory requirements within an HAA operation." The AC is not mandatory and does not constitute a regulation but is provided as best practices, which can enhance safety of HAA operations.

Both Part 135 subpart L and Advisory Circular 135-14B also address National Transportation Safety Board (NTSB) safety recommendations directed at improving HAA safety. For example in 2014, the NTSB released its 2014 Most Wanted List of transportation safety improvements, one of which is, "Address the unique characteristics of helicopter operations." The NTSB suggests operators should

- Develop and implement safety management systems that include sound risk management practices, particularly with regard to inspection and maintenance.
- Develop flight risk evaluation programs and formalized dispatch and flight-following procedures.
- Ensure pilots have access to training that includes scenarios such as inadvertent flight into instrument meteorological conditions and autorotation.
- Install crash-resistant flight recorder systems.

Part 135 subpart L contains the following sections. We also included a brief description, as contained in the respective regulatory section, of the requirements that are related to the equipment (helicopters) operated by Part 135 operators when performing HAA operations.

§ 135.601 — Applicability and definitions.

§ 135.603 — Pilot-in-command instrument qualifications.

§ 135.605 — Helicopter terrain awareness and warning system (HTAWS).

After April 24, 2017, no person may operate a helicopter in helicopter air ambulance operations unless that helicopter is equipped with a helicopter terrain awareness and warning system (HTAWS).

§ 135.607 — Flight Data Monitoring System.

After April 23, 2018, no person may operate a helicopter in air ambulance operations unless it is equipped with an approved flight data monitoring system capable of recording flight performance data.

§ 135.609 — VFR ceiling and visibility requirements for Class G airspace.

§ 135.611 — IFR operations at locations without weather reporting.

Each helicopter air ambulance operated under this section must be equipped with functioning severe weather detection equipment.

§ 135.613 — Approach/departure IFR transitions.

§ 135.615 — VFR flight planning.

§ 135.617 — Pre-flight risk analysis.

§ 135.619 — Operations control centers.

§ 135.621 — Briefing of medical personnel.

The AC breaks its guidance/recommendation/considerations into six primary categories, all of which go beyond Part 135 regulations for operators that have operations other than HAA.

- Operational
- Training
- Equipment

- Inspection and maintenance
- Documentation and recordkeeping
- Safety

1.3.4 Applicability of Congress' 2012 Act and FAA's final rule (Part 135 subpart L) and Advisory Circular 135-14B to Public Aircraft Operations.

- **Is the 2012 Act applicable to LACoFD Air Ops?** No, not directly. With the passage of the 2012 Act, Congress did not change the laws associated with the definition of public aircraft (§ 40102 (a) (41), (C)), or the exceptions that would cause operations to be regulated by the FAA (§ 40125 (b)). However, the intent of the 2012 Act, to improve safety through improved operation's procedures, pilot training standards, and safety-enhancing technology and equipment as it relates to HAA operations, should be considered by LACoFD Air Ops.
- **Are the FAA's final rule and Advisory Circular applicable to LACoFD Air Ops?** No, not directly. Public Aircraft and PAOs are not required to be in compliance with FAA regulations, guidance, or other directives.
- **Summary** - Carl Johnson of the FAA Flight Standards Division during the Helicopter International Association's Industry-Government Forum in January 2015 summarized the question of applicability succinctly. His presentation focused on the 2012 Act and FAA's role related to Public Aircraft. He expressed the following points when addressing questions from the audience regarding why Public Aircraft do not have to follow FAA regulations.
    - The Public Aircraft statute is public law in 49 of the US Code. It is law, not regulation. The FAA did not write it; the congress passed a bill that was passed through legislation. The FAA can't change this law.
    - The FAA has never received guidance or instructions to promulgate regulations to change this statute. However, the FAA can promulgate regulations for all aircraft to protect the safety of NAS (National Air Space).
    - The FAA does not have the authority nor does it intend to promulgate regulations for Public Aircraft.
    - While the FAA has no authority to require public entities to comply with civil regulations, each entity needs to ask itself if they are providing a certain level of safety for their "customers."
    - The civil standards are there to mitigate risk. If the public entity does not follow the regulations, then they should have rules in place that do mitigate the risk associated with the operation.

1.3.5 LACoFD Air Ops considerations for its aviation unit and current fleet regarding the 2012 Act, FAA's final rule, and Advisory Circular.

Although the 2012 Act and the subsequent regulations and guidance established by the FAA's final rule and Advisory Circular do not apply directly to LACoFD Air Ops when it performs PAOs, the larger underlying objective as addressed by these organizations indirectly applies to LACoFD Air Ops. This objective is to improve safety by reducing the risk while performing certain operations, in this case, with an emphasis on HAA operations.

Joining Congress and the FAA's concern regarding safety have been the NTSB and other industry organizations, whose scope is broader than just HAA operations. These organizations want to see overall safety improve for all operations.

In 2011, the NTSB held a public forum Oversight of Public Aircraft Operations: Ensuring Safety for Critical Missions. The forum addressed oversight of public aircraft, which included helicopter operations. As stated in an NTSB event summary, the goals of the forum were to

- Raise awareness of the importance of effective oversight in ensuring the safety of public aircraft operations;
- Identify where responsibility lies for oversight of public aircraft operations; and
- Facilitate the sharing of best practices and lessons learned across a number of parties involved in the oversight of public aircraft operations.

The NTSB was active again when it added helicopter operations to its 2014 Most Wanted List of safety improvements. Helicopters made the list due to their unique operational characteristics. Highlights of the list include:

- Development and implementation of safety management systems that include sound risk management practices, particularly with regard to inspection and maintenance.
- Development of flight risk evaluation programs and formalized dispatch and flight-following procedures.
- Access for pilot training that includes scenarios such as inadvertent flight into instrument meteorological conditions and autorotation.
- The presence of a crash-resistant flight recorder system to assist investigators, regulatory agencies, and operators in identifying causes of accidents.

To reconfirm its commitment to safety, the NTSB added helicopters again to its top 10 items of the 2015 Most Wanted List, this time focusing on public helicopter safety. The Board explained that because public operators are largely exempt from rules that govern commercial passenger-carrying operations, the NTSB is not advocating a regulatory approach to change — instead, it is encouraging operators to make voluntary improvements in training, technology, and operational procedures. Recommendations made in conjunction with the Most Wanted List include more scenario-based training for flight crews; implementation of flight risk evaluation programs and formalized dispatch procedures; and adoption of safety-enhancing technology such as radio altimeters, night vision imaging systems, and terrain awareness and warning systems.

Board member Robert Sumwalt summarized, “We want people to have safety management systems . . . we want people to formally evaluate risk. We’re talking about an organizational culture that embraces safety.”

- **What areas will help an organization mitigate risks that will lead to improved safety?** The 2012 Act identified four general areas of an organization: flight request and dispatch procedures, pilot training standards, safety-enhancing technology and equipment, and other areas left to the FAA Administrator’s discretion. The FAA’s final rule and Advisory Circular expanded upon these areas and provided more guidance and interpretation in all areas.
- **With what areas should LACoFD Air Ops be concerned?** To borrow from Carl Johnson of the FAA, all of the areas are important if they lead to a mitigation of the risk in LACoFD Air Ops operations. To emphasize their importance is the number of organizations that have identified these areas as requiring improvement from an industry perspective. The 2012 Act and subsequent FAA action has started the process for improvement. However, because public entities and PAOs fall outside of this jurisdiction, the responsibility falls upon the public entities to mitigate the risks in their respective operations.
- **What is the status of LACoFD Air Ops current and prospective helicopters as it relates to safety-enhancing equipment?** The primary purpose of this report was to review the LACoFD Air Ops helicopter fleet. An important element of the fleet is the appropriate mission equipment that is required to successfully and safely complete the various missions. A large percentage of LACoFD Air Ops flights are associated with HAA operations. Therefore, we used the required and recommended equipment as identified by the Advisory Circular for HAA operations.

  The following table summarizes what equipment each helicopter type currently possesses (Bell 412 and Current S-70A) and what the S-70i would be equipped with if it is acquired. LACoFD Air Ops personnel provided the information.

As Specified in AC 135-14B			
Part 135 HAA Operations			
	Bell 412	**Current S-70**	**Future S-70i**
Operations – Chapter 3			
Night Vision Goggles	Yes	Yes	Yes
Required Equipment – Chapter 5			
Radio Altimeter	Yes	Yes	Yes
Helicopter Terrain Awareness and Warning System (HTAWS)	Yes	No	Yes
Flight Data Monitoring Systems (FDMS)	No	No	Yes
Overwater Operations - Life Preservers and emergency locator transmitter (ELT)	Yes	Yes	Yes
Recommended Equipment – Chapter 5			
Helicopter -Approved Searchlight	Yes	Yes	Yes
Communications with hospital and first responders	Yes	Yes	Yes
Intercommunications Systems	Yes	Yes	Yes
Wire Strike Prevention Systems	Yes	Yes	Yes
Pyrotechnic Signaling System	Yes	Yes	Yes

The table shows that by acquiring the S-70i, LACoFD Air Ops will meet two of the new equipment requirements as mentioned by Part 135 subpart L, HTAWS and FDMS. The current fleet of Bell 412s or the new production model 412EPI has does not currently have FDMS.

- **Summary** – While the recent changes by Congress and the FAA do not apply to LACoFD Air Ops current fleet of public aircraft from a legislative or regulatory point of view, they do establish new parameters for reducing risk in operations that should improve safety. While the current and proposed fleet of Bell 412 and S-70i helicopters have the required and suggested equipment mission equipment, with the exception of flight data monitoring systems, LACoFD Air Ops should review and evaluate flight request and dispatch procedures, pilot training standards, and safety-enhancing technology to mitigate risk in its operations.

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Section 2 – S-64 Aircrane/Additional S-70i

2.0 LACoFD Air Ops Original Request

This section of the report provides information regarding LACoFD Air Ops option to operate a fourth S-70 helicopter (S-70i version) instead of contracting annually with Erickson Aviation for an S-64 Aircrane (S-64). To assist LACoFD Air Ops with its decision, our analysis was based on three steps.

- Project estimated contract costs associated with the S-64 for a ten-year period.
- Project the estimated costs for a new S-70i helicopter for a ten-year period.
- Examine other issues that are difficult to measure from a cost perspective.

2.1 Conklin & de Decker Approach

This section of the report consisted of three basic steps. The first step estimated the projected costs for the continued use of an S-64 for the next ten years based on two scenarios. The first scenario was based on the historical seasonal lease and the second was on a full-year lease. The second step was to estimate the projected costs for an S-70i over a ten-year period. The purpose of the first and second steps was to serve as the basis for cost comparisons between the two options. The third step was to compare the two helicopter types based on a basis other than costs. The primary non-cost factor considered was volume of water dropped during a hypothetical mission firefighting scenario. Other non-cost factors were also considered.

2.2 Summary

Table 2-1 summarizes the comparison of steps 1 and 2 as outlined in section 2.1, Conklin & de Decker Approach. From a cost perspective only, if LACoFD Air Ops acquired a fourth S-70i, the additional cost to acquire and operate it when compared to the current S-64 contract would range from $1.5 to $3.3 million over a ten-year period.

The S-64 estimate was based on LACoFD Air Ops most recent six-years of actual costs. Based on the historical contract cost information, we computed historical averages for daily rate increases (3.3%), days on contract (126), hourly rate increases (1.8%), and annual billable flight hours (31.9). Using this information, we estimated the total costs of the S-64 for a ten-year period to be $39.9 million.

To create an apples-to-apples comparison, the S-70i estimate included not only maintenance costs based on a TAP hourly rate of $2,600, but also the purchase price and finance costs for a $20.800 million S-70i, fuel costs at $3.00 per gallon, and additional crew member costs for the firefighting and air squad configurations. We chose to present ten-year costs for the two configurations because the LACoFD Air Ops crew differs for each mission, which creates a slightly different overall cost. The total estimated costs of the S-70i for the ten-year period for the firefighting and air squad missions were $41.2 and $43.2 million respectively.

Table 2-1 Operating and Acquisition Cost Comparison - 10-Year Summary (x1,000)		
Aircraft	**10-Year Cost**	**Difference**
S-64	$39,905	
S-70i - Firefighting	$41,376	$1,471
S-70i - Air Squad	$43,237	$3,332

If the current S-64 seasonal contract was extended to a full year and using the same methodology but with the proper adjustments, extend the contract days from 126 to 365 and the annual billable hours from 31.9 to 96, the estimated ten-year cost would be $115.9 million.

The final step in our comparison between the two helicopter types was to examine factors that are not based upon a cost perspective. One important factor was determining the amount of water that could be dropped over a period of time. Conklin & de Decker created a hypothetical mission to measure how the S-70i and S-64 compared to each other. The hypothetical mission and other assumptions are presented in section 2.3.3. During a 12-hour period, Table 2-2 reflects how many gallons of water each helicopter type would deliver. Overall, the S-64 would drop more than the S-70i ranging from 1,600 to 6,400 gallons, depending upon the version of the S-64.

Table 2-2 Water Dropped - 12-Hour Period			
	S-70i	**S-64E**	**S-64F**
Total Drops - 12-Hour Period	34	24	16
Average Gallons Dropped	800	1,400	1,800
Total Gallons Dropped	27,200	33,600	28,800

Additional non-cost factors that LACoFD Air Ops should consider include:

- The benefits and drawbacks involved with the volume of water dropped for any given load. Due to the high weights associated with the delivery of up to 2,650 gallons of water, the interaction between the helicopter and ground crews is important. LACoFD Air Ops experience indicates the S-70i is able to work better with and around ground crews, while the S-64 can work hot areas of the fire without ground crews present.
- The drawback associated with rotor down wash. The S-64 generates higher down wash than the S-70i, which makes working around ground crews more difficult.

- The S-70i is a more versatile airframe. The S-64 airframe is basically designed to carry external loads. The S-70i can, not only, carry external loads but also internal loads and passengers. The internal capabilities are an important variable given the primary missions of LACoFD Air Ops, firefighting, search and rescue, and emergency medical services.
- The S-70i will have more availability. Historically, the S-64 contracts average 126 days of a year. Acquisition of an additional S-70i will expand the availability potential to 365 days.

2.3 Conklin & de Decker Analysis

The analysis in this section consists of three sections. Section 2.3.1 builds two ten-year cost estimates for the S-64. The first is based on leasing the helicopter seasonally as is done currently and the second extends the length of the lease contract to a full year. Section 2.3.2 estimates the ten-year cost estimate for the S-70i considering two current configurations, firefighting and air squad. Section 2.3.3 covers the non-cost factors associated with operating an S-64 versus an S-70i.

2.3.1 Project estimated contract costs associated with the S-64 for a ten-year period.

Cost summary reports from Erickson Aviation for the period of 2010 through 2015 served as the basis for building the ten-year cost projection for the Aircrane. LACoFD Air Ops provided the reports. We used the following approach to construct the estimate.

- Daily Rate – Table 2-3 reflects the daily rates since 2010 as contracted with Erickson Aviation. The average increase since 2010 was 3.3%.

Table 2-3		
Daily Rate Increases		
Year	**Daily Rate**	**Annual Increase**
2010	$20,700	---
2011	$22,250	7.0%
2012	$22,750	2.2%
2013	$23,360	2.6%
2014	$24,060	2.9%
2015	$24,540	2.0%
Average		**3.3%**

- Annual Days on Contract – Table 2-4 reflects the length of the contract as expressed in days. The six-year average was 126 days.

Table 2-4	
Days on Contract	
Year	**Days**
2010	122
2011	127
2012	121
2013	141
2014	120
2015	123
Average	**126**

- Hourly Rate – Table 2-5 reflects the hourly rate that Erickson Aviation charged LACoFD Air Ops in the respective years. The average increase for the six-year period beginning in 2010 was 1.8%. For the projected hourly rate, we used an inflation factor of 2.0%.

Table 2-5		
Hourly Rate Increases		
Year	**Hourly Rate**	**Annual Increase**
2010	$7,086	---
2011	$7,566	6.3%
2012	$7,650	1.1%
2013	$7,827	2.3%
2014	$7,997	2.1%
2015	$7,775	-2.9%
Average		**1.8%**

- Annual Billable Hours - Table 2-6 reflects the hours that LACoFD Air Ops was charged during the respective years. Despite the low flight hours in 2014 and 2015, the six-year average was 31.9. We rounded the average to 32.0 hours to estimate the 10-year costs.

Table 2-6	
Annual Billable Hours	
Year	**Hours**
2010	21.3
2011	41.3
2012	58.4
2013	49.4
2014	6.3
2015	14.7
Average	**31.9**

- 10-Year Projected Costs, Based on Current Seasonal Contract - Table 2-7 reflects the estimated costs ($39.9 Million) that LACoFD Air Ops would incur if it continued to contract for the services of the Erickson Aircrane over the next ten years. The estimate is based upon actual contract information from 2010 through 2015.

Table 2-7											
Projected S-64 Costs											
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**10-Year Total**
Daily Rate	$25,350	$26,186	$27,051	$27,943	$28,865	$29,818	$30,802	$31,818	$32,868	$33,953	
Annual Cost - Daily Rate	3,194,077	3,299,482	3,408,365	3,520,841	3,637,029	3,757,050	3,881,033	4,009,107	4,141,408	4,278,074	**$37,126,466**
Hourly Rate	7,931	8,089	8,251	8,416	8,584	8,756	8,931	9,110	9,292	9,478	
Annual Cost - Hourly	253,776	258,852	264,029	269,309	274,695	280,189	285,793	291,509	297,339	303,286	**2,778,776**
Estimated Annual Cost	**$3,447,853**	**$3,558,333**	**$3,672,393**	**$3,790,150**	**$3,911,724**	**$4,037,240**	**$4,166,826**	**$4,300,616**	**$4,438,747**	**$4,581,360**	**$39,905,243**

Assumptions:

a) **Daily Rate**: For Year 1, used the 2015 S-64 daily rate ($24,540) and increased it by 3.3%, which represented the percentage increase for the six-year period beginning in 2010. Applied the same 3.3% increase to years 2-10.

b) **Annual Cost – Daily Rate**: Multiplied the Daily Rate by the average number of days (126) the helicopter was on contract for the six-year period of 2010 – 2015.

c) **Hourly Rate**: For Year 1, used the 2015 S-64 hourly rate ($7,775) and increased it by 2.0%, which represented the percentage increase for the six-year period beginning in 2010. Applied the same 2.0% increase to years 2-10.

d) **Annual Cost – Hourly:** Multiplied the Hourly Rate by the average number of billable hours (32), which represented the average number of billable hours for 2010 through 2015.

- 10-Year Projected Costs, Based on 365-Day Contract – LACoFD Air Ops requested that we estimate the costs of a full-year contract for the S-64 rather than the current average 126-day contract. The purpose for the request was to get an apples-to-apples comparison when considering the costs based upon a full-year's usage of an acquired S-70i since it will be available for that period of time.

Table 2-8 reflects a ten-year cost based on a 365-day contract of $115.9 million.

Table 2-8											
Projected S-64 Costs - 365-Day Contract											
Year	1	2	3	4	5	6	7	8	9	10	10-Year Total
Daily Rate	$25,350	$26,186	$27,051	$27,943	$28,865	$29,818	$30,802	$31,818	$32,868	$33,953	
Annual Cost - Daily Rate	$9,252,684	$9,558,023	$9,873,438	$10,199,261	$10,535,837	$10,883,519	$11,242,675	$11,613,684	$11,996,935	$12,392,834	**$107,548,891**
Hourly Rate	$7,931	$8,089	$8,251	$8,416	$8,584	$8,756	$8,931	$9,110	$9,292	$9,478	
Annual Cost - Hourly	$761,328	$776,555	$792,086	$807,927	$824,086	$840,568	$857,379	$874,527	$892,017	$909,857	**$8,336,329**
Estimated Annual Cost	**$10,014,012**	**$10,334,577**	**$10,665,523**	**$11,007,188**	**$11,359,923**	**$11,724,087**	**$12,100,054**	**$12,488,210**	**$12,888,952**	**$13,302,692**	**$115,885,220**

Assumptions:

a) **Daily Rate**: Used the same methodology as in Table 2-6.

b) **Annual Cost – Daily Rate**: Multiplied the Daily Rate by 365 days, a full-year contract.

c) **Hourly Rate**: Used the same methodology as in Table 2-6.

d) **Annual Cost – Hourly:** During the average 126-day contract, LACoFD Air Ops used the S-64 an average of 32 hours during the contract period. A 126-day contract is one third of a full-year contract. Assumed the 365-day contract would incur flight hours at the same rate. Multiplied the Hourly Rate by the average number of billable hours (32), which represented the average number of billable hours for 2010 through 2015, times a factor of three or 96 flight hours in a year's time.

2.3.2 Project the estimated costs for a new S-70i helicopter for a ten-year period.

We ran two mission scenarios, firefighting (Table 2-9) and air squad (Table 2-10), to estimate the costs associated with operating a fourth S-70i. The mission scenarios are important due to the additional personnel costs LACoFD Air Ops will incur to perform its missions.

An important assumption underlying the cost projections is the fleet's total annual flight hours of 900 remain the same. With an increase in fleet size from three to four, the annual flight hours per helicopter decreases from 300 to 225.

Firefighting Mission - Table 2-9 summarizes the projected fuel, maintenance, and fixed costs for a 10-year period. The estimated costs would be $41.4 million. The fixed costs would include personnel costs associated with adding a maintenance technician, pilot, and fire fighter/paramedic to the department's staff.

Also included in the fixed costs are the lease costs to purchase. During the ten-year period, LACoFD Air Ops would be financing a $20.8 million purchase of an S-70i at a 9% annual rate (0.75% monthly). The lease would not include a down payment. The total cost to purchase, including interest, would be $24.995 million. The lease costs represent 60 percent of the ten-year total cost ($41.4 million) to acquire and operate the S-70i.

Table 2-9											
Fourth S-70i - Firefighting Mission (x 1,000)											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Total**
Total Variable Costs	$749	$784	$1,028	$897	$1,148	$989	$1,282	$1,072	$1,402	$1,160	$10,510
Total Fixed Costs	$3,363	$3,299	$3,236	$3,174	$3,113	$3,053	$2,993	$2,935	$2,877	$2,821	$30,866
Total Cost	$4,112	$4,083	$4,264	$4,071	$4,261	$4,041	$4,275	$4,007	$4,279	$3,981	**$41,376**

Assumptions:

a) General:

1. Mission: Firefighting.
2. Annual Flight Hours: Assumed flight hours of 225.
3. Inflation Rates: 4% for general inflation and 3.5 % for aviation parts.

b) Variable Cost:

1. Maintenance costs are based upon the new S-70i TAP program from Sikorsky. Rate in the first year is $1,900 for the airframe and $700 for the engines for a total of $2,600. Years 2-10 were adjusted by a 4% annual inflation factor, which is based upon the most recent eight years of rate increases in the current TAP program.
2. Fuel costs were included since the Aircrane hourly rate likely includes this category of cost. The assumed price is $3.00 per gallon.
3. The annual Total Variable Costs consists of the sum of maintenance and fuel costs for the respective years.

c) Fixed Costs:

1. Finance/Lease Cost: $20.8 million S-70i helicopter value at 0.075 percent monthly interest rate. This rate was quoted by Milestone.
2. Added one helicopter technician at a cost of $127,000, one pilot at $207,000, and one fire fighter/paramedic individual at $155,000.
3. The annual Total Fixed Costs consists of the sum of the Finance/Lease Costs and the crew costs for the respective years.

Air Squad Mission - Table 2-10 summarizes the projected fuel, maintenance, and fixed costs for a 10-year period. The estimated costs would be $43.2 million. The fixed costs would include adding a maintenance technician, pilot, and two fire fighters or paramedics to the department's staff.

The lease costs to purchase of $24.995 million would remain a significant percentage (58.1%) of the total costs.

