

Carr Fire CATlines: The Environmental Impacts of Bulldozers in Wildfire Suppression



by

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with

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 **FUSEE**
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ABOUT FIREFIGHTERS UNITED FOR SAFETY, ETHICS, and ECOLOGY (FUSEE): FUSEE

(pronounced FEW-zee) is a national nonprofit organization founded in 2004 that conducts public education and policy advocacy to promote safe, ethical, ecological fire management. FUSEE members include current and former wildland firefighters, fire management managers and scientists, fire educators and students, forest conservationists, rural homeowners and other interested citizens.

Inspired by the great Aldo Leopold's "Land Ethic," FUSEE promotes a new Fire Ethic in fire management policies and practices:

"A thing is right when it contributes to the safety of firefighters and the public, ethical public service and use of taxpayer dollars, environmental protection of fire-affected landscapes, and ecological restoration of fire-dependent ecosystems. It is wrong when it tends otherwise."

FUSEE informs, inspires and empowers firefighters and their citizen supporters to become torchbearers for the new paradigm of Ecological Fire Management.

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*Cover photo: A bulldozer cutting an indirect fireline on the Soberanes Fire.
Over 20 miles of dozerlines were carved into the Ventana Wilderness Area.
Image courtesy of USFS.*

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*Note: This report accompanies the video “Carr Fire CATlines” that can be viewed at:
https://www.youtube.com/watch?v=x4USUprkt_Q&t=92s*



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INTRODUCTION

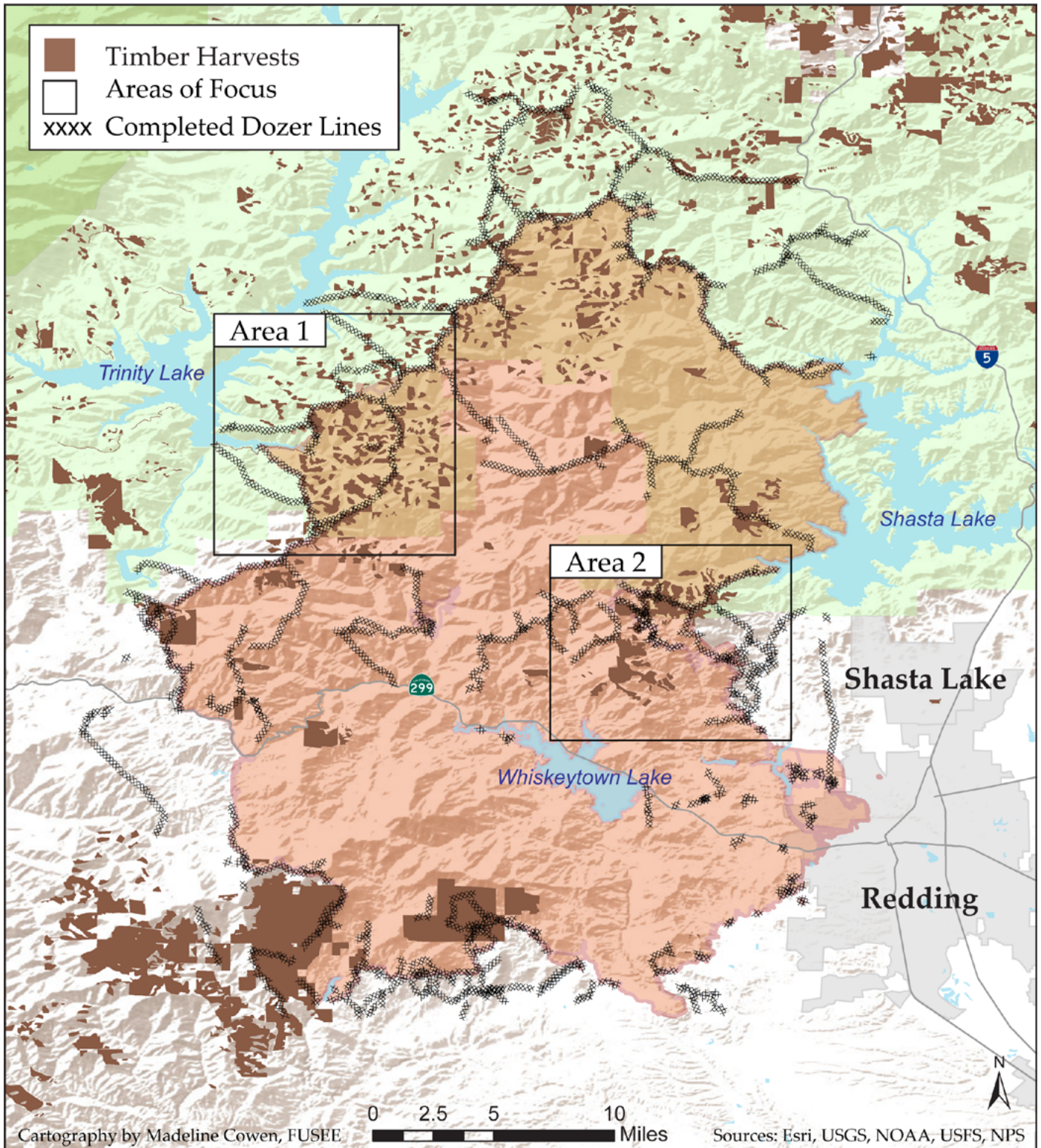
The construction of fire containment lines with bulldozers, called “catlines” in the lexicon of wildland firefighters, is a routine activity in wildfire suppression. Bulldozers can carve firelines at a faster pace and work next to higher flames than ground crews working with handtools. In the right places and conditions, catlines can successfully stop fire spread and contain a given section of a wildfire. However, bulldozing a fireline is one of the most environmentally destructive means of fighting wildfires. In the extreme fire weather conditions that are occurring more frequently due to climate change -- hotter temperatures, higher winds, lower humidities -- catlines frequently now fail to stop wildfire spread. Even in places where they are successful in stopping wildfire spread, the catlines remain as long-lasting visual scars on the landscape long after the fire has gone out and the land begins to naturally revegetate.

