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## *Wetlands Affected by the 2017 Sonoma County Fires*

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### **Abstract**

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In response to the destructive 2017 fires that occurred in Sonoma County, our team determined the proximity and burn severity of the wildfires to wetland habitats. Wetlands are ecosystems that provide people with environmental services such as improving water quality, absorbing pollutants, and reducing the impact of floods. Burn severity was calculated by using pre-fire and post-fire Landsat images. Disturbed wetlands were determined by creating a buffer of 300ft around the perimeter of the wildfires. Wetlands within that buffer were accounted as impacted by the fires and/or fire retardants, resulting in 0.4% of wetlands in Sonoma County determined as disturbed. According to our results, 95.22% of wetlands found in Sonoma County did not burn, 4.63% experienced a low severity burn, and 0.14% experienced moderate severity; none of the wetlands experienced a high severity burn. Unfortunately, we were unable to provide a site visit to these wetlands to assess the damage to these sensitive ecosystems. For the purpose of this study, we assumed that direct fire contact, residual heat, heavy smoke and fire retardants used had a negative effect on the wetlands that were disturbed.

### **Introduction**

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About a month ago, wildfires caused death and massive destruction in Northern California. Sonoma County, which is just north of San Francisco, suffered the most damage. According to a news article in the Washington Post, nearly 3,000 homes were destroyed by the wildfires causing over one billion dollars in damages in Santa Rosa (Bonos 2017). While many agencies and news outlets are monitoring the damage of these fires, our report will primarily focus on the wetlands in the area. Wetlands are ecosystems that provide people with environmental services such as improving water quality, absorbing pollutants, and reducing the impact of floods.

Wetlands themselves are less likely to suffer from severe wildfire burns due to high moisture levels and continuous restoration efforts. Wetland restoration often implements the use of prescribed fire in order to maintain low fuel loads as a preventative wildfire strategy and reduce exotic or invasive species. These burnings often create new habitat by clearing out overgrown vegetation and creating open pools for waterfowl (Roberson and Flaherty 2013). In just the last couple decades, prescribed fire as a restoration effort has become commonly recognized in wetland habitat management. In previous years, the environmental effects from fire were thought to be mostly negative, especially the impacts to amphibians. Compared to other vertebrates, amphibians disperse at much slower rates making them highly susceptible to an encroaching fire (Sinsch 1990). In addition, the permeable skin and eggs of amphibians increases

their vulnerability to heat (Russel et al. 1999). However, more recent studies have determined a much deadlier source to amphibians and other aquatic inhabitants. In the case of large wildfires, hundreds of tons of harsh chemicals are used as fire retardants to stop or slow the fire progression; these chemicals consist of ammonia-based sprays and surfactant-based foams (Pilliod 2003). These chemicals are considered to be of moderate toxicity to aquatic organisms, some even contain sodium ferrocyanide as an anticorrosive agent which releases cyanide when exposed to UV radiation in sunlight (Little and Calfee 2002). In 2012 the U.S. Forest Service updated the Aerial Delivery Policy stating to avoid aerial application of all wildland fire chemicals within 300 feet of waterways including lakes, rivers streams and ponds whether or not it contains aquatic life (USFW 2012).

In order to determine some of the environmental effects of the most recent 2017 wildfires in Sonoma County, our team will identify the proximity of the wildfires to the wetlands in the county. Burn severity will be calculated by using pre-fire and post-fire Landsat images. Disturbed wetlands will be determined by creating a buffer of 300 feet around the perimeter of the wildfires.



