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BEFORE THE PUBLIC UTILITIES COMMISSION OF THE STATE OF CALIFORNIA

Order Instituting Rulemaking into Policies to Promote a Partnership Framework between Energy Investor Owned Utilities and the Water Sector to Promote Water-Energy Nexus Programs.	Rulemaking 13-12-011 (Filed December 19, 2013)

ASSIGNED COMMISSIONER'S RULING ENTERING WORKSHOP REPORT INTO THE RECORD AND SEEKING COMMENT

Summary

In today's ruling, I am entering a seventh workshop report into the record of this proceeding. I invite parties to comment on the report and the themes arising from the proceeding more broadly.

1. Proceeding Scope

On April 27, 2015, I issued an Amended Scoping Memo in this proceeding incorporating actions related to the water/energy nexus to address Governor Brown's Executive Order B-29-15 relating to the drought emergency (issue 3 of the Amended Scoping Memo); actions to address the water/energy nexus in water conveyance, delivery, and use for water storage, water recharge and water delivery and other areas including enabling demand response and time shifting (issue 4, bullet 1 of the Amended Scoping Memo), actions to address the water-energy nexus in energy production, transmission, distribution, and use, design, deployment, and utilization of onsite micro grids, construction and design of energy generation, storage and management facilities, implementation

of demand response, ancillary services, grid services, advanced grid services; and interconnection issues, ownership issues for maximum effectiveness in agricultural pumping and irrigation, in residential and commercial landscaping, in current and potential for water recycling efforts and programs, and in maximizing local water sources (issue 4, bullet 2 of the Amended Scoping Memo).

Water and energy utility coordination on energy smart meter piggybacking pilots and the water/energy nexus cost calculator are only the first of many steps in fully considering the water/energy nexus. We also need to ensure that adequate telecommunications infrastructure is accessible to enable proper management of water and energy. Reliable and affordable telecommunications is necessary for distributed energy resources (DERs)[1] and energy facilities, all water pumping, treatment, processing, recycling, and desalination operations. Each of these facilities are energy intensive and produce operations data that must be managed. This management, if optimized, could benefit both the water and energy ratepayer through more reliable service, lower overall costs, and enhanced stewardship of our natural resources. This information exchange can happen over a variety of telecommunications technologies.

Our goal is to ensure that energy and water utilities, other investor-owned utilities (IOU), and respondent telecommunications carriers take the necessary actions to promote water management and conservation, energy management and conservation, through access to communications facilities and services.

[1] Per the Assembly Bill 327 definition, distributed energy resources include renewable generation, storage, energy efficiency, demand response, and electric vehicles.

Infrastructure and services to provide both voice and internet communications including narrowband and broadband signals are critical to water and energy management, resources use, and public safety. By breaking down silos, we promote utility collaboration to solve big problems through coordinated effort.[2]

The Water/Energy/Communications Nexus track of this proceeding examines the nexus of water, energy, and communications (e.g., the use of information management and data systems, high-speed internet access, social media and apps, Supervisory Control and Data Acquisition (SCADA) systems), for energy facility management, DER integration, water system management, water treatment and the communications needs in SCADA and other systems, and steps to foster access to energy and communications technologies, and facilities that enable electricity system and water system management, water storage, treatment, and use, including for wildfire and other public safety measures, in a manner that addresses the water/energy nexus. Telecommunications enables the collection and transmission of data to facilitate energy, DER, and water facility and service action and analysis based on data. Telecommunications including internet access describes all possible physical configurations of telecommunications services that provide access to voice, narrowband internet, broadband internet, and data signals, regardless of the technology.

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[2] Amended Scoping Memo at 2 (Collaboration between utilities saves ratepayers from double paying and can provide access to operational information about water and energy resources and facilities that are critical to their deployment and can increase the reliability and safety of service).

The Water/Energy/Communications Nexus will also evaluate the link between power access and communications facilities; broadband internet access for water storage, treatment, conveyance, recharge, recycling, managers, utilities, and users; and consider steps to promote such access to address the water/energy nexus.

A data request in the instant proceeding will elicit information on the types of telecommunications facilities and services water and energy utilities under this California Public Utilities Commission's (Commission) jurisdiction use to manage their operations and gather data. While the ongoing evolution of communications technology and deployment of communications technology may change the method of data transmission, access to reliable communications is increasingly critical to optimize water and energy facility operations and management as our state works to forestall, and in some cases to mitigate or adapt to climate change, and to reduce Greenhouse Gases associated with the electric, natural gas, and water sectors. The water energy telecommunications nexus explores the critical role of telecommunications for the optimization and management of water and energy to provide safe, reliable service, at just and reasonable rates, that helps achieve our goals of protecting the public and environment.

Today's Assigned Commissioner's Ruling (ACR) introduces a seventh workshop report regarding the telecommunications/water/energy nexus and questions related to them.

2. Proceeding Workshops

Seven workshops have been held in the Water/Energy/Telecommunications Nexus portion of the Water/Energy Nexus Proceeding, Rulemaking (R.) 13-12-011: August 13, 2014; September 10, 2014;

July 10, 2015; October 30, 2015; June 9-10, 2016; September 9, 2016; September 29, 2016 and a final workshop will be held on October 20, 2016. A report for the September 29, 2016 workshop is attached to this ruling in the appendix. A report on the October 20, 2016 workshop will be issued for comment shortly after the conclusion of that workshop. The following workshop report is incorporated into the proceeding for public comment and reply comment. We request that parties comment on the topics discussed in the workshop and on the summary of themes raised in the workshop. Parties may also submit additional information and studies for consideration in the proceeding as appropriate and responsive to the proceeding scope.

3. September 29, 2016 Workshop

On September 29, 2016, the workshop focus was on the urban-rural connection related to disasters including fire and its effect on watershed management and existing water, energy and telecommunications infrastructure. During and after a fire, investor-owned and municipal utilities must spend time and money to coordinate with public safety personnel on the management of utility resources including water, electric, and gas power. Following a fire, utilities must clean up debris from fires to comply with California Department of Toxic Substances (DTS) regulations regarding Handling Ash, Debris and other Hazardous Materials from Burned Structures.[3] Utilities must also spend money and time to replace burned facilities including poles and wires, resulting in costs

[3] California Department of Toxic Substances Control, Emergency Guidance on Wildfires #1, Handling Ash, Debris, and other Hazardous Materials from Burned Structures, [hereinafter "DTS, Wildfires #1"], https://www.dtsc.ca.gov/hazardouswaste/upload/fire_emergency_guidance_fs_1.pdf.

to ratepayers borne through Catastrophic Event Memoranda Accounts (CEMA), and other charges.

The first case study involved the San Francisco Public Utilities Commission (SFPUC) continued water and electricity service to its Greater Bay Area customers during the 2013 Rim Fire disaster in and around the Hetch Hetchy Reservoir located in Tuolumne County. The workshop discussed how the SFPUC worked with first responders and the community to protect drinking water quality and the watershed as many communications services failed during the Rim Fire, cell service was extremely limited, and a working payphone in a nearby community became a crucial asset and the target of "quarter runs" to drive rolls of quarters from San Francisco up to the payphone in Tuolumne County to keep communications open during the fire.

Courtney Aviation described how enabling a downlink of movable fire maps from an aerial tactical unit, a firefighting airplane, to ground control and disaster management permits decisive action to be taken to combat wildfire, protect utility infrastructure, protect public safety and property. They described technologies to enable planes to see through fire such as use of infrared signals, and the critical importance of ensuring that ground crews have prompt access to communications networks that allow downloads of these critical photos of the moving fire. Courtney Aviation described the use of Multiple In-Multiple Out (MIMO) mesh networks as one method to quickly deploy emergency communications networks that link public safety ground personnel with each other and with properly equipped aircrews. This coordination can shorten the length of the fire, protect the lives of fire fighters and the communities, wildlife, watershed, infrastructure, forest, and water, energy, and telecommunications utility assets endangered by fire.

Finally, Supervisor Edson of Calaveras County detailed County response to the Butte Fire in 2015 when telecommunications and power infrastructure burned during the Butte Fire. He discussed the complex work of watershed management and fire cleanup to protect the public and the state's waterways, reservoirs, hydroelectric facilities, drinking water, and agricultural production following the Butte Fire. Supervisor Edson also detailed his proposal for interagency collaboration for better watershed management to promote economic and resource development for the state. Fire debris blocks watershed and water resources that affect hydro-electric facilities, water used for energy, and drinking water. Counties and private property owners must spend large amounts of money to clean up debris to comply with DTS regulations and to protect the public health and public and private property. A Workshop Report and the Workshop outline are Attachment A to this ruling. The video webcast of the workshop can be accessed at:
http://www.adminmonitor.com/ca/cpuc/workshop/201609292/

We seek comment on the Workshop Report, and suggestions about what steps the Commission should take in this or other proceedings to address the issues raised in this workshop.

4. Proceeding Meta-Themes, Water/Energy/Communications Nexus

The Workshop and record in this proceeding have highlighted the following "Meta-Themes." Please comment on the theme below and what action the Commission should take to address this Meta-Theme in the Water/Energy/Communications Nexus Proceeding or through other proceedings or actions. In addition, the workshop report, attached, identifies additional information for parties to respond to.