Bulldozers were used extensively on the 2018 Carr Fire in northern California (see map 1), almost to no effect in preventing the wildfire from spreading across 230,000 acres and roaring into the city of Redding where it ignited an urban conflagration that destroyed or damaged nearly 2,000 homes. Eight people were killed, including three firefighters, one of whom was a bulldozer operator. Another dozer operator was severely injured and almost died.

Numerous catlines were carved into the hills and ridgelines north, south and west of the city trying to stop the spread of the fire, but almost all of them were breached by flying embers that were lofted in hot, dry, fast-moving winds that spread flames over the catlines. Months after the wildfire was over, the damage left behind by the vast network of catlines is now revealing itself. This report is intended to provide context for the video “Carr Fire CATlines” produced by Firefighters United for Safety, Ethics, and Ecology (FUSEE). This report presents an array of the adverse environmental and cultural impacts that are commonly created by catlines, some of which are visible in the video footage.



Map 1: Location of the 2018 Carr Fire.



Map 2: A total of 305.6 linear miles of catlines were carved into the landscape during the Carr Fire. As the map shows, some portions of these catlines successfully contained wildfire spread, but many portions did not. Some catlines went well outside the wildfire perimeter, designed as contingency firelines just in case the main containment lines failed to stop the fire spread.

CATLINES HEAVILY IMPACT SOILS, SLOPES, AND STREAMS

The main purpose of using bulldozers in wildfire suppression is to strip off all surface vegetation by digging down through all burnable organic matter in the topsoil, and to expose bare mineral soil. When flames run into bare mineral soil with no fuel left to burn, they are unable to spread unless an ember is lofted over that line. Bulldozers alternately displace large volumes of topsoil with their steel plow blades, and then compact it with the weight of their steel tank treads. Both actions initiate soil erosion when winter rains and spring snowmelt start water flowing over catlines devoid of any protective vegetative cover.



Image 1: A catline running along a ridge near Shasta Lake.

