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INTRODUCTION TO GIS

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AN ANALYSIS OF RESPONSE CAPABILITIES WITHIN THE SAMOA PENINSULA FIRE DISTRICT

INTRODUCTION

In an effort to become more familiar with the many tools ArcMap, from Esri Inc., has to offer, analysis of available data was performed to determine response times for the Samoa Peninsula Fire District from their two fire stations. The Department has two stations in the two main communities of Samoa and Fairhaven within the fire district. Using the Network Analyst extension and the service area tool response times can be calculated. This analysis has many limitations and the higher quality data you can acquire the higher quality the results can become.

METHODS

Data pertaining to the analysis of the Samoa Peninsula Fire District was mainly acquired through the Humboldt County GIS website. The data used in this analysis included road data including, speed limits, shape lengths, and properly transecting road intersections and turns. Furthermore, data was also needed in regards to fire stations and for information purposes, data pertaining to the location of fire hydrants within the district was also included. All data went through a quality assurance/quality control process before its use. Due to the scope of this project, on the ground sampling for accuracy analysis was not conducted and determination of quality of data was limited. Some of the County GIS data proved to be 10 plus years old. In an effort to determine if there was more current GIS data responsible contacts contained within the metadata were contacted to no avail.

Once data was acquired and determined to be appropriate it was loaded into ArcMap for analysis. A polygon encompassing the area of interest, being the fire district responsibility area, was created and used as a template to clip data layers. The roads, fire stations, and fire hydrants layers were clipped to only include the data within the Samoa Peninsula Fire District to help speed up analysis. The Fire Stations layer displayed the U.S. Coast Guard Station Humboldt Bay as a fire station. It may have been at one point but at this time Samoa Peninsula Fire District provides all fire suppression services for the facility. The point location for the Coast Guard station was therefore deleted. The roads layer was cross referenced and was shown to have some outdated speed limits so using the “select by attributes” function within the attribute table, all of the 45 miles per hour (mph) speed limit zones were selected and upgraded to 55 mph. These roads mainly pertained to New Navy Base Road which runs the vertical distance of the district. Two additional fields were added to the roads attribute table. One of these was the calculated geometry of the length of each segment of road. The next important attribute field was the time in minutes to travel the lengths given the speed limit. Once these two additional fields were added and correct, a “network dataset” was created to run the “service area” analysis.

Next the "Network Analyst" toolbar was opened as was the window. Using the toolbar a new service area layer was opened. District Fire Stations were loaded into the facilities layer within the service area layer. The service area settings were also improved for the purpose of the analysis. Analysis settings were edited so that impedance was in minutes and breaks were set to include 1, 2, 3, 4, and 5 minute response coverages. Once the settings were set properly the service area layer was solved and the resulting in the analysis shown in Figure 1.

An analysis was also ran using the "location-allocation" tool within the network analyst to display which fire hydrants could be reached within two minutes of leaving a station. This analysis has little value but was included as an exercise to become more familiar with various tools within the network analyst.

RESULTS

Resulting analysis shows the approximate areas that can be reached given the speed limits (Figure 1.). The analysis shows that the most at risk areas, or areas with the longest response times, are in the middle portion (Finntown) and southern portions of the district. This analysis shows that if limited to two stations, the two existing stations are located in ideal locations. Based solely on population densities, the two stations are located within the two large communities were the majority of the population resides on the peninsula. Areas within these two communities can be responded to within 1-2 minutes of apparatus leaving their respective station.

Discussion

This analysis has many limitations some of which I am sure could be resolved given more time and experience with ArcMap. Some of the main concerns I have regarding this analysis are the layout of the response polygons. In areas that are dominated by large densities of roads, represented by accurate and well catalogued GIS data, these forms of analysis may become much more valuable than for this fire district. Due to the age of the data and limitations on which roads are included in the dataset, response times are not always accurate. If the dataset could be amended by data collected on the ground it would allow for an improved understanding of the reach and capabilities of each station. Conversely, many of the roads have been gated and locked resulting from a decline of industrial activity. The fire department can get through the majority of these gates and blocks but it may cause a delay in response to areas were access is restricted. Some of these gates are open during business hours and are closed otherwise further complicating the response capabilities model.

A large majority of calls on the peninsula have no address or are located in the brush or on the beach due to recreational activity or homelessness and this model does not account for that. If a system of paths and walkways could be collected for response to these areas the response polygons could only become more useful.

It seems that the software in an effort to fit all time breaks will just default to a preset distance to fit them all in in areas where data is limited.