4.1. Communications for the Protection of Water and Energy Facilities, Services, Public Safety and Economic Development

Accessible and reliable communications at competitive prices are required for all California water and energy facilities and services. Many remote areas lack access to communications facilities and services especially during disasters when water and energy facilities, public safety, and property are uniquely at risk. Old school methods such as pay phones, sirens, and ham radio operators, radio and television offer technologies and services that in many cases work in case of emergency when other technologies fail. Increasing access to communications facilities and services is a foundational enabler to address each of the Meta-Themes in this proceeding.

Water facilities and water utilities require energy inputs to provide service to Californians. The state's current energy generation fleet utilizes water as a significant component. Six years of drought necessitates innovative water and energy management.

DER deployments across the state will require reliable communications facilities and services that meet energy regulatory standards to provide visibility about their operational status, and control necessary to operate as a utility service and a grid asset. Visibility and controls are necessary for DER managers, utilities, and the California Independent System Operators.

Questions:

What actions should the Commission take to increase accessible and reliable communications at competitive speeds and prices for California water and energy facilities and services, public safety provision, watershed protection, water system management, and economic development?

Should the Commission require collaboration between the multiple utilities to address communications access?

Should water, energy and telecommunications utilities be required to have disaster management plans to protect ratepayers investment in water and energy facilities?

Should these plans be filed with the Commission?

What actions should the Commission take to leverage federal and state investments in communications infrastructure through the Connect America Fund, the mobility fund, the California Advanced Service Fund, or other mechanisms to ensure the water and energy facilities have access to communications facilities and services that meet their needs and regulatory standards at competitive prices and speeds?

Should the Commission direct water, energy, and telecommunications utilities and respondents to invest in technologies such as MIMO mesh networks, drone-based communications, or other methods, to quickly deploy emergency communications networks that link public safety ground personnel with each other and with properly equipped aircrews, while not interfering with aviation or public safety personnel during fire and other emergencies?

What policies should the Commission adopt regarding utility access to communications technologies and services to ensure safe, reliable service, at just and reasonable rates, and to maximize the operational potential of water and energy facilities and services?

Should the Commission order electric, gas, or water utilities to enter into pilot projects or partnerships to improve watershed management, reduce fire risks to utility resource and infrastructure, and increase water availability for energy and water use?

4.2. Other Meta-Themes

Are there other "Meta-Themes" that arose from the proceeding scope that the Commission should address in the Water/Energy Nexus Proceeding? If so, please suggest other Meta-Themes from this proceeding and appropriate Commission action to address that theme.

IT IS RULED that:

1. This proceeding takes official notice of the guidance from the California Department of Toxic Substances regarding Handling Ash, Debris and other Hazardous Materials from Burned Structures.
2. Comments and reply comments are sought on the attached workshop reports, meta-themes and questions, and workshop report themes and questions.
3. Comments shall be filed by October 26, 2016.
4. Reply comments shall be filed by Monday, October 31, 2016.
5. A workshop will be held on Communications for Optimized Water and Energy Management on October 20, 2016, at the California Public Utilities Commission, located at 505 Van Ness Avenue, San Francisco, California 94102.

Dated October 19, 2016, at San Francisco, California.

/s/ CATHERINE J. K. SANDOVAL
Catherine J.K. Sandoval
Assigned Commissioner

ATTACHMENT A

REPORT ON SEPTEMBER 29, 2016 WATER-ENERGY-TELECOMMUNICATIONS NEXUS WORKSHOP

ATTACHMENT A

Report on September 29, 2016 Water-Energy-Telecommunications Nexus Workshop

The video webcast of the workshop can be accessed at:

http://www.adminmonitor.com/ca/cpuc/workshop/201609292/

Prepared by Jamie Ormond, Legal and Water Advisor to Commissioner Sandoval

THEME: The need for reliable communications is critical, especially in areas of high fire risk where cell coverage is limited to non-existent and satellite often doesn't reach, personnel don't have satellite phones, or satellite signals may be blocked by smoke, pine needles, mountains, canyons, or other issues. Old school communication technologies can work when others don't, for example, the San Francisco Public Utilities Commission (SFPUC) utilized the payphone located at Camp Mather to communicate between SFPUC headquarters in downtown San Francisco and workers near the Hetch Hetchy water facility in Tuolumne County ("upcountry") during the Rim Fire. SFPUC reported that the payphone at Camp Mather work during the fire when all other communications methods failed. As a result, SFPUC had personnel drove up rolls of quarters from banks all across the state so that workers and residents could use the payphones. Should we order utilities to request pay phones or similar facilities and technologies with hardened lines in areas of high fire danger near their critical facilities such as hydro- electric facilities or key substations or treatment plants?

THEME: Counties such as Butte and Lake County where cell and other coverage are limited or lines have stopped working during fires as radial lines of telephone poles and wires are burned are considering installing sirens and other technologies that don't rely on poles, wires, and electric power.
Should the CPUC order utilities and respondents to meet with County OES offices and public safety first responder agencies to evaluate options for emergency communications if telephone and power lines fail during fires or natural disasters?

THEME: Need for reliable communication to ground personnel. Courtney Aviation's infrared cameras can see through smoke from an airplane and identify fire zones or zones to avoid. This can be critical both for fire-fighting and first responder personnel and to utility crews coordinating with first responders on fire response. Mesh networks through technologies such as Multiple In Multiple Out (MIMO) are examples technologies that can be deployed on the ground to increase the ability of planes to communicate with ground personnel and for ground personnel including first

responders and utility representatives to communicate with each other. At the October 20, 2015 Water Energy Nexus Proceeding Workshop at CalOES, PG&E representatives expressed concern about their personnel working in fire zones when no cell or communications service was available.
Should the CPUC order utilities and respondents to procure technologies that facilitate ground communication when in areas where cell coverage is poor or are vulnerable to communications failure by landlines or satellite phones during fires or similar disasters? Should the CPUC order electric, gas, and water utilities to file an application to procure such technologies to protect worker and community safety, reliability, utility infrastructure, and to forestall damage charged to Catastrophic Memorandum Accounts (CEMA)? Should technologies that allow both communication with ground crew and facilitate aerial transmission of information be procured through an application? In light of tree mortality, the drought, and fire hazards, should such applications be filed between General rate cases? What should be the budget for such technologies to increase communications safety and reliability?

THEME: Guidance from the California Department of Toxic Substances (CDTS) regarding Handling Ash, Debris and other Hazardous Materials from Burned Structures[4] requires the cleaning up such debris as soon as possible. These rules protect watershed and ensure compliance with the Clean Water Act and to protect the water and air. They are relevant to water resources for drinking water, power, and other needs, and energy resources including hydro and energy generation. Failure to clean up can also increase debris flow that clog hydro facilities and water facilities, and lead to flooding that poses more risk to utility infrastructure.
Are the utilities and entities under the jurisdiction of the California Public Utilities Commission promptly complying with these DTS rules? Should the utilities under the CPUC jurisdiction be required to submit compliance documents with CDTS, CalOES, and the CPUC to ensure compliance?
Workshop Notes:
Adrienne Arnold, Emergency Planning and Security Analyst with San Francisco Public Utilities Commission, San Francisco:
San Francisco Public Utilities Commission utilizes a number of distinct locations to provide water, electricity and sewer services to the greater Bay Area. Two areas of distinction include the Downtown SFPUC office located in the city of San Francisco and the Upcountry, located in and near Moccasin, California, in Tuolumne County (Located

[4] *Id*.

near the intersections highways 120 and 49). The Upcountry location houses the SFPUC water distribution and power generation and distribution systems that provide water, power and sewer services to customers in the Greater Bay Area.
SF PUC provides hydro generated electricity to SF, city buildings, SFO airport, MUNI, through PG&E distribution lines.
The Hetch Hetchy reservoir area is the SFPUC's biggest water facility of greatest importance as the main Bay Area water source, except Marin. The Hetch Hetchy reservoir area was located just inside Rim Fire burn zone, where it, along with other SF PUC facilities, was threated. Along with Cherry Lake (also called Lake Loyde) and Lake Eleanor, these facilities generate clean hydroelectric power for SFPUC.
Camp Mather, an location owned by SFPPUC and run by the San Francisco Parks department as a family camp, was located right in the middle of the burn zone. This was an important location to defend during the fire and for fire management.
The 2015 Marshes Fire recently ignited threatening the very same area, the very same power lines. If the powerlines in that area burn, SFPUC would not be able to push water from Hetch Hetchy through the system to be used by the Bay Area.
The Rim Fire of 2013 was the 3rd largest wildfire in California, burning 257,214 acres, and cost over 127 million dollars to contain. It ignited on October 17, was mostly contained by October 25th , but burned for over 69 days through the end of November of 2013.
The Rim Fire cost the City and County of San Francisco over 50 million dollars in damages and is still dealing with FEMA request for reimbursement and filing insurance claims.
Cell phone service did not work. There were awful potential impacts of fire in the water shed including runoff and erosion into the water source and into reservoirs, increased levels of sediment and debris, and impacts to peak flow for reservoir output.
The Rim Fire resulted in losses and damage to the SFPUC water distribution system, destruction of a powerhouse, loss of non-critical structures, loss of cabins and vehicles, mechanical sheds lots, damage to road systems, culverts under the road (the SFPUC water transportation system), complete loss of communication systems, and damage to their power distribution system. Power lines fell, many polls needed to be rebuilt.
There was a great amount of damage to the power distribution system – many polls needed to be rebuilt, it was expensive!
Power system and hydro power house impacts were large, but consumers didn't feel it as SFPUC was able to maintain water service and quality through tremendous effort.
During the Rim fire, the SFPUC supplemented grid power to San Francisco and SFPUC customers by purchasing power from PG&E at a cost about 1.5 million dollars. The SFPUC can apply to get some of that money back from insurance as a "business interruption" claim.