Disturbed soils are even more prone to erosion when catlines are located on ridgelines where soils are naturally thin and fragile. Catlines running straight down or across slopes are highly erosive due to the extra velocity that gravity adds to flowing water. Exposed soils are subject to rainsplash and sheetwash erosion processes, which in turn can trigger mass wasting events and long-term gully erosion. The large berms created from soil piling up on each end of a bulldozer's blade can also alter natural hydrological flows, concentrating and channeling subsurface water flows in ways that intensify their erosion potential. Ultimately, the soil displaced from catlines ends up in streams, where it leads to siltation and sedimentation that is particularly destructive to water quality and fish habitat.

Although wildfires that burn away surface vegetation do naturally expose soils to greater erosion potential, these are temporary effects that disappear when new vegetation and downed logs start re-covering the ground surface and holding onto soil. Catlines, however, are long-term chronic sources of soil erosion and sedimentation in streams (similar to logging roads). Nonetheless, unlike logging roads that are engineered with the intention of resisting erosion, catlines are carved into mountain-sides with little thought to their longevity or their impact on soil erosion and stream sedimentation.

It can take hundreds of years to create a few inches of fertile soil in mountainous forests, and this precious resource can be stripped away in minutes with the passing of a dozer’s blade. This is one of the most significant, long-lasting environmental impacts of catlines. Long after vegetation has recovered on burned slopes, catlines remain as open wounds, oozing soil and mud into mountain streams. Video footage clearly displays the exposed, disturbed soils from Carr Fire catlines, many of which run along ridgelines straight downslope to the edge of lakes and streams (Image 2 and Map 4). The “suppression repair” phase of a firefighting operation is supposed to be completed before fire crews are released and the fire is declared “out.” This “repair” often involves constructing water bars and dragging vegetation back onto the catline scar using bulldozers and excavators. Unfortunately, this involves more tracked vehicles, some bearing the seeds of invasive species, all churning and compacting the soil. Perhaps even worse, FUSEE’s investigation found many catlines had minimal or no suppression repairs as the winter rains bore down.



Image 2: Catlines plowed right to the lakeshore are now dumping sediment into the water. Note that the lake level was very low when this image was taken in Fall 2018.

CATLINES CREATE LINEAR CLEARCUTS THAT FRAGMENT FOREST HABITATS

Bulldozers remove all vegetation in their path that could potentially ignite and spread flames. In the case of grasses, shrubs, and downed woody debris, these are churned up with the soil and pushed aside. In the case of trees, these are pushed over to one side of the catline (the side opposite of where the wildfire is coming from). Catlines plowed through dense trees stands thus leave linear “clearcuts” that cause significant impacts in the form of forest fragmentation.

There are several species of wildlife, such as the California spotted owl, that are highly sensitive to forest fragmentation because it exposes them to their predators such as great horned and barred owls. While recent scientific research has discovered that spotted owls thrive in the habitat conditions created by mixed-severity forest fires, they are highly sensitive to clearcuts and logging roads. Catlines cut through closed-canopy forest stands create open corridors that resemble the worst of clearcuts and logging roads, and provide pathways for predators of spotted owls and other vulnerable species.

Some of the most jarring video footage are the images of the catline in which large logs lay on bare soil, creating clearcut corridors through the forest canopy that clearly failed to stop the spread of the wildfire (Image 4).



Image 3: Catlines leave clearcut corridors that fragment forests and degrade wildlife habitat. This catline failed to stop the fire from crossing over the ridge.

CATLINES INCREASE HAZARDOUS FUEL LOADS FOR FUTURE WILDFIRES

One of the ironies of catlines is that even though they are intended as firebreaks that are devoid of fuel, the noxious weeds that often accumulate in their aftermath become a more hazardous fuel type than the original vegetation cover. Grasses, shrubs, and invasive weeds are what usually take hold and grow fast inside catlines. This kind of vegetation is much more prone to ignition and rapid fire spread than native forest cover. When catlines heave over large trees, they often create jackpots of downed heavy fuels, and a “windrow” of flammable logs, limbs, and root wads that lie adjacent to the flashy fuels of grasses, weeds, and shrubs growing inside the catlines. Adding to these potential fuel hazards, catlines increase sunlight and wind speeds on surface fuels, and the cleared corridors create edge effects that can allow highly flammable invasive weeds to spread within the adjacent native forest stands.

