Daybreak Couplet Speed Study and Design Alternatives

TWGS Engineering: Brad Magnusson; Shawn Larson; Ken Rose; Alexander Wright

CE EN 472, Brigham Young University

Daybreak Couplet Project, South Jordan, UT

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Executive Summary

TWGS Engineering was given the task of re-designing the Daybreak Parkway Couplet in South Jordan, UT in order to reduce the 85th percentile speed enough to lower the speed limit back to 25 mph. Maximizing pedestrian safety and commercial access were essential constraints to the project.

Volume and speed studies were conducted to determine the current conditions of the road. It was found that the vehicles speeds are still higher than the desired rate. The average speed was found to be between 31 and 32 mph and the 85th percentile speed was between 35.5 and 37 mph. The volume data was also used to help better understand the site. The level of service for the couplet was found to be no lower than a C and no traffic lights were warranted at either of the intersections. The stopping sight distance was also analyzed and found to be sufficient.

Many different traffic calming devices were considered in an effort to reduce the speed of traffic. The methods analyzed were the following: speed limit pavement markings, road narrowing, colored/textured crosswalks, radar equipped driver feedback signs, vertical displacements, 60 degree parking, traffic lights, and a permanent bike lane. A final design recommendation was made using four of the traffic calming devices that were analyzed. The four methods selected as part of the final design were speed limit pavement markings, road narrowing, colored/textured crosswalks, and radar equipped driver feedback signs. These methods were strategically placed throughout the couplet to achieve maximum effect.

It was determined that if the final design was implemented at the sight there would be enough of a decrease in speed to return the speed limit to 25 mph. TWGS engineering believes that their design was the best option to reduce vehicle speeds to the desired 25 mph in the most economical and pedestrian friendly way.

Introduction

This report was created by TWGS Engineering for Kennecott Land for the Daybreak Parkway Couplet Project. The scope of this project is found in the Background section of this report. The Data Collection and Analysis sections contain the outlined processes and results of the studies performed by TWGS Engineering for this project. A summary of research performed during the design process is included in the Design Section along with the information about the final design and its specifications. A final cost analysis along with further explanations and conclusions are found in the Conclusion section.

Background

This section will outline the project given to TWGS Engineering from Kennecott Land. The necessity of this project is described along with the scope of the design work. It also contains a description of the site for which the project was designed.

Project

Due to unfinished construction and current road design the Daybreak Parkway Couplet has had issues with a high 85th percentile speed. The original speed limit of 25 mph was found to be much lower than the free flow speed of the vehicles traversing this site during 2011. Because of this speed difference the site was being used as a speed trap by local law enforcement. These tickets were subsequently appealed in court. To temporarily mitigate the problem the speed limit was increased to 35 mph. Since that time, a new modified striping plan has been implemented but it was believed that increased speeds still existed.

TWGS Engineering was asked to perform speed studies to gain an understanding of the effects that the recent redesign and striping plan have had on the speeds. That data is to be analyzed and, according to

need, a design is to be created to decrease the speed sufficient enough so that the ultimate goal of reducing the speed limit back to 25 mph can be accomplished.

Site

This project is located on the Daybreak Parkway couplet in South Jordan, Utah. The couplet consists of two one way roads with roundabouts on each end. This couplet is bisected by Kestrel Rise Road. The site was designed and built by Kennecott Land, a division of Rio Tinto. They are the major contributor to the design and layout of the Daybreak community surrounding the couplet. The site resides in the planned community zone of South Jordan (Jordan, 2012) and is located on a local trucking route (Jordan Truck Routes, 2012). Due to its location within the community it supports both residential and commercial traffic. The couplet has in recent time undergone some redesign in striping and signage, in an attempt to reduce the speed along the couplet.

Figure 1: Site Map

Data Collection

In order to establish the necessity or degree speed calming warranted at this site, it was necessary to determine the current speed and volume of cars passing through the couplet. TWGS Engineering completed a speed study and both vehicle and pedestrian volume studies. These studies yielded valuable information that contributed to the design of the sight. These tests were performed in accordance with standard practice (Currin, 2001) and will be outlined below.

Speed Studies

The speed studies were performed at the four locations designated by Kennecott Land. These are the locations that previous speed data was taken from. The speeds were shot at each location inside of an inconspicuous vehicle parked in the parallel parking stalls located at each spot. In this report these locations will be designated by a numerical identifier 1-4. Please see Figure 2 below or refer to the appendix for identification of the individual locations. The arrows seen on Figure 2

show the direction that the radar was shot and therefore point into the direction of oncoming traffic.