Table 2-10											
Fourth S-70i - Air Squad Mission (x 1,000)											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Total**
Total Variable Costs	$749	$784	$1,028	$897	$1,148	$989	$1,282	$1,072	$1,402	$1,160	10,510
Total Fixed Costs	$2,516	$2,542	$2,569	$2,596	$2,625	$2,656	$2,687	$2,719	$2,753	$2,789	$32,727
Total Cost	**$3,265**	**$3,326**	**$3,596**	**$3,494**	**$3,773**	**$3,644**	**$3,969**	**$3,792**	**$4,155**	**$3,948**	**$43,237**

Assumptions:

a) General:

1. Mission: Air Squad
2. Annual Flight Hours: Assumed flight hours of 225.
3. Inflation Rates: 4% for general inflation and 3.5 % for aviation parts.

b) **Variable Cost:**

1. Assumptions remained the same as the firefighting mission.

c) Fixed Costs:

1. Added one helicopter technician at a cost of $127,000, one pilot at $207,000, and two fire fighter/paramedic individuals at $155,000 each or a total of $310,000.

2.3.3 Examine other issues that are difficult to measure from a cost perspective.

➢ Water delivery comparison between the two types of aircraft - Operational costs are probably the most commonly used measure when evaluating the value of a helicopter to an operation. However, cost is just one perspective to consider when making an informed decision. Another measure relevant to the S-70i and S-64 is the amount of water each helicopter can deliver in a given period of time. An evaluation based on water tank capacity provides just a part of the picture. For example, the S-64 has a water tank capacity of 2,650 gallons, while the S-70i tank capacity is 1,000. The “best” helicopter based on this criterion would be the S-64. A more complete measure would be the amount of water each helicopter type could deliver in a given period of time. There are many important variables in a mission’s logistics and helicopter performance that will affect the amount of water delivered in a given period of time. Helicopter speed, time to refill the water tank, flight duration, refueling parameters, and location of water source are a few examples of factors that can affect the quantity of water delivered over a period of time.

Conklin & de Decker created a hypothetical mission to measure water delivered over a period of time for the S-70i and S-64. We used the following assumptions for the mission.

- Mission Profile –
  - Distance from the respective primary bases to the open water source is 20 miles. The S-64 primary base is the Van Nuys airport. While LACoFD

Air Ops has several base locations in the county, for the purposes of this analysis, we assumed a primary base at Pacoima's Barton Field.

- o Distance from open water source to fire's location is 10 miles.
- o Distance from fire location to primary base is 20 miles.

- Helicopter Speeds (knots) –
  Each helicopter's speed is important as it will dictate how long it takes to perform the mission profile. The speed actually used in missions can vary based upon a number of variables such as the type of mission, weight of the aircraft, internal/external loads, and atmospheric conditions. Table 2-11 provides a range of speeds -- two speed points (Vne and Maximum level speed at sea level) for each helicopter type based on reliable industry sources and estimated speeds more closely associated with the firefighting mission as provided by LACoFD Air Ops personnel. We used an average firefighting mission speed (highlighted) in the hypothetical mission. Based on the average speed, the S-70i can fly 25 knots faster than the S-64 variants.

Table 2-11		
Speeds		
	S-70i Firehawk	**S-64 Aircrane**
Vne at Max Gross Weight	193	99/104
Maximum Level Speed @ S/L	160	109
Long Range (Max Cruise Speed)	132	91
Speed Range - Minimum	100	80
Speed Range – Average	110	85
Speed Range - Maximum	120	90

Notes:

- Vne at Maximum Gross Weight – Sources of information were the respective type certificates for each S-64 type. The S-64E Vne was 99 knots and the S-64F was 104 knots. The Vne for the S-70i was obtained from Sikorsky-provided information and was based on the UH-60L.
- Maximum Level Speed at Sea Level – Source of information was *Jane's, All the World's Aircraft, 1974-75* and *1988-89*.
- Speed Range, Minimum/Maximum – Source of information was based on discussions with LACoFD Air Ops personnel.
- Speed Range, Average – Calculated based on the minimum and maximum. The average speed was used to calculate flying times for the hypothetical mission.

- Water Pick-up and Drop –
  The ideal source for filling the helicopters' water tanks is an open water source, which makes the best use of tank refill technology, therefore reducing the

amount of time required to fill the tanks. If an open water source is not available, temporary or portable (pumpkins) water sources can be used. The limited rate at which the portable units can be refilled normally means only one helicopter type will use the resource. Most commonly, the S-70i will use the portable unit while the S-64 will find an open water resource. This would normally mean the S-64 is going further to find available water, which would add to the mission's roundtrip between the fire and refilling.

Based on discussions and available industry information, we assumed one minute to fill the tanks for both helicopter types. We assumed three minutes for each helicopter to remain at the drop area before departing to the water source.

- Refueling –
  A significant difference exists between the helicopter types regarding refueling. The S-70i can refuel while its engines continue to operate, which is also known as hot refueling. The S-64 must shut down its engines before refueling.

  A second factor that affects the time associated with refueling is the availability of fuel trucks. If fuel trucks are available, flight time is not required to return to the primary base for refueling. This would allow more time fighting the fire.

  Based on discussions with LACoFD Air Ops personnel, the County, when available, will use fuel trucks during most firefighting missions, while the S-64 normally refuels at its primary base in Van Nuys. Based on this information, the hypothetical mission was based on the assumption that the S-70i would use a fuel truck and the S-64 would not.

  Table 2-12 reflects the amount of time we assumed for refueling and flying to the refueling location.

Table 2-12		
Refueling Information		
	S-70i	**S-64**
Distance - Fire to Fuel Source (miles)	5	20
Est. Time to Refuel (minutes)	30	45

- Mission Duration –
  The mission's duration is the length of time the helicopter can fly between refueling. Important variables when calculating duration are fuel capacity, fuel consumption rate, and amount of fuel reserves.

Table 2-13 summarizes the variables used to calculate the mission duration for each helicopter type. We used the flight duration with reserves in the calculations for our hypothetical mission.

Table 2-13			
Mission Duration			
	S-70i	**S-64E**	**S-64F**
Fuel Capacity (gal)	355	1,356	1,356
Fuel Capacity (lbs)	2,414	9,221	9,221
Fuel Consumption (gal per hr)	162	550	700
20-Minute Fuel Reserve (gals per hr)	54	183	233
Mission Duration w/o reserve	2.2	2.5	1.9
Mission Duration w/ reserve	1.9	2.1	1.6

Notes:

- Fuel Capacity (gallons): Fuel capacity for the S-70i was obtained from Conklin & de Decker's *Aircraft Performance Comparator, 2016*. Source of information for each S-64 type were the respective type certificates.
- Fuel Capacity (pounds): Assumed the weight of Jet A fuel was 6.8 pounds per gallon.
- Fuel Consumption (gallons per hour): Fuel consumption for the S-70i was obtained from Conklin & de Decker's *Aircraft Cost Evaluator, 16.1*. The S-64 fuel consumptions were obtained from LACoFD Air Ops personnel.
- 20-Minute Fuel Reserve (gallons per hour): Twenty-minute fuel reserve is one third of the hourly fuel consumption for each helicopter type.
- Mission Duration without Reserve: Calculated for each helicopter type by dividing the Fuel Capacity by the Fuel Consumption.
- Mission Duration with Reserve: Calculated for each helicopter type by subtracting the 20-Minute Fuel Reserve from the Fuel Capacity. Then dividing the newly calculated Fuel Capacity by the Fuel Consumption (Example: S-70i, Subtract 54 gallons per hour from 355 gallons equals 301 gallons. Divide the 301 gallons by the hourly fuel consumption of 162.)

- Water Delivered per Drop –
  One factor that influences the amount of water that each helicopter can deliver is an obvious one, the capacity of the tank. Table 2-14 shows the tank capacity for the respective helicopters. It is important to note that the tank's capacity is not always an accurate measure of the amount of water that can be dropped at any one time. There is a critical factor that will limit all helicopters from delivering a tank's capacity of water. That factor is available useful load. Several variables reduce a helicopter's useful load. For example, the amount of

fuel carried, the helicopter's configuration, and density altitude (higher temperature and altitude reduce useful load) are common variables that reduce useful load. Actually the size of each water load will vary during a fuel cycle. As the helicopter burns more fuel, the useful load increases to allow the pick-up of more water.

A more useful measure of the amount of water dropped per load is an average rather than a maximum. LACoFD Air Ops personnel indicated a more reasonable expectation for the amount of water delivered for the S-70i and S-64 is reflected in Table 2-14.

Table 2-14			
Water Drop in Gallons			
	S-70i	**S-64E**	**S-64F**
Tank Capacity	1,000	2,650	2,650
Typical Range for Drops	700-900	1,000 – 1,800	

- Water Dropped (12-hour period) -
  An important final measure is to determine the amount of water that each helicopter type can deliver over a period of time. For this analysis we assumed a twelve-hour period. Table 2-15 summarizes our estimates.

  Based upon our assumptions and the variables, the S-64E is estimated to be able to drop the greatest amount of water during a 12-hour period at 33,600 gallons. The two primary factors contributing to its ability to deliver the higher total is average gallons delivered when compared to the S-70i and longer flight duration when compared to the S-64F.

Table 2-15			
Water Dropped - 12-Hour Period			
	S-70i	**S-64E**	**S-64F**
Water Drop Cycle (minutes)	14.9	18.1	18.1
Water Drops -Initial Cycle	6	6	4
Water Drops - Subsequent Cycles	28	18	12
Total Drops - 12-Hour Period	34	24	16
Average Gallons Dropped	800	1,400	1,800
Total Gallons Dropped	27,200	33,600	28,800

Notes:

- Water Drop Cycle: Based upon the cycle of flying to the water source, filling the tank, flying to the fire, dropping the water, and then returning to the water source. Combining the cycle's distances with the estimated average speed (Table 2-10) yields the amount of time in minutes to complete a cycle.

- Water Drops – Initial Cycle: This represents the number of water drops the helicopter could make between refuelings. The initial cycle is based upon a departure from the primary base to the water source.

  Both the S-70i and S-64E are able to make six drops during the initial cycle. While the S-64E has a slightly longer fuel cycle than the S-70i (2.1 to 1.9 hours), the S-70i has a faster speed (110 to 85 knots). The S-64F travels slower than the S-70i and has a lower fuel duration (1.6 hours) than the S-70i and S-64E. The combination of slower speed and lower fuel duration means the S-64F will make 4 water drops during the initial cycle.
- Water Drops - Subsequent Cycles: Reflects a combination of the number of water drops the helicopter can make during each fuel cycle following the initial cycle and the number of fuel cycles that would occur during the remaining 12-hour period. The S-70i would make 7 water drops during each of four more fuel cycles for a total of 28 drops. The S-64E would make 6 water drops during three fuel cycles for a total of 18 drops and the S-64F would make 4 water drops during three fuel cycles for a total of 12 drops. The difference in drops between the S-64 E and F is attributed to a longer fuel cycle (2.1 vs 1.6 hours) and a lower estimated fuel burn rate per hour (550 vs 700 gallons). Both types have the same fuel capacity per the respective type certificates.
- Total Drops - 12-Hour Period: The sum of water drops from the initial and subsequent cycles.
- Average Gallons Dropped: As estimated by LACoFD Air Ops personnel. The S-70i and S-64E are an average of the estimated range, while the S-64F average is higher than the S-64E due to its increased gross weight of 5,000 pounds, which increases the useful load, and the increased performance of the engines.
- Total Gallons Dropped: Calculated by multiplying Total Drops - 12-Hour Period times the Average Gallons Dropped for each helicopter type.

➢ Primary Usage during Firefighting Mission – Each helicopter type can deliver significant amounts of water per drop with the S-64 able to deliver more than the S-70i. While quantity is one important aspect of fighting fires, other factors can influence a helicopter's effectiveness. One factor is the down wash from the main rotor blades. The heavier the gross weight of the helicopter, which generally creates greater main rotor disc loading, the greater the down wash. A strong down wash can create adverse conditions for ground crews. A second factor is the weight of water. Each gallon of water weighs 8.35 pounds. As the drop size increases, the weight of the water increases which can affect how closely the water can be dropped by the ground crew.

Due to these factors, LACoFD Air Ops personnel indicate the best areas of the fire for the S-64 are on the "shoulder" and "head" of the fire. While the S-70i can also work the same areas, its best use is working the flanks of the fire supporting the ground crews and engine crews with hose-lays or hand tools only. Both the S-64 and S-70i can be used to cool the flank of a fire that is "hot." Cooling requires dropping large amounts of water to build a wet-line to impede the spread of the fire.

- <u>Helicopter Availability</u> – If LACoFD Air Ops acquired a fourth S-70i in lieu of its seasonal, historical average 126-day contract for the S-64, the County would have the use of an additional helicopter for a full year's time. And, as compared in sections 2.3.1 and 2.3.2 of this section of the report, the fourth S-70i would cost less for a full year's availability ($3.5 to $3.7 million average annual cost, Tables 2-9 and 2-10) than a partial year for the S-64 ($4.0 million, Table 2-7).

- <u>Airframe Versatility</u> – The S-64 airframe is basically designed to carry external loads. The S-70i can, not only, carry external loads but also internal loads and passengers. The internal capabilities are an important variable given the primary missions of LACoFD Air Ops, firefighting, emergency medical services, and search and rescue. Both helicopter types can perform the water drop portion of the firefighting mission (external loads) as has been demonstrated in previous tables. However, the S-70i offers more versatility for the
    - Firefighting mission as it can carry ground crews and other essential fire crews (12 to 14 individuals),
    - Search and rescue mission offers a better platform due to the external hoist configuration and significant room for the mission crew and rescued personnel, and
    - Emergency Medical Services mission to critically-ill patients.

  The S-64 internal area only has room for one mission crew member.

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Section 3 – Options for S-70 Fleet

3.0 LACoFD Air Ops Original Request

Analyze acquisition and maintenance costs, including TAP, for three options regarding the Sikorsky S-70 (S-70) fleet. The three options are:

- Retain the current S-70A helicopters.
- Update the current S-70A helicopters with new fuselage, new avionics, and overhaul of current drive system components per the Exchange and Sales Authority (ESA) program.
- Obtain new S-70i aircraft.

The comparative analysis should include the effects of aircraft aging on maintenance costs, increasing risk of obsolescence associated with avionics and other systems, parts availability, and limited TAP coverage.

3.1 Conklin & de Decker Approach

The current fleet of three S-70A helicopters will reach an important date at the end of the calendar year in 2016. At that time, the Total Assurance Program (TAP) contract for the S-70A fleet will expire. Due to the importance of TAP, both from cost predictability and logistical support perspectives, LACoFD Air Ops has decisions to make regarding its S-70A helicopters. Initial and multiple exploratory discussions with Sikorsky identified three possible options.

- Continue to operate the current fleet of three S-70A helicopters.
- Upgrade the current S-70A airframes to a more current airframe version, the S-70L.
- Replace fleet with new S-70i helicopters.

This section examines these options and offers cost estimates, maintenance and acquisition, to assist LACoFD Air Ops with making a more informed decision about which option best fits its needs.

3.2 Summary

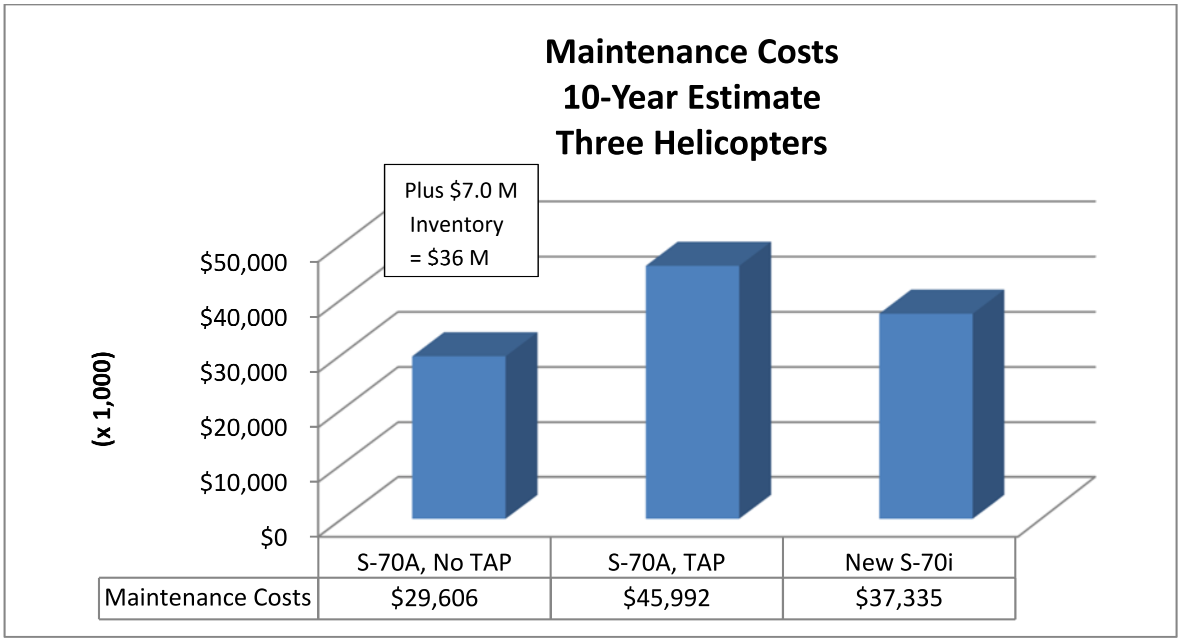
The option to upgrade the current S-70A airframes from A to L configurations was not viable. Sikorsky had initially encountered higher than expected modification costs on the first few airframes with other clients, which made the option not feasible from an economical point of view. Subsequent efforts to initiate a modification process with outside contractors had not developed adequately to become an option.

As a result, we analyzed the two remaining options; continue to operate the existing fleet of S-70A helicopters and replace the existing fleet with new S-70i helicopters. Retaining the current S-70A helicopters had two alternatives, one to maintain the fleet without Sikorsky's (TAP) and the other to maintain the fleet with a new contract for TAP.

Chart 3-1 summarizes the estimated maintenance costs for each option.

- **Least expensive option but with more risk** - If LACoFD Air Ops retains the current S-70A fleet but does not re-enroll into TAP, the estimated costs for the ten-year period are approximately $30.0 million. The option is less expensive than the existing fleet with TAP, however, this option would lose certain valuable, but difficult to measure, features that are associated with Sikorsky's TAP. This option has a higher level of risk associated with cost and operations predictability. For example,
    - Sikorsky's consignment inventory of approximately $7 million will more than likely be removed from the Air LACoFD Air Ops location.
    - The budgeting exercise will become more difficult as each year will vary due to the timing of significant scheduled cost events and the uncertainty associated with unscheduled maintenance.
    - Aircraft availability could be affected because Sikorsky will no longer incur the TAP penalty when an aircraft is down due to spares unavailability.
    - Engineering and technical support will diminish as the manufacturer moves on to more current versions of the S-70, the versions it is actively selling.
- **The most expensive option** - If LACoFD Air Ops retains the current S-70A fleet and continues to use TAP but with a new contract, it will spend approximately $46.0 million for maintenance during the next ten-year period. Sikorsky has indicated the new TAP contract will be for a three-year period only and is unlikely to be renewed. The $46.0 million estimate is based upon the first year's estimated TAP rate of $3,400 and increased by four percent annually for the ten-year period ($3,400 rate obtained from Sikorsky in March 2016). The proposed new 2017 TAP rate is a significant increase from the 2016 rate of approximately $1,770.
- **Middle cost option and new helicopters** - If LACoFD Air Ops chooses to acquire new S-70i helicopters, it will cost approximately $37 million to maintain a fleet of three helicopters for a ten-year period. The maintenance costs were based on a new TAP contract that would be offered for five years and eligible for negotiating a new TAP contract after the initial five years. Sikorsky proposed the new TAP hourly rate for the first year to be $2,600, which would cover the airframe and engines.

Chart 3-1



Notes:

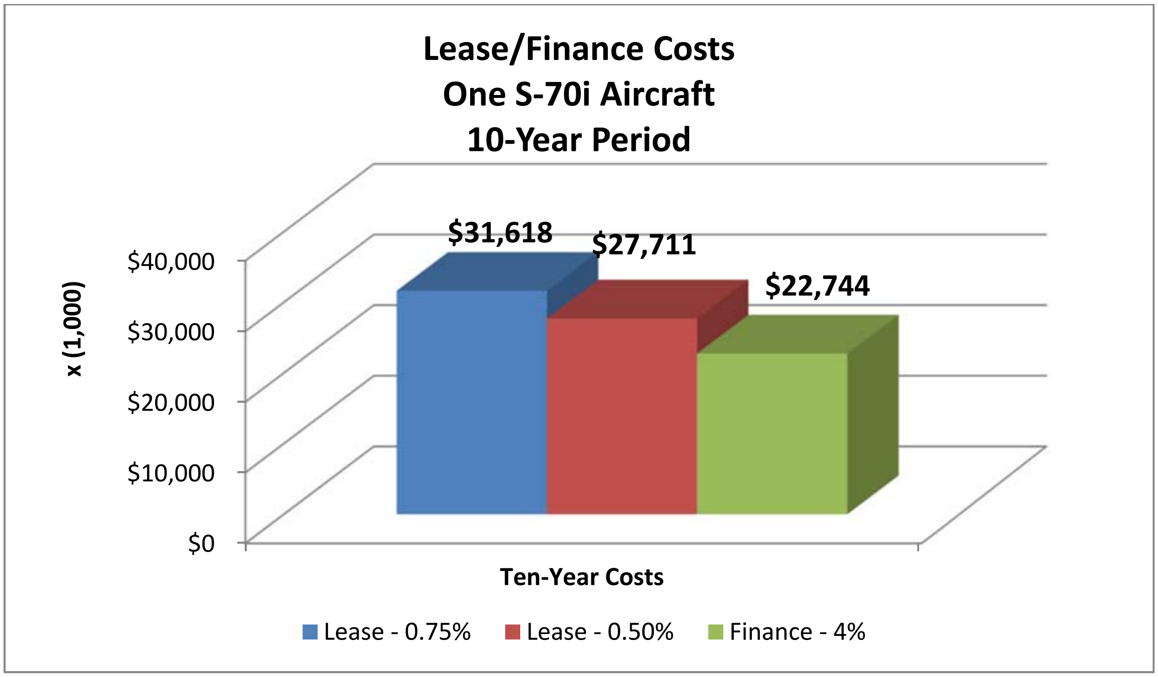
1) **S-70A, No TAP – Retain the current S-70A fleet but operate without TAP. This option would require LACoFD Air Ops to purchase additional inventory to replace the consigned inventory provided by Sikorsky. The estimated value of the current inventory is $7.0M.**
2) **S-70A, TAP - Retain the current S-70A fleet and operate with a new contract for TAP.**
3) **New S-70i – Move into new S-70i helicopters with new TAP contracts. Estimate based upon an initial year rate of $2,600. The rate would include the airframe and engines.**

LACoFD Air Ops also requested that we analyze lease and finance options for acquiring one to five new S-70i helicopters using three financing scenarios. The acquisition price was estimated to be $20.8 million based on discussions between LACoFD Air Ops and Sikorsky.

- Lease to purchase at a monthly finance rate of 0.75 percent (9% annual rate). Based on our research, this is the most likely rate in the current economic situation.
- Lease to purchase at a monthly finance rate of 0.5 percent (6% annual rate). Rate requested by LACoFD Air Ops.
- Finance to purchase at a 4 percent annual interest rate with a ten percent down payment.

Chart 3.2 summarizes the estimated acquisition costs for leasing or purchasing one S-70i helicopters. Page 3-26, Chart 3-12 offers a summary of purchasing one to five S-70i helicopters over the same ten-year period using the same leasing/financing alternatives.