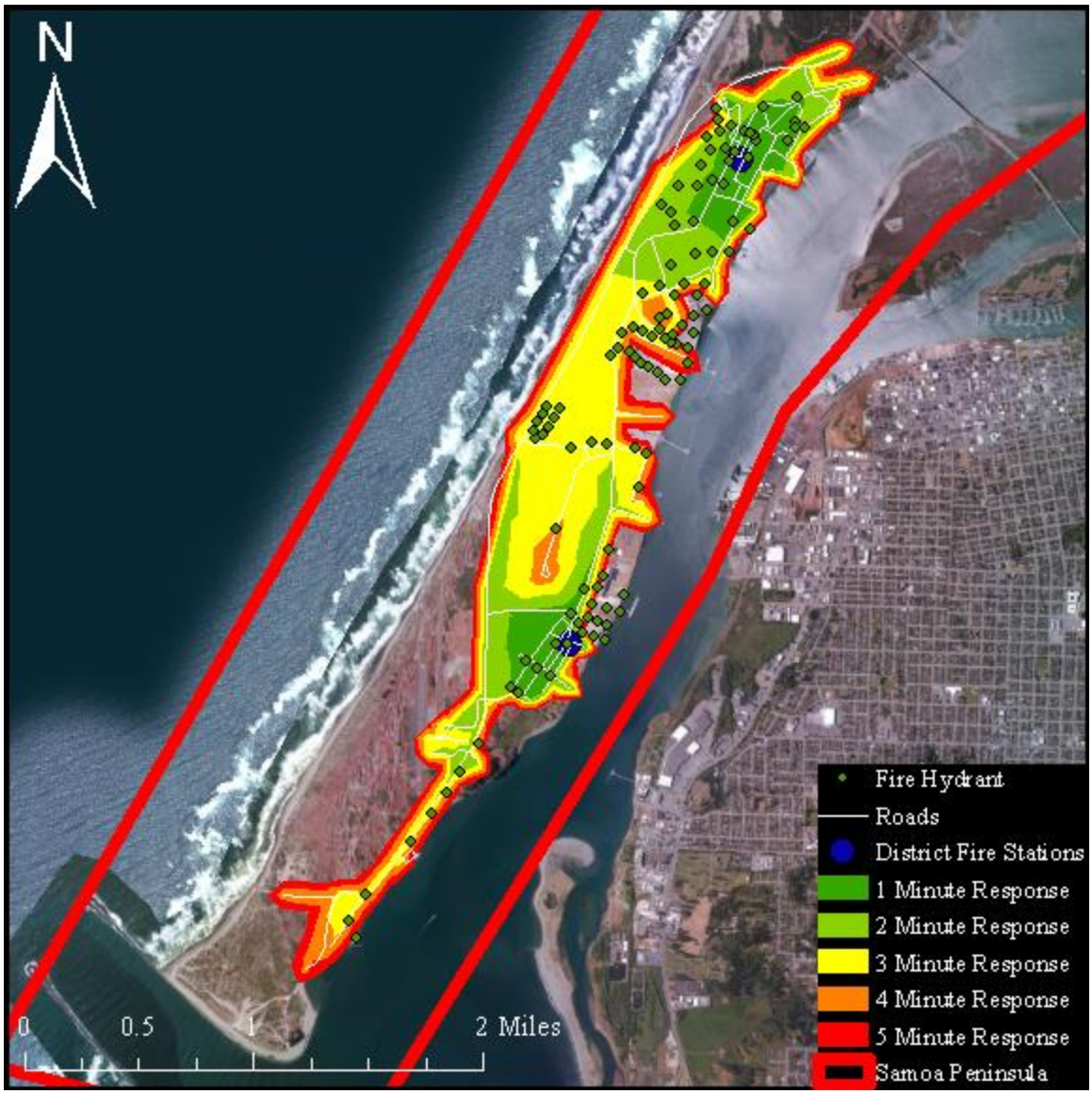

FIGURE 1. Map of the Samoa Peninsula Fire District including response reach polygons based on time and roadway speed limit from each respective station.