**Figure 1- Locator Map of Sonoma County, CA**

## Methods

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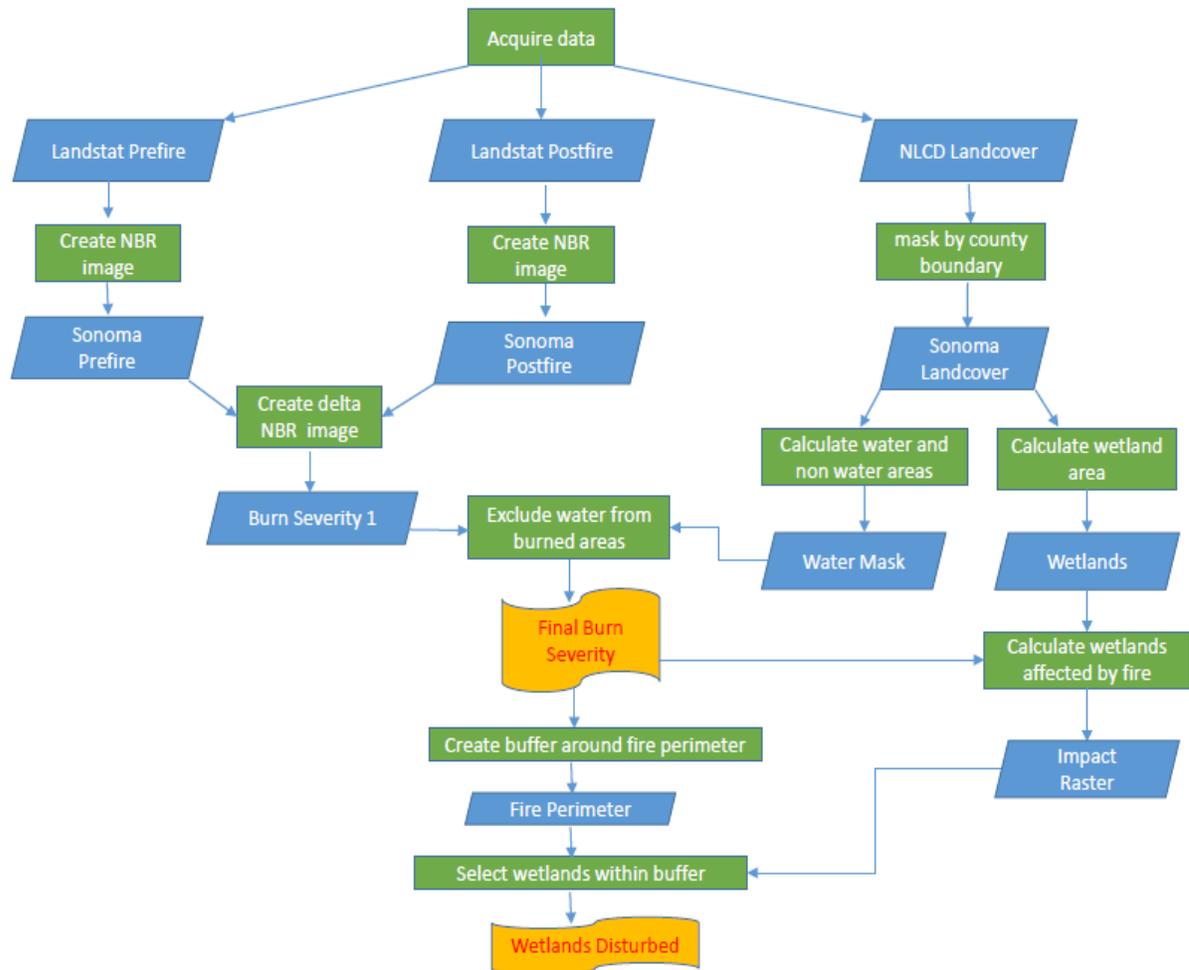
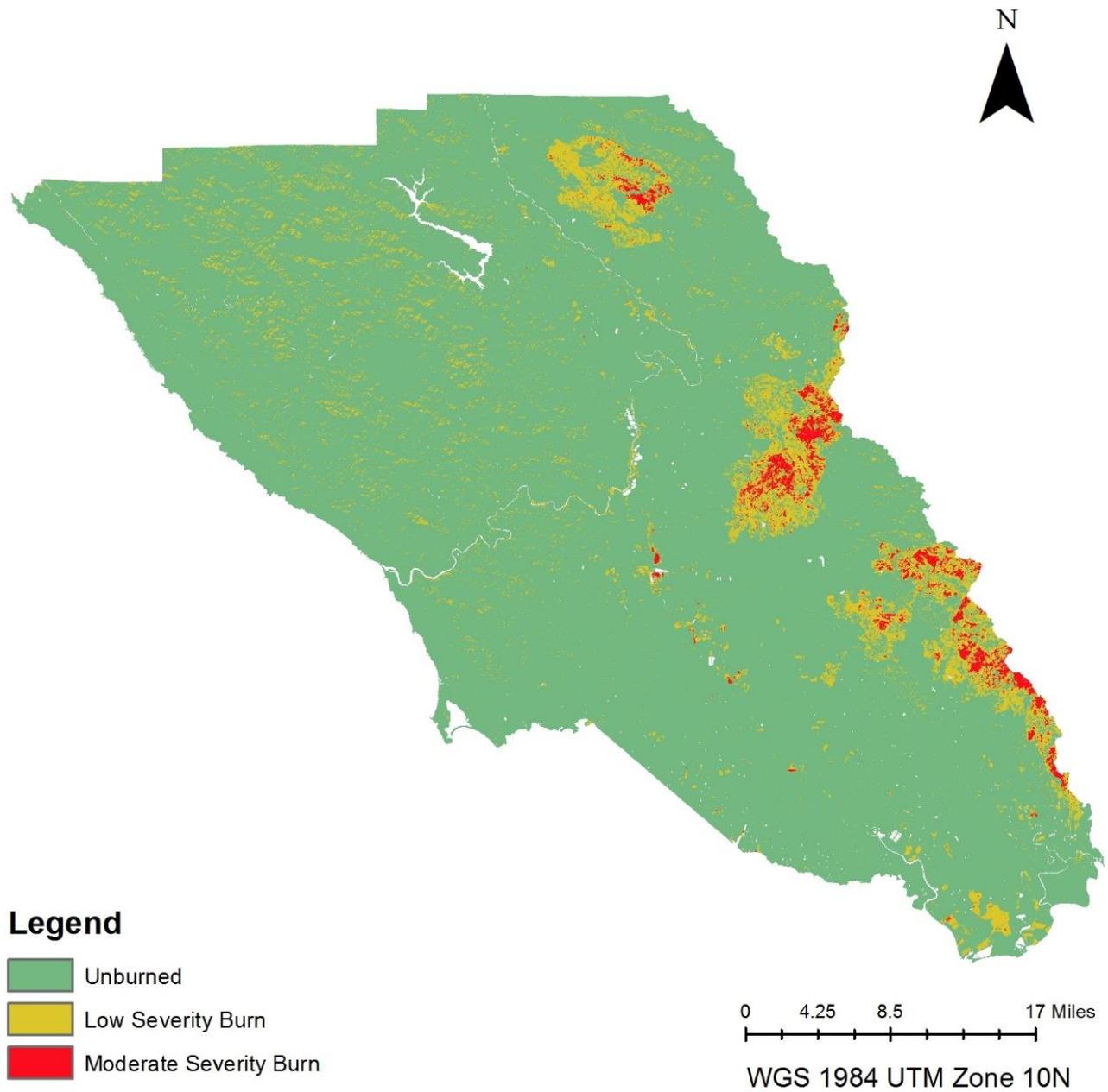