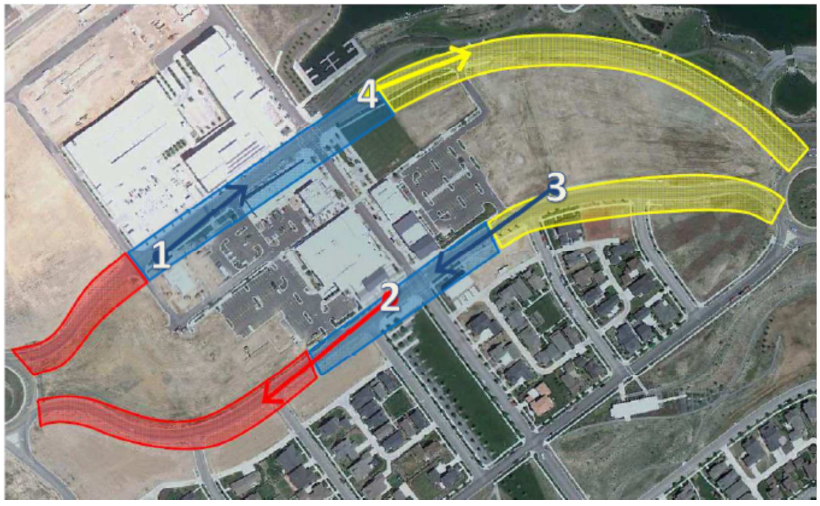


Figure 2: Data Collection Locations

The speed studies were performed during a variety of times including peak hours in order to accurately display the range of speeds through the site. Speed studies were performed at all four locations on Saturday February 4, 2012 during the mid to late afternoon beginning at 3:00 PM. Speed studies at locations one and four were performed on Thursday February 9, 2012 during the peak hour traffic beginning at 5:00PM. Tests were performed at these locations and during this time in order to register the speeds of vehicles returning to their home from work. Finally, Speed studies were taken at locations 2 and 3 on Friday February 10, 2012 during the morning peak hour traffic beginning at 7:00 AM. These studies were to register the speeds of vehicles leaving the Daybreak Community on their way to work. The following table (Table 1) shows the speed study schedule.

Table 1: Speed Data Collection Schedule

Location	1	2	3	4
Day/Date/Time	Saturday February 4, 2012 3:23 PM	Saturday February 4, 2012 4:00 PM	Saturday February 4, 2012 4:45 PM	Saturday February 4, 2012 5:23 PM
	Thursday February 9, 2012 5:03 PM	Friday February 10, 2012 7:15 AM	Friday February 10, 2012 7:45 AM	Thursday February 9, 2012 5:38 PM

Using standard methods speed data was collected for a total of 200 vehicles at the designated locations (Roess, Prassas, & McShane, 2011). All speeds were taken using a standard Decatur Radar gun. The speeds taken on Saturday February 4, 2012 were taken from every car in a specified lane. The left hand lane was studied at locations one and two. The right hand lane was studied at locations three and four. The speeds taken on the weekdays, February 9 and 10, 2012, were taken from every third car in both lanes. The results were from both of these methods were analyzed against each other and were within one standard deviation of each other, for these results please see the Appendix. Both of these data sets were included in our overall analysis. Weather did not play a role in altering speeds as each day for which data was collected was dry and free of ice.

Volume Studies

Volume studies were performed at the intersections of both sides of the couplet and Kestrel Rise Road. These locations are labeled 5 and 6 in order to easily identify and distinguish them from the speed study locations. These locations are shown on Figure 3 below.

Figure 3: Volume Collection Locations

Both vehicle and pedestrian counts were recorded using a standard Jamar counter. Volume counts were made for a minimum time of one hour per session and broken up into 5 minute increments. These volume studies were performed at the same time as the speed studies. A summary table of the volume count schedule can be found in Table 2 below.

Table 2: Volume Study Schedule

Location	5	6
Day/Date/Time	Saturday, 2/4/2012, 3:15 PM	Saturday, 2/4/2012, 3:20 PM
	Thursday, 2/9/2012, 5:00 PM	Friday, 2/10/2012, 7:15 AM

Analysis

Upon completion of the speed and volume studies, the data was analyzed to aid in design selection. The speed data was used to determine the average and 85th percentile speed. The volume data from the intersections was run through traffic signals warrants and was analyzed to determine the level of service (LOS).