Chart 3-2



Notes:

1) **Lease – 0.75%: Lease aircraft at 9% annual or 0.75% monthly rate.**
2) **Lease – 0.50%: Lease aircraft at 6% annual or 0.50% monthly rate.**
3) **Finance – 4%: Finance the purchase at 4% annual interest rate with a 10% down payment.**

If LACoFD Air Ops chooses to replace the current S-70A helicopters, the amount it can expect to receive for each aircraft is difficult to determine. The minimum value of $500,000 is influenced due to the military's release of surplus UH-60A helicopters to the market. The Army estimates it will release between 400 and 800 to helicopters over the next 10 years. Our research indicated that airframes auctioned by the General Services Administration to the helicopter market were in the ballpark of $500,000. However, the LACoFD Air Ops should expect a higher value due to the helicopters' known history and usage which is not the case with ex-military surplus helicopters.

3.3 Conklin & de Decker Analysis

The analysis in this section consists of three sections. Section 3.3.1 has two sub sections. One estimates the ten-year maintenance costs if LACoFD Air Ops retained its S-70A helicopters and did not use Sikorsky's TAP. The second sub section used the same scenario but did include the new proposed TAP rate as proposed by Sikorsky. Section 3.3.2 summarizes the second option as offered by Sikorsky, to upgrade the S-70A helicopters to L models. Section 3.3.3 estimate the acquisition and maintenance costs associated with S-70i helicopters.

3.3.1 Continue to operate the current fleet of three S-70A helicopters.

3.3.1.1 Summary

The first of the three options regarding the S-70A fleet is to continue to operate the current helicopters. The current Sikorsky TAP program will expire at the end of the calendar year 2016. Sikorsky initially indicated that it would not extend TAP beyond this time; however they have decided to offer a new three-year-only contract but with an increased hourly rate of $3,400 per hour, a significant increase over the current 2016 rate of $1,770 ($3,400 rate obtained from Sikorsky in March 2016).

Given this situation, LACoFD Air Ops asked Conklin & de Decker to analyze two options should it continue to operate its current fleet of S-70A helicopters.

- The first option was to estimate the maintenance costs of the fleet over the next ten-year period based on the primary assumption that Sikorsky would not offer a modified guaranteed maintenance program.
- The second option would include the three-year TAP contract as offered by Sikorsky. This program would also include the engines.

To accomplish the analysis, we used historical maintenance information from LACoFD Air Ops, prior outside cost research on UH-60 helicopters, and Conklin & de Decker's *Life Cycle Cost* software program. The software allows cost projections based upon individual helicopter information.

Chart 3-3 compares the estimated costs for the two options associated with continued operation of the S-70A fleet. The chart shows that operating the existing fleet (first option) over the next 10 years without a guaranteed maintenance program is approximately $29.6 million. If Sikorsky continues with an adjusted TAP rate based on Sikorsky estimates, the same fleet over the same period of time would cost an estimated $46.0 million. Sikorsky indicated that to continue TAP on the existing fleet, the rate would go from the current 2015 rate of $1,700 to $3,400 as estimated by Sikorsky in March 2016. The *Life Cycle Cost* software inflated the new $3,400 rate by 4 percent each year.

Chart 3-3

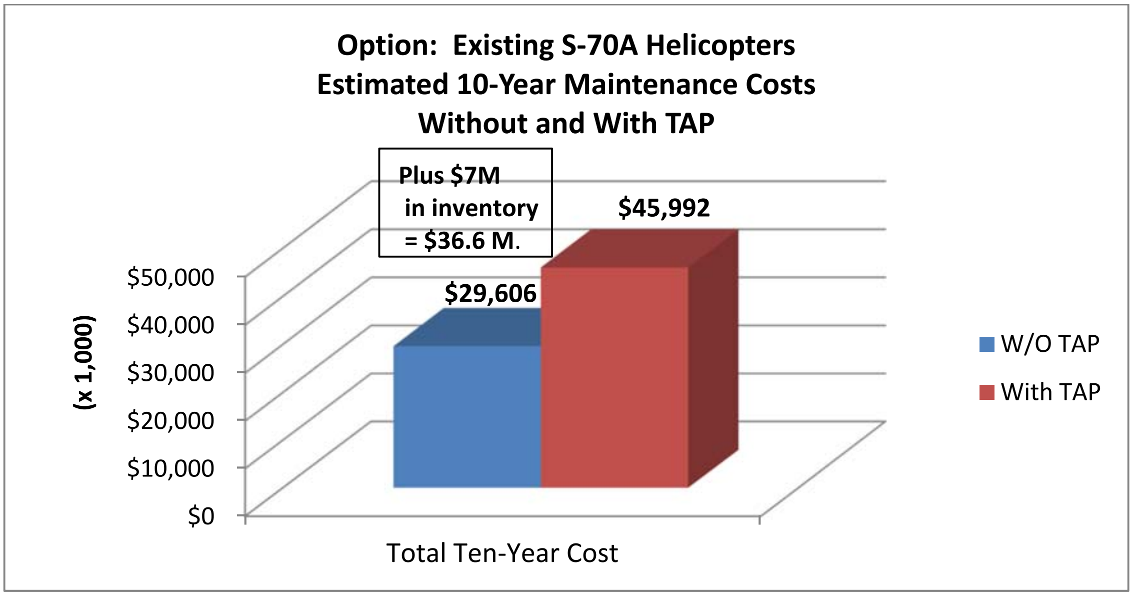
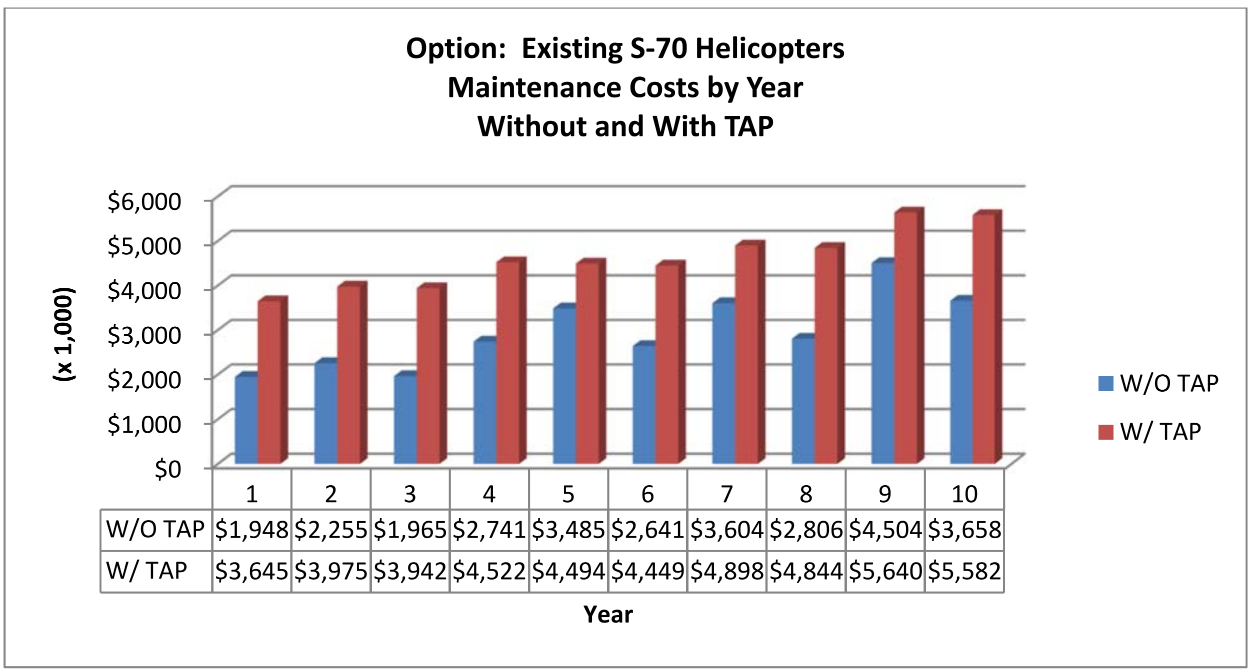


Chart 3-4 uses the same information that generated Chart 3-4 but displays the information as it is predicted to occur by year.

Chart 3-4



	1	2	3	4	5	6	7	8	9	10
W/O TAP	$1,948	$2,255	$1,965	$2,741	$3,485	$2,641	$3,604	$2,806	$4,504	$3,658
W/ TAP	$3,645	$3,975	$3,942	$4,522	$4,494	$4,449	$4,898	$4,844	$5,640	$5,582

Based on a maintenance cost perspective only, initially it would appear that maintaining the S-70A fleet without TAP makes the most sense. However, it is important to recognize that operating without this type of program also eliminates other program elements that are more difficult to measure their value than just by dollars. If Sikorsky does not offer TAP, the $7 million consigned inventory is most likely removed from the Pacoima site, aircraft availability will likely decrease based on reduced spares availability, budgeting will become more difficult due to less predictability, and Sikorsky's engineering and maintenance support may decline for helicopters that are out-of-production and at an age when those services are most needed.

3.3.1.2 Overview - Operate Existing Fleet without TAP

Initially, Sikorsky mentioned that it would not offer TAP on the existing S-70A helicopter fleet. However, it would consider offering a guaranteed maintenance program but reduced in scope when compared to TAP, a program that would cover the powertrain systems only. With that possibility, that TAP or only a reduced guaranteed hourly maintenance program might be offered, LACoFD Air Ops asked Conklin & de Decker to estimate what the S-70A helicopters would cost to maintain during the next ten-year period?

Unfortunately, a guaranteed hourly cost is only part of the value of a program like TAP. Other benefits (e.g. consigned inventory, engineering support), whose value is more difficult to measure, should be considered when evaluating the option of continuing with a fleet of S-70A helicopters. A summary of these benefits is provided on Pages 3-9 and 3-10.

Chart 3-5 shows that based on our assumptions, which are discussed in the next section, we estimate the maintenance costs for the current three S-70A helicopters to total $29.6 million over the next ten-year period. The chart shows that years 5, 7, 9, and 10 will require significantly more resources as certain scheduled maintenance events (e.g. overhauls or retirements) will occur than in the other years.

Chart 3-5

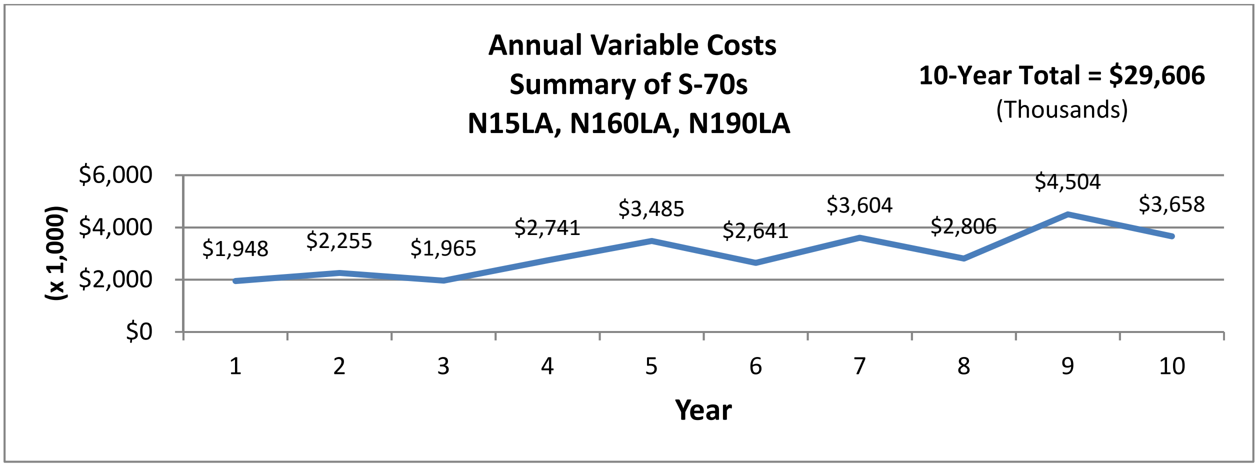
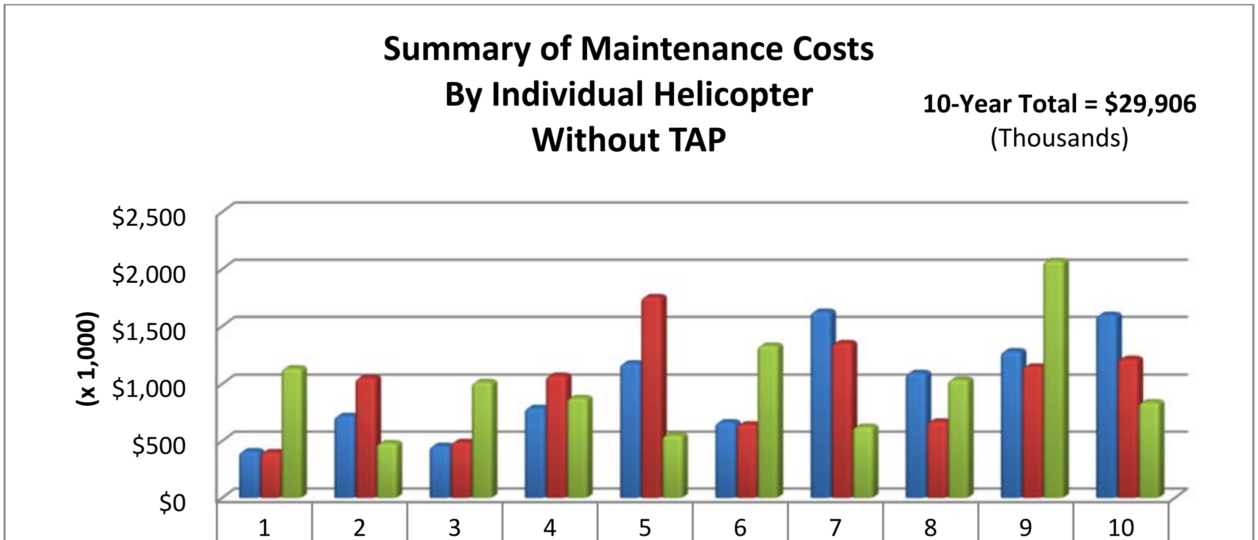


Table 3-1 takes the combined fleet total of $29.6 million and shows what each helicopter will consume. Interestingly, each helicopter's total cost over the ten-year period is similar, within a $150,000 range.

Table 3-1	
Total 10-Year Cost by Helicopter	
N Number	Cost (x 1,000)
N15LA	$9,825
N160LA	$9,815
N190LA	$9,967

Chart 3-6 shows a further breakdown for each helicopter by year for the ten-year period. Whereas the total cost for each helicopter may be similar, the chart shows the costs can vary significantly by year. N190LA illustrates this point. In Year 2 this helicopter will encounter $481,000 in maintenance costs while in Year 9 it will cost close to $2.1 million. This is a variation of almost $1.6 million. This is one of the primary reasons that programs like TAP are well received. They have a smoothing effect on the potential variation in annual costs.

Chart 3-6



	1	2	3	4	5	6	7	8	9	10
N15LA	$409	$721	$457	$791	$1,180	$664	$1,626	$1,097	$1,281	$1,599
N160LA	$402	$1,054	$491	$1,073	$1,755	$645	$1,352	$671	$1,152	$1,219
N190LA	$1,137	$481	$1,017	$878	$550	$1,331	$625	$1,038	$2,071	$839

When evaluating this option to maintain the S-70A helicopters without a guaranteed maintenance program, LACoFD Air Ops should consider other factors whose value is more difficult to measure in dollars but has the potential to affect LACoFD Air Ops in different ways.

- Sikorsky's Consignment Inventory – Air Operations estimates the amount of inventory at the Pacoima site is close to $7 million. If the S-70A's operate without TAP, it is almost certain that Sikorsky will remove the inventory. If this occurs, LACoFD Air Ops will need to spend a significant amount to create an inventory for the continued operations.
- Aircraft Availability – Striving to attain a high percentage of helicopter availability is one of the most important objectives of a maintenance department. In addition to the high cost to establish its inventory for the S-70A helicopters, LACoFD Air Ops will also create the risk of not having replacement parts available when needed. With TAP, the manufacturer faces an incentive to support availability, a penalty for helicopter downtime. Without TAP, the manufacturer does not have a penalty, which means LACoFD Air Ops will not enjoy the priority in spares support that it now has.
- Reserve for Future Maintenance Costs – Based on the cost behavior illustrated in Chart 3-6, the budgeting exercise will become more difficult as each year will vary due to the timing of significant scheduled cost events (e.g. component overhauls,

retirement of life-limited items). Also, uncertainty associated with unscheduled significant costs will contribute to uncertainty regarding the budget. If LACoFD Air Ops is similar to other governmental agencies, it is difficult to gain approval for widely varying budgets.

- <u>Manufacturer's Support Program</u> – Key elements of a manufacturer's support program include training, engineering support, and maintenance support. Will the manufacturer continue to offer support of this nature for versions of the S-70A that are out of production with certain systems (avionics) that are considered obsolete? Engineering support becomes more relevant as an aircraft ages. For example, the airframe structure will experience more cracks and corrosion as the airframe ages both in hours flown, missions performed, and years operated.
- <u>LACoFD Air Ops Support Supply Chain</u> – A TAP program limits the number of vendors with which LACoFD Air Ops interacts. Operating without TAP and operating a helicopter type that is out-of-production will force LACoFD Air Ops to establish a more robust vendor network. While difficult to measure how much, establishing a vendor network will cost LACoFD Air Ops resources. Also, it is likely the supply chain will become longer as measured in time. It will take longer from time of request for part or repair to the receipt of item or service. A longer supply chain will increase the probability of lower helicopter availability.

- **<u>Conklin & de Decker Approach and Analysis - Operate Existing Fleet without TAP</u>**

The estimates provided in the Overview of this section were generated using Conklin & de Decker's *Life Cycle Cost* software. The results for each *Life Cycle Cost* analysis are dependent upon a number of assumptions and variables. Also, the software tool's computations and results can be complex, which requires explanations about the functionality of the software. The following information provides more insight about the key assumptions and process that apply to the analysis performed for the LACoFD Air Ops.

- <u>Length of Life Cycle</u> – 10 years
- <u>Average Annual Flight Hours</u> – Table 3-2 shows the average annual flight hours for each helicopter since beginning operations. The average for the fleet was 288 annual hours. We chose to round up and use 300 flight hours for each helicopter in the life cycle analysis.

Table 3-2					
S-70A Flight-Hour History					
Helicopter Registration Number	**Total Flight Hours(1)**	**Date of Flight Hours(2)**	**Year Placed in Service(3)**	**Years of Operation(4)**	**Avg. Annual Flight Hours(5)**
N15LA	3,234	May 2016	2004	12	270
N160LA	4,396	May 2016	2001	15	293
N190LA	4,538	May 2016	2001	15	303
Fleet Average					**288**
Source: LACoFD Air Ops MxManager Component Detail Report for the respective aircraft was the source for the Total Flight Hours and Date of Flight Hours.					

Notes:

(1) Total flight hours for each helicopter were obtained from MxManager reports as generated by the Maintenance Tracking module.

(2) Reports were generated in May 2016.

(3) Provided by LACoFD Air Ops.

(4) Calculated by using the year 2016 in column (2) and subtracting the respective year value in column (4).

(5) Calculated by dividing column (1) by the respective values in column (4).

- Variable Cost Maintenance Categories – Each *Life Cycle Cost* summary provides estimated maintenance costs for the respective S-70A helicopters. Six categories constitute the total estimated maintenance costs -- Parts, Labor, Inspections, Life-Limited Items, Component Overhauls, and Engine Restoral. The following information provides further explanation and insight about the respective cost categories as it relates to all three aircraft. Unique information for each helicopter is explained in the respective sections for each helicopter.
    - Life-Limited Items – Items or parts on a helicopter that must be replaced ("retired") based upon a mandated period of time or level of usage, are commonly referred to as life-limited items. Recognizing when these items are scheduled for retirement is important due to their usually significant costs.

      For a more accurate life cycle cost analysis, certain information is important for each item -- cost, retirement life, and remaining life. LACoFD Air Ops MxManager software provided data for retirement and remaining lives. Cost data was more difficult to obtain due to several factors.
        - LACoFD Air Ops has used Sikorsky's TAP since taking delivery of the S-70A's. In this program, LACoFD Air Ops pays an agreed-upon hourly rate and Sikorsky provides replacement parts or

components. Unfortunately, in this type of arrangement, underlying or actual costs are unknown. Therefore, historic cost information is not available for the life-limited parts that are replaced.

- The size of the S-70A fleet operated by other-than-military operations is limited thus making maintenance cost data based on other operators' records difficult to obtain.
- S-70A cost information from Sikorsky is not readily available.

However, we were able to secure cost data from other sources and make cost assumptions about life-limited items that are also found on similar models.

- Overhaul Components – Components that are overhauled or repaired are similar to life-limited items in that they have a maintenance event that will occur based upon usage or passage of time. They are different from life-limited items in that a component is not retired from service; rather it is refurbished for future use. Examples of components that typically require overhaul or repair work are gearboxes, actuators, hubs and landing gear.

  Overhaul components are similar to life-limited items in that certain data is important to develop a more accurate estimate for the life cycle cost analysis. The important data is cost of overhaul, overhaul interval, and remaining life before overhaul. LACoFD Air Ops MxManager software provided data for the intervals and remaining life before overhaul. However and also similar to life-limited items, overhaul cost data is difficult to obtain for the same reasons.

  The maintenance tracking reports generated by LACoFD Air Ops only list the Auxiliary Power Unit (APU) as having an overhaul interval. This implies that some significant components (main gearbox, tail rotor gearboxes, main rotor hub, landing gear, hydraulic actuators) are removed and overhauled based upon their condition, also known as an on-condition event. As a result, we included an estimate for these types of components in the life cycle cost model to give a more reasonable estimate for what LACoFD Air Ops might incur maintaining its own aircraft without a TAP program. Table 3-3 contains a summary of the overhaul components that we added to the life cycle estimate.

Table 3-3			
Component Overhaul Assumptions			
Component	**Qty**	**Estimated Cost**	**Estimated Interval (Hours)**
Actuators	3	$ 16,700	13,000
Tail Rotor Gearbox	1	$ 75,000	5,000
Main Gearbox Module	1	$ 120,000	2,300 (1)
Main Rotor Damper	4	$ 52,400	5,500
Shock Strut	1	$ 27,800	7,666

Note:

(1) Interval based on conversation with LACoFD Air Ops personnel and reflects actual removal rate for the S-70A fleet.

- Inspections – The S-70A requires a series of inspections (e.g. 10-hour, 30-hour, 60-hour), which apply to various systems on the helicopters (e.g. airframe, engines, avionics, mission equipment). However, the most significant inspection event is the 500-Hour Inspection. Due to its significance, it is the only inspection that we classified in the Inspection category. The other inspections were included in the Parts and Labor cost categories.

  Sikorsky, based upon LACoFD Air Ops request, frequently sends a maintenance crew to assist with the 500-Hour Inspection. Table 3-4 reflects the average estimated cost to perform the 500-Hour Inspection as performed by the Sikorsky team.

Table 3-4				
500-Hour Inspection - Sikorsky Crew Support Estimate				
Category (1)	**Daily Charge (2)**	**Mechanics (3)**	**Days (4)**	**Estimated Cost (5)**
Minimum	$ 1,599	4	25	$ 159,900
Maximum	$ 1,599	5	45	$ 359,775
Average				$ 259,838

Notes:

(1) The labor required to complete a 500-Hour inspection varied based upon, primarily, the discrepancies that were found during the inspection tasks. Since the cost variation could be quite large, we wanted to provide a minimum cost, few discrepancies, and a maximum cost, significant discrepancies. From the range would be calculated an average.

(2) Provided by LACoFD Air Ops. The daily charge for one technician as charged by Sikorsky in 2015. (The 2016 rate is $1,655, a 3.5 percent increase. The 2017 is estimated to increase again but the size of the increase is unknown.)

(3) Provided by LACoFD Air Ops. The Sikorsky crew size could vary.

(4) Provided by LACoFD Air Ops. The range in days required to complete the inspection.

(5) The estimated cost calculated by multiplying Daily Charge (2) x Mechanics (3) x Days (4).