Figure 2 - Analysis Flowchart

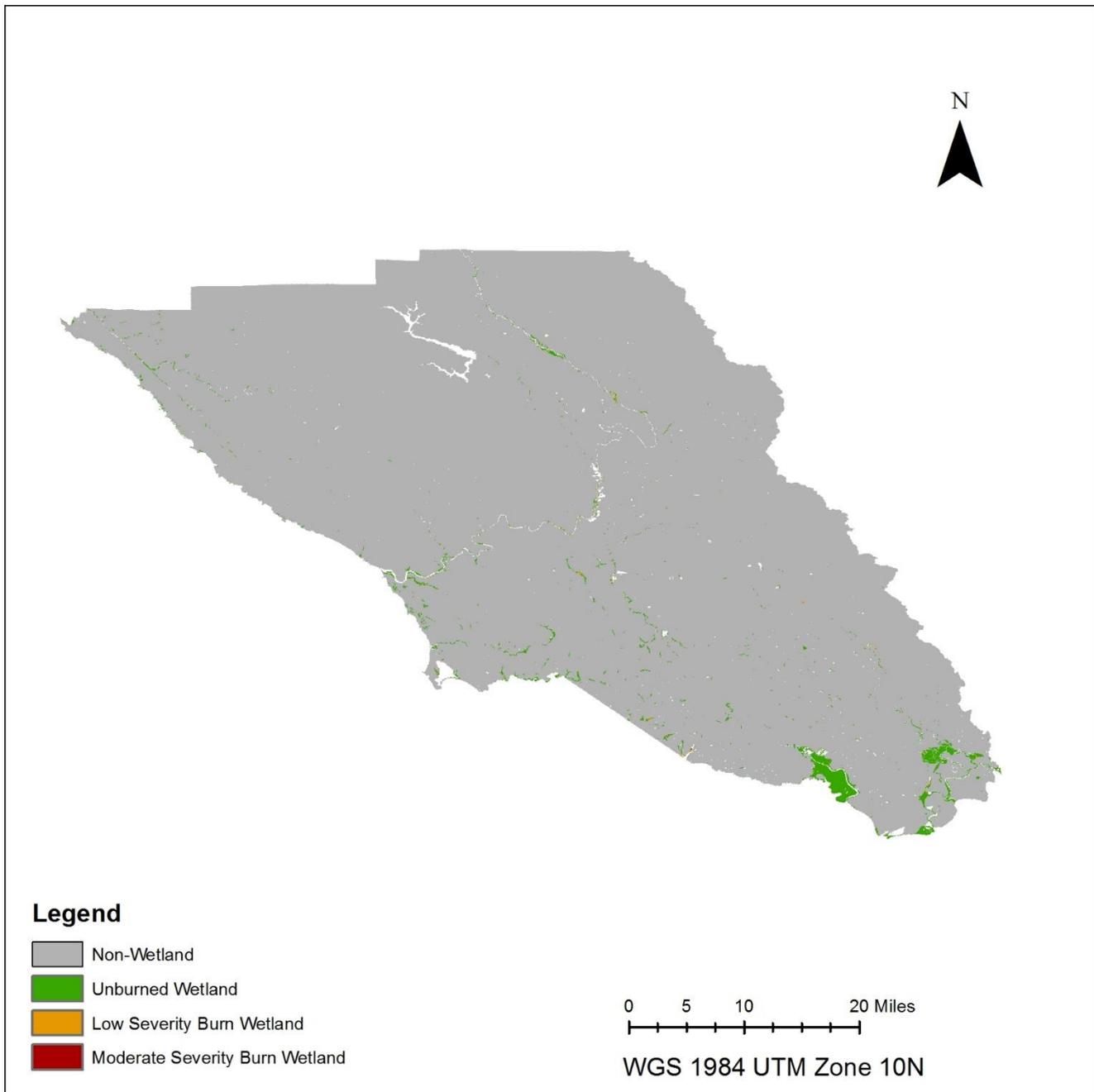
## Results

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Out of the 402,085.0 hectares that make up Sonoma County, 1.29% or 5256.01 hectares of that land are wetlands. After the 2017 Sonoma wildfires, 95.22% of wetlands did not burn, 4.63% experienced a low severity burn, and 0.14% experienced moderate severity; none of the wetlands experienced a high severity burn. Wetlands within a buffer of 300 feet around the wildfires were considered impacted by the fires and/or fire retardants; resulting in 0.4% of wetlands in Sonoma County determined as disturbed.