Due to the range of speeds in our study (15-46 mph), analysis was necessary to determine both the average and 85th percentile speeds for the site. These values were calculated both by computer calculations and confirmed graphically (See Appendix). This analysis showed that the 85th percentile speed is still in accordance with the current speed limit of 35 mph but higher than the desired speed of 25 mph along the couplet. When compared to the original data collected on 11/1/2011, which was given to us by Kennecott Land, a slight decrease in speed may be present but no major difference is seen. It was from these results that we concluded that the striping plan implemented by Kennecott Land has not caused a decrease in 85th percentile speed to the level desired. Table 33 shows the average and 85th percentile speeds for all data locations, including the previous data from Kennecott Land.

Table 3 - Summary of Speed Data Analysis

	Kennecott Data		TWGS Data	
Location	**Average Speed (mph)**	**85% Speed (mph)**	**Average Speed (mph)**	**85% Speed (mph)**
1	29.7	34	31	35.5
2	38.9	42	31.3	35.9
3	33.3	36	32.6	36.5
4	35.1	38	32.5	37

The next step in the analysis was to determine if any of the traffic signal warrants were met for the two intersections along the couplet at Kestrel Rise Road. Warrants were analyzed for both the vehicle and pedestrian counts. The volume counts discussed in the previous section were used for this analysis. The

data from these studies can be found in the appendix of this report. It was determined that the peak hour warrant volumes were not met due to lack of heavy traffic along the minor street, Kestrel Rise Road. The pedestrian warrant was also not reached due to a low volume of pedestrians during the times studied. However, it is of TWGS Engineering's opinion that because the studies were performed in the middle of winter, the number of pedestrians was lower than the rest of the year. It is recommended that these studies be repeated during the summer months of the year in order to collect a more accurate result. (Roess, 2011)

Secondary Analysis

During site visits and initial research a few areas of concern to both the speed and safety of the couplet came to the attention of TWGS Engineering. These areas of interest include the stopping sight distance and accident rates in both the roundabouts and the one way streets. This secondary analysis was not specifically requested in the scope, but we felt in order to efficiently design this site these concerns needed to analyzed and addressed.

Level of Service

The volume studies were used to determine the level of service for the intersections of Daybreak Parkway with Kestrel Rise Road. This was accomplished using HCS+ software. Through all of the calculations run by TWGS Engineering, the lowest levels of service that was obtained was a level of C. The reports from this calculation can be found in the appendix of this report. This level of service is acceptable for this site and in this situation. During the simulation of the intersections some of the variables in HCS+ were unknown like peak hour factor, saturation flow rate, and critical gap. In these situations, the standard values, according to the Highway Capacity Manual (Insert Reference Here) were used for these variables.

Sight Distance

Evaluation of stopping site distance is important for determining safety of a roadway section. Because of excessive speeding along the daybreak couplet we decided to spend some time looking at the sight distance along the roadway. The stopping and movement sight distance for this exercise were determined using A Policy on Geometric Design of Highways and Streets 2004. The values used for checking the sight distance can be seen in Table 4.

Table 4: Sight Distance Values

Roadway Speed	Stopping Sight Distance	Through/right turn Movement Sight Distance
25 mph	155 ft	240 ft
35 mph	250 ft	335 ft

The left turn intersection sight distance was not included in this table because the major road is a one way street and the vehicle turn left is not required to cross additional lanes of traffic. From the calculations a number of observations were made. The first observation is that there is no major sight distance issues, as none of building are in the sight distance triangles. However, during our time as the site we noticed that the parallel parking might cause some issues especially with pedestrians, as they try to cross the roadway. The parking can make it difficult to notice pedestrians and for pedestrians to notice oncoming vehicles. The parallel parking also affects the sight distance of turn vehicles. Figure 4 below show the sight distance triangle for the through or right turn from the minor street. The triangle was measured from the stop bar and it should be noted that the vehicle is most likely to roll past this bar before turning. This triangle uses the 35 mph speed limit. As the speed is reduced any potential problem should be reduced as shown in Figure 5. In the final design both of these issues will be considered.