Thus, ironically, catlines attempt to create firebreaks during a fire, but what is left behind and develops over time is a quick-igniting, fast-spreading, long-burning “fuse” of hazardous fuels that greatly increases risks for firefighters facing the *next* fire. Video footage was taken before the spring greenup, so catlines are still devoid of vegetation, but large jackpots of downed logs can be seen in some of the Carr Fire catlines (Image 4).



Image 4: Catline “suppression repair” still leaves jackpots of logs and limbs — fuel ready to feed the next wildfire.

CATLINES CREATE “GHOST ROADS” FOR ILLEGAL OFF-ROAD VEHICLE USE

One of the most significant impacts of catlines that is rarely addressed is the fact that they are often used for unauthorized or illegal off-road vehicle (ORV) travel. Catlines enable access to motorized vehicles in places that they otherwise would not or could not travel. With ORV use comes additional adverse impacts on soil, water quality, and wildlife habitat, but also some impacts unique to some irresponsible ORV users. These include littering, vandalism, wildlife poaching, and an increased risk of wildfires ignited by accidents or arsonists driving along abandoned catlines. Catlines thus can become “ghost roads” that are not visible on any recreation map but are still pathways that bring all the normal negative impacts of forest roads deeper into wildland areas where motorized vehicles do not belong.

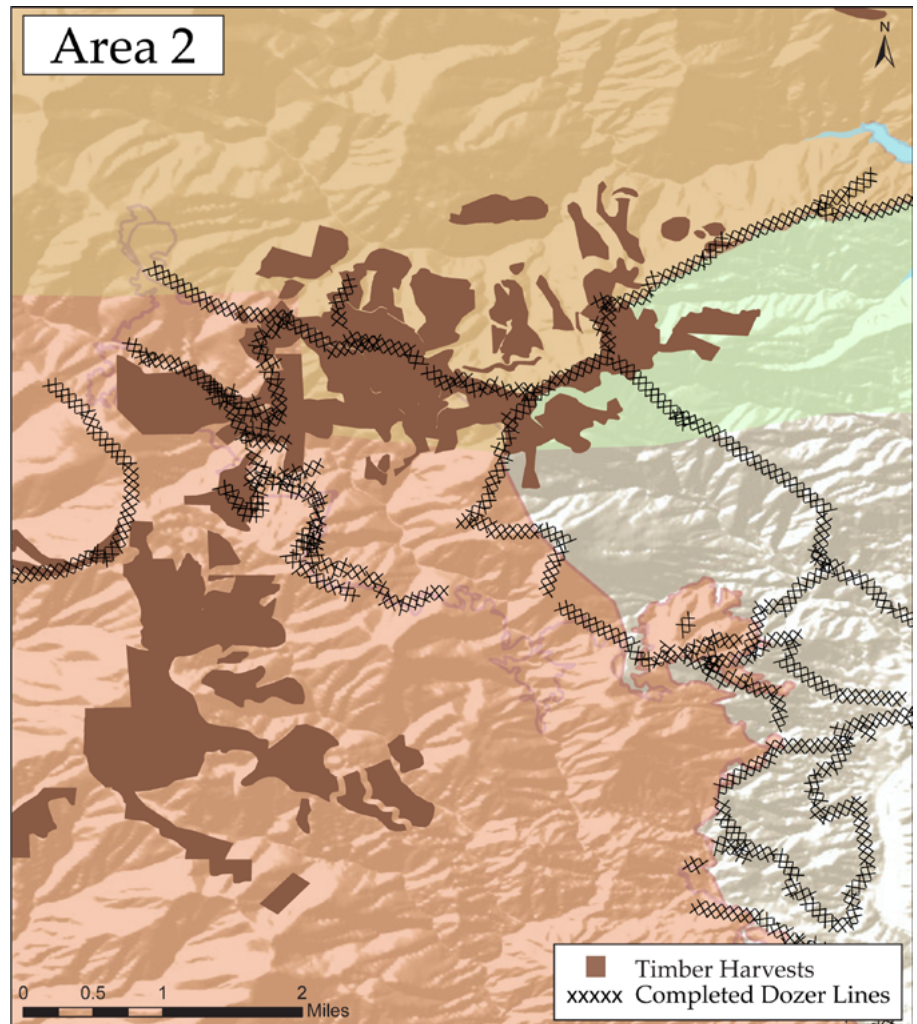
However, not all ORV riders are irresponsible. In the Chappie-Shasta ORV area, an authorized network of existing trails located on BLM land within the Carr Fire area, riders volunteered to repair trails, barriers, and signs that were damaged by fire. Their intent was to limit erosion and restrict unauthorized use off of these trails, and volunteers are pledging to perform repairs to other ORV trail networks damaged by other fires in California. However, catlines are inviting routes for riders, and it takes just takes a few irresponsible individuals to cause long-term damage.