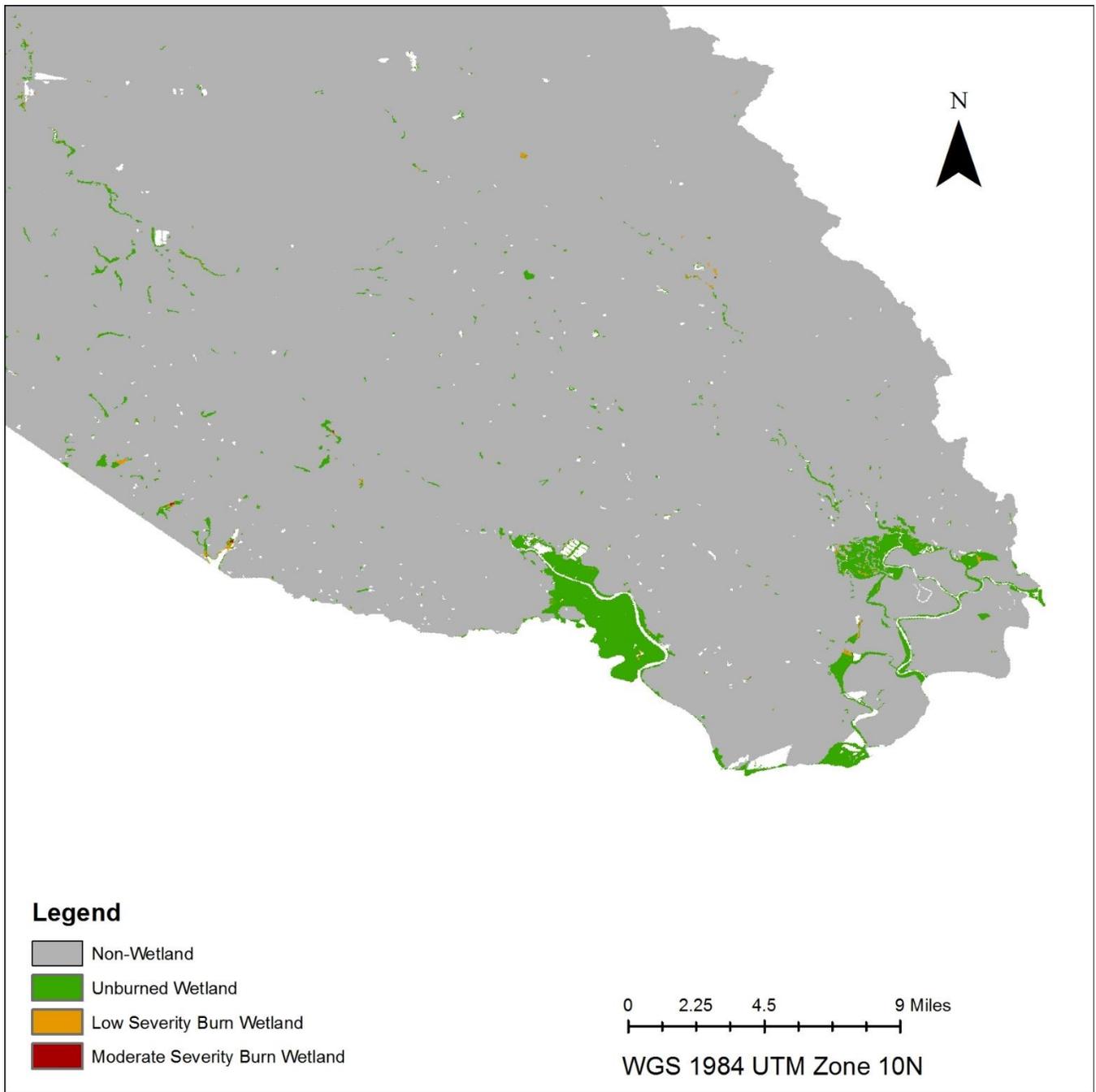
**Figure 3 – Map of the burn severity in Sonoma County caused by the 2017 wildfires**