For the life cycle cost estimate, we used the average cost ($259,838) as the base and rounded up to $260,000. The average cost includes labor costs only, as the part and repair costs associated with discrepancies are covered by TAP, unless the value was under $200 per item, which creates the same situation as mentioned in life-limited items and overhaul components. No cost basis exists for these inspection costs.

During the 500-Hour Inspection, the LACoFD Air Ops technicians supplemented the Sikorsky team effort by performing other inspections and repairs while the helicopter was disassembled. Labor costs associated with the LACoFD Air Ops effort were classified in the Labor category.

- <u>Engine Restoration</u> – Engine restorations in the *Life Cycle Cost* software consist of three categories of cost, those associated with life-limited items (e.g. disks, shafts, plates, blisks), which are very similar to accounting for life-limited items on the airframe, significant engine inspections (500-hour inspection on the GE T700 engine), and overhauls. The GE T700 engine's life-limited items have scheduled removal times normally based upon cycles that frequently measure how "hot and hard" the engine performs.

  As with airframe overhaul components, the helicopter's engines will eventually require significant maintenance, which is commonly referred to as an overhaul. The engines on the LACoFD Air Ops S-70A helicopters do not have scheduled overhauls based upon flight hours, a common parameter, but rather, will incur heavy maintenance based upon the engines' condition or performance, also known as an on-condition event? Based on this situation, we had to make certain assumptions to account for engine overhauls in the life cycle cost projections. Our assumptions were as follows:

  - To establish an estimated overhaul period, we reviewed the replacement intervals for the life-limited items and determined which items would require significant teardown of the engine to replace. We determined and confirmed in conversations with LACoFD Air Ops personnel, that this type of event would occur at 5,000 hours.
  - To estimate an overhaul cost, we used the existing data in the *Life Cycle Cost* program ($915,000), and removed the cost of the life-limited items to determine an estimated cost for an overhaul ($520,000) considering just the parts and repairs based upon the condition of the engine.
  - During our research on the LACoFD Air Ops S-70A helicopters, we learned the GE engines have had several premature removals due primarily to the type of mission and environment in which the helicopters operate. In this case, the engines are sent back to GE for re-work or repair. We calculated the estimated cost to be 30% of an engine overhaul ($156,000) and established a removal interval of 1,500 hours based upon discussions with LACoFD Air Ops personnel.

- <u>Parts</u> – This category is the "catch all" category for costs that don't belong in life-limited items, component overhauls, inspections, or engine restoration. It is more difficult to define Parts parameters than the other categories, and it can be a significant category of costs.

  For purposes of this analysis, the types of cost that would be classified as Parts would include mission equipment, items that cost less than $200 (non-TAP covered items), and any other part and repair costs not covered by TAP.

  The source of data for this category was LACoFD Air Ops *MxManager* software. This type of information is captured in the work order portion of the software. We made several adjustments to the work order totals for parts and repairs by identifying and removing costs assumed to be covered by TAP. Table 3-5 shows the work order total for parts and repairs prior to and after our adjustments.

  The post-adjustment totals served as the basis for the starting point of the part and repair costs in the *Life Cycle Cost* model for each helicopter. For example, the estimated cost to operate N15LA after removing costs associated with items covered by TAP is $570,500 or $201 per flight hour.

The average for all three S-70A helicopters is $243 per hour.

Table 3-5				
Parts and Vendor Repair Costs				
	Pre-Adjustment		**Post-Adjustment**	
Helicopter Registration Number	**Dollars**	**Cost per Hour**	**Dollars**	**Cost per Hour**
N15LA	$ 1,635,547	$ 577	$ 570,547	$ 201
N160LA	1,857,094	476	949,494	243
N190LA	1,529,691	369	1,175,091	283
Average				**$ 243**
Source: LACoFD Air Ops MxManager work order history.				

- Labor – This category is similar to Parts in that it consists of labor that is associated with activities other than significant scheduled events (e.g. component overhauls, major inspections, engine restoral). Activity in this category would include inspections with intervals less than the 500-Hour inspection, engine inspections, mission equipment inspections, and squawks or discrepancies associated with these inspections.

  The source of data for this category was LACoFD Air Ops *MxManager* software. This type of information is captured in the work order portion of the software. We made one adjustment to the work order labor-hour totals by identifying and removing labor hours associated with the 500-Hour inspection. Labor hours associated with this inspection are estimated in the Inspection category.

  The post-adjustment totals served as the basis for the starting point of the labor hours in the LCC model for each helicopter. For example, the estimated labor hours to operate N15LA after removing the 500-Hour inspection amount is 12,823 or 4.5 labor hours per flight hour.

  Table 3-6 summarizes the labor-hour information.

Table 3-6				
Labor Hour				
	Pre-Adjustment		**Post-Adjustment**	
Helicopter Registration Number	**Labor Hours**	**Labor Hours per Flt Hours**	**Labor Hours**	**Labor Hours per Flt Hours**
N15LA	19,643	6.9	12,823	4.5
N160LA	22,889	5.9	17,370	4.4
N190LA	32,525	7.8	22,625	5.5
Average				**4.8**
Source: LACoFD Air Ops MxManager work order history.				

- Aging Factor – The *Life Cycle Cost* software has the ability to apply a factor based upon the general aging of helicopters. Due to the age in years of the current S-70A fleet, we applied the aging factor in our analysis for each helicopter. The aging factor applies to the Parts and Labor categories. In essence, the aging factor is applied to the averages that were calculated for Parts and Labor.
- Inflation Factors – The *Life Cycle Cost* software has the ability to apply two inflation factors. The first factor, an annual factor, reflects aviation increases and is applied to the Life-Limited Items and Parts maintenance cost categories. We used a 3.5% annual factor for the analysis.

  The second inflation factor is a general factor and applies to the other maintenance cost categories. For example, in Year 1 of the analysis, the labor rate is $75. This rate would increase by 2.5% each of the ten years in the analysis.

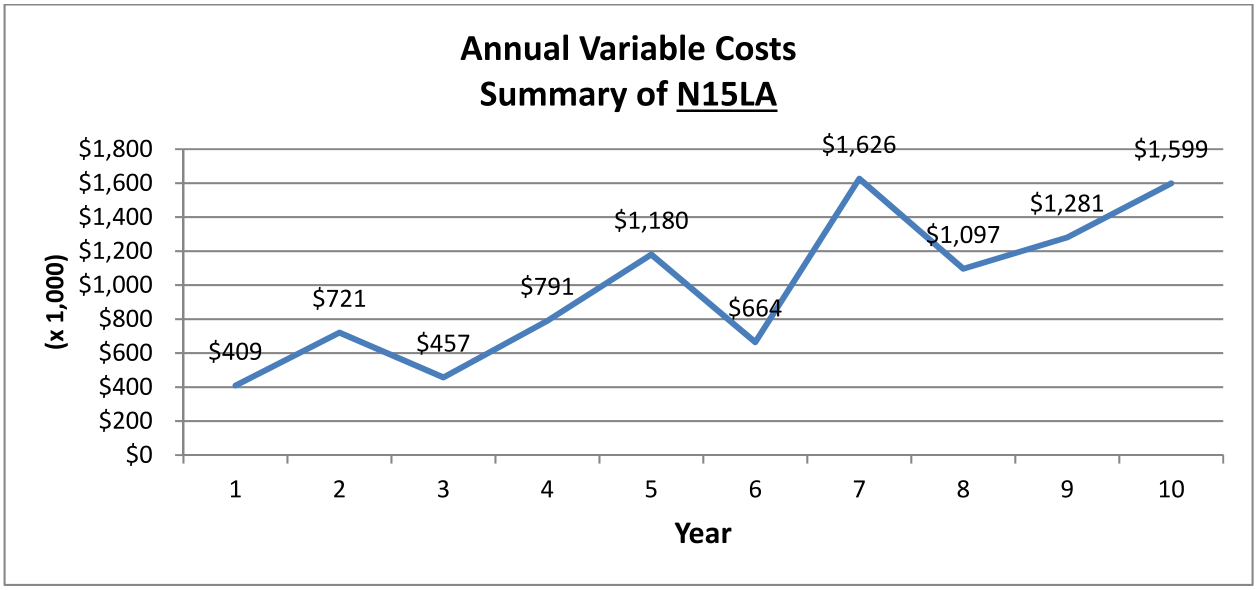
- Mission Equipment – The estimates in our analysis also include costs associated with mission equipment. These items also add to the cost of maintenance. The Parts and Labor categories include the costs to maintain the mission equipment as reflected by the work order information in LACoFD Air Ops *MxManager*. The following listing contains the more significant mission equipment on the S-70A helicopters.
  - Water Tank and related systems
  - Snorkel
  - Rescue Hoist
  - Nightsun

- HEMS-related equipment

Based on these assumptions and applying them in the *Life Cycle Cost* software, we estimated what the maintenance costs would be for each S-70A helicopter over a ten-year period.

- **N15LA Estimated Costs** – If N15LA flies an average of 300 annual flight hours over the next 10 years, LACoFD Air Ops can expect to spend an estimated $9.8 million maintaining the helicopter. This estimate is based upon the assumptions described in the previous section as well as applying the remaining lives for components, engines, and life-limited items installed on this helicopter as of July 2015. This method of estimate does not include TAP or any other form of a guaranteed maintenance program. The estimated resources required to maintain the helicopter for the individual years are displayed in Chart 3-7.

Chart 3-7



N15LA will incur costs above $1 million in 5 of the ten years – years 5, 7, 8, 9, and 10. The scheduled maintenance events contributing to costs in the respective years are summarized in the Table 3-7.

Table 3-7						
Summary of Annual Significant Scheduled Events - N15LA						
Year	**Category**	**Significant Maintenance Driver**	**Estimated Cost**	**Scheduled Maintenance Subtotal**	**Total Dollars (2)**	**Scheduled to Total (2)**
5	Airframe Inspection	500-Hour (1)	$ 310,300			
	Engine Restoration	Interim Removal	$ 366,200	$ 676,500	$ 806,400	84%
7	Airframe Inspection	500-Hour (1)	$ 343,200			
	Life-Limited	M/R Rotor Cuffs	$ 81,600			
	Engine Restoration	Overhaul (1 Engine)	$ 626,000	$ 1,050,800	$ 1,226,300	86%
9	Airframe Inspection	500-Hour (1)	$ 381,200			
	Component Overhaul	Main Rotor Damper	$ 63,800			
	Engine Restoration	Power Turb Shaft/Impeller	$ 217,500	$ 662,500	$ 852,000	78%
10	Airframe Inspection	500-Hour (1)	$ 409,200			
	Component Overhaul	T/R Gearbox	$ 93,700			
	Engine Restoration	Interim Removal (qty 2)	$ 441,200	$ 944,100	$ 1,155,800	82%

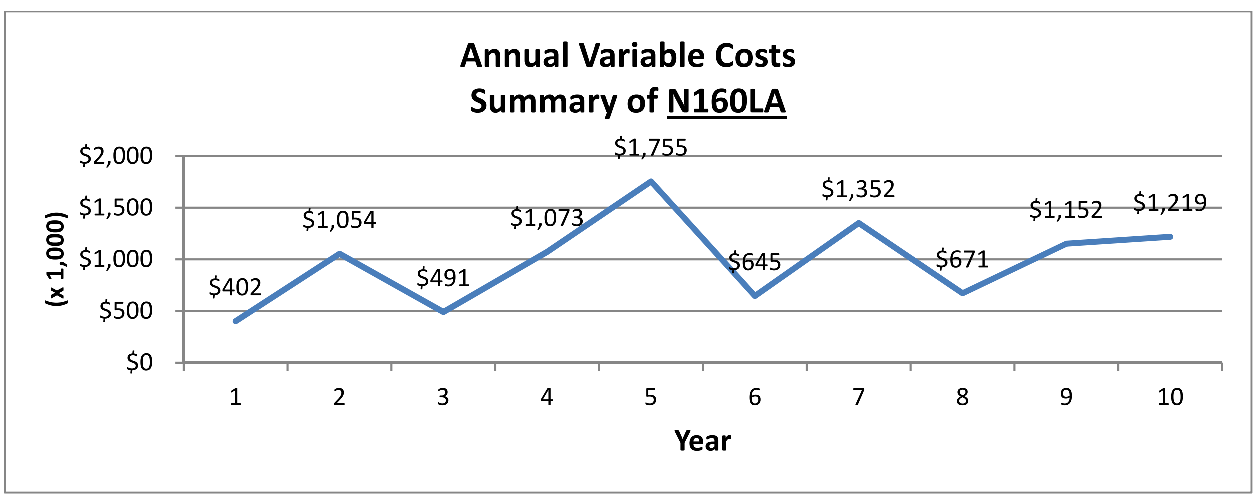
Notes:

(1) The cost for the 500-Hour inspection increases each year due to the inflation and aging factors that are applied in the *Life Cycle Cost* model.

(2) The amounts in these columns are also increasing due to the effects of the aging and inflation factors.

- **N160LA Estimated Costs** – If N160LA flies an average of 300 annual flight hours over the next 10 years, LACoFD Air Ops can expect to spend an estimated $9.8 million maintaining the helicopter. This estimate is based upon the assumptions described in the previous section as well as applying the remaining lives for components, engines, and life-limited items installed on this helicopter as of July 2015. The estimated resources required to maintain the helicopter for the individual years are displayed in the following chart.

Chart 3-8



N160LA will incur maintenance costs of more $1.0 million or higher in six of the ten years. Scheduled maintenance events -- inspections, component overhaul, life-limited items, and engine restoration -- are the primary reason for the increase costs for those years. The primary cost drivers related to the scheduled maintenance are summarized in Table 3-8.

Table 3-8

Summary of Annual Significant Scheduled Events - N160LA

Year	Category	Significant Maintenance Driver	Estimated Cost	Scheduled Maintenance Subtotal	Total Dollars (2)	Scheduled to Total (2)
5	Airframe Inspection	500-Hour (1)	$ 317,900			
	Engine Restoration	Overhaul (1 Engine)	$ 872,800	$ 1,190,700	$ 1,396,300	85%
7	Airframe Inspection	500-Hour (1)	$ 359,500			
	Life-Limited	Several Items	$ 64,500			
	Engine Restoration	Interim Removal (qty 2)	$ 384,800	$ 808,800	$ 967,700	84%
9	Airframe Inspection	500-Hour (1)	$ 402,100			
	Engine Restoration	Cooling Plates (qty 3)	$ 119,600	$ 521,700	$ 740,500	70%
10	Airframe Inspection	500-Hour (1)	$ 424,600			
	Life-Limited/Overahul	Several Items	$ 56,200			
	Engine Restoration	Life-Limited Items	$ 119,600	$ 600,400	$ 793,000	76%

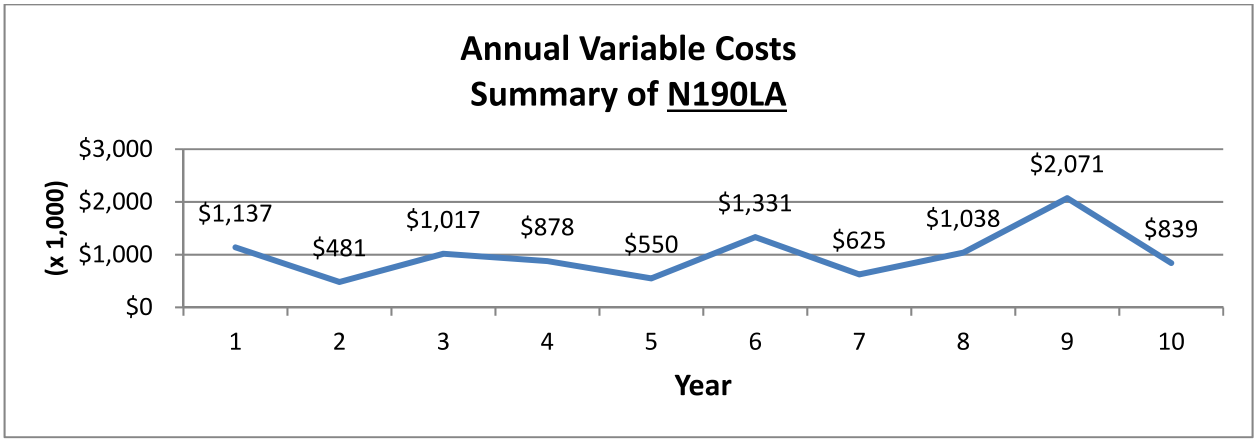
Notes:

(1) The cost for the 500-Hour inspection increases each year due to the inflation and aging factors that are applied in the life cycle cost model.

(2) The amounts in these columns are also increasing due to the effects of the aging and inflation factors.

- **N190LA Estimated Costs** – If N190LA flies an average of 300 annual flight hours over the next 10 years, LACoFD Air Ops can expect to spend an estimated $10.0 million maintaining the helicopter. This estimate is based upon the assumptions described in the previous section as well as applying the remaining lives for components, engines, and life-limited items installed on this helicopter as of July 2015. The estimated resources required to maintain the helicopter for the individual years are displayed in Chart 3-9.

Chart 3-9



N19LA will incur scheduled maintenance costs above $1 million in five years (1, 3, 6, 8, and 9). Scheduled maintenance events -- inspections, component overhaul, life-limited items, and engine restoration -- are the primary reason for the increase costs for those years. The primary cost drivers related to the scheduled maintenance are summarized in Table 3-9.

Table 3-9

Summary of Annual Significant Scheduled Events - N190LA

Year	Category	Significant Maintenance Driver	Estimated Cost	Scheduled Maintenance Subtotal	Total Dollars (2)	Scheduled to Total (2)
1	Airframe Inspection	500-Hour (1)	$ 260,000			
	Component Overhaul	Main Gearbox	$ 120,000			
	Engine Restoration	Interim Removal (qty 2)	$ 321,900	$ 701,900	$ 836,200	84%
6	Airframe Inspection	500-Hour (1)	$ 334,900			
	Life-Limited	Several Items	$ 64,100			
	Engine Restoration	Interim Removal (qty 2)	$ 364,200	$ 763,200	$ 973,900	78%
9	Airframe Inspection	500-Hour (1)	$ 402,100			
	Component Overhaul	Main Gearbox	$ 146,200			
	Engine Restoration	Overhaul (1 Engine)	$ 851,400	$ 1,399,700	$ 2,071,133	68%

Notes:

(1) The cost for the 500-Hour inspection increases each year due to the inflation and aging factors that are applied in the life cycle cost model.

(2) The amounts in these columns are also increasing due to the effects of the aging and inflation factors.

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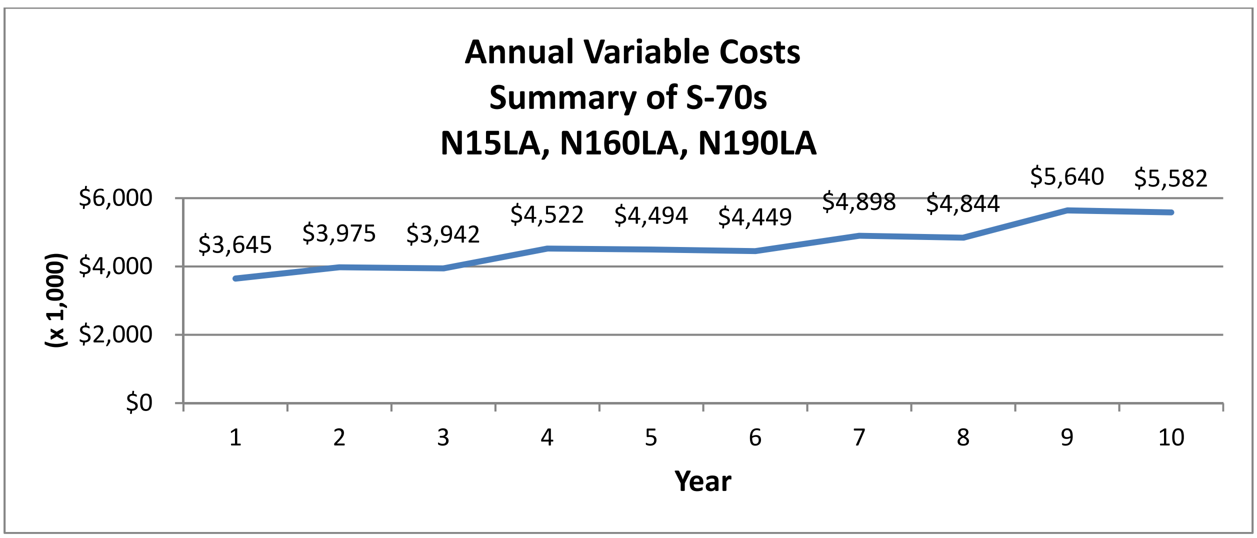
3.3.1.3 Overview - Operate Existing Fleet with TAP

If LACoFD Air Ops choses to operate its existing fleet of three S-70A helicopters, a second option exists regarding maintenance costs. Sikorsky initially indicated that it would not extend TAP beyond the end-of-month December, 2016. However, and according to LACoFD Air Ops personnel, Sikorsky has reconsidered its decision and will offer a new TAP contract for the existing S-70A helicopters. The new TAP contract will start in January 2017, be offered for a three-year period only, and is unlikely to be renewed. The 2017 TAP rate of $3,400 per hour is a significant increase from the 2016 rate of approximately $1,770 ($3,400 rate obtained from Sikorsky in March 2016).

Chart 3-10 shows the maintenance costs for the three S-70A helicopters to total $46.0 million over the next ten-year period. The $46.0 million estimate is based upon the first year's TAP rate of $3,400 and increased by four percent annually. The chart illustrates the effects of TAP as it has removed the peaks and valleys associated with significant maintenance events that exist when a program such as TAP is not present. The gradual increase is due to the effects of annual increases of 4 percent in the TAP rate.

Chart 3-10



Maintenance Not Covered By TAP – While TAP covers a significant percentage of the costs to maintain the S-70A helicopters, there are three basic categories not covered, parts and repairs under $200, maintenance for mission equipment, and LACoFD Air Ops labor. We applied a labor factor of approximately 6.5 maintenance hours per flight hour and a general parts consumption rate of $243 per hour. Both amounts were calculated based upon the information captured in the operation's *MxManager* software program.

3.3.2 Upgrade the current S-70A airframes to a more current airframe version, the S-70L.

When initial conversations began almost two years ago between LACoFD Air Ops and Sikorsky regarding the options that LACoFD Air Ops might consider for its S-70 fleet, one of the options was to upgrade its existing airframes to a more current production airframe. In short, Sikorsky would upgrade its older A model airframes to the current L model airframe. Other improvements that would be part of the upgrade included an upgraded main transmission, an improved avionics suite, overhauled GE 701D engines, and zero-time or less than 1,000-hour overhaul airframe components.

Additionally, the upgraded version would also receive the full support package such as manufacturer's training, TAP, on-site spares, and engineering and maintenance support.

However, what sounded like a good idea on paper began to run into problems as Sikorsky researched the upgrade program. Based on similar military upgrade programs, Sikorsky learned that each A model airframe had enough differences when compared to another that each upgrade was a specialized process rather than standard, which increased the cost for each upgrade, so much so that the upgrade fee was approaching the price of a new S-70i airframe.

Sikorsky then began to research to determine if outside vendors could perform the airframe upgrades for a more reasonable cost. As of August 2016 that option was still not available.

Unless something changes soon related to this option, the upgrade program for LACoFD Air Ops does not seem reasonable. Therefore, we did not analyze this option further.

3.3.3 Replace the current S-70A fleet with new S-70i helicopters.

3.3.3.1 Summary

A third and final option discussed with Sikorsky involved replacing the current S-70A helicopters with new S-70i helicopters. The S-70i was created and intended primarily for international governments and other operators that were not U.S. military. The helicopters are assembled in Poland by PZL Mielec.

Sikorsky estimated a purchase price for a fully-configured S-70i was $20 million in 2015 dollars. This purchase price was offered in mid-2015 and represents Sikorsky's standard list price before any special considerations by the manufacturer. The expected annual price increase was 4 percent. Table 3-10 reflects the estimated purchase price through 2020.