There are limitations to the analysis given the GIS data available for areas within the district boundaries as well limitations that seem to arise from the way the analysis is run. Figure 2. Shows the response polygons for the community of Fairhaven. In the Northern portion of the map you can see the analysis has worked well showing that the isolated road "UNN 7" requires more time to reach then the northern portions of "Bendixon" directly to it's east. Despite being the same distance as the bird flies from the station, responding to "UNN 7" will take more time due to the road structure. Furthermore, there are errors such as in the southern portion of Figure 2. Where "New Navy Base" curves and enters the 3 minute response time only to continue to curve and re-enter the 2 minute response area. These discrepancies can be found throughout the fire district. In Figure 3. In the southern portions, you can see the industrial buildings that lie east of "Bendixon" do not even fall within the 5 minute response polygon simple because of their distance from the road. I know from personal experience that these buildings belong in the 2 minute response as you can easily walk to them from the road as well as drive up to them using roadways not registered in the dataset used for processing. This issue is also demonstrated in Figure 4. In

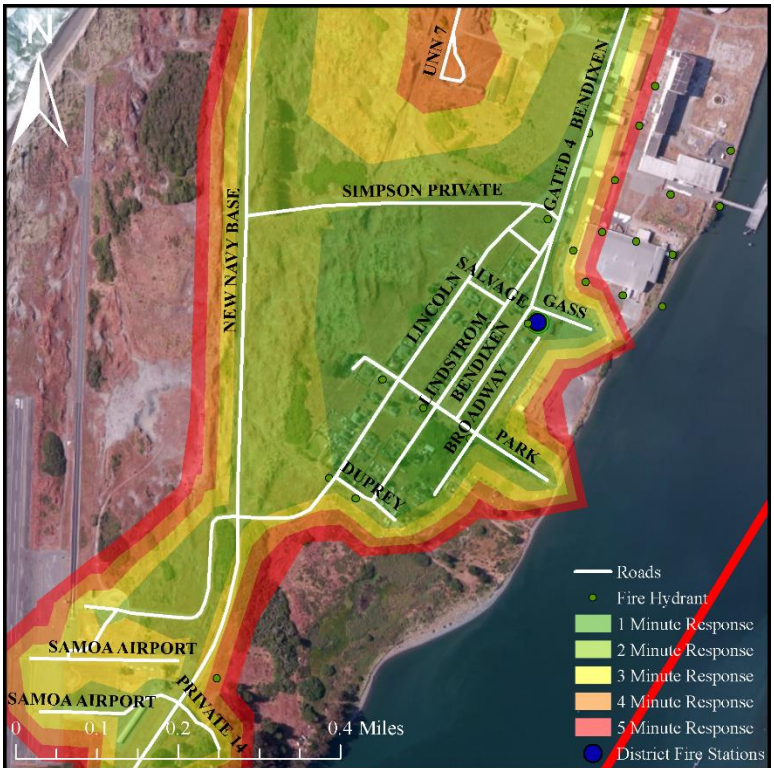

FIGURE 2. Large scale view of the community of Fairhaven within the Samoa Peninsula Fire District.

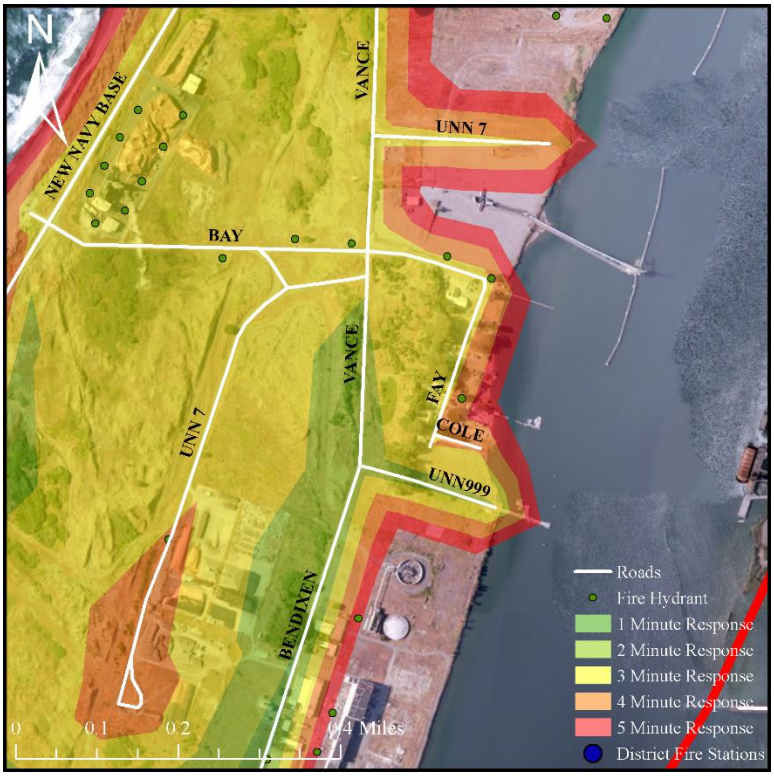

FIGURE 3. Large scale view of the community of Finntown within the Samoa Peninsula Fire District.

regards to the large industrial building adjacent to the station.