There was severe damage to roads from fire. Downed trees and erosion made access to various service areas impossible until fire crews mopped up access roads and dead trees were felled. Access during and after the fire was dangerous.
Loss of communications was a very big deal: SFPUC depends on multiple communications channels/systems for business communications. Cell phones didn't work, internet and internet data didn't work, neither low band nor high band radios worked, text messages didn't work. Instead the SFPUC used a satellite phone to communicate but it only from one single point in the middle of O'Shaughnessy Dam at the Hetch Hetchy Reservoir as a result of the thick smoke layer. SFPUC employees could not drive around on the roads in the area to find service because roads were dangerous. Email only worked from outside of the fire area at the Moccasin Command Post. Land lines, however, continued to work during the fire.
The SFPUC had to communicate with business services in external communications in the downtown area regarding its continued response to incident. Both the public and media were interested in the event and the fire could be seen from space.
CalFire crews came to help from all over the country. There were at least 30 strike teams including people from Florida and San Francisco. It was important to limit damage to SFPUC infrastructure so the SFPUC embedded SF Fire Liaison into CalFire incident command to push CalFire to prioritize SFPUC facilities.
SFPUC put forward some **Lessons Learned** when traditionally relied upon communications stop working during disasters: 1) evacuation communications were difficult because there was little to no way to communicate and coordinate when SFPUC in the city could not get in touch with their employees except through the payphone in Moccasin, California near Camp Mather. SFPUC dispatched door knockers to ensure that people were safe.
2) Communication between Downtown and Upcountry was challenging on multiple levels during the disaster. Upcountry dwellers were emotionally connected to the areas where their homes were located and that made SFPUC prioritization of protecting places difficult to communicate from downtown. Downtown requests to Upcountry were more easily received when then the SFPUC sent people from the city, including the mayor and team leaders, upcountry to communicate in person and see what was actually going on.
3) Camp Mather had an old pay phone that continued to work throughout the fire emergency when communications were down. That pay phone became the primary communications channel from inside the fire zone. Calls got dropped continually as people ran out of quarters to feed the phone. SF PUC got quarters from many banks and drove them up to the payphone to ensure continued communications from the burn area to the downtown SFPUC office for coordination.

4) Communications with communication providers were a challenge at the beginning but resulted in a partnership with Verizon. Verizon brought out a portable tower during the fire. For the future, the lesson learned is to have a contingency plan in place before you need it especially about communications and logistics (places to stay for first responders). As noted, it's also important to protect the line that connects the tower that creates the microwave radio linking the communications for it to work.

COURTNEY AVIATION –

Courtney Aviation has worked with the Bureau of Land Management, the Forest Service and CalFire for 30 years. They help with coordination between the air tactical control aircraft, fire fighters, and responders. Courtney Aviation began looking for better firefighting solutions when 15 forest fire fighters perished in a fire.

Courtney Aviation highlighted the relationship between fires, watersheds, and timber management, and opportunities for watershed management to reduce the devastating effects of wildfire. To protect watershed in this fashion requires addressing climatic, cultural, policy, and technical issues. Fires increase greenhouse gas emissions into atmosphere and reduce the ability for watershed to collect and filter water. The buildup of fuels in forest due to forestry management choices, coupled with the impact of drought and tree mortality due to the bark beetles and other tree diseases, leads to tree death, more combustible material, and challenges to watershed, fire risk, and public safety management.

Fire management today fields many competing needs. Some communities need "safe to burn days" to eliminate fuel too costly to convert to biomass. The lack of fuel management has also been associated with increasing large and destructive fires that risk public safety hazards, produce greenhouse gases, and compromise air quality.

The State of Colorado, as an example, invested in primary attack firefighting resources because research indicates that post-fire impacts are more costly than fire suppression if commenced at the onset of a fire. With 80% of Colorado rivershed under Colorado state control and fire-fighting responsibility, Colorado's governor's determined after a research review that downstream/down year effects of a fire are far more costly and damaging to the water and ecosystem, and the economy, than fighting the fire. A bill was introduced to investigate firefighting and create a better product to fight fires. The biggest obstacle to be overcome was the solution to how to link aircraft in the air and the data and information collected in planes to the firefighters and public safety personnel on the ground. Courtney Aviation described solving this problem as one half of the holy grail of firefighting. The other half would be to identify the exact location of each firefighter fighting the fire, and the location and direction of the fire.

There are money issues at stake when fighting fire. Two pots of money immediately come into the picture: emergency money for fighting the fire and pre-assigned money. These distinctions make fire suppression efforts complicated as pre-assigned money may be depleted during a bad fire season or successive bad fire years.
For fire suppression to be valuable to utilities, the cost of fire suppression and utility rebuild post-fire needs to be better analyzed and understood. The cost to San Francisco, for example, when power lines near Moccasin are shut down and the SFPUC has to buy power from PG&E for use by the city is a good number to begin understanding economic consequences of fires and the economic value of fire suppression to all utilities and the customers they serve.
Courtney Aviation provided tactical control for fire fighters to assist with coordination for part of the time during the Rim Fire in 2013.
Courtney Aviation reported that based on their 30 years of firefighting experience, when time is of the essence and temperatures are running hot in an emergency, pictures worth are 1,000 words. Even better, a moving picture is worth 10,000 words! Digital maps and moving maps were a technology offered up by NASA over 20 years ago. Moving this technology into firefighting has created more issues than technology transfer to communicate moving maps and photos of a fire zone. These challenges are likely a result of bureaucratic issues and understandable “we have never done that before”-itis. People with a lot at stake in firefighting theaters are reluctant to depend on systems that are flimsy, frail, or don't work. Firefighters still use pick axes as they did millennia ago, though they increasing rely on cell phone and internet communication set up through a Cell on Wheels (COW) or Cell on Light Truck (COLT), which may take a week to ten days or more to establish if communications backhaul must be built or arranged. Once an internet connection is established, some teams use those connections to track fire behavior, deploy and call for resources, and coordinate with other first responder teams including utilities to protect people, property, infrastructure, watershed, and communities.
Communications between command and the multiple levels of the response structure utilizes a different language than what members of the response team at the lowest levels of command structure will use to communicate (order-based command and control communication). Person to person communications in tactical operations enables outcomes, especially in the face of uncertainty, issues, and conditions unknown to the command structure.
Courtney Aviation utilizes advanced firefighting and communication technology such as infrared spectrum devices to cut through communication obscurity and facilitate fast decision-making based on clear, real time data.
If wind drives a smoke column, planes ordinarily can't see the fire through the smoke. With infrared technology (more familiar to most consumers as the signal that your

television remote uses to change a channel), firefighters can see through the smoke and spot the exact location of the fire or hot spots. Courtney Aviation uses infrared technology mounted in a gimbal ball mounted underneath the airplane to gather real-time fire data. This technology enables ground forces to be alerted to the specific location of the fire, facilitates dispatch or evacuation of fire fighters, and informs decision-making for evacuations and fire suppression efforts.

Downlinking that visual information from the aircraft to fire command on the ground provides better common operating picture overall for all members of incident management, staff, and higher level decision-makers, senators, others, anyone who needs justification of firefighting decisions. Visual mapping data enables putting information before interested parties and receiving information in response to it.

Communications deployment leaves gaps in the ability of those on the ground to receive the information from planes using infrared or other technology to map fires as those on the ground can't access this information without accessible networks in the fire zone.

Microwave downlink using a mesh network enables the information from the air to be transported/ linked to the command staff on the fire to see what's happening at real time on the fire. Digital data needs to be moved at a high rate of speed to enable this process to occur. MIMO technology, multiple in multiple out, provides multiple pathways at speeds around 50 Megabites per second (MBPS). The network moves data around in a network of transmitting boxes, transmitters and repeaters. To Courtney Aviation, it became apparent that communications in rural areas were severely lacking to enable this type of data downlinking.

Communications Today:

DSL lines supporting 50 MBPS in rural communities can be available in few or no locations, especially in areas where wildland fire burn. Often during a fire incident, there are no reliable communications services, and even emergency services such as a COLT or a COW can be taxed. During a fire, a community of 400 people turns into a community of 2400 to 5000 people all competing within a fire camp for access to communications. Everyone competing and the system gets clogged. A backbone needs to be deployed to make the system work during an incident. That can, and often does, take a long time to occur, a week to ten days or more.

Sometimes communications in a community disappears when someone accidently digs through a fiber-line with a backhoe. This disruption can take down an entire community's communication services. If this occurs during a disaster incident, sometimes, pilots become the human relay communicating between fire dispatches in different territories becoming the human repeater.