Table 3-10	
S-70i Purchase Price (Fully-Configured)	
Annual Inflation - 4%	
Year	**Price** (x 1,000)
2015	$20,000
2016	$20,800
2017	$21,632
2018	$22,497
2019	$23,397
2020	$24,333

LACoFD Air Ops also requested that Conklin & de Decker run several variables using its *Life Cycle Cost* software. The significant variables included:

- The methods of acquiring the new S-70i helicopters. LACoFD Air Ops was considering acquiring the assets as a purchase or lease.
- The annual flight hours. If LACoFD Air Ops acquired a fourth S-70i, the historical annual flight hours would decrease from 300 to 225.
- The length of time in years for operating the S-70i helicopters. LACoFD Air Ops requested the scenarios be 10, 12, and 15 years.
- The S-70i helicopters would come with TAP.

Based on these primary assumptions, we divided the estimates into two separate tables. Table 3-11 summarizes the estimated maintenance costs for the S-70i helicopters, while Table 3-12 summarizes the estimated costs to purchase or acquire the new helicopters.

Table 3-11 displays the estimated maintenance costs for one S-70i assuming two different annual flight-hour totals (e.g. 225, 300) over varying periods of years (e.g. 10, 12, 15). Maintenance costs are based on the Sikorsky-provided $2,600 TAP rate, which includes airframe and engines, LACoFD Air Ops labor costs, and parts that are over $200 or associated with mission equipment. Our analysis estimates that an S-70i will cost $9.2 million to maintain over a ten-year period flying 225 annual hours. The estimated costs would increase to $12.4 million if the aircraft is flown 300 annual hours.

Table 3-11		
Maintenance Cost Estimates (x1,000)		
	Annual Flight Hours	
	One Aircraft	
Years	**225**	**300**
10	$9,197	$12,445
12	$11,658	$15,614
15	$15,552	$21,081

Table 3-12 summarizes the costs to acquire one to five S-70i helicopters through financing or leasing over the same period of years as used for Table 3-11. We used three scenarios to acquire the S-70i helicopters.

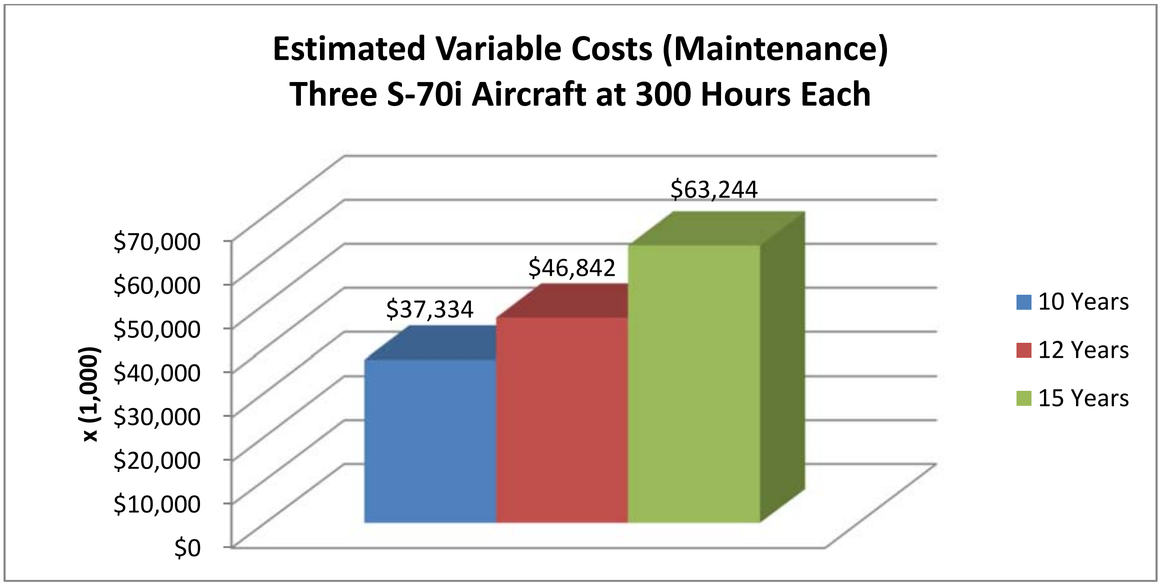
1. Lease to purchase, no down payment with a monthly interest rate of 0.75 percent. The interest rate represents a common rate as quoted by Milestone Aviation Group, helicopter leasing company.
2. Lease to purchase, no down payment with a monthly interest rate of 0.50 percent, as requested by LACoFD Air Ops.
3. Finance with a 10 percent down payment ($2.080 million) at a four percent interest rate.

Table 3-12 shows that to acquire one S-70i helicopter using the three lease/finance methods over a ten-year period will range between $22.7 and $31.6 million. The least expensive method involves finance to purchase with a ten percent down payment at four percent interest. If the repayment period is extended to greater than ten years, the total payment made will increase regardless of the finance/lease method used.

Table 3-12				
Lease / Finance Options (x 1,000)				
	Number of Aircraft			
	One	Three	Four	Five
10 Years				
Lease, No Down Payment, Level Payments, Interest Rate - 0.75% monthly, 9% annual	$31,618	$94,855	$126,473	$158,091
Lease, No Down Payment, Level Payments, Interest Rate - 0.50% monthly, 6% annual	$27,711	$83,132	$110,843	$138,554
Finance, 10% Down Payment ($2.080 M), 4% Annual Interest	$22,744	$68,231	$90,975	$113,719
12 Years				
0.75% Monthly Interest	$34,086	$102,259	$136,345	$170,431
0.50% Monthly Interest	$29,229	$87,686	$116,915	$146,143
Finance - 4% Annual Interest	$23,601	$70,804	$94,406	$118,007
15 Years				
0.75% Monthly Interest	$37,974	$113,922	$151,897	$189,871
0.50% Monthly Interest	$31,594	$94,782	$126,376	$157,970
Finance - 4% Annual Interest	$24,925	$74,774	$99,698	$124,623

Chart 3-11 illustrates the total variable costs (maintenance costs only) for three S-70i helicopters flying 300 annual hours each. For example, at ten years it is estimated that three S-70i helicopters will cost $37.335 million ($12.445 x 3). If we compare this total to the estimated cost to retain the current three S-70A helicopters ($46 million as shown in Chart 3-1), LACoFD Air Ops would spend approximately $9 million less to maintain a fleet of S-70i helicopters.

Chart 3-11



3.3.3.2 Conklin & de Decker Approach and Analysis - Replace the current S-70A fleet with new S-70i helicopters.

The information in this section supports the Summary section by offering more analysis and description about the Conklin & de Decker methodology. The primary tool used to generate the estimates in this section was the company's *Life Cycle Cost* software. As discussed previously life cycle cost analysis is dependent on a number of assumptions. The following information discusses the important assumptions that were used to generate the acquisition and maintenance costs of the S-70i helicopters.

Key Assumptions and Comments:

- General Assumptions:
  - Length of Life Cycle – LACoFD Air Ops requested that we use three different lengths in years -- 10, 12, and 15.
  - Average Annual Flight Hours – LACoFD Air Ops requested that we use two annual flight hours -- 300 and 225. The 300 flight-hour estimate was based upon the historical average for each S-70A helicopter in the current fleet. The current fleet has three helicopters and flies a total of 900 hours. The 225 annual flight hours is based upon the possible addition of a fourth S-70i to the fleet but without the fleet's total flight

hours increasing. Under this assumption the 900 annual flight hours would be spread among four S-70i helicopters.

- <u>Aging Factor and Inflation Rates</u> – Both factors were applied as described in the section on maintenance costs for the existing S-70A helicopters. (See 3-15 for more information)
- <u>Fuel</u> – Fuel was not included in this analysis because the option for retaining the current S-70A helicopters did not include this category of cost. We wanted to maintain an apples-to-apples comparison.

- <u>Variable Maintenance Cost Assumptions</u> – Acquiring new S-70i helicopters would mean that Sikorsky would offer TAP to cover the maintenance costs; however, not all maintenance costs would be covered by TAP. The following information explains our approach to building an estimate for maintenance costs.
    - <u>TAP Rate</u> – Although not announced officially by Sikorsky, the hourly rate offered would likely be $2,600. In prior discussions with LACoFD Air Ops, the company indicated a new rate would likely be 45% higher than the existing rate. Using the estimated 2016 rate of $1,770 (a 4% increase over the 2015 rate), we applied a 45% increase to arrive at a calculated rate of $2,562. We rounded up to $2,600 and applied this rate in three areas of the *Life Cycle Cost* software.
    - <u>Maintenance Not Covered By TAP</u> – While TAP covers a significant percentage of the costs to maintain the S-70 helicopters, there are three basic categories not covered, parts and repairs under $200, maintenance for mission equipment, and LACoFD Air Ops labor. We applied a labor factor of approximately 6.5 maintenance hours per flight hour and a general parts consumption of $243. Both amounts were calculated based upon the information captured in the operation's *MxManager* software program.
- Financial Costs -
    - <u>New S-70i Helicopter Value</u> – Based upon discussions with Sikorsky, the estimated mission-ready S-70i helicopter would cost $20,000,000 in 2015 dollars. Sikorsky also estimated that the purchase price would increase by 4 percent annually. We assumed a purchase price based on 2016 of $20,080,000.
    - <u>Method of Financing</u> – LACoFD Air Ops requested that we look at two methods of acquiring the new S-70i helicopters, purchase and lease.
        - Purchase Method – We assumed a 10% down payment with financing for the remaining 90% value with a 4% annual interest rate. We assumed a 10% resale value of the original purchase price at the conclusion of the financing term.

- Lease Method – Leases do not require a down payment. We used two lease rates based upon LACoFD Air Ops request. The first annual interest rate used was 9% or a .75% monthly rate. This rate was the default rate used in *Life Cycle Cost* and was confirmed by two independent sources as a reasonable rate. The second rate, 6% annual rate or .05% monthly rate, was requested by LACoFD Air Ops.

- <u>Disposition Value of Existing S-70A helicopters</u> – Generally, the current value of S-70A helicopters is very low due to the military's release of surplus UH-60A helicopters to the market. The total released over the next 10 years is estimated by the Army to be between 400 and 800. Our research indicated that airframes auctioned by the General Services Administration to the helicopter market were in the ballpark of $500,000. However, the LACoFD Air Ops should expect a higher value due to the helicopters' known history and usage which is not the case with ex-military surplus helicopters. Due to the uncertainty regarding the current value of S-70A (UH-60A) helicopters, we chose not to include this element in our analysis.

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Section 4 - Current Aircraft Fleet Review

4.0 LACoFD Air Ops Original Request

With the Total Assurance Program (TAP) for the current Sikorsky S-70A helicopters concluding in December 2016, LACoFD Air Ops recognized the opportunity to review various aspects of its Air Operations (Air Ops) organization. More specifically, LACoFD Air Ops asked Conklin & de Decker to research the following areas regarding its current fleet.

- Review aircraft fleet to include recommendations for aircraft type and quantity to support the current and foreseeable missions.
- What are the available options for spare part plans for existing aircraft and potential aircraft acquisitions?
- What are the maintenance cost differences when comparing the retention of current aircraft versus newer aircraft?

4.1 Conklin & de Decker Approach

During the period of time between issuance of the contract and research for this section, several priorities or the focus on certain subjects changed. Based on that changing situation, we approached the first request, aircraft type and quantity to support the current and foreseeable missions, separately. For the aircraft type, we focused on a range of helicopter candidates that were similar in performance to the Bell 412 and S-70A. For the appropriate quantity, we focused on the number of S-70 helicopters in the fleet. We did not address the spare part plans due to subsequent events following the issuance of the contract. For the third request, we compared the maintenance costs for new and used Bell 412 and S-70 helicopters and estimated the costs associated for a light single-engine helicopter, which could perform the HLCO mission.

4.2 Summary

Discussions with LACoFD Air Ops revealed the current aircraft types, S-70A and Bell 412, are able to perform the three primary missions, firefighting, emergency medical services, and search and rescue. Also, the group did not foresee its missions changing in the future. Based on that information, Conklin & de Decker chose to focus on two objectives regarding candidate aircraft and size of fleet.

- Identify other helicopter candidates and compare them to the current fleet based on selected parameters. The aircraft we selected for further review were Airbus Helicopters H145, H175, and H225, Agusta/Westland AW169, AW139, and AW189, and Sikorsky S-92. The parameters to compare the candidate helicopters were Maximum Gross Weight, Cabin Volume, Maximum Seating, Water Tank Capacity, Estimated Useful Load, Estimated

Endurance, Hover Capabilities, and Estimated Variable Costs. The S-70 compares very well to the candidates, while also having the largest tank capacity.

- Determine the appropriate size of the helicopter fleet with an emphasis on the S-70 helicopters. We based our recommendation on two key assumptions.

  - LACoFD Air Ops would want to keep the equivalent of three S-70 helicopters available 365 days or a total availability of 1,095 (365 days x 3) days in a year's time.
  - Helicopter availability, as measured in days, is an important ingredient in determining the "correct" fleet size.

Table 4-1 displays two important pieces of information, the effects of availability (Availability Range) on the number of helicopters required (Aircraft Required to Meet Target) to keep three helicopters active throughout the year. For example, if LACoFD Air Ops is able to attain a level of 75 percent availability for its fleet, it will need four S-70 helicopters to meet the 365-day, three-helicopter requirement.

Table 4-1					
Estimated Fleet Size - S-70A					
Target (Days)	1,095	1,095	1,095	1,095	1,095
Availability Range	50%	60%	70%	75%	80%
Annual Days Available	548	657	767	821	876
Current Aircraft in Fleet	3	3	3	3	3
Available Days per Aircraft	183	219	256	274	292
Aircraft Required to Meet Target	6.0	5.0	4.3	4.0	3.8

The current fleet level of availability for LACoFD Air Ops is 55 percent, 59.1 percent for the S-70A helicopters and 53.2 percent for the Bell 412 helicopters. The following should improve that level.

- Acquire S-70i helicopters. This version of the S-70 has longer inspection intervals, which will have an impact on availability.
- Develop a system that measures aircraft availability. (Started by maintenance in 2015.)
- Measure the efficiency of the maintenance department.
- Evaluate the missions.

A further description of our suggestions begins with section Role of Maintenance and Its Effect on Availability on page 4-28.

The second request regarding available spare part plans for existing aircraft and potential aircraft acquisitions was related to the existing fleet of S-70 helicopters and the possible expiration of TAP. Sikorsky mitigated the issue when it offered a new TAP contract for the existing helicopters should LACoFD Air Ops decide to continue to operate the S-70A helicopters. Due to this offer by Sikorsky, we did not perform analysis in this area.

The third LACoFD Air Ops request asked to compare the maintenance costs if current aircraft were retained versus acquiring new aircraft.

- **How do the maintenance costs of LACoFD Air Ops current Bell 412s compare to a new Bell 412 EPI?**

  Table 4-2 estimates the ten-year costs for each current Bell 412 and compares the savings for each when compared to a new Bell 412EPI. If LACoFD Air Ops decides to move out of certain Bell 412 helicopters, it is important to understand the timing of the estimated maintenance costs by year as well as the total cost over a ten-year period. By understanding the timing, LACoFD Air Ops can avoid encountering certain years of significant maintenance costs and plan the timing of the disposition of aircraft, which can affect the resale value of the helicopter when LACoFD Air Ops decides to purchase replacement helicopters. Chart 4-13 on page 4-31 illustrates this perspective.

Table 4-2

Bell 412 - Estimated Maintenance Costs (x1,000)

	N110LA	N120LA	N14LA	N17LA	N18LA	New 412EPI
10-Year Costs	$4,209	$4,209	$4,098	$3,818	$4,276	$3,763
Savings *	$446	$446	$335	$55	$513	

Note – * Savings represents the estimated savings between maintenance costs of a new Bell 412EPI and the respective current 412s. In each case, the current helicopters will cost more to operate during the next ten-year period than a new 412EPI.

- **How do the maintenance costs of a LACoFD Air Ops current Sikorsky S-70s compare to a new Sikorsky S-70i?**

  Table 4-3 estimates the ten-year costs for the current S-70A helicopters and compares the savings for each when compared to a new S-70i.

Table 4-3				
S-70 - Estimated Maintenance Costs (x 1,000)				
	N15LA	**N160LA**	**N190LA**	**New S-70i**
10-Year Costs	$15,083	$15,359	$15,549	$12,445
Savings *	$2,638	$2,914	$3,105	

Note – * Savings represents the estimated savings between maintenance costs of a new S-70i and the respective current S-70 helicopters. In each case, the current helicopters will cost more to operate during the next ten-year period than a new S-70i.

- **What are the typical maintenance and fuel costs associated with a light single-engine helicopter, which would be used primarily for observation and command missions?**

  We chose an Airbus H125, which is the new version of the AS350. We used the *Life Cycle Cost* software to estimate the maintenance costs. Table 4-4 shows the annual variable costs over a ten-year period for a new helicopter.

Table 4-4											
Estimated Fuel and Maintenance Costs (x 1,000)											
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Total**
Total	$8,340	$33,221	$29,123	$66,226	$52,306	$84,208	$62,872	$95,642	$70,106	$109,032	**$611,075**

If LACoFD Air Ops used a light-single engine helicopter for the HLCO mission, it would save significantly when compared to using a Bell 412 for the same mission. As estimated in Chart 4-12 (page 4-30) to maintain an existing Bell 412 for a ten-year period would average approximately $4 million. The H125 maintenance costs for the same time period would be approximately $611,000. This is a savings of close to $3.4 million.

4.3 Conklin & de Decker Analysis

The analysis in this section consists of three primary sections. Section 4.3.1 compares performance characteristics of candidate helicopters to the current fleet and reviews the appropriate fleet size for the S-70 helicopters. Section 4.3.2 did not require further analysis regarding spares and Sikorsky's TAP program. Section 4.3.3 compares maintenance cost projections between the current fleet and new version of the same helicopter types and estimates the costs associated with a light single-engine helicopter.

4.3.1 Review the aircraft fleet to include recommendations for aircraft type and quantity to support the current and foreseeable missions.

4.3.1.1 Background Information

- Area of Coverage - LACoFD Air Ops provides fire protection and emergency medical services for the unincorporated parts of Los Angeles County, California, as well as 58 cities, including the city of La Habra, which is located in Orange County and was the first city outside of Los Angeles County to contract with LACoFD Air Ops. The department is responsible for just over 4 million residents spread out in over 1.2 million housing units across an area of 2,305 square miles. LACoFD Air Ops uses a variety of equipment to accomplish its missions and includes fire engines, bulldozers, HAZMAT vehicles, and helicopters.

  The Air Ops section contributes to the mission of LACoFD Air Ops by using a fleet of eight helicopters owned by LACoFD Air Ops plus a leased helicopter.

- Infrastructure – LACoFD Air Ops is based at Barton Heliport, which is adjacent to Whiteman Airport in the city of Pacoima. The base also serves as the primary departure point for the helicopter fleet as well as the site for maintenance activity and flight, mission crew, and administrative activities.

  To cover its area of responsibility, LACoFD Air Ops dispatches its helicopters to four bases, three primary and one seasonal, within the county. The bases are as follows:

  - Camp 8, in the Malibu area (WAO – Western Air Operations), is where the West County Air Squad (WCAS) is deployed during daytime hours. The nighttime deployment site for this squad is the primary base at the Barton Heliport in Pacoima. The helicopter deployed to Camp 8 will be either the Bell 412 or S-70A. During the late Fall, the primary aircraft deployed to Camp 8 will be the S-70A with a Fly Crew. The aircraft type for the rest of the year will be determined by the weather conditions, aircraft availability, and fire danger. Camp 8 is a primary base.
  - Fire Station 129 (NCAS – North County Air Squad) in Lancaster serves as the 24-hour site for Northern Air Operations (NAO) deployments during the year. Depending on the Air Squad's staffing plan for the summer/fall months, FS129 site will be the nighttime deployment site if the dual-mission (Fire/HEMS) aircraft is located at Camp 9 during daylight hours. Either the Bell 412 or the S-70A will operate out of this base. Aircraft type is determined by weather conditions, type availability, and department needs. This location is a primary base.

- Camp 9 is the seasonal standby location for the "dedicated" or dual-mission (Fire/HEMS) aircraft during "declared" fire season (July-December). Those months are typically the hottest and driest months of the year and are generally when the weather conditions indicate the high likelihood of wildland fire activity. LACoFD Air Ops will deploy its primary firefighting helicopter, the S-70A, almost daily to the camp. Camp 9 is not fully staffed with a dedicated Fly Crew outside of the "declared" fire season or when fire conditions are low. If a dual-mission, helicopter is required, which is also typically the S-70A, the nighttime deployment site will be FS129.
- The Eastern Air Operations Base (EAO) is located at La Verne/Brackett Airport in the east end of Los Angeles County. The primary aircraft for this base is the Bell 412 with a pilot and 2 FFPM's (Firefighter Paramedics) for staffing. The aircraft is available 24 hours a day/7 days a week with the primary responsibility of providing an air ambulance for 911 trauma flights from the Pomona/East San Gabriel Valley area back to the main trauma center in East Los Angeles at the USC/LA County Medical Center. The next most frequent mission responses are SAR/Hoist Rescues in the Angeles National Forest, Wildland Fire, Catalina Island (all types of responses) and backup assistance to the other assigned aircraft in the county (i.e., the West County Air Squad, North County Air Squad, LA Sheriff's Department Air Rescue 5 Base at Barley Flats in the Angeles National Forest).

- Aircraft Fleet – LACoFD Air Ops owns and operates eight helicopters, three S-70As and five Bell 412s, two HPs and three EPs. LACoFD Air Ops also began leasing a light single-engine helicopter (Airbus Helicopters AS350) in November 2015 to use primarily for the observation and command missions, which were previously performed by Bell 412 helicopters.

  LACoFD Air Ops has two primary mission configurations for its helicopters. The first, known as an Air Squad, is the primary configuration for the fleet. It offers flexibility in the types of missions that it is able to perform such as water and crew delivery for firefighting (all aircraft have tanks for the water delivery), emergency medical services, search and rescue, and hoist operations. The crew for the Air Squad configuration is 1 pilot and 2 firefighters/paramedics.

  The second configuration, known as the Fireship, is designated for the firefighting mission. While this configuration will not have the extent of the medical equipment carried by the Air Squad-configured helicopter, it will have some additional equipment for mission flexibility. The additional equipment can include water hoses for ground filling stations, rescue ropes, hoist rescue harnesses and victim extraction system, and night vision goggles.

LACoFD Air Ops also uses its helicopters for a third mission, Helicopter Coordinator (HLCO). HLCO can work in concert with the ATGS (Air Tactical Group Supervisor) or on its own when an ATGS is not assigned to the incident. When both command aircraft are present, typically, the ATGS will assume control of the retardant dropping Air Tankers and the HLCO will control the rotary wing and water dropping airborne assets. Both resources (HLCO and ATGS) are in direct communication with the ground commander and staff throughout the fire operation. HLCO operates with 1 pilot and 1 Chief Officer. LACoFD Air Ops leased an Airbus Helicopters AS350 in November 2015 to perform this mission, which does not require a helicopter the size of the Bell 412 or S-70A.

The Bell 412 and S-70A helicopters are used to perform all of three the primary missions, firefighting, emergency medical services, and search and rescue. While each helicopter type performs the missions well, a difference does exist in their performance capabilities. The S-70A has greater water tank capacity (1,000 to 360 gallons), is able to fill the water tank with a snorkel as well as ground fill, has better hover performance, a longer mission endurance (2.2 to 1.5 hours), and a faster speed (130 to 105-110 knots)

Table 4-5 highlights relevant information about the S-70A. Total Flight Hours are as of the end of May 2016.