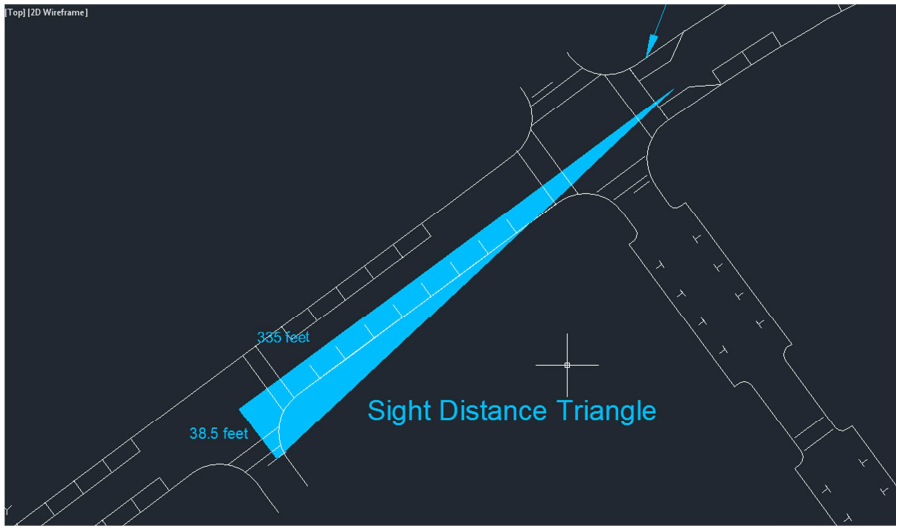


Figure 4: 35 mph Sight Distance

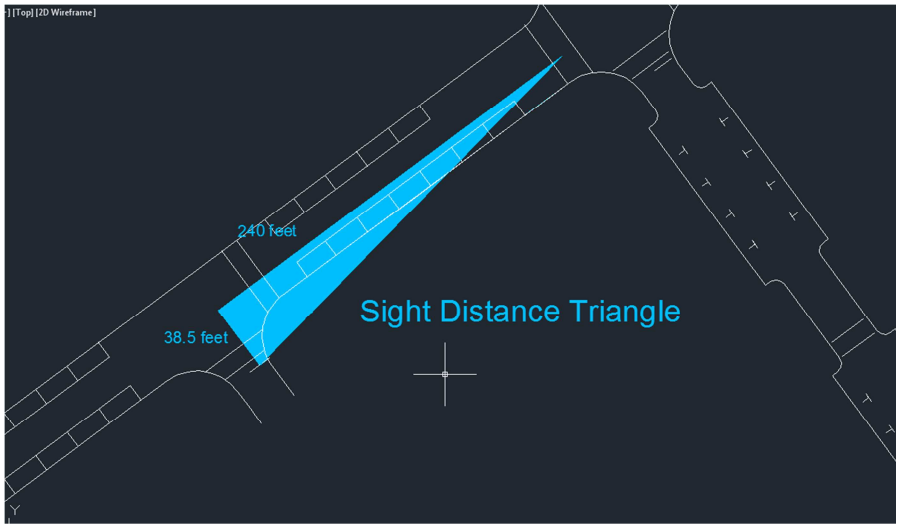


Figure 5: 25 mph Sight Distance

Accident Rates

Data was collected from South Jordan City regarding accident occurrences along this part of the road. The city of South Jordan has posted online the accident occurrences for this section of road from February to October 2011. (West Jordan, 2012) We observed that the number of accidents at the roundabout on the east side of the project is considerably higher than most of the other intersections along this section of road, notably the other roundabout on the west side (Figure 6). We recommend, due to the high accident rates at this intersection, that this intersection be considered for redesign in the future. We also noted that the north intersection of Daybreak Parkway and Kestrel Rise Road, in

front of the Rio Tinto building, has a relatively higher number of accidents. This issue was considered during TWGS Engineering's design process.

