Facilitation of Safety for Bicycle Commuters in the Eureka to Arcata Corridor: The Identification of Potential Hazard Zones

Introduction

There has been a recent groundswell of public support and publicity examining potential construction of a dedicated pedestrian and cyclist path to increase safety in the Eureka to Arcata, California corridor. In the last year there has also been a significant contribution toward funding such a project, as the City of Arcata was granted $3.1 million to assist in construction of a portion of this path. According to the Humboldt Trails Council Website, the California Coastal Commission has given the California Department of Transportation (CalTrans) the go-ahead to start construction on The Eureka to Arcata Corridor improvement plan, but not without providing an alternative right of way to cyclists and pedestrians in the same thoroughfare. This finding, combined with the necessity to take into account for sea-level rise and an existing right of way occupied by an unused section of railroad make the possibility of construction of a safe alternative for cyclists a distant reality indeed. What is the cycling public to do in the meantime?

A multitude of practical reasons dictate a trend toward growth in the number of people using their bicycle for personal transportation. The growth trend of cyclists has also led to a corresponding increase in the number of people injured or killed in cycling accidents. According to the National Highway Transportation Safety Administration's (NHTSA) National Center for Statistics and Analysis, "In 2011, 677 pedal cyclists were killed and an additional 48,000 were injured in motor vehicle traffic crashes (NHTSA 2013)." While total numbers of cyclist deaths has slightly dropped, the percentage of cyclists killed in comparison to drivers/occupants of motor vehicles has actually grown from 1.5% - 2.1% in the 2002 – 2011 time period (NHTSA 2013). Having myself been a statistic among the 48,000 injured in such accidents in the sampled year, as well as within the last 3 hours gives me ample perspective on this subject. My accident in the last three hours, at five minutes past five P.M. in Eureka, California. The cliché of "accidents always happen close to home" held true, just three blocks from home.

There are many behaviors a cyclist can exhibit to promote their safety on the roadway including; obeying the laws of the road and physics, wearing a helmet and other safety gear, and carefully considering their route selection. These considerations are the few safety measures that a cyclist has complete control over when they enter the roadway. Another key consideration for cyclist safety is the time they are upon the roadway. According to the same NHTSA report as the above paragraph 30% of all cyclist fatalities occurred between 4pm and 7:59pm, or what most people would refer to as "rush hour". Granted, 4pm-7:59pm is more than a single hour, it is the time period when roadway use tends to peak, creating the highest probability of collision.

The corridor between Eureka and Arcata on Interstate 101 has been designated as a safety corridor for drivers by the California Highway Patrol. The safety corridor is also one of the many sections of 101 where many different user types are allowed on the roadway. The 101 safety corridor is the most direct option for cyclists travelling between Eureka and Arcata. *Route selection* was identified above as one of the few factors a cyclist has in their control that can optimize their own safety, and the purpose of this report is to inform the cycling public of potential hazard zones they may encounter in the corridor between Eureka and Arcata in order to assist in the selection of a route that works best for them.

Methods

In order to assess the potential hazard zones present on the Eureka to Arcata Corridor it was necessary to ride the three typical routes used by cyclists in both directions. Locations which exhibit close proximity between cyclists and vehicular traffic, poor road condition upon the shoulder to be occupied by a cyclist, and steep pitch were identified, graded and notated in a field notebook. The location of these sites was recorded using a SPOT Global Positioning System (GPS) enabled device, which links a cell-phone and transponder to act as a functional GPS unit. One of the key benefits of using this system is the ability to summon emergency personnel, or family members from nearly anywhere on Earth. Another benefit to using this system is the ability to send messages via 128 character TXT function in one-way fashion. The most practical function of the SPOT GPS is that it only collects data in World Geodetic Survey 1984 (WGS84), which leads over time to quality assurance of data by minimizing human error in the data collection and notation process. Data that the end user can have a high level of confidence in speaks directly to level of error in the mapmaking process. According to the SPOT Connect technical data sheet, the instrument error is higher than one would like to see at 10m. For the purposes of this project an instrument error is suitable.