Cell service, tower to tower radio communication, could be a non-wire resilient alternative. The problem is that despite the tower infrastructure, all communications

services are trunked through the fiber-lines or some other type of physical line that connect the towers!
There may only be a single link for all communications in a region: cell phones, credit card machines, gas station machines, and the whole community could drop out of modern communication if there's an issue with communication service. If someone digs through a fiber line and the entire communications system goes out, a rural community will be at risk. Some California communities have alternate means of communication such as radio transmission (AM/FM), handheld radios for communication over short distances, sirens, or an established HAM radio community to use amateur radio spectrum to step into communications voids.
The MIMO, multiple in multiple out, system used by Courtney Aviation, provides a dispersed, independent communications network that allows data to be moved throughout a territory. It could be set up at lookout towers to give firefighting a communications infrastructure. Public safety could use it, forest service could use it, there's an opportunity to create another complete communications system for firefighting and public safety.
Mesh network built into fire vans: Adding nodes to the network makes the network stronger with another backup. The network bandwidth and speed grows as nodes are added. Nodes can be easily added to airplanes, vehicles, and individuals carrying them in backpacks. Courtney Aviation suggested build a mesh network into Infrared technology on the airplanes, connected to mesh network on the ground in cars, at stations such as utility substations, and in backpacks worn by emergency personnel.
Multiple infrared cameras on the airplanes, some pointed, some can be moved via touch screen. In the 2016 Vandenberg Fire, infrared cameras were used to develop live information and downlink it from the plane to the ground to incident operations center, EOC, emergency operating center for Vandenberg fire as well as, incident command post (ICP) working other fires. Information from the plane can also been seen from operations on the ground by quickly deploying mesh network node vans upon arrival at the fire command site.
Furthermore, plane mounted cameras can be operated from the ground through the touch screens. Un-manned aerial vehicle (UAV) camera mounts, and gimbal mounts on a manned aircraft, are advances in technology that allow fire fighters to do advanced mapping to fight fires in real time, transmitting that information to incident command as people are working to put out the fire. The gimbal is a ball that can be pointed in different directions, and the cameras are gyrostabilized, so that the picture sent back is stabilized.
Infrared gimbal mounted gyrostabilized technology can look through the smoke with ease of use through a touch screen. Then, a communications network is required to get this information out of the plane and down to the ground where it can be seen,

analyzed, shared, and acted upon by public safety personnel including fire fighters. Courtney Aviation use the 5GHZ band of unlicensed spectrum to transmit to its signal. Enabling communication of the plane's signal to the ground requires fast deployment strategies such as a mesh network.

"Mobile multiple in multiple out" MIMO allows for ad-hoc high speed network between nodes – airplane, people, van nodes, mountain top nodes, etc. Mountain top notes have solar power to keep them running. Mesh have been created for the 2016 Sobrannes and Marshes fires, and each node set up adds to the mesh making it more resilient, faster, strong, self-healing, self-building mesh. Mesh networks can also bring network access into canyons where it wouldn't otherwise be reached, if network nodes are deployed in such places.

Downlinking from the aircraft is a 2 year old process and Courtney Aviation is the first to roll out the moving map, moving infrared, gimbaled infrared, on forest fire fighting. The Rim fire was first deployment of infrared for fire spotting from a plane. The Happy Camp Complex fire in Siskiyou County, California, was the first downlinking of infrared to a mesh network. Courtney Aviation is looking forward to testing a mesh network in a watershed so that it's ready to deploy during an initial or sustained firefighting attack for multiple stakeholders to use in the fire suppression business.

MIMO nodes cost in the $10,000 range, though new nodes are available for $5,000 or less. With the supporting solar power setup, each node is currently in the $15,000 range, though new options are available at lower prices. A single MIMO node could transfer data over a 50-100 mile hop to another node or data access point, but for safety and reliability, nodes should be deploy at least every 30 miles.

Look out towers as a MIMO node location: Using fire lookout towers for MIMO node set ups have many advantages: 1) great line of sight; 2) power or solar power; and 3) security.

MIMO not limited to aircraft, can be located in street lights to provide internet, or in a variety of urban, suburban, rural, and wildland locations. Consider a MIMO node like an Ethernet cable. If there are many systems coming up with operating technologies, access to a MIMO box could provide a common operating picture technology, maps, pictures of people of the ground, display maps. MIMO could provide an opportunity to work through that information and provide data through the box. MIMO is a common network to allow inter-operability and communications for multiple agencies that may not share radio frequencies. More nodes you have, more ubiquitous communications through every nook and cranny and deeper penetration into canyons.

New MIMO boxes have recently been developed by DARPA grants to allow voice communication through a radio + conduit of Ethernet value. This new set up also helps to track public safety users. It may be less expensive overall, costing about $6000.

MIMO nodes “listen well,” and may be sensitive to other wifi frequency uses. MIMO often doesn’t work well when located directly at a cell phone tower due to interference, but works very well in wildland areas with limited interference.
What's the economic bang for the buck? Are insurance companies are your saviors to fund firefighting? Don't count on it. Wildland fire-fighting is supported by California’s General Fund and is a tremendous financial drain. When a spot fire occurs to the side of an active wild fire, as seen on an infrared screen, a downlink of the picture to operations command enables decisions to be made quickly to potentially prevent larger fire incidents from occurring. Improving communication for fire-fighting can save money for fire-fighting, and protect public safety personnel, the public, property, infrastructure including utility infrastructure, and reduce GHGs, environmental damages, and pollution.

The Honorable Cliff Edson, Supervisor, Calaveras County

Rural California counties are income-poor compared to urban counties in California, though many rural counties have essential resources. California's major water resources, including those used for hydro-electric facilities and to provide water for energy production, come largely from the state’s rural areas.
Calaveras County has 23 major rivers and streams. Vegetation slows the flow of water and debris into aquifers. Properly managing forest and rangeland enhances water flowing into the streams and aquifers, and prevents or controls flooding. One-third of all water supplied to the San Joaquin basin comes from Calaveras County via the three major watersheds located in the county. Debris from watersheds also flows into aquifers or watersheds used by hydro-electric or water facilities, and needs to be managed.
Drought reduces water in water table, and reduces farming production on ranch lands and farms. Farmers with communications could use advanced technologies to promote better agricultural management during the drought. Supervisor Edson argued that communications facilities and services need to be bolstered in rural communities to protect public safety during and after emergencies such as fires, private and public property, watershed, water systems, electricity from hydro power, San Joaquin Valley, and other agriculture, and California’s economy.
Communications can easily be disrupted in a fire. When a large 2000 degree fire burns through the land, like during the Butte Fire in 2015, infrastructure on land and underground gets destroyed. Animals and people near these hot burning fires are at grave risk. Lungs can be severely burned 300 feet away from the flames of such a fire. Fire emergencies trigger expenditures for firefighting and then post fire expenditures trigger the opening of a second pot of money to help communities deal with recovery. This money segmentation makes recovery very challenging.

Supervisor Edson described the unintended consequences of fire disaster in rural communities: Post- fire, lots of debris and pollution from destroyed homes flows into the watershed at the first precipitation. Fire danger, fire-fighting, and post-fire activities lead to conflict with marijuana growers and others. Marijuana cultivation across rural communities in the state has resulted in illegal water diversion, illegal chemicals seeping into the water system, and destruction of water tables all around rural parts of the state. Many chemicals used in marijuana cultivation harm the environment and kill animals and are, in fact banned in the United States, but used in illegal grow operations. These chemicals must be removed from the water system prior to permitting drinking water to reach customers which likely increases energy and cleaning expenses for water utilities.

Communications were an issue that rose almost immediately during the 2015 Butte Fire. Forty-six different police units were called to evacuate people during the Butte Fire, but all communications technologies were almost immediately inoperable. No one knew exactly where the fire was located and but police units were sent into the danger zone to evacuate people anyway. Supervisor Edson described the Butte Fire as a Big Giant Monster throwing fireballs emerging from the Mokelumne River Canyon. This had never happened before.

The first effective communication technique used in the fire response was the standing of **sandwich boards that** detailed where the fire was on a daily basis. These sandwich boards were placed at community gathering points daily.

AT&T took two weeks to provide communications during Butte Fire through a Cell On Wheels to enable communications between community members, responders, and fire fighters. All power lines and phone lines in the area were destroyed. At least 791 power polls burned. Communications redundancy would have been helpful. CalFire stated at the emergency operations center for the Butte fire that it had no idea where the fire was as it was moving so quickly. CalFire did not have the technology to see the fire, and Supervisor Edson was glad to learn about infrared fire-spotting services such as those provided by Courtney Aviation.

Butte Fire expenses: Calaveras County spent $100 million dollars to remove debris from burnt houses so that home pollutants don't make it into watersheds, and comply with Department of Toxic Substances, Cal Environmental Protection Agency, and other regulations. CalFire fire spent $70 million on the Butte fire management. All totaled, including road, tree and watershed damage, close to $400 million dollars was spent on the Butte fire. The Rim Fire may have been slightly less expensive because the fire occurred largely on Federal Lands.

Supervisor Edson argues that it’s time to collaborate to proactively fight fires and protect watershed better. Agency collaboration and preparation is essential!

Supervisor Edson proposes rewarding value with incentives, and streamlining

regulation. For example, the removal of 8600 dead trees from public right of ways requires NEPA study prior to removal. But with wind, rain or snow, these trees will be removed by themselves potentially endangering people and roadways. He emphasized that communications facilities and services will enable collaboration, before, during, and after disasters, and can help prevent or minimize fires.

A forest properly managed including harvesting overgrowth and clearing underbrush, maximizes snow-pack so snow will accumulate, and melt more slowly. This creates slower moving water ways, leading to less erosion, and less debris in waterways, and increases water yield of water by up to 20%. Properly managed rangeland and meadow land creates healthier watersheds. Properly controlled water basins help with flood control, is good for aquifer recharge and environmental habitat.