CATLINES DESTROY NATIVE AMERICAN ARTIFACTS AND HERITAGE SITES

Catlines are routinely placed along ridgelines because that is one of the places where crews have the best potential to control wildfire spread. However, ridgelines were also historic pathways for Native Americans and can be rich with artifacts, rock cairns, and tree blazes that mark legacy sites important to Native American heritage and religious ceremonies. These sites can be destroyed under a bulldozer's blade. While agencies such as the Forest Service have at times attempted to avoid bulldozers impacting these sites, for example, by steering dozers around rock cairns that marked vision quest sites, it is important to realize that the rocks do not just mark a sacred site, but rather, a sacred *landscape* in which historically fire played an integral part. Even if a dozer avoids running over a specific site, the spiritual value of the landscape can be desecrated by the scars created by catlines and other aggressive firefighting actions.

Many California Indian Tribes were, and continue to be, renowned fire practitioners, and ridgelines were common areas for igniting burns to maintain open travel corridors, and to maintain habitats for plants and animals that were used for food, fiber, medicine, and ceremony. Additionally, lightning strikes were more common at higher elevations, and thus, ridgelines were historically more open habitats due to frequent ignitions from both Indian burning and lightning fires. Thus, ridgelines were places where fires were *started*, not stopped, and catlines are particularly destructive to the legacy of the original human inhabitants of the land.

There is no evidence visible in video footage of Native American heritage sites that were impacted by bulldozers. Fieldwork by archaeologists, aided by the fact that the wildfire has removed vegetation cover that previously obscured artifacts, may yet reveal the extent that this was another significant impact of the Carr Fire catlines.



Map 3: Ridgelines with views of Mt. Shasta were traditional pathways for the Karuk that are marked by “prayer seats” and other artifacts indicating ceremonial sites for spiritual practices. Catlines along ridgelines on the east side of the Carr Fire likely impacted some of these sacred sites. Note the clearcuts and catlines in the interior that failed to stop the fire, the sections of the fire perimeter that stopped without the use of catlines, and all the contingency catlines outside the fire perimeter that never engaged the wildfire.

BULLDOZERS ARE BECOMING LESS EFFECTIVE IN STOPPING WILDFIRE SPREAD

The above items are a few of the significant impacts that are commonly caused by catlines, but some people would deem these impacts to be acceptable trade-offs if bulldozers were successful in stopping wildfire spread. But in the conditions that drive large wildfires such as the Carr Fire--extremely hot temperatures and high winds, steep and rugged terrain, dense and dry vegetation-- conventional “contain and control” fire suppression tactics are increasingly ineffective. Bulldozers can cut wide firelines very quickly, but large wildfires can leap over eight-lane freeways and fly over rivers. Indeed, the Carr Fire did just that: jumping across Highway 299, igniting vegetated islands and boats docked inside Whiskeytown Lake, and hurling embers across the wide Sacramento River to burn down homes on the riverbanks.