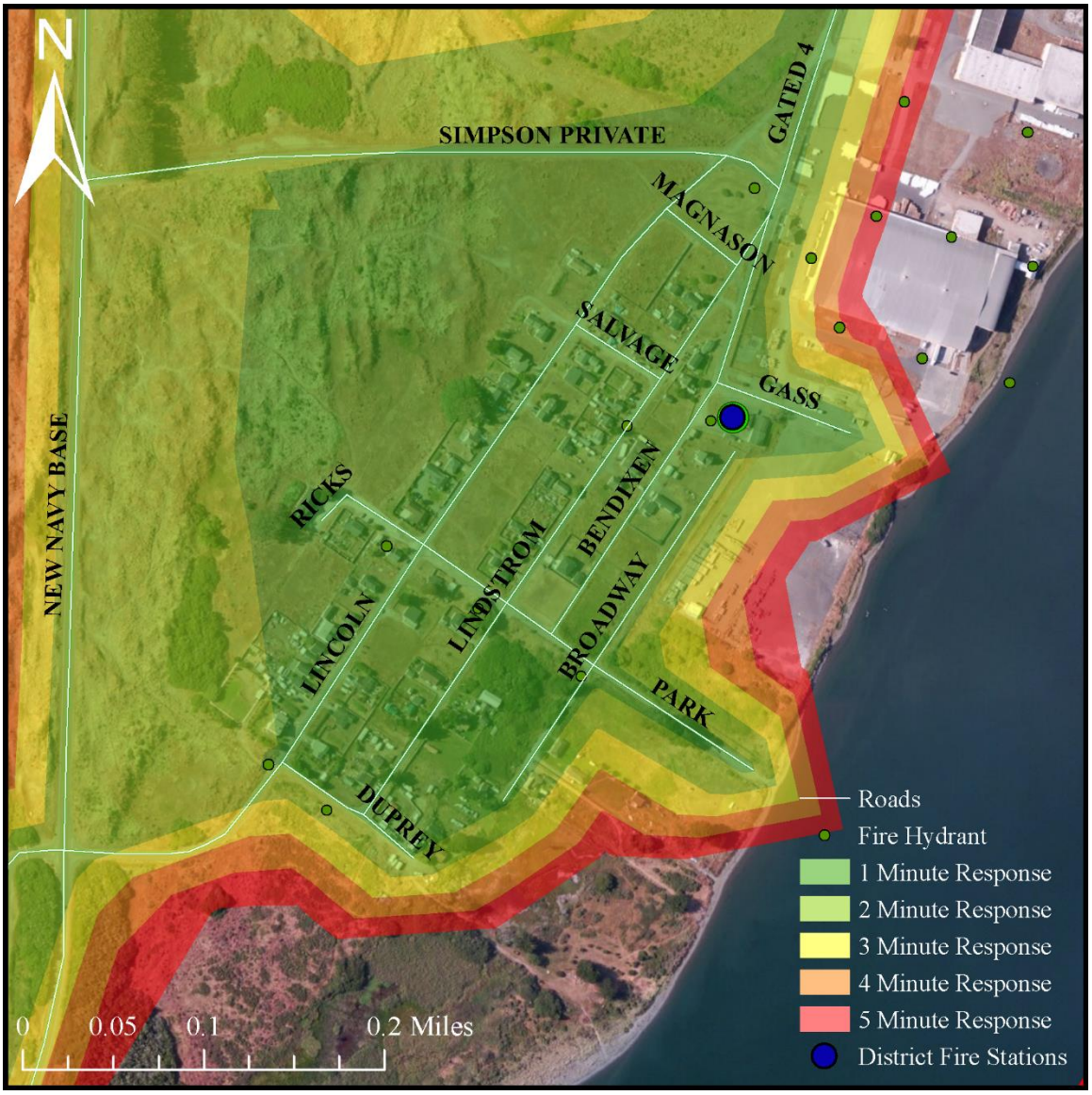

FIGURE 4. Large scale map showing the residential and commercial community of Fairhaven as well as response polygons for the community given the roadways and speed limits available.