We can look at innovative ways to deal with dead trees by developing new methods of watershed management to benefit both Calaveras County and urban communities of the State of California.

It is time to look into preventative maintenance instead of spending on fire fighting and post-fire rebuilding. Communications will assist in enabling preventative maintenance and less fire destruction.

Drought and the bark and pine beetles have killed many trees in the rural communities and wildland areas. Tree mortality will increase forest fires danger and watershed management challenges in the near future. Creatively and proactively managing watershed will be helpful to us all.

(END OF ATTACHMEN A)

ATTACHMENT B

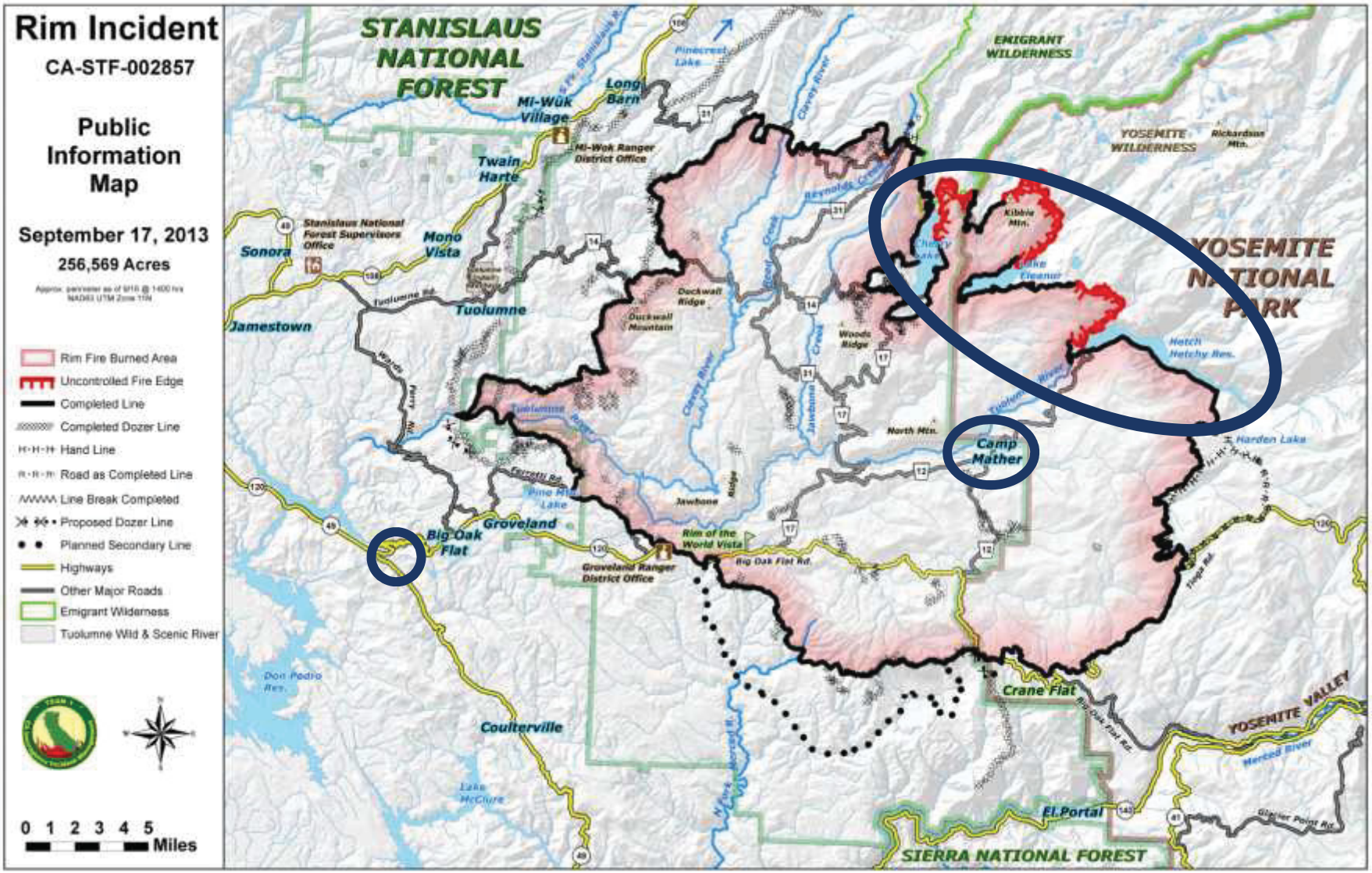
SAN FRANCISCO PUBLIC UTILITIES COMMISSION PRESENTATION SLIDES

Smoke on the Water…
Fire in the Sky!

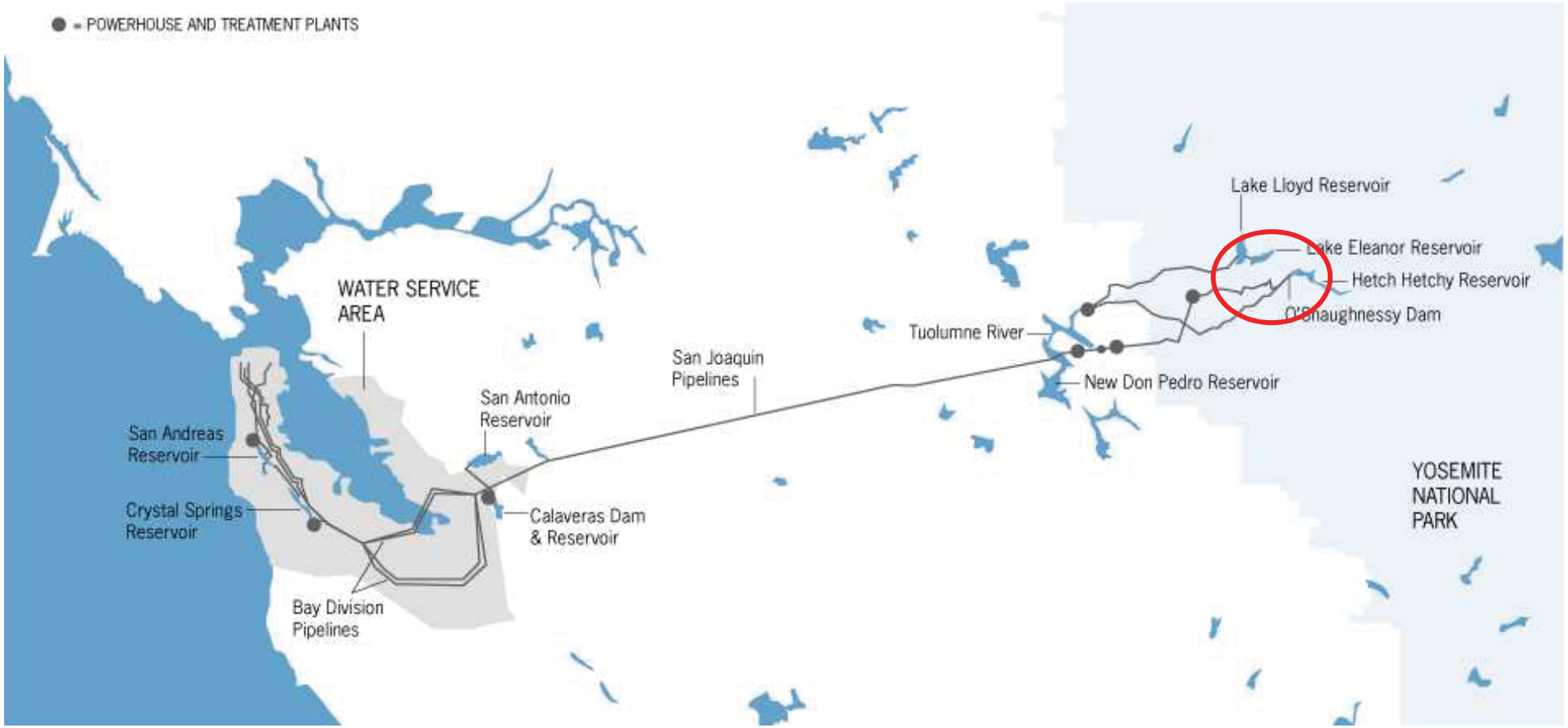
Effects of the 2013 Rim Fire on the SFPUC