Many of the Carr Fire catlines were attempting to protect young timber plantations (Image 5). Indeed, there were large clearcut areas within the wildfire area, and even these “maximum fuels reduction” areas failed to stop the flames. In fact, clearcut timber plantations are highly flammable and vulnerable to catastrophic burning. These clearcuts, devoid of any large trees or logs that could have offered habitat to species that actually thrive in burned forests, laden with logging slash and densely covered with evenly planted trees, burned catastrophically and now resemble “moonscapes” that are ringed by catline scars (Image 5).

In general, bulldozers are not justified for fireline construction in remote backcountry wildlands where mixed-severity fires are part of the ecosystem and a diversity of plant and animal species are naturally adapted to recurring wildfire. Rather, these catlines are more justified if they are located close to frontcountry communities where homes and other buildings are absolutely destroyed by fire. However, even catlines located on the edge of communities--even in people’s backyards--may not succeed because there may still be plenty of fuel available between the catlines and homes. If the catlines are breached, then flames



Image 5: Young timber plantations ringed by catlines that failed to stop fire spread, leaving barren “moonscapes” in the burned clearcuts.

can march right up to the walls of homes. Additionally, homes are vulnerable to ignitions from burning embers that can fly up to a mile or more, well over catlines, paved streets, even parking lots.

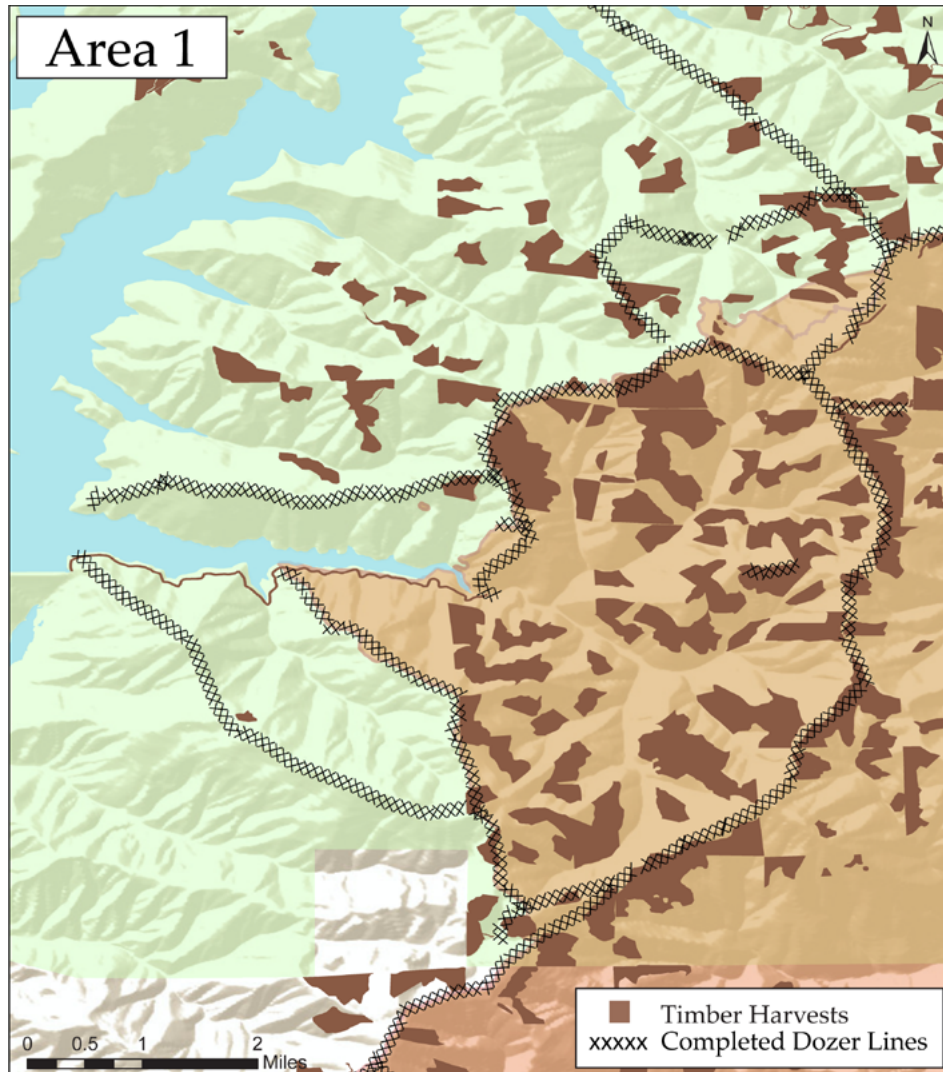
In order to successfully protect communities from wildfires that burn during extreme weather conditions, and cannot be stopped by conventional fire suppression strategies and tactics, efforts must focus on proactively reducing the ignitability of the homes themselves, not on desperate efforts to cut firelines on the edge of towns. Again, the biggest bulldozer cannot stop the tiniest ember that flies through the air to land on a rooftop and burn a house down. In the case of the Carr Fire, extreme winds that resembled a “firenado” of swirling flames and embers that could not be stopped by the biggest bulldozers or fire engines occurred right inside of the city. Firefighters, including dozer operators, were killed and severely injured in heroic attempts to stop the Carr Fire that ultimately was humanly unstoppable.