Table 4-5				
Sikorsky S-70 Fleet				
Model	**Serial Number**	**Registration Number**	**Year of Manufacture**	**Total Flight Hours as of May 2016**
S-70A	702846	N15LA	2004	3,234
S-70A	702453	N160LA	2001	4,396
S-70A	702479	N190LA	2001	4,538

While each S-70A helicopter has relatively low total flight hours, the age in years is the more relevant variable. Expiration of the current TAP at the end of 2016 forced LACoFD Air Ops to evaluate its options regarding the continued operation of the existing S-70A. The primary issue was whether or not Sikorsky would extend the program for helicopters that were 12 years or older. Factors surrounding the primary issue included the rate increase for a new TAP, continued availability of consigned inventory, aging avionics and airframe, increase in unscheduled maintenance, and level of technical and engineering support for versions of the S-70A that are no longer in production.

Table 4-6 highlights relevant information for the Bell 412 fleet. Total Flight Hours are as of the end of May 2016.

Table 4-6				
Bell 412 Fleet				
Model	**Serial Number**	**Registration Number**	**Year of Manufacture**	**Total Flight Hours as of May 2016**
Bell 412 EP	36392	N110LA	2005	2,588
Bell 412 EP	36455	N120LA	2007	2,201
Bell 412 EP	36393	N14LA	2005	2,750
Bell 412 HP	36044	N17LA	1992	8,334
Bell 412 HP	36043	N18LA	1992	7,712

Similar to the S-70A fleet, the age of the Bell 412 fleet as measured in flight hours is not that high. However, two of the helicopters N17LA and N18LA are nearing the age of 25 years. Additionally, the useful load for each of the Bell 412s limits the amount of water dropped during the firefighting mission. The aircraft can still transport ground crews but its limited useful load and performance in hot and high conditions reduces its capacity to drop water well below the 360-gallon water tank capacity.

- Flight-Hour History

LACoFD Air Ops tracks its annual flight hours and has done so since fiscal year 2002 (fiscal year begins July 1 and ends on June 30). Chart 4-1 illustrates the average monthly flight hours for the fleet over a 15-year period beginning with fiscal year 2002. It shows the busiest months are July and August but the busy season starts in May and runs through October, a six-month period.

Chart 4-1

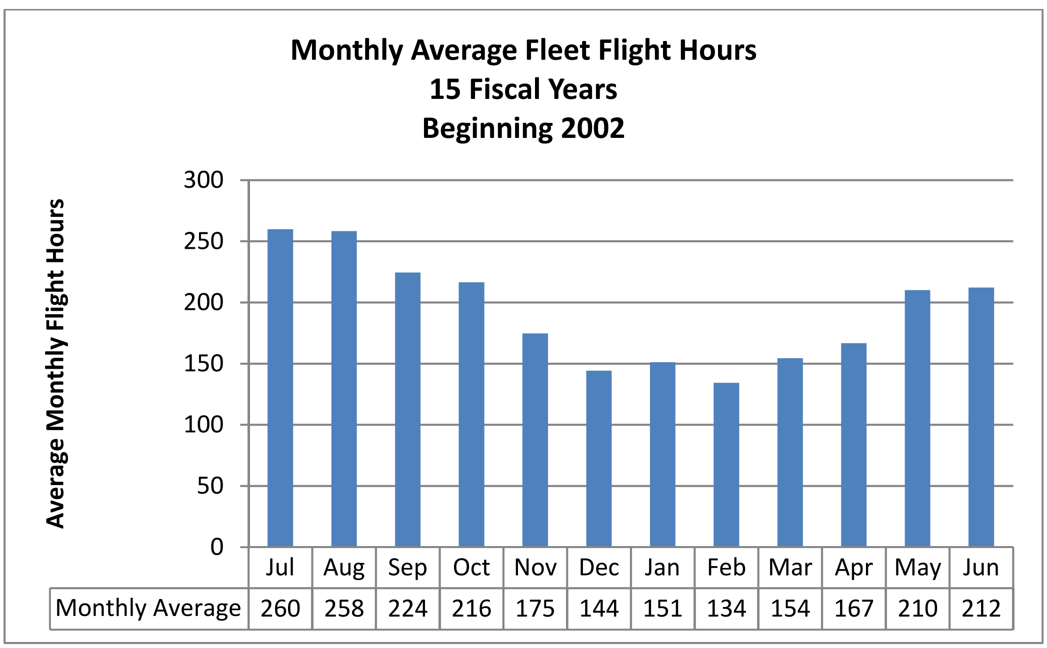
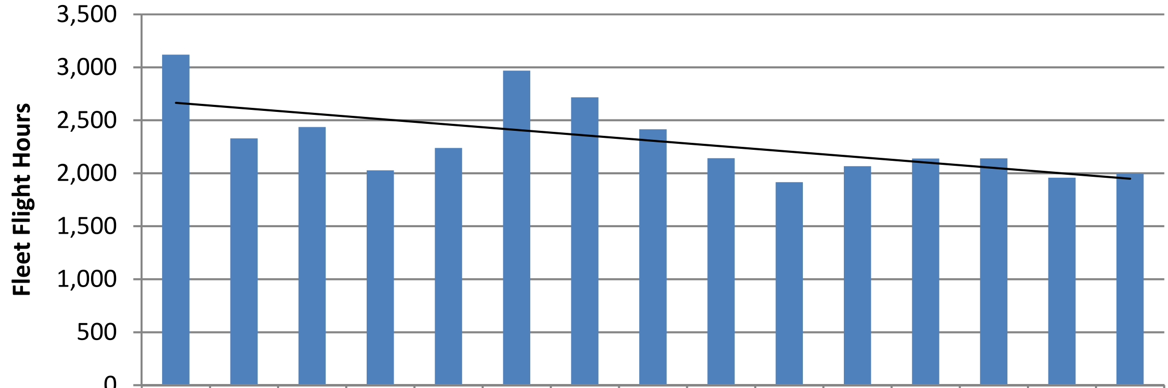


Chart 4-2



	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Fiscal Year	3,119	2,328	2,436	2,027	2,238	2,968	2,717	2,414	2,142	1,916	2,066	2,138	2,140	1,958	1,995

The average annual flight hours during the 15-year period are 2,307. Chart 4-2 reflects a trend that reflects an overall decline in flight hours during that same period, which may be caused by the mission requirements (i.e. fewer fires) or reduced availability (i.e. aircraft aging, maintenance capacity).

➢ <u>Mission History</u>

LACoFD Air Ops provides a service for the county that is difficult to measure in flight hours. Another important measurement is the number of missions or responses the group performs. Table 4-7 summarizes LACoFD Air Ops mission activity for each of the last five years beginning in 2011 and the five-year average for the same period of time.

The information in the table confirms that firefighting, emergency medical services ,and search and rescue are the three primary missions and constitute almost 84 percent of LACoFD Air Ops response activity.

Table 4-7						
Summary of Responses and Deployments						
Type of Response	**2011**	**2012**	**2013**	**2014**	**2015**	**Avg.**
Rescue (EMS) 1-3 patients	768	970	1,009	957	1,072	955
Hoist Rescues (Day/Night/Injured/Non-injured) 1-4 patients	80	82	67	70	95	79
Fire - Day/Night	266	319	342	229	284	288
Searches	26	31	25	27	41	30
Avalon (Catalina HEMS)	11	6	9	9	49	17
Reconnaissance	17	16	17	16	13	16
Admin, Drill, Hoist Training, Pilot Training, Maintenance, etc.	192	204	184	218	162	192
Subtotal	1,360	1,628	1,653	1,526	1,716	1,577
Deployments	992	997	967	703	709	874
Total	**2,352**	**2,625**	**2,620**	**2,229**	**2,425**	**2,450**

Response Type Descriptions:

- Emergency Medical Service Rescues – Number of patients per year that were transported or treated.
- Hoist Rescues – Number of individuals (injured/non-injured) that were hoisted by the unit each year. Hoist rescues can occur in day or night conditions.
- Fire – Number of fire responses each year for day/night conditions. In 2011, LACoFD Air Ops flew 237 day and 29 night missions. The total for 2012 was 273day/46 night, 2013 was 306 day/36 night, and 2014 was 203 day/26 night. A breakdown for 2015 was not available.
- Searches – Annual search missions conducted.
- Avalon – Number of patients flown from Catalina for Helicopter Emergency Medical Services.
- Reconnaissance – Number of reconnaissance flights.
- Other – Number of flights that included missions such as administrative, drill, hoist training, pilot training, and maintenance.
- Mission Subtotal – Number of missions performed by the LACoFD Air Ops fleet during the respective years.
- Deployments – This value represents the number of aircraft deployment flights for the purpose of positioning aircraft to their appropriate deployment site or a return flight to Barton. There would be no response activity associated with a deployment flight.

4.3.1.2 Change in Missions

LACoFD Air Ops indicated that missions would not change in the foreseeable future. Based on these plans, we did not conduct further research for this subject.

4.3.1.3 Potential Future Helicopter Candidates

Given the impending decisions regarding its current fleet – the S-70A TAP contracts will expire and the new rates will double at the end of 2016 and the Bell 412 airframes age --

LACoFD Air Ops requested that Conklin & de Decker research certain helicopter types should it decide to change the content of its fleet.

Conklin & de Decker selected several helicopters that were close to or between the performance capabilities of the current helicopters in the fleet. The helicopters selected for further review, in order by maximum gross weight, were:

- Airbus Helicopters H145: When announced and prior to its recent name change, this was known as the EC145T2, which was a new version of the EC145. The primary change was the use of a Fenestron for anti-torque control rather than the more-commonly used tail rotor.
- Bell 412EPI: Announced at the 2013 Heli-Expo and is an enhancement to the Bell 412EP. The enhancements include a conversion to an integrated digital avionics system, improved hot-high performance, and improved Category A performance.
- Leonardo AW169: This manufacturer was formerly known as Agusta/Westland and Finmeccanica. The AW169 received EASA certification in July 2015 and is expected to receive FAA certification in mid to late 2016.
- Leonardo AW139/E: The manufacturer announced an enhanced version of the AW139 at Heli-Expo 2015. The primary change was an increase in gross weight of approximately 1,300 pounds. Both versions of the AW139 are available for purchase.
- Airbus Helicopters H175: A newer production helicopter that received its EASA certification in 2014 with FAA certification expected in 2016.
- Leonardo AW189: A new production helicopter that received EASA certification in mid-2014 and FAA approval in March 2015.
- Airbus Helicopters H225: This is the current production model of the Super Puma series and received its certification in 2004. The helicopter is used for emergency medical services and search and rescue missions but its most common mission is personnel transport for the offshore oil and gas industry. The H225 fleet has been grounded for several months due to an accident in 2016.
- Sikorsky S-92: Similar to the H225, the S-92 primarily serves the oil and gas offshore transport of workers and supplies. The S-92 received FAA certification in 2002. Its flight controls, main rotor, and certain drive train components share commonality with the S-70.

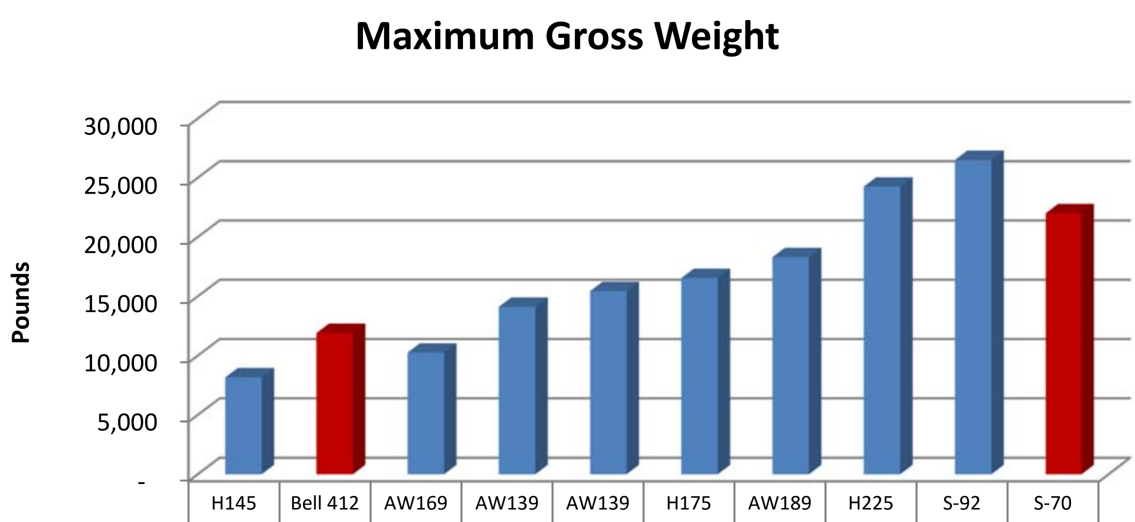
An additional helicopter that was not included in the comparison was the Bell 525. We did not include it because its certification date is not expected until 2017, which means much of its weight and performance data is still uncertain. However, the Bell 525 is expected to compete with the H175, AW189, and S-70i as the expected maximum gross weight will be 20,000 pounds and will be able to carry up to 20 passengers.

The following information provides certain performance features and other aspects of the candidate helicopter to give LACoFD Air Ops a perspective as to how each helicopter compares to the current helicopter fleet. Further analysis would be required if LACoFD Air Ops considered acquiring one of the candidate helicopters as certain important parameters are not included in this report. Also some of the data has not been vetted by Conklin & de Decker due to the recent introduction of the helicopter type or its status regarding certification. For those aircraft whose data has not gone through our process, we used manufacturer's published information.

The parameters we analyzed are listed and are compared to the existing fleet (red) in the following charts.

- Maximum Gross Weight (Chart 4-3)
- Cabin Volume (Chart 4-4)
- Maximum Seating (Chart 4-5)
- Water Tank Capacity (Chart 4-6)
- Estimated Useful Load (Chart 4-7)
- Estimated Endurance (Chart 4-8)
- Hover Capabilities (HIGE and HOGE) (Chart 4-9)
- Estimated Variable Costs (Chart 4-10)

Chart 4-3

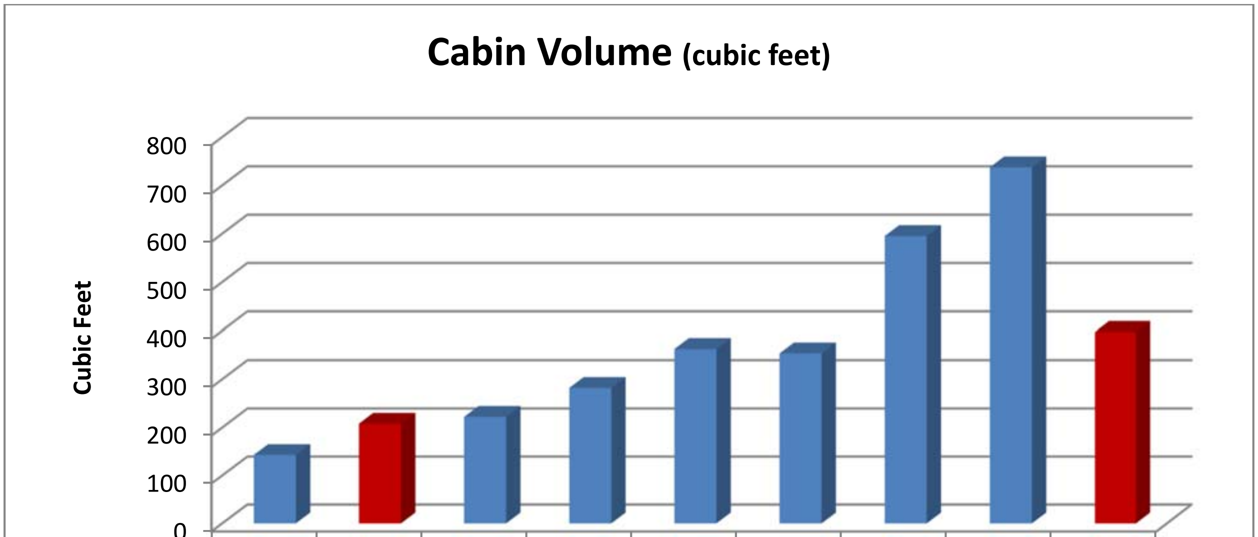


	H145	Bell 412	AW169	AW139	AW139 E	H175	AW189	H225	S-92	S-70
Max Gross Weight	8,157	11,900	10,250	14,110	15,432	16,535	18,300	24,250	26,500	22,000

Notes: Conklin & de Decker's published data served as the source for the H145, Bell 412, AW139, H225, and S-70. The information for the remaining helicopters types was obtained from the manufacturers or other industry sources.

Comment: When comparing the helicopter types based upon maximum gross weight, the S-92 has the highest at 26,500 pounds. The H225 has the next highest at 24,250 pounds.

Chart 4-4

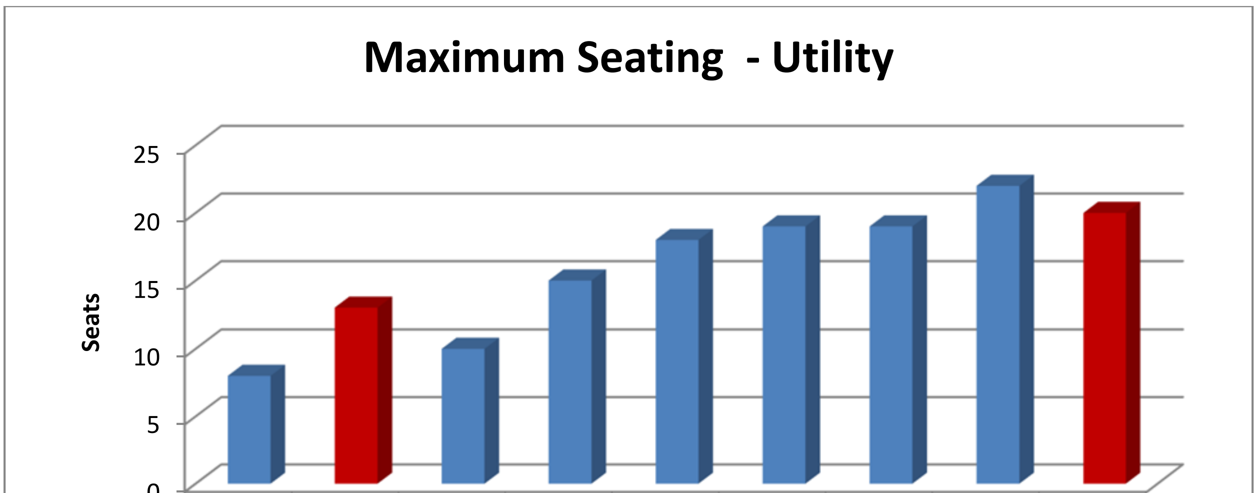


	H145	Bell 412	AW169	AW139	H175	AW189	H225	S-92	S-70
Cabin Volume	143	208	222	282	362	353	595	737	397

Notes: We used the dimensions (height, width, length) of the respective helicopters to calculate the cabin volume. The source of the information was Conklin & de Decker's *Aircraft Cost Evaluator*. The actual cabin volume can differ from the calculated volume due to the non-symmetrical shapes of the cabins and different mission configurations (e.g. utility, corporate, HEMS).

Comment: The S-92 has the largest calculated cabin volume. The H225 has the next largest volume.

Chart 4-5

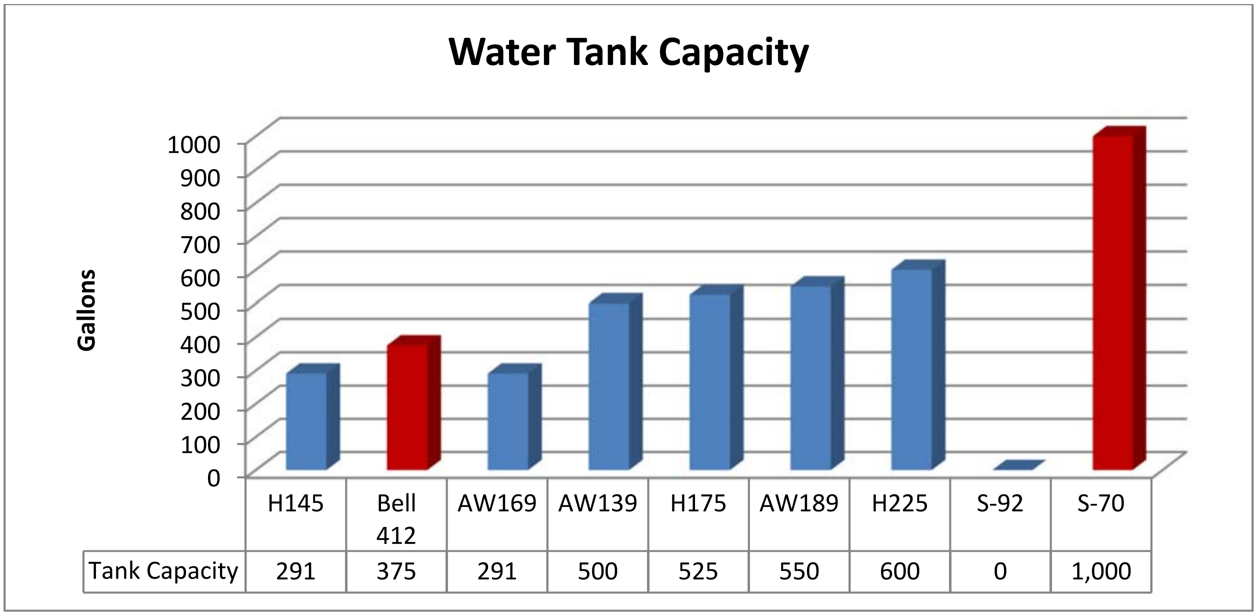


	H145	Bell 412	AW169	AW139	H175	AW189	H225	S-92	S-70
Seating	8	13	10	15	18	19	19	22	20

Notes: Conklin & de Decker's *Aircraft Performance Comparator 16.1*, utility high density configuration (associated with personnel transport for the oil and gas offshore industry), served as the source for the H145, Bell 412, AW139, H225, S-92 and S-70. The count does not include the pilot or co-pilot seats. The information for the remaining helicopters types was obtained from the manufacturers.

Comments: The S-92 in the utility configuration is able to seat up to 22, which is the most passengers for this group of helicopters. The H225 can also seat 22 in its high-density military configuration that does not have crashworthy seats for the passengers. The civil certified seating, with crashworthy seats for everyone is 19.

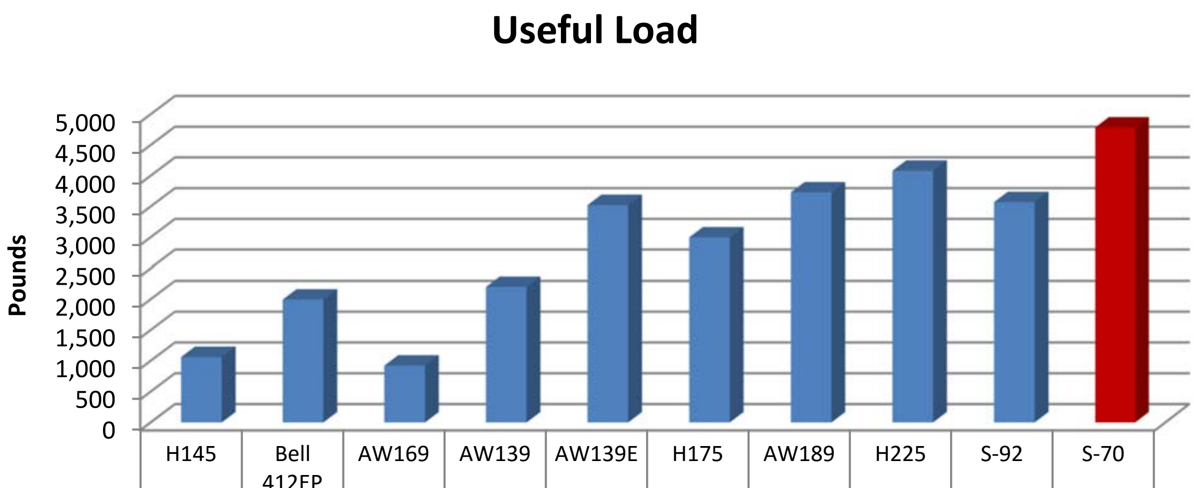
Chart 4-6



Notes: The source for this information, when available, was based upon vendors that provide tanks for the specific helicopter types. Certificated tanks existed for the H145, Bell 412, AW139, H225, and S-70. For the AW169, we used the H145 tank capacity. We estimated the H175 and AW189 based upon the AW139 existing tank's capacity while also considering the maximum gross weight of each helicopter. We were not able to locate an approved tank for the S-92. Since the helicopter overall is more capable than the S-70, we did not want to estimate a tank capacity for this helicopter. It is important to restate that to the best of our knowledge, certificated tanks do not exist for these helicopters. The certification process will likely create tanks that differ from these estimates.