For each location that was found to be a change from one class to another a degree decimal latitude and longitude coordinate was acquired using the SPOT GPS enabled device, and notes for the location were entered into the TXT field of the cellphone screed for later recovery and analysis. Each location was notated in a table using Microsoft Excel with degree decimal Latitude and Longitude coordinates using the WGS84 Geoid, and the corresponding notes were given a field in Excel. This process was repeated in both Northbound and

Southbound directions upon the three most common routes between Eureka and Arcata to take into account varying directional conditions experienced by cyclists.

The three observed routes in this study were:

1.) Interstate 101 Safety Corridor

2.) Samoa Boulevard/Highway 255/New Nave Base Rd.

3.) Old Arcata Road/Myrtle Rd.

Sites that were seen as hazardous were given a moderate or high classification to differentiate from the default status of “reasonably safe” based upon the three criteria described above (proximity to vehicular traffic, road condition, and slope). In order to simplify the process, safe/low (default) = 1, moderate = 2, highly hazardous = 3. These classifications were assigned and color coded for later use in map making; 1 = green, 2 = yellow, 3 = red. This is the most simple and approachable classification system that would be repeatable in a range of environments that could be devised in the short period of time available to establish protocols. My personal apologies to those that are red-green color blind, as safe (green) classes could be confused with highly unsafe (red) classes for this large segment of society. The condition of non-inclusiveness will be remedied in future modifications of this project.

The specifics of the above Hazard Classification Assessment was based upon a numerical scale of 1-10, with 1 being low hazard level and 10 being high hazard level. The three above described criteria; proximity to vehicular traffic, road condition, and slope were given numerical scales depending on their perceived importance. ***Proximity to vehicular traffic*** is given more importance as it is completely unavoidable by cyclists and as was cited as a key factor causing an increased incidence of death and injury to cyclists in various NTHSA reports. As a result half of the 1-10 scale is accounted for by this single criteria. ***Road condition*** as a criteria was given three points in the scale as it has the potential to cause riders to be thrown, potentially into traffic. ***Slope*** was given minimal consideration as the vast majority (>95%) of the study area was shown to be below 5% grade in a slope analysis. A summary of this system is as follows:

- **<u>Proximity to vehicular traffic – Six Point Scale - (0-5)</u>**
  - **(0) A thoroughfare that is completely separate from automobile traffic.**
  - **(1) A thoroughfare that is a "bike path" with a wide margin {+ 2 meter}.**
  - **(2) A thoroughfare that is a "bike path" with a narrow margin {- 2 meter}.**
  - **(3) A thoroughfare that has an ample shoulder for bicycles, and sufficient buffer.**
  - **(4) A thoroughfare that has a narrow shoulder in violation of new 3" clearance law.**
  - **(5) A thoroughfare that has nearly no shoulder or no shoulder; also in violation.**

    (Special consideration is given to roadways which are undivided roads with a narrow or no shoulder in violation of new California 3' clearance laws: All of such thoroughfares will automatically receive a classification of High Hazard regardless of their numerical count in this survey in order to promote general safety and inform the decision-making process of cyclists and pedestrians).

- **<u>Road Condition – Four Point Scale – (0-3)</u>**
  - **(0) Fresh, non-pitted or non-cracking concrete or asphalt**
  - **(1) Aging, pitted concrete or asphalt, may contain small cracking**
  - **(2) Aging, pitted concrete or asphalt with large fissures {exceeding 1"} from road surface**
  - **(3) Aging, pitted concrete or asphalt with large fissures {exceeding 2"} and or missing chunks of roadway {potholes}.**

- **<u>Slope – Three Point Scale – (0-2)</u>**
  - **(0) Slope 0%-4%**
  - **(1) Slope 5%-7%**
  - **(2) Slope > 8%**

Scale Range Conversion to Hazard Classes

An overall score of 1-3 is given a Low Hazard Class (1): Denoted in green in Fig 2.

An overall score of 4-5 is given a Moderate Hazard Class (2): Denoted in yellow in Fig 2.

An overall score of 6-10 is given a High Hazard Class (3): Denoted in red in Fig 2.