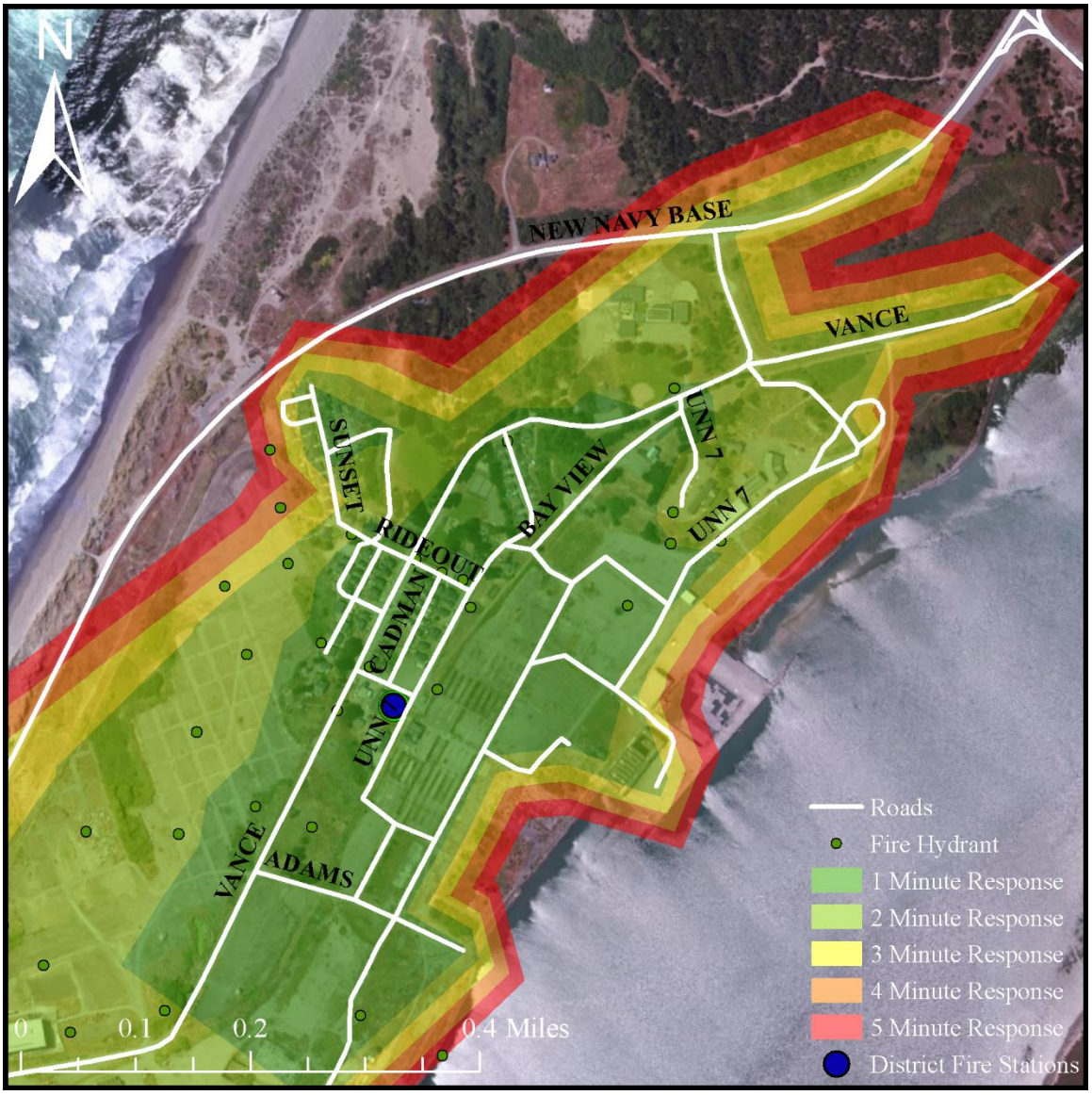

FIGURE 4. Map displaying the response reach given respective time class and local roadway speed limitation within the community of Samoa.