Comments: The S-70 tank capacity of 1,000 gallons almost doubles the capabilities of the nearest helicopter types, the AW189, H175, AW139, and H225.

Chart 4-7

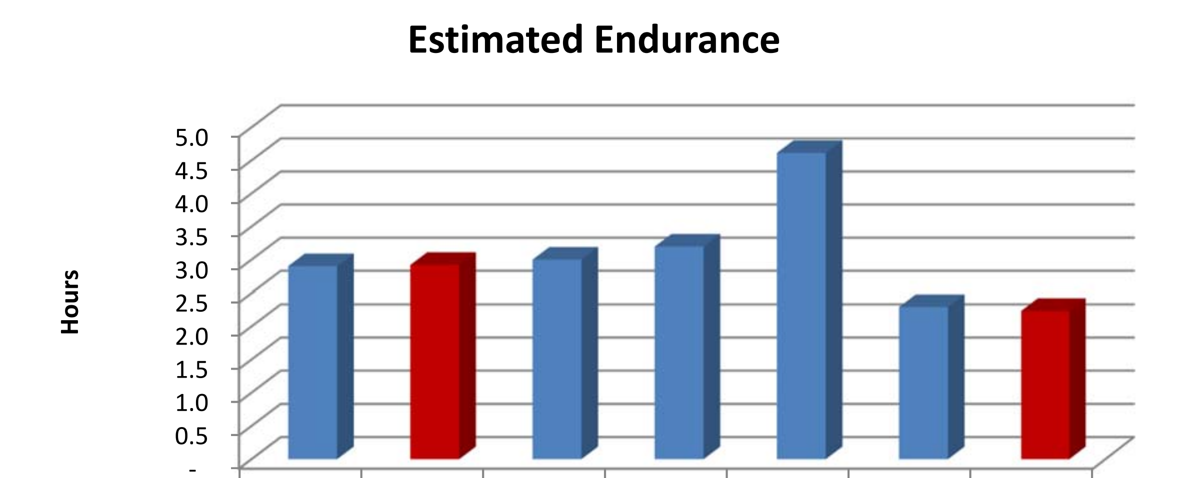


	H145	Bell 412EP	AW169	AW139	AW139E	H175	AW189	H225	S-92	S-70
Useful Load	1,062	1,995	922	2,201	3,523	2,997	3,729	4,080	3,570	4,785

Notes: Conklin & de Decker used a basic formula to compute the amount of water the respective helicopters would be able to carry in a utility configuration with full fuel. We started with the maximum gross weight, subtracted the mission-ready weight, and then subtracted the weight associated with full fuel. As mentioned previously, we used the *Aircraft Performance Comparator 16.1* to obtain the mission-ready weight estimate for the H145, Bell 412 series, AW139, H225, S-92 and the S-70. We relied upon the manufacturers' published material for the AW169, H175, and AW189.

Comments: For the initial drop of water with full fuel, the S-70's capacity is significantly higher than the other helicopter candidates. Based on our computations, the H175's initial drop amount is small given its class of helicopter. However, the H175 has a very high potential range or endurance (Chart 4-8) due to its primary mission of providing transportation for the oil and gas deep sea activities. For the firefighting mission, the H175's water drop capacity would increase as it continued dropping water over a longer period of time than the other helicopters.

Chart 4-8

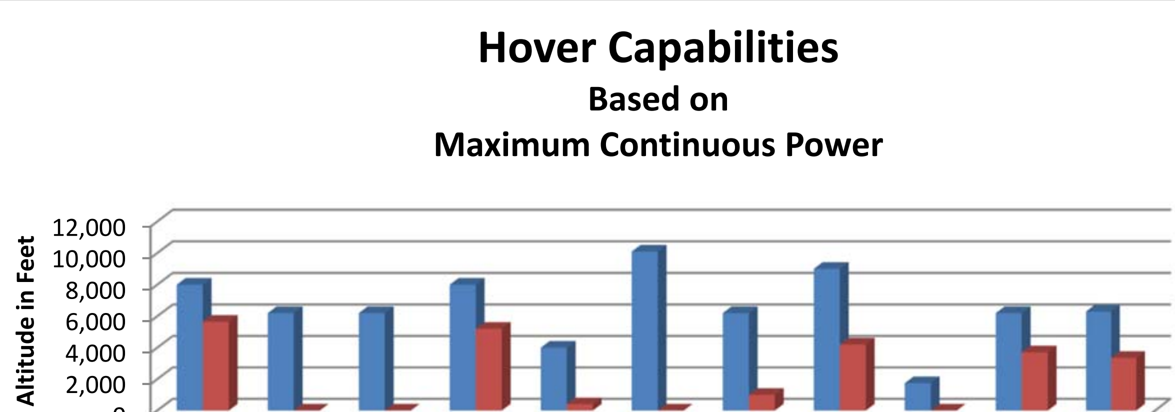


	H145	Bell 412	AW169	AW139	H175	AW189	S-70
Est. Endurance	2.9	2.9	3.0	3.2	4.6	2.3	2.2

Notes: Conklin & de Decker's *Aircraft Cost Evaluator 16.1* served as the source for the H145, Bell 412, AW139, and S-70. The computation of the fuel burn for each helicopter is based on data that is generally derived from flight manuals and is calculated at typical cruise speeds at 2,000 feet of altitude. The information for the remaining helicopters types was obtained from manufacturers' material where speed and altitude are not always revealed. The unknown assumptions make apples-to-apples comparisons more difficult. Fuel capacity was based upon standard fuel configuration and does not include auxiliary tanks.

Comments: The chart highlights the endurance or potential range of the H175, which has an estimated endurance of 4.6 hours.

Chart 4-9



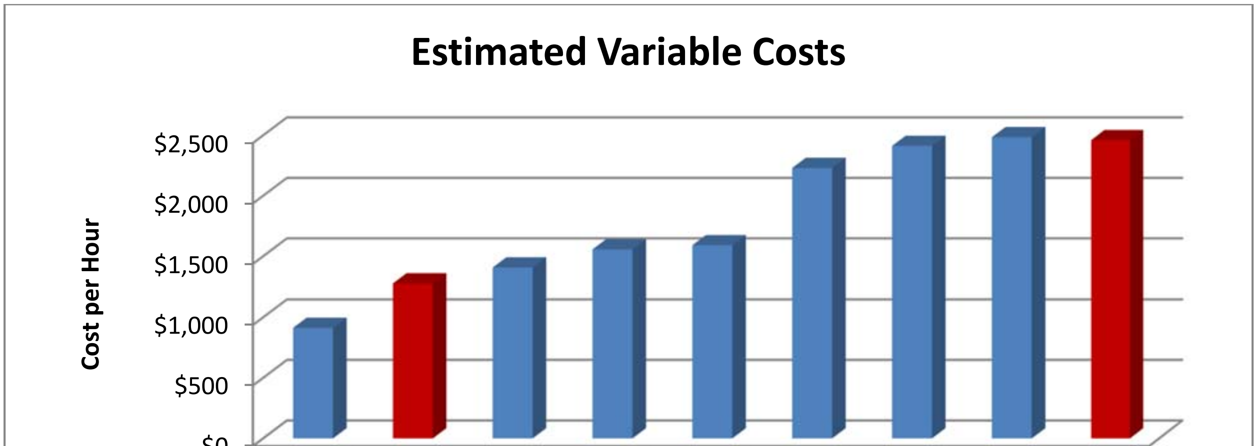
	H145	Bell 412HP	Bell 412EP	Bell 412EPi	AW169	AW139	H175	AW189	H225	S-92	S-70
HIGE	8,000	6,200	6,200	8,000	4,000	10,100	6,200	9,000	1,743	6,200	6,300
HOGE	5,650	0	0	5,200	400	0	1,000	4,200	0	3,700	3,350

Notes: The manufacturers' performance material contained in their respective technical brochures served as the source for the hover capabilities. Conklin & de Decker assumed International Standard Atmosphere (ISA) +20 degrees at maximum gross weight using Maximum Continuous Power (MCP).

Comments: Hovering is one of the more demanding performance elements of a mission. The demand for power increases when the mission occurs in higher temperatures and higher altitudes, which can be common when performing the firefighting mission. To hover out-of-ground-effect (HOGE) requires more power than hovering in ground effect (HIGE). Both types of hovering are employed during missions performed by LACoFD Air Ops.

- **The H145 information was based upon TOP, which had values of 10,000 feet for HIGE and 7,650 for HOGE. We reduced the maximum altitude by 2,000 feet to represent MCP.**
- **The Bell 412HP and EP, according to hover performance charts, cannot HOGE when at maximum gross weight at ISA +20^{o} C. If the Bell 412 HP and EP are at a weight of 11,500 pounds, the HOGE is 2,000 feet.**
- **Bell 412EPI performance charts were assumed to be based on MCP. Resource did not have performance information at TOP.**
- **The AW169 values are based on MCP. If TOP is considered the performance increases to 10,891 feet for HIGE and 7,500 for HOGE.**
- **The AW139 values are based on MCP. The AW139 cannot HOGE at maximum gross weight at ISA +20^{o} C. At 13,600 pounds, the helicopter can HOGE at 2,000 feet. If TOP is considered the performance increases to 12,310 feet for HIGE and 6,000 for HOGE.**
- **The H175 numbers are estimated to represent hovering capabilities based on MCP. The manufacturer only provided information based on TOP. Based on TOP performance charts HIGE was 8,200 feet and 3,000 for HOGE. We reduced the altitude by 2,000 feet to represent MCP performance.**
- **The AW189 information was based upon TOP, which had values of 11,000 feet for HIGE and 6,200 for HOGE. We reduced the maximum altitude by 2,000 feet to represent MCP.**
- **The H225 information was based upon TOP, which had values of 3,743 feet for HIGE and 305 for HOGE. We reduced the HIGE by 2,000 feet to represent MCP. Because the MCP data was not available, we reduced the HOGE to zero and assumed the aircraft can HOGE at a lighter weight than gross maximum.**
- **The S-92 information had the least support for the performance numbers. The assumptions provided were sea level, standard day at maximum gross weight. The material did not provide whether the engine performance was TOP or MCP. Based on the assumptions provided HIGE was 9,200 feet and HOGE was 6,700. We reduced the performance numbers by 3,000 feet for both HIGE and HOGE estimates to represent ISA +20^{o} C and MCP performance.**
- **The S-70 performance information was based on input from LACoFD Air Ops.**

Chart 4-10



	H145	Bell 412EPi	AW169	AW139	H175	AW189	H225	S-92	S-70
Variable Costs	$913	$1,275	$1,407	$1,557	$1,591	$2,230	$2,412	$2,484	$2,460

Notes: The source for the variable costs is the *Aircraft Cost Evaluator 16.1*. The variable cost includes fuel and maintenance and is based upon the following assumptions:

1. **Maintenance Labor Rate - $75 per hour.**
2. **Fuel Cost = $3.00 per gallon.**
3. **The cost per hour for the S-70 ($2,500) is based on the estimated cost to maintain a new helicopter and does not consider the costs associated with Sikorsky's TAP.**
4. **The *Aircraft Cost Evaluator* estimates the costs over an assumed long period of time and a high number of flight hours, also known as full-life. Full-life estimates will include significant maintenance events such as engine overhauls, life-limited items, component overhauls and major inspections, that have long intervals. With the full-life estimate, we are providing an average estimate for each hour the helicopter is operated regardless if the actual maintenance event is encountered. The life cycle cost concept estimates the costs associated with actual hour accumulation over a given period of time.**

Comments: The purpose for providing the estimates for the candidate helicopters is to add another dimension to the evaluation. The charts prior to Chart 4-10 are all focused on the performance or attributes of the helicopters. By adding cost, LACoFD Air Ops gains an idea about how much it would pay in variable costs to operate the candidate helicopters. The helicopters with highest estimated cost but also providing the best performance are the S-70, H225, and S-92.

4.1.3.4 Future Fleet Size

Ironically, the helicopter mission requirements for LACoFD Air Ops are very similar to the maintenance requirements of helicopters, they both have elements that are predictable (scheduled) and unpredictable (unscheduled). The predictable element of flight operations is the daily assignment of helicopters to the various bases. The unpredictable portion of operations is the performance of specific missions. Firefighting, emergency medical services, and search and rescue are all based on the occurrence of difficult-to-predict needs or events. Not only is it difficult to predict when an event will occur, but also, the length of the event.

As a result, determining the appropriate fleet size for LACoFD Air Ops is a difficult task given the nature of its primary missions.

LACoFD Air Ops has nine helicopters in its fleet, which includes the leased AS350. As of the date of this report, LACoFD Air Ops had not committed to the continued lease or purchase of a helicopter of this type to perform the HLCO mission; therefore we considered the current permanent fleet size to be eight helicopters, three S-70A and five Bell 412 helicopters.

Using available LACoFD Air Ops information, the following analysis will highlight certain aspects of the current operation that would be considered important factors when making decisions regarding the fleet size for LACoFD Air Ops. Our approach will include the following steps:

- Estimate the annual predictable element of flight operations as measured in days.
- Calculate the potential and actual availability capacity of the current fleet as measured in days.
- Discuss the effects of the unpredictable element of flight operations.
- Identify factors to improve availability.

➢ **Estimate the annual predictable element of flight operations as measured in days.**

Based on discussions with LACoFD Air Ops personnel and review of historical mission information, we determined the number of days on average that helicopters are assigned to the respective bases. The type of helicopter assigned involves both the S-70A and Bell 412. Depending upon the time of year, the number of assigned helicopters will vary as reflected in Table 4-8.

Based upon the assumptions, the predictable element of flight operations requires that the helicopter fleet be able to provide 1,285 days of availability. The 24-hour, 365-day coverage of the three primary bases (Camp 8, Fire Station 129, Eastern Air Ops), consume the largest percentage of days at 85 percent.

Table 4-8			
Average Annual Assigned Days			
Line Item	**Aircraft Assigned**	**Required Days in Year**	**Total Days Required**
1	3	365	1,095
2	1	152	152
3	1	31	31
4	1	7	7
Est. Annual Days			**1,285**

Notes:

- **Line Item 1 – LACoFD Air Ops assigns three helicopters for 24 hours a day/ 7 days a week for 365 days. The assignment of three helicopters represents the minimum commitment of helicopters during the year.**
- **Line Item 2 – A fourth helicopter is assigned for 5 months during the months when fire threat is at the highest risk. One hundred and fifty-two days was computed by dividing 365 days by 12 months and multiplying the result by 5 months.**
- **Line Item 3 – The possibility of a fifth helicopter is assigned for 1 month during a typical year. Using the same methodology to compute the numbers of days as in Line Item 2, we rounded the computed monthly number of days of 30.4 to 31 days.**
- **Line Item 4 – Infrequently LACoFD Air Ops will assign a sixth helicopter for an estimated one week or 7 days.**

➢ **Calculate the potential and actual availability capacity of the current fleet as measured in days.**

Potential Availability of the Current Fleet - If the current fleet did not experience any downtime due to the variety of factors that can lead to a helicopter being unavailable, what is the most capacity the current fleet of eight helicopters could deliver? At 365 days of availability for each helicopter, times the fleet size of eight, the current fleet could deliver 2,920 days of operation under perfect conditions.

Actual Availability of the Current Fleet - However, perfect conditions do not exist, most obviously because helicopters are machinery and all machinery requires maintenance. Downtime due to maintenance can occur in several ways such as scheduled maintenance (e.g. inspections), frequency of scheduled maintenance (intervals between inspections), unscheduled maintenance (e.g. required maintenance between inspection events and during scheduled inspections), the timing of maintenance (e.g. maintenance performed during normal flight operations), and a poor logistics system (e.g. lack of available spares).

If 100 percent availability is not attainable, then what is an acceptable level and what level of availability does LACoFD Air Ops experience? Based on discussions with operators, availability can vary widely depending upon the type of operation (e.g. predictable or scheduled missions versus unpredictable or as-needed missions.) The range of availability can typically vary from 70 to 90 percent.

The maintenance group of LACoFD Air Ops began tracking its availability less than a year ago. It measures availability in days. If an aircraft is not ready for dispatch by 10:00 a.m. each day, then the helicopter is considered as unavailable for the day. Availability is measured in this manner because helicopters are dispatched each day to bases at this time.

Using the actual availability data for the current fleet, beginning in January through July 11 of 2016, shows that for the overall fleet of Bell 412 and S-70A helicopters, the availability percentage is 55.4 percent. If this seven-month period is representative of LACoFD Air Ops experience over a longer period of time, the current fleet of helicopters is able to generate 1,618 days of availability (2,920 days at 100% availability x 55.4%).

This would mean that for the predictable element of flight operation's missions, the current fleet of helicopters can provide more flight days than are required, by 333 days.

Table 4-9 summarizes the availability percentage for each helicopter in the fleet during the seven-month period in 2016. The table also reflects the type of maintenance, scheduled or unscheduled, that caused a helicopter to be unavailable.

It is interesting to note that two helicopters have a significant effect on the overall percentage of availability. During the seven-month period a Bell 412, N14LA, was unavailable for the entire time due to a major five-year inspection and N190LA was only available 30 percent due to its major 500-hour inspection. If these helicopters are excluded from the Overall percentages, availability would increase to 69 percent.

However, we chose to use the Overall percentage of 55.4 percent because the major inspections occur frequently enough that their inclusion are more representative of the fleet's actual availability. For example, LACoFD Air Ops has five Bell 412 helicopters. With appropriate planning, at least one Bell 412 helicopter would be unavailable due to this inspection every year. N14LA has been down longer than the seven months of tracking for 2016 that is represented in Table 4-9.

The same situation is true for the 500-hour S-70A inspection. Although the downtime for the inspection is less than the Bell 412, three months, the occurrence for the fleet of three S-70A helicopters will occur about every 1.5 to 2 years.

Table 4-9					
Actual Availability and Cause of Downtime					
		Days		**Maintenance**	
Type	**N Number**	**Available**	**Unavailable**	**Scheduled**	**Unscheduled**
Bell 412					
	N110LA	77.8%	22.2%	76.2%	23.8%
	N120LA	63.5%	36.5%	100.0%	0.0%
	N14LA	0.0%	100.0%	100.0%	0.0%
	N17LA	53.4%	46.6%	75.0%	25.0%
	N18LA	71.4%	28.6%	35.2%	64.8%
	Total	**53.2%**	**46.8%**	**84.8%**	**15.2%**
S-70A					
	N15LA	75.7%	24.3%	32.6%	67.4%
	N160LA	72.0%	28.0%	50.9%	49.1%
	N190LA	29.6%	70.4%	83.5%	16.5%
	Total	**59.1%**	**40.9%**	**65.9%**	**34.1%**
	Overall	**55.4%**	**44.6%**	**78.3%**	**21.7%**

An additional factor to consider is the age as measured in years for both types of helicopters. The S-70 helicopters are 12 to 15 years old, while the Bell 412 helicopters have a wider range of 9 to 24 years. The factor to consider is what effect aging may have on unscheduled maintenance, which in turn affects availability.

Since we don't have historical LACoFD Air Ops information, we must rely upon the industry's general concept and as researched by Conklin & de Decker that as an aircraft ages, its percentage of unscheduled or on-condition maintenance increases. The increase will occur in two primary areas, the number and nature of unscheduled maintenance events between inspections and the number and type of fixes required during inspections. Regardless of when the unscheduled/on-condition maintenance occurs, the effect is the same, an aircraft's availability decreases or its maintenance resources increase to maintain a given level of availability.

Table 4-9 highlights the current status of the LACoFD Air Ops fleet. For the three S-70A helicopters, unscheduled maintenance causes 34.1 percent of the unavailable days. This percentage is more than likely higher because the 500-hour inspection is classified as a scheduled event, even though unscheduled or on-condition maintenance occurs during the inspection event. Using the current measurement system, the effect of aging would be difficult to determine on the duration of the inspections. If the effects of N190LA are removed from the totals in Table 4-9, then the unscheduled percentage increases to 57.6 percent. The actual experience somewhere between 34 and 57 percent but it's the nature of unscheduled maintenance that is troublesome for keeping an aircraft available. Unscheduled maintenance is unpredictable.

As a point of information, 15.2 percent of unscheduled maintenance contributes to days when the Bell 412 fleet is unavailable. If the effects of N14LA are removed from the total, the percentage increases to 26.5 percent.

When comparing the two fleets, a significant difference exists that is associated with unscheduled maintenance.

- **Discuss the effects of the unpredictable element of flight operations.**

If the LACoFD Air Ops mission profile was predictable and could be taken care of by simply assigning its helicopters to bases, then the material covered in the prior two sections would indicate that the current fleet size is adequate to cover the mission. The estimated predictable assignments to bases would require 1,285 days. The current fleet of eight helicopters in a perfect situation (no downtime) could deliver more than enough days (2,920) to fulfill the 1,285-day requirement. Because ideal conditions do not exist with mechanical equipment, we estimated the current capacity, which was based upon LACoFD Air Ops current availability percentages, to be 1,618 days or 333 days above the requirement.

Unfortunately and due to the nature of its primary missions, another important element exists regarding its primary missions, uncertainty. Firefighting, search and rescue, and emergency medical services are not predictable as to when they will occur or, in the case of firefighting, the duration of the event. Assigning helicopters to bases strategically placed within the county addresses some of the uncertainty. For example, if an accident occurs and an individual requires transport, it is more than likely that LACoFD Air Ops will have a helicopter available to perform the mission even though it was an unpredictable event.

However, if the mission involves firefighting, the base-assigned helicopter may not be adequate. One helicopter can deliver the initial attack but multiple helicopters are frequently required due to the proximity of the fire to residential property, threats to the population, weather conditions (e.g. dry and windy), and the size of the fire. Overall, LACoFD Air Ops is dedicated to accomplishing the industry-accepted objective to extinguish or control the wildland fire as quickly as possible.

The firefighting mission presents the biggest challenge for LACoFD Air Ops due to its uncertainty regarding timing, intensity, and location. For LACoFD Air Ops, the most effective helicopter type to meet the industry objective is the S-70A, due to a variety of reasons but most prominently is its water dropping capabilities when compared to the Bell 412. Ideally and because its fleet size is three, LACoFD Air Ops would want, when the conditions require it, availability of all three helicopters.

Although the likely occurrence of fires is still seasonal, due to changing climate and weather conditions (e.g. Los Angeles area's extended drought), we made the assumption that LACoFD Air Ops would want the available capacity for possible firefighting to equal its current three S-70A helicopters.

- **Estimate potential fleet size based on availability assumptions.**

Based on our analysis, there are two important assumptions:

- LACoFD Air Ops would like to have three S-70 helicopters available for 365 days of the year. This means the fleet would provide 1,095 days for operations (3 helicopters x 365 days).
- Helicopters will not be available 100 percent of the time as measured in days. Due to the fact that helicopters are mechanical, and all things mechanical require maintenance, the actual availability percentage will be less than 100 percent.

Given the actual availability reflected in Table 4-9 of 59.1 percent for the S-70A fleet, the fleet is available 647 days (1,095 potential available days for three aircraft x 59.1 percent) or 216 days per helicopter (647 days / 3 helicopters).