Hetch Hetchy Regional Water System

Rim Fire – August to October 2013



Hetch Hetchy
Regional
Water
System

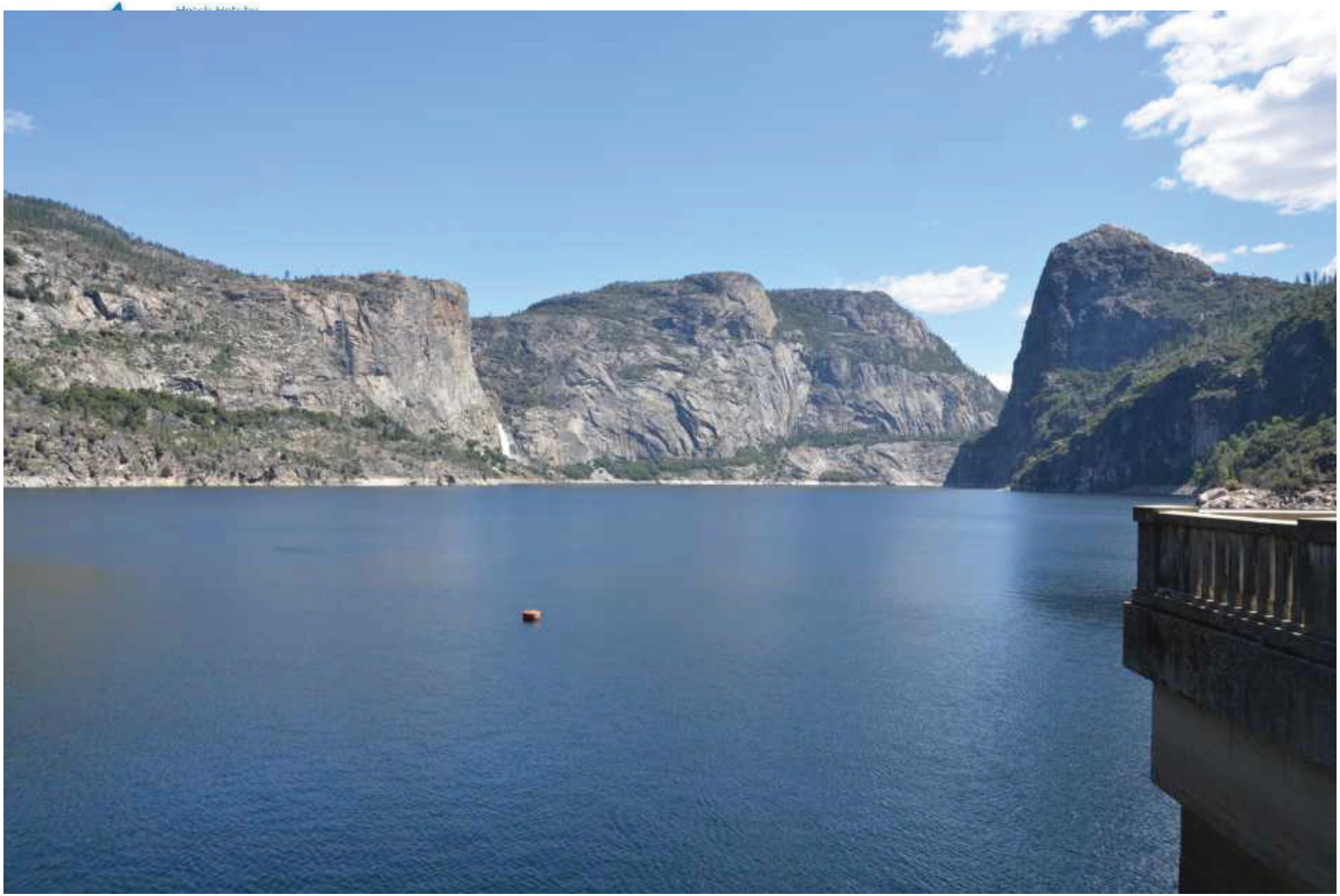



WHY SHOULD WE CARE ABOUT WILDFIRES WAY OVER IN THE SIERRAS?
WHY IS SMOKE COMING OUT OF OUR COLD WATER FAUCET?
meyer

Hetch Hetchy Regional Water System

Rim Fire

- Total of 257,314 acres burned
- August 17 through October 25, 2013
- Firefighting costs: $127.35 million



SFPUC Affected Assets

- **No damage to the water delivery system**
- Power distribution system damage
- Holm Powerhouse roof fire
- Loss of multiple non-critical structures
- Damage to roads systems
- Loss of communications systems

Hetch Hetchy Regional Water System

Power Distribution System Damage

Hetch Hetchy Regional Water System

Holm Powerhouse Roof Fire

R.13-12-011 CJS/ge1

Power System Damage - Impacts

- No municipal power service interruption
- Municipal power needs met through power banking agreements and market purchases
  - Totaled roughly $1.5 Million
  - Purchased power claimed to insurance as business interruption
- Municipal load met again in September

Hetch Hetchy Regional Water System

Loss of Non-Critical Structures

Hetch Hetchy Regional Water System

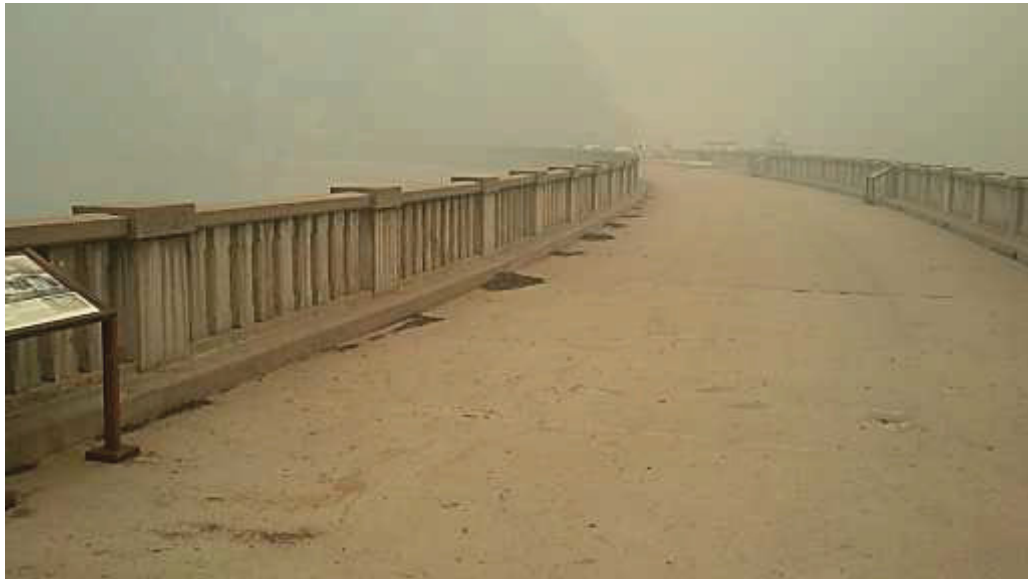
Damage to Roads Systems

Hetch Hetchy Regional Water System

Loss of Communications

Communications are Essential

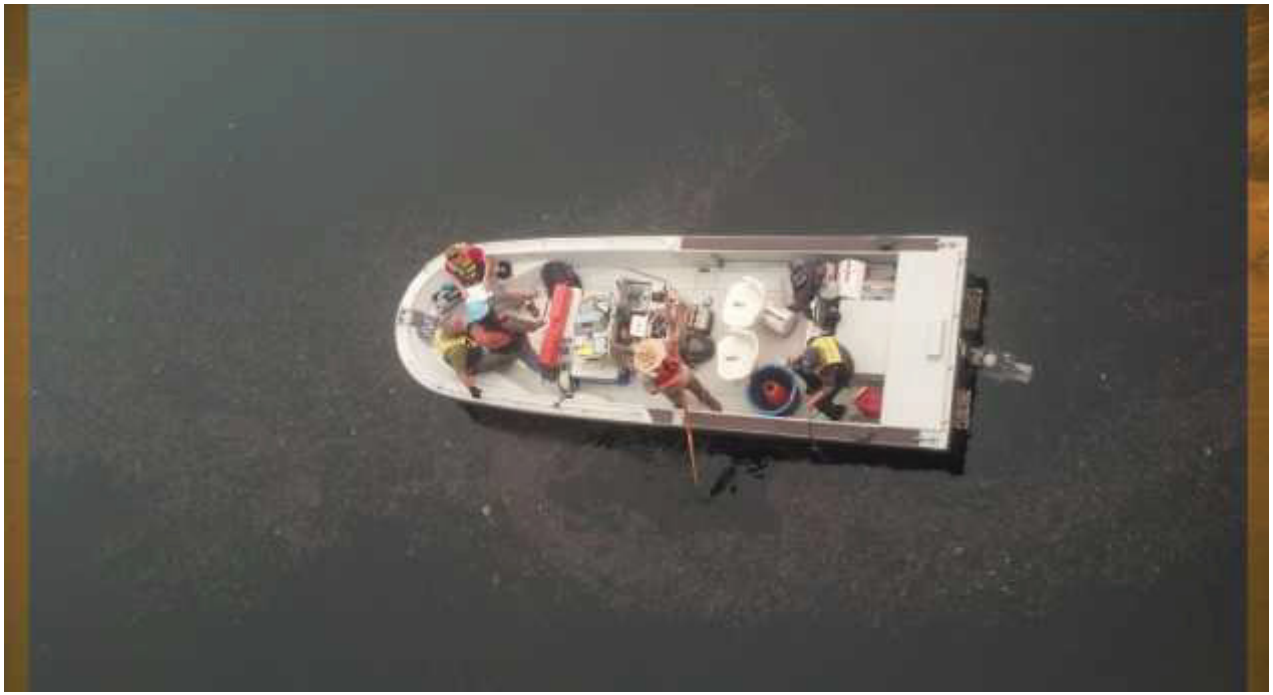
- Internal communications –
  - ~~Cell phones~~
  - ~~Internet/Data~~
  - ~~Radios~~
  - Satellite Phones
  - Land lines
  - Email



Hetch Hetchy Regional Water System

Communications are Essential

- External Communications
  - Stakeholders, i.e. wholesale and retail customers
  - Public
  - Media



Hetch Hetchy Regional Water System

Key to Limiting SFPUC Damage

Limiting SFPUC Infrastructure Damage

- Cal Fire, SFFD and SFPUC response crews worked together to protect critical infrastructure

Communication Lessons Learned

- Evacuation communications
  - Ensuring that everyone is accounted for
- Incident response from afar can be difficult
  - Upcountry vs. downtown
- When infrastructure fails, you make something work

Thank you!