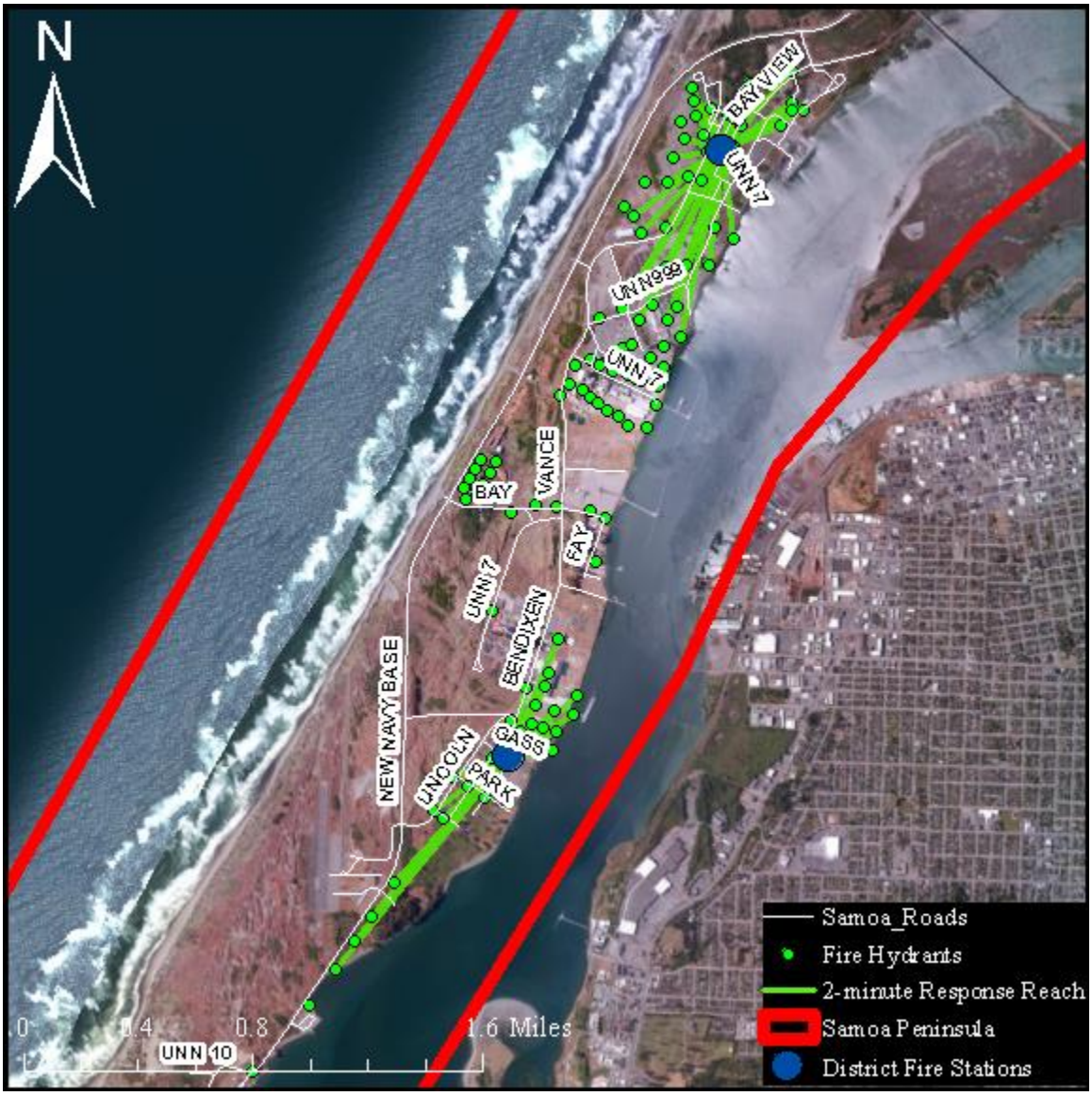

FIGURE 5. Map including the two major communities (Samoa in the North and Fairhaven in the South) residing within the Samoa Peninsula Fire District displaying which fire hydrants may be reached within a two minute drive from each respective station.

CONCLUSION The use of the service area tool for various applications contains much value. It is easy to see how valuable a tool this might be for areas that reside within or have a larger more extensive road transportation system. In this case getting within reasonable proximity to emergency incidents may be more easily achieved using only roads and small discrepancies within the response polygons may be minimized. I feel that the minimization of areas would be achieved in many urban areas with more stations where response areas may overlap more easily. The analysis also did not account for the minute or two it may take personnel to don personal protective equipment, determine the call location, and mount the apparatus. I feel that this can be a very valuable tool in planning the location of stations, and determining response boundaries between a series of stations. The applications of this tool and others within ArcMap and other GIS software make it easier and more efficient to make decisions for a large variety of public services applications as well as industrial.

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