Data collected in WGS84 was projected into the most locally used Spatial Reference System for plotting and analysis using ArcMap 10.2. The spatial reference system chosen was North American Datum 1983 Universal Transverse Mercator Zone 10 North (NAD83 UTM Zone 10N) due to the availability of associated map layers, shapefiles, and imagery for download from multiple resources including the Humboldt County Website and United States Geologic Survey. Point data was transposed upon basemaps provided by ESRI in ArcMap 10.2 for visualization purposes and to begin the lengthy process of digitization. Once roads were digitized they were classified by adding a field in the select by attributes function in ArcMap 10.2 and manually assigning classes to individual features (lines) representing sections of roadway. Once this task was completed the data was saved as a shapefile and a layer for later use.

Results

The map that resulted from the data collection involved in this project can be viewed in (Figure 2). A summary table of data points which represent hazard class changes is available to view below in (Table 1).

Table 1. Summary Data Table for the Eureka to Arcata Corridor

NB Samoa Eureka to Arcata					
Long	Lat	Class	Time	Date	Notes
-124.153554	40.806034	2	11:36	102914	NB Samoa Begin Bridge 2
-124.16085	40.815121	2	11:43	102914	NB Samoa End Bridge 2 Begin Wide Shoulder Across from Cyp
-124.16703	40.819756	3	11:49		NB Samoa Beg Bridge 1
-124.174347	40.824573	3	11:57	102914	NB Samoa End Bridge 1; Has CP for a few hundred yards
-124.145057	40.866426	3	12:18	102914	NB Samoa Beg CP; Narrow Shoulder
-124.109995	40.868272	3	12:27	102914	NB Samoa End CP
		1			Begin Wide Shoulder Through Town
SB Samoa Arcata to Eureka					
Long	Lat	Class	Time	Date	Notes
-124.109309	40.868357	3	15:15	102514	SB Samoa Choke Point Begin/Very narrow shoulder
-124.135058	40.868433	3	15:27	102514	SB Samoa Choke Point END/VeryNarrow shoulder
-124.140015	40.867757	2	15:34	102514	SB Samoa Choke Point Begin 1on1
-124.174347	40.824455	2	15:57	102514	SB Samoa Choke Point END 1on1
-124.174347	40.824455	3	15:57	102514	SB Samoa BEG WORSE CP ON BRIDGE
-124.167116	40.819681	3	16:03	102514	SB Samoa END CP ON 1st Bridge
-124.167116	40.819681	1	16:03	102514	SB Samoa BEG WIDE SHOULDER BETWEEN BRIDGES
Old Arcata Rd/Myrtle					
Long	Lat				
-124.085619	40.785445	3	13:20	102914	SB Arcata Road BEGIN CP Kneeland Rd./3corners market
-124.103065	40.785338	3	17:37	102914	SB Arcata Road END CP
-124.103065	40.785338	1	17:37	102914	SB Arcata Road BEGIN Bike Lane
					SB Arcata Rd. End Bike LN
Cutoff RDS.					
Long	Lat	Class	Time	Date	
-124.081693	40.834894	3	12:21	102614	EB Bayside Cutoff: Narrow Shoulder
-124.073024	40.834905	3	12:26	102614	EB Bayside Cutoff:END Narrow Shoulder
-124.073002	40.835055	3	12:29	102614	WB Bayside Cutoff: BEG Narrow Shoulder
-124.081757	40.835195	3	12:34	102614	WB Bayside Cutoff: END Narrow Shoulder
-124.09328	40.820163	1	12:43	102614	EB Indianola Cutoff: BEG WIDE SHOULDER
-124.08622	40.810443	1	12:49	102614	EB Indianola Cutoff: END WIDE SHOULDER
-124.086027	40.810615	1	12:53	102614	WB Indianola Cutoff: BEG WIDE SHOULDER