- Questions?

Adrienne Arnold

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San Francisco Public Utilities Commission

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(END OF ATTACHMENT B)

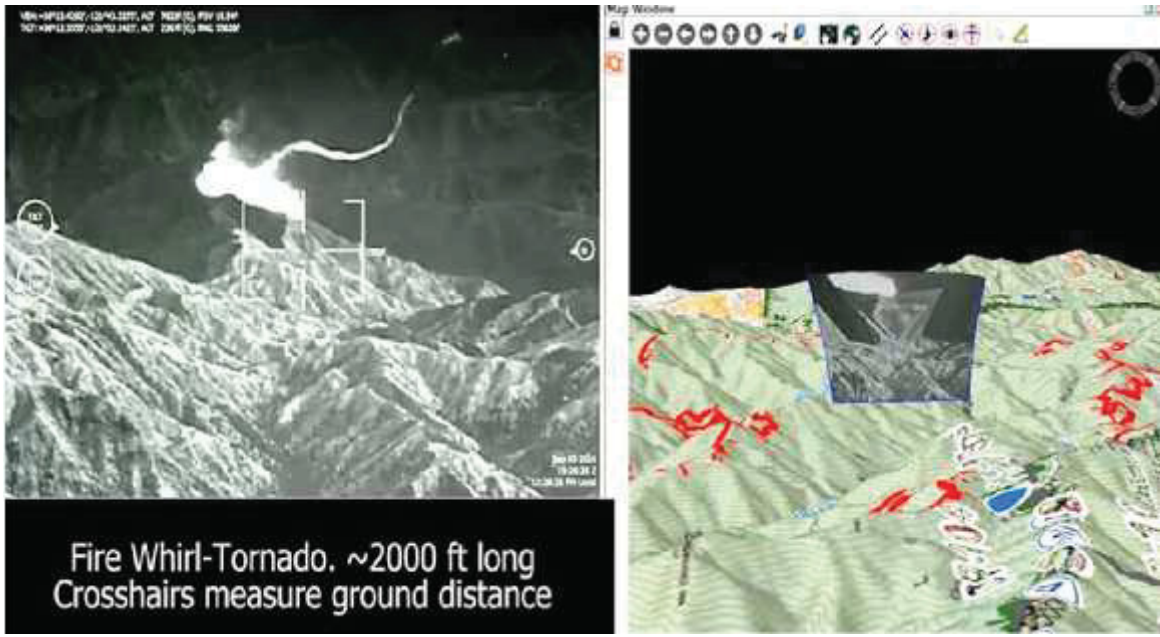
ATTACHMENT C

WATERSHED FIRE MANAGEMENT

Reducing scarred watershed through better fire suppression

By Courtney Aviation:

- Aerial wildland firefighting since 1967
- 11 Aircraft supporting USFS & CalFire
  - Air Attack planes exceed radio requirements
  - Infrared sensors, 26x visible zoom, hi-speed downlink
- 2 Mobile comm vans & 4 solar mountain repeaters
  - One Million + acre self building, low-latency mesh network instantly deployed



Live viewed/captured in multiple fire camps Monterey Soberanes fire Sept 2016

Improved fire suppression through better Data Comm

- Incident Command System has never implemented data communications
- Communications, Internet not available
- Maps slow to create through verbal description and 2-day old GPS tracks
- Paper maps can take another day to deliver to field people
- Verbal communications is the only way to provide data, fire location and description, directions to get to the fire, Tactical Planning

Integration, standard interfaces, and data structures that lead to rich information delivery

- Critical for the safety of first responders
- Essential to assessing the situation
- Integrates first responder information into a plan of attack
- Necessary information to handle victims, impacted population, and what caused the event – wildfire, natural or man-made disasters
- Safe, effective management of the incident

Current issues of Incident Command System

- Lack of real-time information
- Lack of shared situational awareness among participants
- Ineffective presentation of data as usable information
- Inefficient and inaccurate verbal communications
- Key information gets "lost in the noise"
- Agency data links do not exist or are not interoperable
- Incident history not accurately recorded

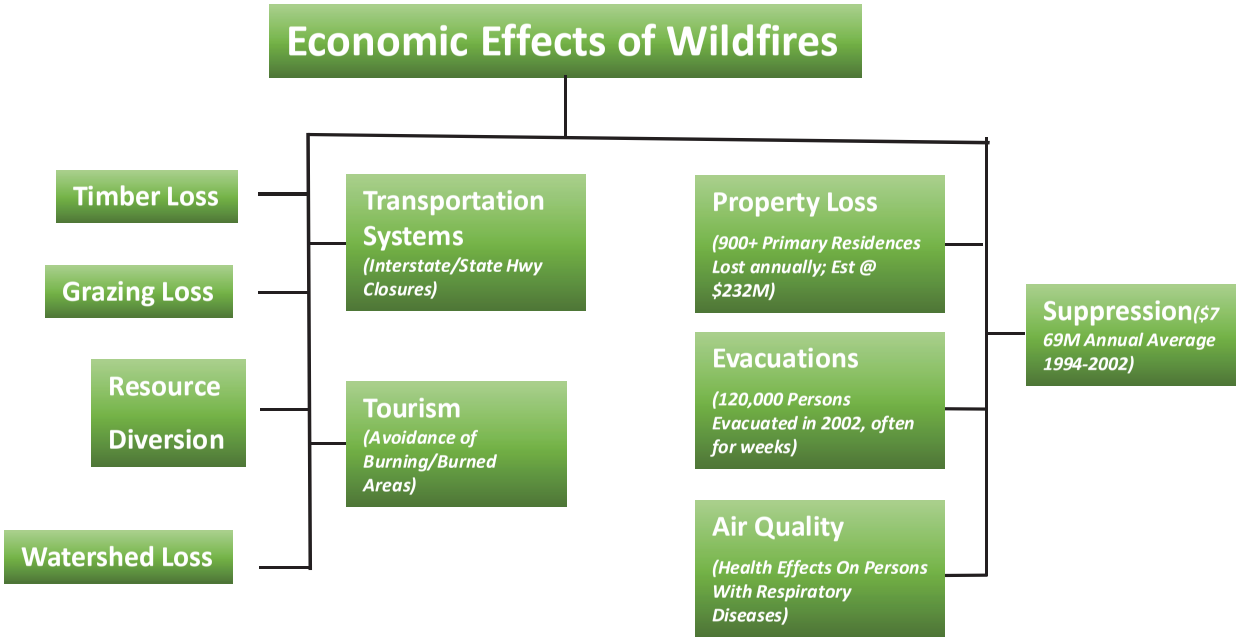
Lack of common situational awareness and a comprehensive data communications capability negatively impacts command and control

Effects of Ineffective Information Management

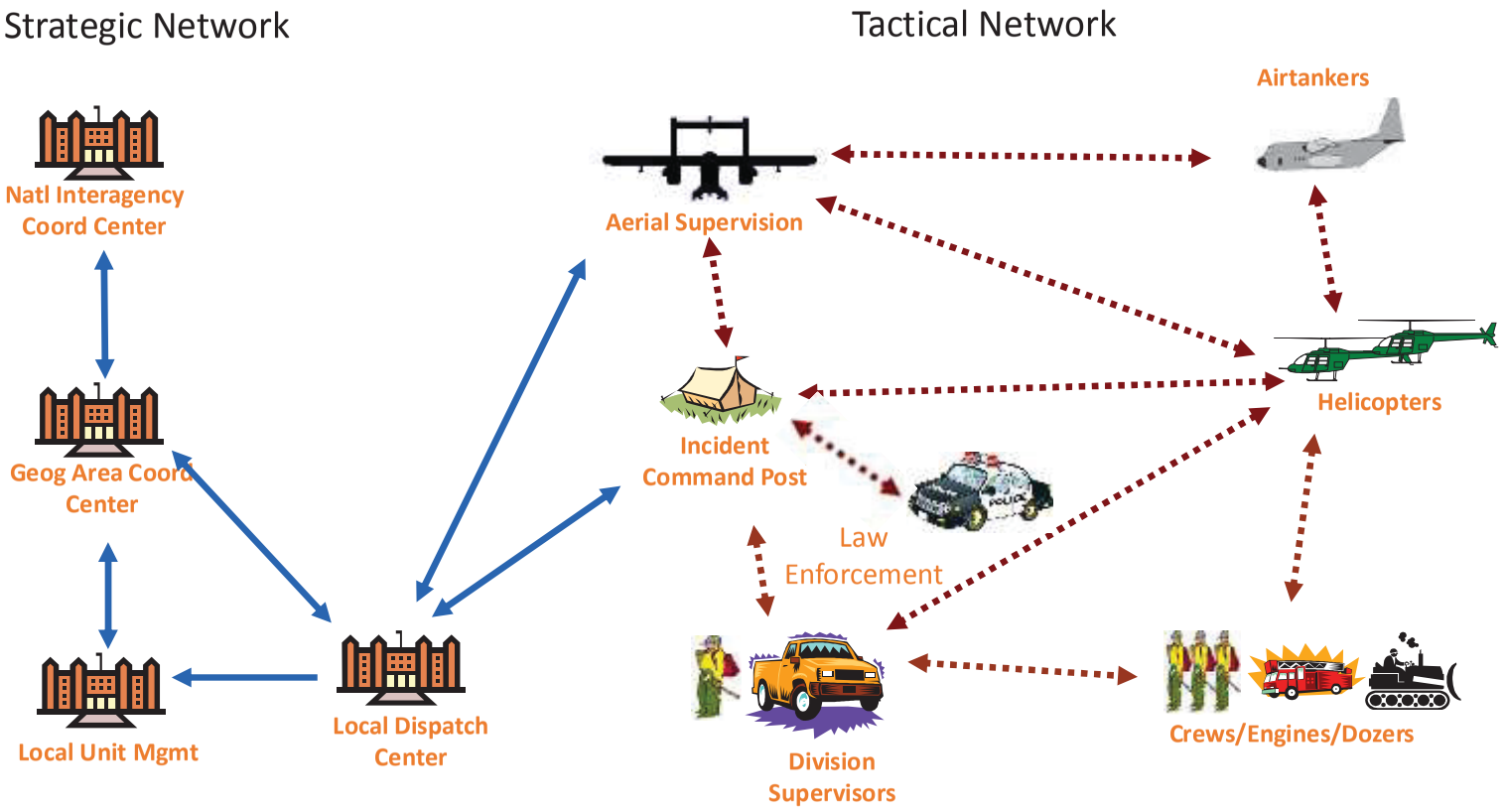
<u>Limited situational awareness and lack of timely communications</u> produce inefficiencies in incident response and operations