**Figure 4- Map of burn severity to wetlands in Sonoma County caused by 2017 wildfires.**

**Table 1 – Proportion of Wetlands in Sonoma County**

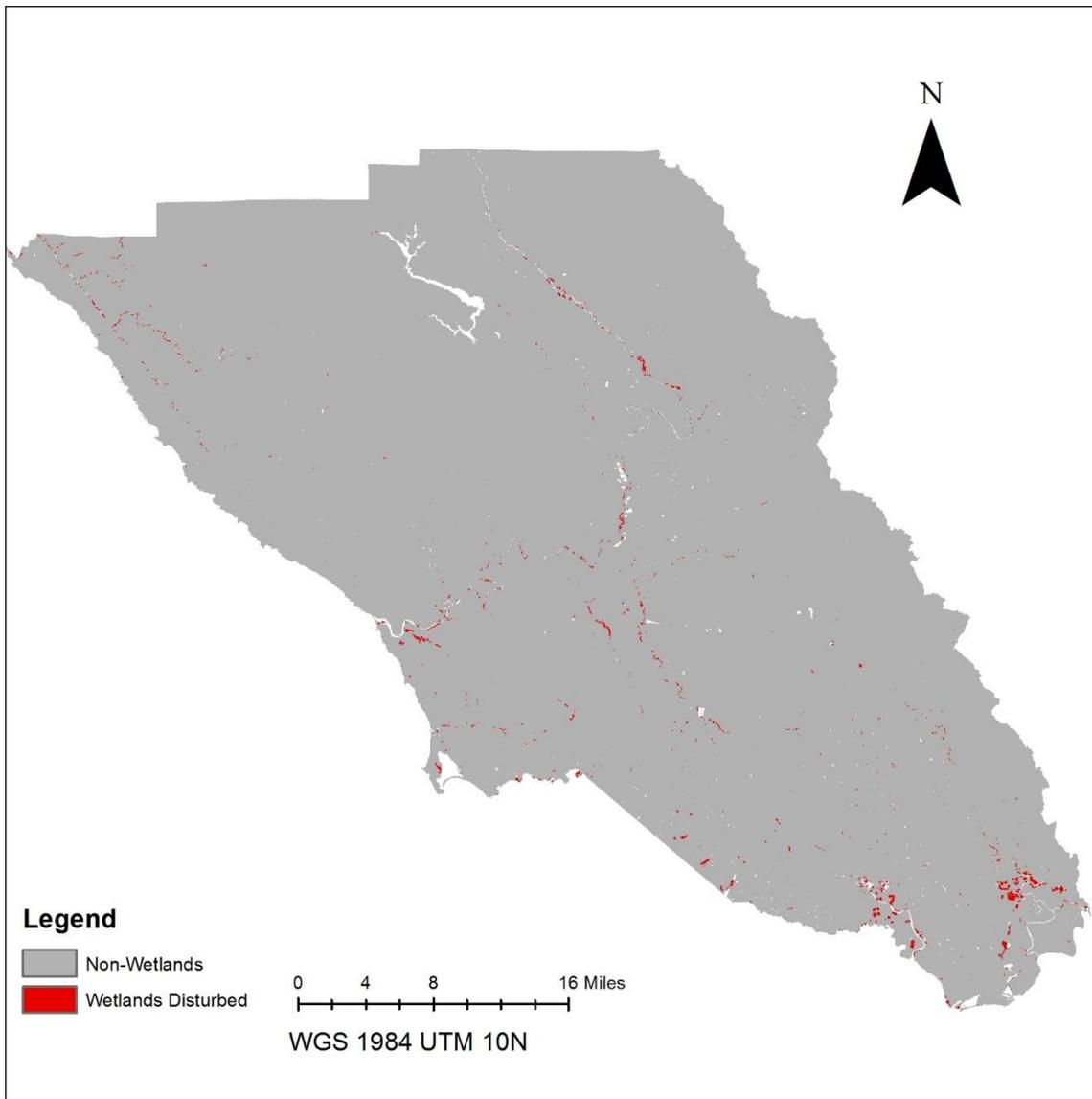
<b>Sonoma County</b>	<b>Proportion</b>	<b>Area (in hectares)</b>
Non-wetland	98.71%	402,085
Wetland	1.29%	5256.01



**Figure 5 - Sonoma County Wetlands Burned (southern extent)**

**Table 2 - Burn Severity of Wetlands in Sonoma County**

<b>Wetlands</b>	<b>Proportion</b>	<b>Area (in hectares)</b>
Unburned	95.22%	5,005
Low-Severity Burn	4.63%	243.45
Moderate Severity Burn	0.14%	7.56



**Figure 6- Map of wetlands disturbed and non-wetlands in Sonoma County.**

**Table 3 - Proportion of Wetlands Disturbed in Sonoma County**

Sonoma County	Proportion	Area (in hectares)
Wetlands Disturbed	0.40%	1652.4

## Conclusion and Discussion

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According to our results, the majority of wetlands found in Sonoma County did not actually burn. This is likely due to control efforts in combination with the high moisture content in wetlands. Severe wetland wildfires occur rarely, perhaps on a few times per century (UFIFAS, 2015). This could explain why there were no wetlands with high severity burn areas within Sonoma County. However, smoke and heat from adjacent burning areas and the use of fire retardants can have an impact on wetland wildlife.

As you can see in Figure 5, a good portion of wetlands in Sonoma County were disturbed by nearby burning areas. Depending on the fire's severity, the fire and smoke's effect on wetlands can vary. According to publication by Australia's Water and Rivers Commission, "The effect of fire on the survival of wetland fauna depends on the intensity, frequency, and extent of the fire and the ecological requirements of the particular requirements of the particular species concerned" (2000). Unfortunately, we were unable to provide a site visit to these wetlands to assess the damage and see just how the fires affected these sensitive ecosystems. We are assuming that the fires had a negative effect on the wetlands that were disturbed. There is a chance that the fires lead to the following: minor toxicity from fire retardants loss of vegetation, loss of fauna habitat, and degradation of soils.

There are a variety of fire management practices to prevent fires around wetlands in the future. Fuel reduction is necessary to lower the intensity and frequency of future fire outbreaks. This can be achieved by thinning out overgrowth, exotic species and litter using control fires. It is also important to establish firebreaks where needed (AWRC, 2000). Fire management needs to continue to be well planned and implemented in order to mitigate the damages to wetlands.

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