CONCLUSION

This report provides a brief overview of the kinds of significant social and environmental impacts that are commonly created by firelines constructed by bulldozers. Catlines displace soils and destabilize slopes, denude native vegetation and help spread flammable invasive weeds, degrade water quality and closed-canopy forest habitat, destroy Native American artifacts and heritage sites, and despoil the scenery of fire-affected wildlands. Using “big iron” bulldozers can cut a lot of fireline quickly and brutally, and in the right places and conditions these catlines can stop wildfire spread. But during extreme conditions that drive large wildfires like the Carr Fire--conditions that are becoming more frequent due to climate change--catlines are becoming increasingly ineffective in stopping wildfire spread.

While more detailed field analysis of the impacts of catlines constructed during the Carr Fire suppression efforts await until after the first winter’s precipitation when soil erosion impacts can be assessed, some of the general impacts of catlines are already visible in video footage recorded just months after the fire. Years from now, the land will have undergone natural recovery processes that change the visual quality of the landscape, in some cases for the better as a broader diversity of plant and animal life typically inhabits wildfire areas. But the scars of catlines, running atop ridgelines and ringing clearcuts, will remain on the landscape for a long, long time -- reminding people of the heroic, but futile, efforts to stop the fire from spreading into town.

Given the increased frequency of large-scale wildfires and the apparent ineffectiveness of conventional fire suppression methods such as catlines to stop these fires from spreading into communities, it is time to reassess society’s relationship with wildland fire. In particular, bulldozer operators are being asked more often to assume greater risk that hand crews, alone, cannot surmount. At the same time, ecosystems and species that are adapted to wildland fire are facing rapid decline. We must shift the paradigm to ecological fire management with greater ecological fire use. This involves using more controlled burning in spring and fall, and actively managing wildland fires during summer in ways that minimize the risks to firefighters and communities, mitigate impacts on social assets and natural resources, and maximize the social and ecological benefits of burning. Using fire to restore forest ecosystems is also one of our best tools for reducing smoke impacts; indeed it is through active fire management that we can best accomplish smoke management. One of the first steps in actualizing this paradigm shift is to focus on reducing home ignitability so that communities are prepared for fires of all kinds: prescribed fires, wildfires, and urban fires. The sooner we prepare communities for fire, the sooner we can restore ecosystems with fire. It is hoped that the video, “[Carr Fire CATlines](#),” will help initiate that rethinking process for the communities impacted by the California firestorms of 2017 and 2018.



Map 4: Catlines attempted to save a large cluster of clearcut timber plantations, but failed to stop the fire. Dozers ran along ridgelines up to the water's edge of Trinity Lake (see Image 2).