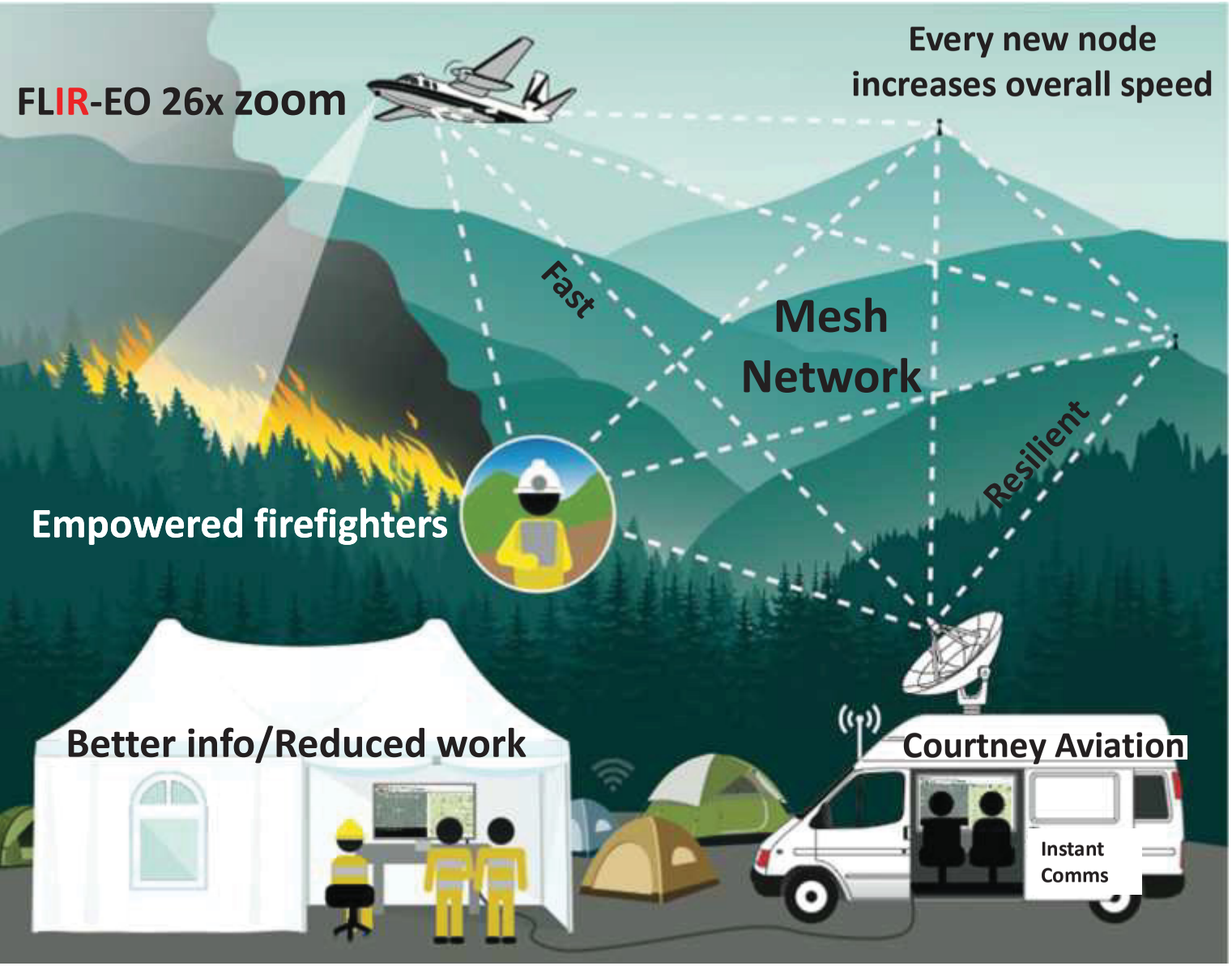
Results of inefficiencies:

- **Increased fatalities and injuries for emergency personnel and civilians**
- **Billions of Excessive property annually**
- **Additional asset loss (equipment, aircraft, etc.)**



Common Operating Picture (COP)
Command Structure Communications Network





IR Downlink

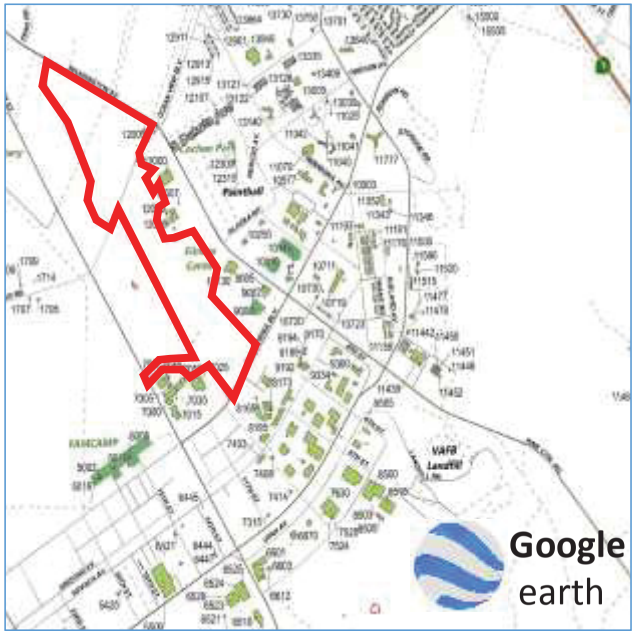
Live ground viewing and control
- Operate Aerial Cameras
- Easy, Intuitive, Distributable
- Great depth of information

Microwave Mesh MIMO Radios
- Very long links
- Fast & self healing connections
- Huge aggregate throughput

Common Operating Environment
- Right Information to the right people In a timely manner
- Accessible on any mobile device

Live Mapping

- Live video positioned on moving-map
- Super zoom tracks ground personnel
- IR tracks heat changes through smoke



Vandenberg GIS with real-time perimeter to PCs or mobile device

Washington Fire new start 9/22/16. Fire jumping the line

- Augmented reality increased situational awareness
- Real time fire perimeters distributed on Google Earth.
- Live video feed interpreted into actionable intel.
- Drastically increase ICP's situational understanding
- Dramatically decrease radio traffic

Radio Mesh Net

- Up to 85 Mb per hop
- Additive Overlapping Mesh
- IP/Ethernet transport
- MIMO Multiple Input-Output
- Self-Forming/Self-Healing
- Beam forming
- Non Line-of-Sight
- Walkie-talkie
- Truck kits
- Mobile Adhoc and Wide area

Regional Watershed Test

- Save watershed through better fire suppression
- Deploy Radio Mesh to bring Hi-speed data and internet to all remote locations of a watershed
- Test Location: Stanislaus National Forest
  - * Southern Mokelumne River
  - * Stanislaus River
  - * Tuolumne River
  - * Northern Merced River
  - * Western Carson River
  - *Yosemite National Park
- Other benefits:
  - Emergency Services
  - Resilient infrastructure
  - Internet
  - Monitoring projects
- Engage Watershed stake holders:
  - BLM, Nat'l Forests & Parks, State Forests & Parks, Water Manager, Electrical Utilities and industries

Protect Watershed with 21st Century Fire Suppression

- Advance Emergency Services and Fire Response will save watershed
  - Regional Mesh test for Remote Data
  - Common Operating Environment: Right info to right people at right time for decisions
  - Empowering people through accurate info to be less reliant on radios
- Bring Information super-hwy to the county roads of remote watersheds
  - Connects high speed internet hundreds of miles into the National Forests.

Successful stop of a high risk fire

Washington Spot4 live at ICP & Vandenberg EOC to plan resources and evacuations 9/23/16

(END OF ATTACHMENT C)