Table 4-10 illustrates the importance of availability in determining the fleet size for the S-70A by combining the desired day objective with the effects of availability. For example, to meet its current desired days of availability (1,095 days) with its current level of availability (60 percent), LACoFD Air Ops will need a fleet of five S-70 helicopters.

If the availability rate slips to 50 percent, LACoFD Air Ops would need six S-70A helicopters to provide 1,095 days of availability. If the availability rate increased to 75 percent, it would require a fleet of four S-70 helicopters.

We have offered suggestions for LACoFD Air Ops to consider that should improve the current availability level (See section entitled, Role of Maintenance and Its Effect on Availability, which begins on page 4-28).

Table 4-10					
Estimated Fleet Size - S-70A					
Target Days – (365 days x 3 helicopters)	1,095	1,095	1,095	1,095	1,095
Availability Target	50%	60%	70%	75%	80%
Annual Days Available	548	657	767	821	876
Current Aircraft in Fleet	3	3	3	3	3
Available Days per Aircraft	183	219	256	274	292
Aircraft Required to Meet Target	6.0	5.0	4.3	4.0	3.8

Notes:

- **Target Days – Obtained from Table 4-8 and represents the number of days that a fleet of 3 helicopters could provide in a 365-day year.**
- **Availability Target – If LACoFD Air Ops could attain different levels of availability, how would it affect the fleet size? The current availability for the S-70A fleet is 60%.**
- **Annual Days Available - Calculated by multiplying the Target (Days) by the respective Availability Target.**
- **Current Aircraft in Fleet – This is a given and equals the assumed equivalent number of aircraft LACoFD Air Ops would want available throughout the year.**
- **Available Days per Aircraft – Calculated by dividing Annual Days Available by the Current Aircraft in Fleet.**
- **Aircraft Required to Meet Target – Calculated by dividing the Target (Days) by Available Days per Aircraft.**

Because availability is an important factor in helping to determine the desired fleet size, Conklin & de Decker has suggestions in two areas that LACoFD Air Ops should consider. The first area involves the availability improvements that would be gained by obtaining new S-70i helicopters and the second involves the important role of maintenance and its effect on availability.

S-70i Improvements - A factor to consider when comparing the current S-70A fleet to the proposed S-70i is the change in the inspection intervals. The current S70A fleet has a major inspection interval of every 500 hours with less significant inspections intervals every 10 and 30 hours. The S-70i has increased those intervals. For the major inspection interval the S-70i will be 720 hours, with an interim inspection at 360 hours. Also, the less significant inspection intervals will increase to 40 hours.

This change in intervals is important due to the effect it will have on aircraft availability. In short, the less time an aircraft is down for inspections, the higher its availability percentage should be for flight operations. The following example will illustrate the benefits LACoFD Air Ops should experience with the new S-70i aircraft.

Expanding the data in Table 4-5 on page 4-7, we calculated the average annual flight hours for each S-70A by dividing the total flight hours by the years in operation as represented by the year the aircraft was manufactured. Table 4-11 shows the average flight hours have varied about 12 percent when comparing N15LA (270) to N190LA (303). The average for the fleet is 288.

Table 4-11					
Sikorsky S-70 Fleet					
Model	**Serial Number**	**Registration Number**	**Year of Mfgr**	**Total Flight Hours**	**Average Hours per Year**
S-70A	702846	N15LA	2004	3,234	270
S-70A	702453	N160LA	2001	4,396	293
S-70A	702479	N190LA	2001	4,538	303
			S70A Fleet Average		**288**

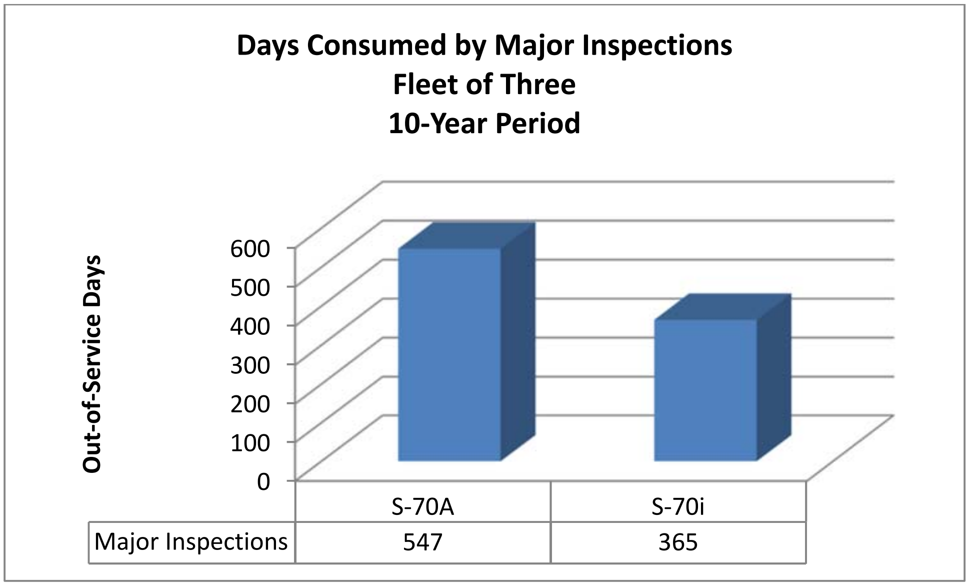
Rounding up the actual average of 288 to 300 flights hours means the average number of flight hours per month is 25 (300 / 12 months). Based on its interval, the S-70A will have a 500-hour inspection performed every 20 months (500-hour interval / 25 flight hours per month). As a result, each helicopter will have six 500-hour inspections performed in a 10-year period, or 18 for the fleet.

The S-70i will have a 720-hour inspection performed every 29 months (720-hour interval / 25 flight hours per month) or four in a 10-year period. For a fleet of three helicopters, the total 720-hour inspections performed would be 12.

This difference in the number of major inspections begins to illustrate the potential impact on availability between the S-70A and S-70i, an impact that becomes more evident when we consider three S-70 helicopters over a ten-year period.

Assuming each inspection takes 3 months to complete, Chart 4-11 demonstrates the effect on the fleet's availability as measured in days. In essence, by changing to the S-70i helicopters, LACoFD Air Ops would realize a potential improvement of 33 percent by having to perform fewer inspections, 36 rather than 54. Stated in days, assuming an average month of 30.4 days, LACoFD Air Ops would have an estimated 182 (547 – 365) more days of fleet availability.

Chart 4-11



If LACoFD Air Ops decides to increase the current fleet size from three and the assumed annual flight hours remains the same (900 hours for the fleet), the number of flight hours per helicopter will be reduced. For example, if the fleet increases to four S-70i helicopters, then the monthly flight hours would be reduced from 25 to almost 19 (18.75 actual hours per month). This would extend the 720-hour inspection interval to every 38 months rather than 29. The reduction in frequency would mean three rather than four 720-hour inspections in a ten-year period per helicopter.

The increase in interval for the less significant inspections would also have an effect on availability. Basically, the S-70i inspection interval is every 40 hours versus the S-70A interval of 10 hours. If the interval is 40 rather than 10 hours, an aircraft will encounter a higher number of inspection events. For example, in a 120-hour period, a current S-70A helicopter will incur 12 inspection events (10, 10, 30, 10, 10, 60, 10, 10, 90, 10, 10 120) while the S-70i will incur 3 inspection events (40, 80, 120). While each 40-hour interval inspection may require more labor hours than a ten-hour interval, the number of times a helicopter is unavailable in the 120-hour period is fewer.

Also, the S-70i helicopters will be active for longer periods than which they are currently. For example, a normal firefighting day for a helicopter can easily be ten or more hours. Currently at 10 hours, the S-70A becomes unavailable for a 2-to-3-hour-period to perform 10 hours of labor. This has a significant effect on the availability and potentially reduces the fleet of three actively fighting the fire to two or one.

The short inspection interval also places significant burdens on the maintenance department to monitor flight-hour accumulation on each helicopter. It is easy to see how, without proper coordination, all three helicopters, after a busy firefighting day, could be down for the 10-hour inspection at the same time.

Extending the inspection interval to 40 hours on the S-70i reduces the likelihood of having all three helicopters or two helicopters unavailable at the same time.

Role of Maintenance and Its Effect on Availability – As discussed previously, helicopters require maintenance. Maintenance causes downtime, which translates into an unavailable status and as a result another aircraft is required. How long the aircraft is unavailable depends upon several factors including significance of the maintenance, efficiency of the maintenance technicians, and timing of when the maintenance is performed (i.e. does maintenance occur during peak or non-peak flying activity).

Conklin & de Decker is concerned about the current level of availability (55.4%) that is reflected in Table 4-9. We acknowledge the current seven-month summary may not be representative of the actual availability rate until more data is collected. However, if it is accurate, there are some fundamental steps that LACoFD Air Ops may want to consider to gain more insight about an important element that can affect aircraft availability.

- Measure aircraft availability. The maintenance department has implemented what is considered the first step. Toward the end of 2015, it began to measure availability by each helicopter. The measurement tool is simple and seems to collect data that will influence decisions. The objective is to keep collecting data so informed decisions can be made later.
- Measure the efficiency of the maintenance department. Measuring an aircraft's availability is just the first step to improving the efficiency of the maintenance department. Measuring the following areas in maintenance would lead to a better understanding of efficiency.
    - Determine a realistic capacity of the current maintenance organization. What is the total amount of labor hours that can be expected from the current staff?
    - Examine the frequency of performing certain significant maintenance events (i.e. inspections, component overhauls). Should LACoFD Air Ops be performing the maintenance on significant events that are infrequent?
    - Determine time standards for maintenance events. The standard is normally expressed as an average but more meaningful is developing minimums and maximums as well. Unfortunately on-condition or unscheduled maintenance is difficult to predict but capturing data can lead to better estimates for completion of the work

- Measure actual maintenance time to the standard. Develop a system to record the actual time spent on different maintenance events. This is not a popular suggestion, but labor costs are significant for any organization. How efficiently is it performing?
- Compare when flight activity and maintenance occur. Does maintenance occur when mission are likely to occur? Is maintenance performed during the "off" hours of the day or during the most likely time for mission? Understanding the trends may identify the best times to perform maintenance or when it might have the least impact on flight operations.
- Evaluate the missions. LACoFD Air Ops already has a start in this area but the system should identify the peaks and valleys of flight activity by time of day, day of the week, and time of the year. Also important is the activity by base and type of mission. Analyzing this data can lead to a more informed decision about the number and type of helicopters that LACoFD Air Ops needs.

4.3.2 What are the available options for spare part plans for existing aircraft and potential aircraft acquisitions?

Based on discussions with LACoFD Air Ops, this item was related to the existing fleet of S-70 helicopters and the possible expiration of the current TAP contract in December 2016. That issue has been resolved for the existing fleet as Sikorsky has agreed to offer an amended TAP contract for a three-year period at a significant rate increase. We did not perform analysis in this area.

4.3.3 What are the maintenance cost differences when comparing the retention of current aircraft versus newer aircraft?

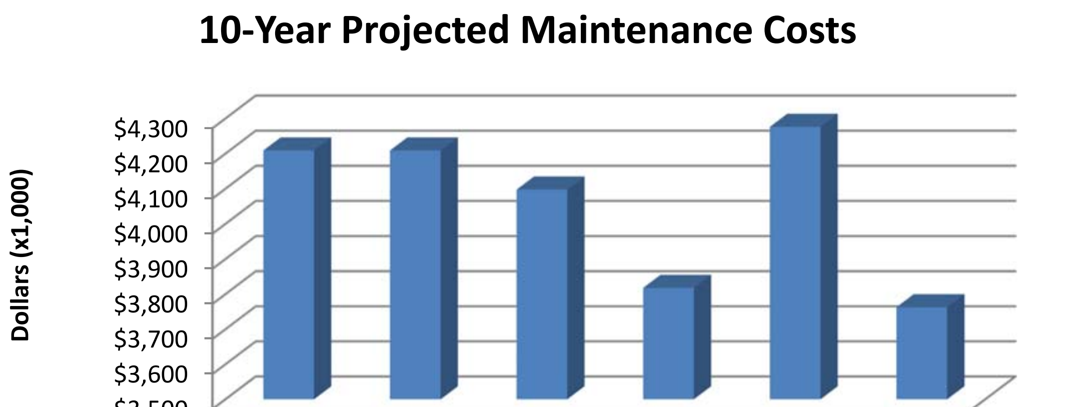
4.3.3.1 How do the maintenance costs of LACoFD Air Ops current Bell 412 helicopters compare to a new Bell 412 EPI?

To answer this question, we used Conklin & de Decker's *Life Cycle Cost* software to estimate the maintenance costs for each of the current Bell 412s. The software's projection is based upon each helicopter's remaining hours/cycles associated with components that require overhauls, life-limited items, major inspections, and significant engine maintenance (e.g. overhaul). This information was reflected in LACoFD Air Ops maintenance tracking software, MxManager, for each helicopter. The analysis for each helicopter also considers the airframe's age to calculate increasing costs associated with on-condition and unscheduled labor, parts, and repairs costs.

The second step in the comparison was to use the same software tool to estimate the costs associated with a new Bell 412EPI. Unlike the existing fleet, the new helicopter projection would not have accumulated time on the more significant maintenance items and events. Therefore, one would expect the projections for the new helicopter to be significantly lower than the current fleet. However, the difference can be less than expected due to the length of time of the analysis, which is 10 years in this case. Not all significant maintenance costs will occur within the next ten-year period on each helicopter.

Chart 4-12 summarizes the projected costs for each Bell 412 that is currently in the fleet as well as a new 412EPI.

Chart 4-12

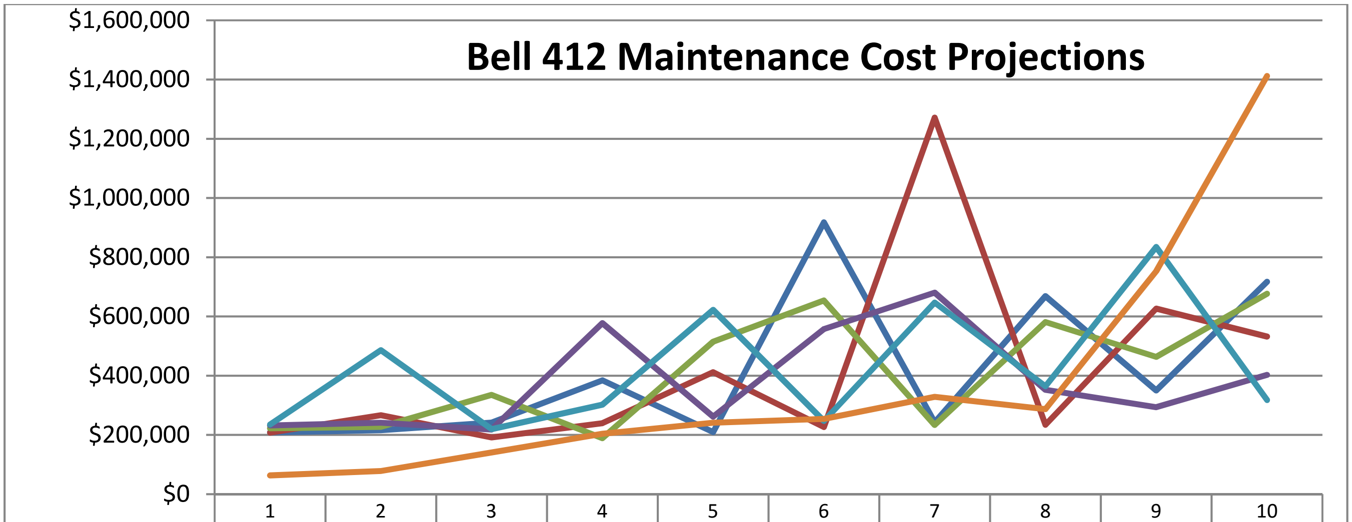


	N110LA	N120LA	N14LA	N17LA	N18LA	New 412EPI
10-Year Costs	$4,209	$4,209	$4,098	$3,818	$4,276	$3,763

During the next ten-year period flying 300 annual hours per helicopter, the *Life Cycle Cost* analysis estimates the average cost for the five Bell 412s is $4.1 million. N18LA will encounter the highest maintenance costs of the current Bell 412 fleet at approximately $4.3 million.

Total cost for each helicopter is only one variable LACoFD Air Ops might consider. Chart 4-13 illustrates the timing of the maintenance for each helicopter by year. For example, N12LA will incur $4.2 million in maintenance costs during the ten-year period, however approximately 30 percent of that cost does not occur until Year 7 and another 15 percent in Year 9. N18LA will encounter 26 percent of its costs within the first five years, plus it has the highest overall costs ($4.276 M) during the ten-year period. As a final observation, the new Bell 412EPI has the lowest ten-year maintenance cost, as would be expected. However, in Year 10, the helicopter will experience the highest annual maintenance cost ($1.4 M) when compared to the other helicopters.

Chart 4-13



	1	2	3	4	5	6	7	8	9	10
N11LA	$208,570	$215,688	$242,027	$384,059	$209,591	$917,732	$242,149	$668,594	$350,299	$717,365
N12LA	$208,037	$266,736	$191,693	$239,553	$411,738	$226,750	$1,271,691	$234,171	$626,489	$532,127
N14LA	$222,193	$227,281	$335,375	$188,980	$515,011	$653,955	$233,452	$581,191	$463,440	$676,711
N17LA	$232,245	$241,319	$218,406	$577,591	$261,669	$557,377	$680,618	$352,405	$293,502	$402,794
N18LA	$235,155	$486,285	$219,561	$302,206	$622,111	$247,096	$646,883	$364,149	$834,704	$318,020
New 412EPI	$63,309	$78,306	$140,971	$203,805	$241,089	$254,230	$328,832	$287,223	$753,103	$1,411,913

In summary, it is important to understand the timing of the estimated maintenance costs by year as well as the total cost over a ten-year period. If LACoFD Air Ops decides to move out of certain Bell 412 helicopters, it is important to understand the timing of the estimated maintenance costs by year as well as the total cost over a ten-year period. By understanding the timing, LACoFD Air Ops can avoid encountering certain years of significant maintenance costs and plan the timing of the disposition of aircraft, which can affect the resale value of the helicopter when LACoFD Air Ops decides to purchase replacement helicopters.

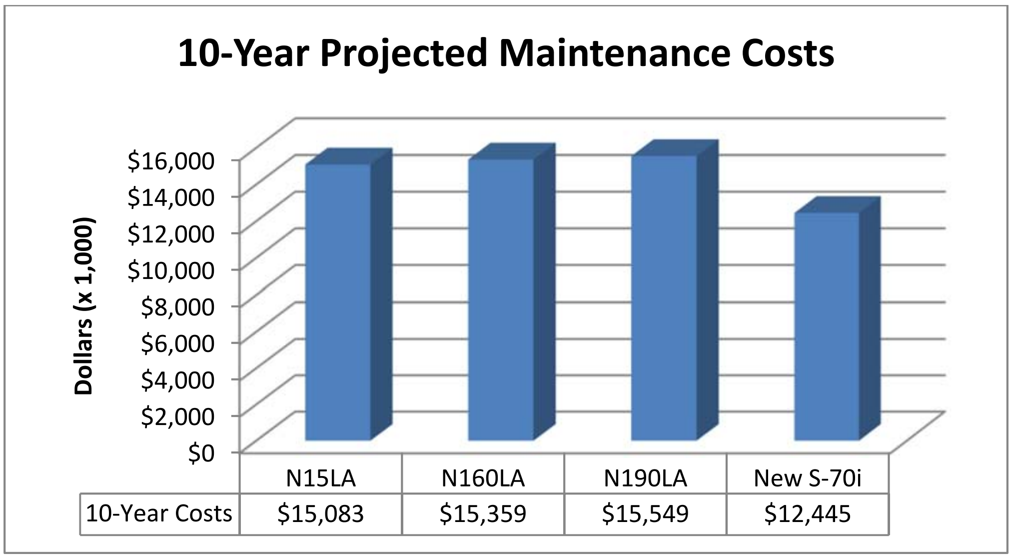
4.3.3.2 How do the maintenance costs of a LACoFD Air Ops current Sikorsky S-70A helicopters compare to a new Sikorsky S-70i?

As with the Bell 412 estimates, we used Conklin & de Decker's *Life Cycle Cost* software to estimate the maintenance costs for each of the current Sikorsky S-70A helicopters. Unlike the Bell 412s, the Sikorsky S-70A helicopters are covered by TAP, a guaranteed hourly rate for maintenance, which nullifies the effects of significant maintenance events and items (e.g. component overhauls, life-limited items, major inspections, and significant engine maintenance) The estimated TAP rate effective in 2017 will be $3,400 per hour as estimated by Sikorsky in March 2016. The analysis for each Sikorsky S-70A helicopter also considers the airframe's age to calculate increasing costs associated with on-condition and unscheduled labor, parts, and repairs costs that are under $200 or costs that are associated with mission equipment maintenance. TAP does not cover these costs.

The second step in the comparison was to use the same software tool to estimate the costs associated with a new Sikorsky S-70i. The TAP rate for the new helicopter will be $2,600. Maintenance costs under $200 or costs associated with mission equipment were also included in the projection.

Chart 4-14 summarizes the projected costs for each Sikorsky S-70A that is currently in the fleet as well as a new S-70i.

Chart 4-14



During the next ten-year period flying 300 annual hours per helicopter, the *Life Cycle Cost* analysis estimates the new S-70i will cost approximately $12.4 million. The average cost for the current fleet is $15.3M. The reduction of maintenance costs is between $2.6 and $3.1 M over a ten-year period. The range in cost reduction is dependent on which current helicopter is used in the comparison. For example, if the S-70i estimate is compared to the ten-year projection for N16LA, the reduction in cost is $2.9 M.

4.3.3.3 What are the typical maintenance and fuel costs associated with a light single-engine helicopter, which would be used primarily for observation and command missions?

Historically, LACoFD Air Ops has used a helicopter of this size and performance to perform the HLCO function during its primary missions of firefighting, emergency medical services, and search and rescue. During a portion of 2015, LACoFD Air Ops leased an Airbus AS350 helicopter to perform these missions. LACoFD Air Ops requested an estimate of variable costs (maintenance only) for a light single-engine helicopter in the same class as the leased Airbus AS350.

We chose an Airbus H125, which is the current production version of the AS350. We used the same *Life Cycle Cost* software to estimate the maintenance costs. Table 4-12 shows the annual maintenance cost estimate over a ten-year period and assumes a new helicopter.

Table 4-12

Estimated Maintenance Costs

Year	1	2	3	4	5	6	7	8	9	10	Total
Fuel Additives/Lubricants	1,013	1,038	1,064	1,090	1,118	1,146	1,174	1,204	1,234	1,264	**$11,343**
Maintenance Labor	5,119	7,495	14,853	22,574	26,905	30,060	32,225	33,900	35,638	37,138	**$245,908**
Parts	2,208	3,265	13,067	20,054	24,135	27,228	29,473	31,308	33,234	34,971	**$218,943**
Inspections	0	21,423	0	22,507	0	25,775	0	29,067	0	31,844	**$130,615**
Component Overhaul	0	0	0	0	0	0	0	0	0	3,639	**$3,639**
Life Limited Components	0	0	138	0	148	0	0	164	0	176	**$626**
Total	**$8,340**	**$33,221**	**$29,123**	**$66,226**	**$52,306**	**$84,208**	**$62,872**	**$95,642**	**$70,106**	**$109,032**	**$611,075**

Assumptions:

1. **Annual Flight Hours – 250**
2. **Maintenance Labor Rate - $75 per hour**
3. **Annual Inflation Rates - General Inflation 2.5%, Parts Inflation – 3.5%**

If LACoFD Air Ops used a light-single engine helicopter for the HLCO mission, it would save significantly when compared to using a Bell 412 for the same mission. As estimated in Chart 4-12 (p. 4-30) to maintain an existing Bell 412 for a ten-year period would average approximately $4 million. The H125 maintenance costs for the same time period would be approximately $611,000. This is a savings of close to $3.4 million.

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