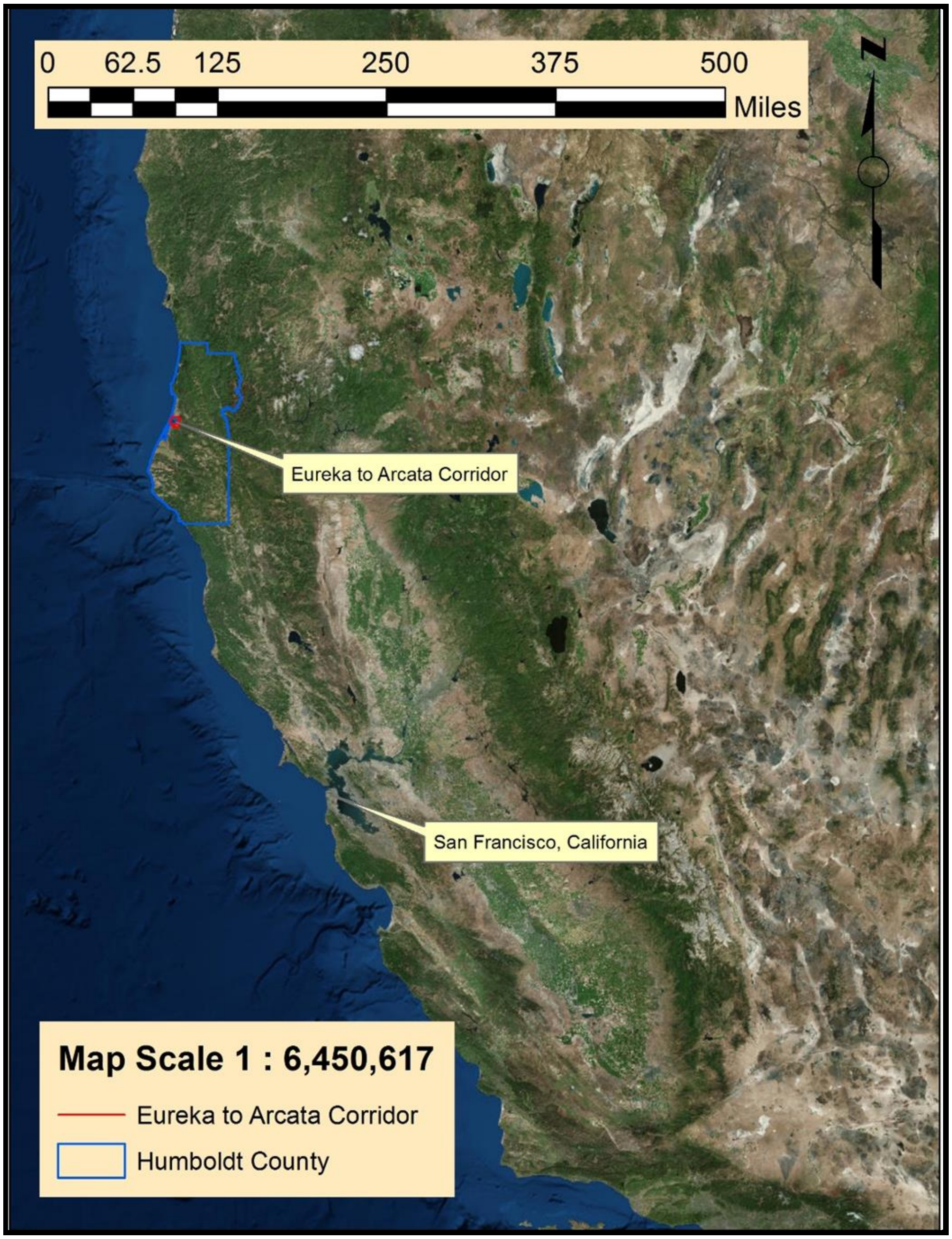

Figure 1. Locator Map for the Eureka to Arcata Corridor

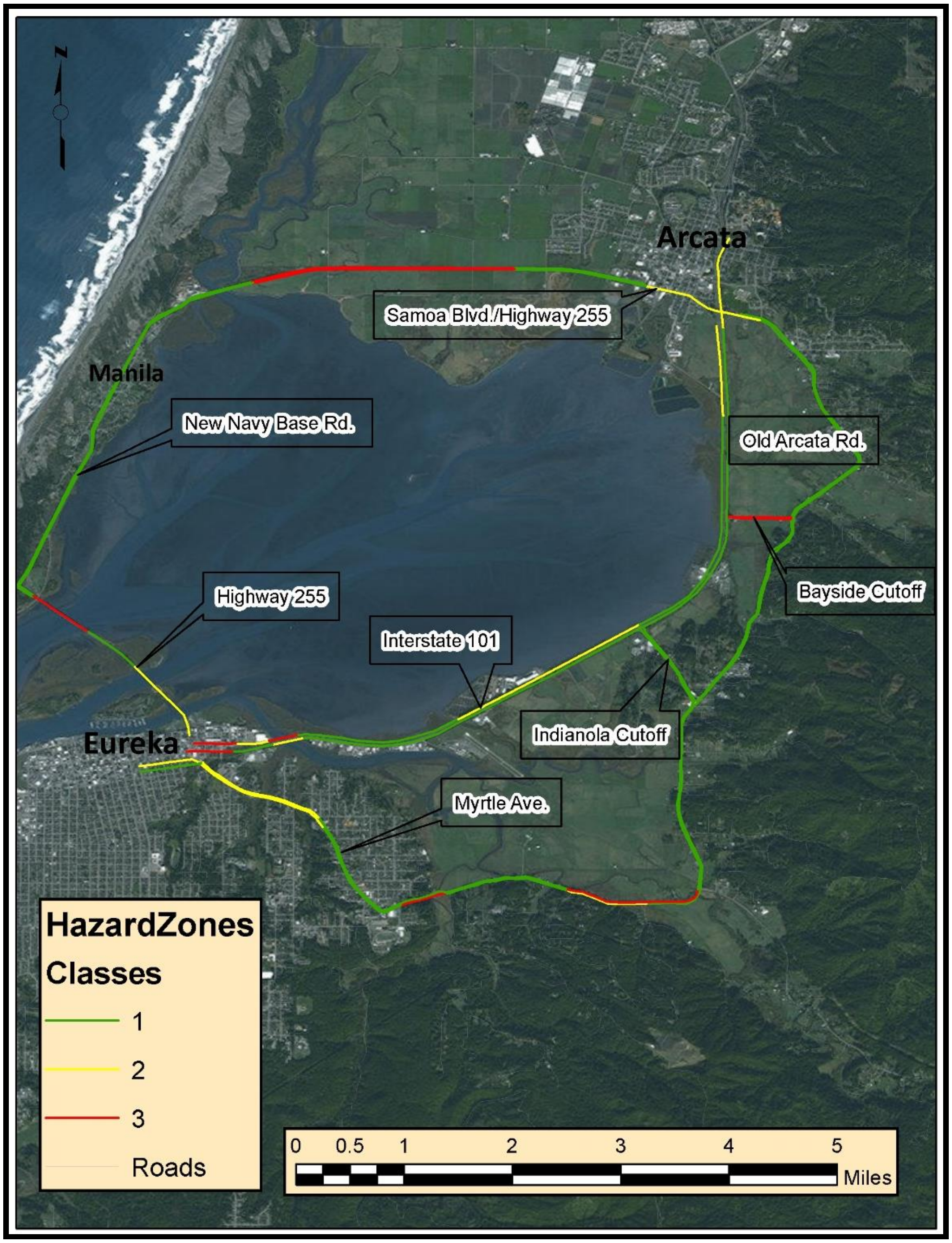

Figure 2. Hazard Classification Map for the Eureka to Arcata Corridor

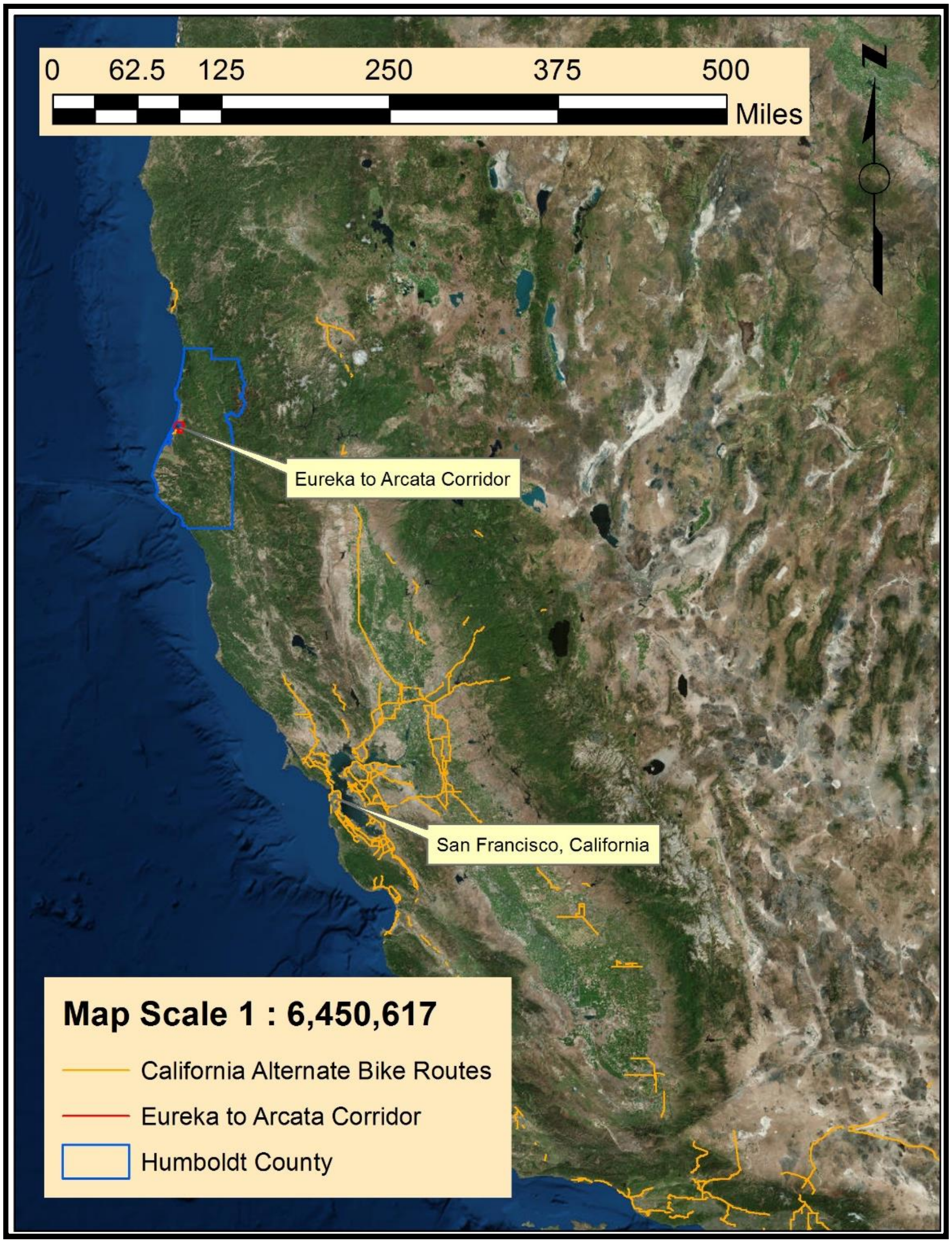

Figure 3. Eureka to Arcata Corridor and California Alternate Bike Routes

Conclusion

Multiple bottlenecks were identified in the region of study. In fact, no route was free of potentially hazardous interaction between cyclist and motorist. One can see that there is a clear need for a separate thoroughfare for cyclists and pedestrians alike, as there is no option for travel that provides optimal safety for the cyclist user class in the Eureka to Arcata Corridor. The map that resulted from this data collection can be used for informing the general driving and cycling public of potential hazard areas, though it is important to consider the generalized nature of this map making endeavor. It is important to consider the inherent error in sensing equipment, as multiple readings for each location were not taken for later analysis. Another important consideration for cyclists is the regular occurrence of inclement weather in Humboldt County. Even reasonably distant proximity (~10ft.) to cars that are travelling at 50 miles per hour in wet conditions will cast off a fine mist into the shoulder having an effect on visibility and air quality entering the cyclist's lungs. In the rainy season it is especially important to consider the health and safety issues which are commonplace for the cycling community.

Acknowledgements

My thanks to the patient teaching staff of the Humboldt State University Geospatial Science Department for their direction on the completion of this project. Thanks to my data collecting machine.

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