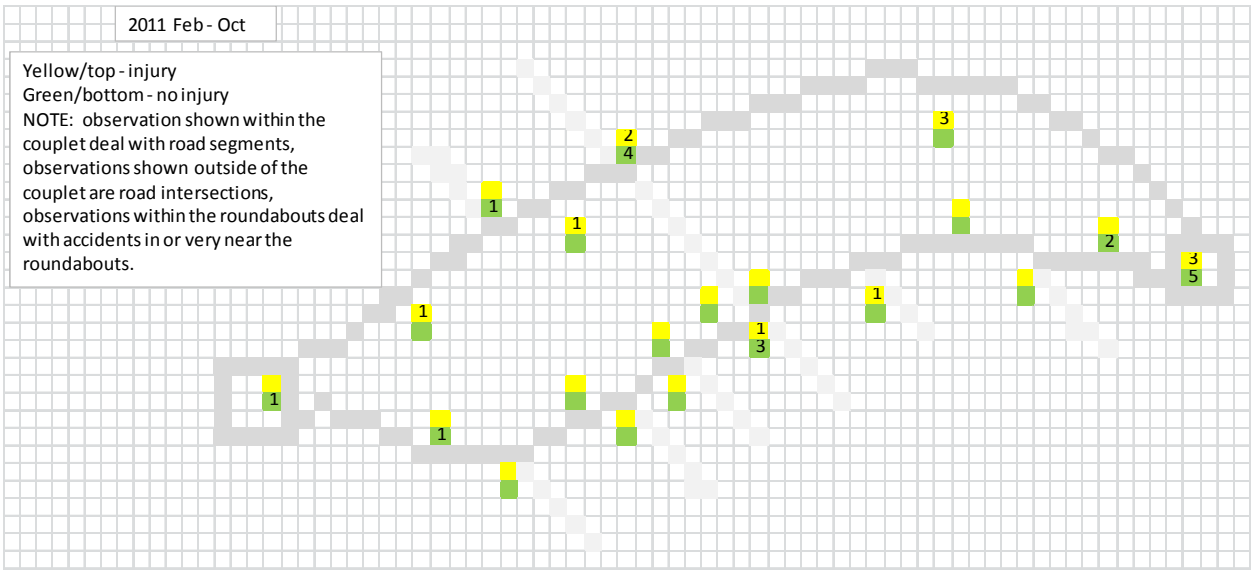


Figure 6 – Figure of accident rates at intersections, compiled from the South Jordan City Website. Numbers are generally accurate, but for specifics refer to South Jordan City.

It was also observed during the traffic counts multiple vehicles turning the wrong way along both one way streets. This mistake was observed at least once during each hour of observed traffic. This type of driving causes more accidents and is a hazard to everyone on the road. Because this is an issue with Kestrel Rise Road it was not addressed in TWGS Engineering's final design.

All of these observations and secondary analysis were taken into consideration during the design process. The problems that were found including wrong turns, stopping sight distance and accident rates are legitimate problems and are treated accordingly. The design selected will reduce these problems and allow for a better overall experience when on site.

Design

The studies and analysis performed were all used in the process to design a better road so that the speed limit could be brought down to the desired 25 mph. The design process was constrained by several factors. The first constraint is the fact that the road has already been designed and built, a complete rebuild of the roads on site was out of the question. Secondly, an inexpensive practical design was sought to reduce the speed sufficiently for a reasonable price. Local city standards also played a role in determining the final solution. Finally, maximizing pedestrian safety and commercial access guided the design process.

TWGS Engineering went with an interchangeable design that contained multiple traffic calming devices that could be used in any combination to achieve the desired results with the money willing to be spent. Many different traffic calming methods were researched in preparation for this design. This following section outlines the all of the measures considered for the project. The first four are methods that were researched but were not included in the final design due to issues explained below. These methods include traffic lights, vertical displacements, 60 degree parking and a permanent bike lane. Four methods were included in our recommended final design: speed limit pavement markings, road narrowing, colored/textured crosswalks, and radar equipped driver feedback signs. Following the descriptions of these traffic calming measures, a section containing the design specifications and an outline of how these methods will be implemented at the site is included.

Traffic Calming Measures Considered

Traffic Light

Installation of a traffic light was considered at the two intersections of the Daybreak Parkway with Kestrel Rise Road. This would have slowed traffic along the couplet during cross traffic and would add a considerable amount of pedestrian safety. However, according to the warrants for both peak hour traffic and pedestrians there was not enough traffic traveling across the parkway to warrant a light at these intersections.

Vertical Displacements

Vertical displacements like speed bumps and speed tables were considered along the parkway. These traffic calming devices would no doubt decrease the 85th percentile speed of the roadway, however, they also cause a few logistical problems. The first problem is that during winter the snow plows, which are essential to safe driving, tear up almost anything above the pavement level. The second problem is that emergency vehicles need to be able to traverse this area as quickly as possible, as it is an arterial road to the Daybreak Community. A potential solution was found in a removable speed cushion. These speed cushions are narrow enough to pass underneath the emergency vehicles and would not impede their travel. They also could be removed in the winter to avoid destruction from snow plows. However in the end, it was decided that it would not be worth the work and effort to install and remove these speed cushions every year for decreased speeds during only half of the year.

60 Degree Parking

The idea was to create a meandering traveled way within the road that has already been built. This would have been done by alternating sections of 60 degree parking along the sides of the road. This would have forced the drivable lanes of the road to drift away from each parking section. The application of this idea could potentially decrease speeds however visibility issues for cars backing out and the increased possibility for car to car collisions created too many safety problems for this design to be implemented.

Permanent Bike Lane

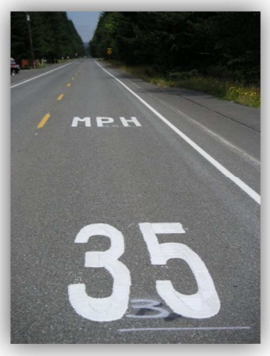
Currently, bicyclers share the right lane of Daybreak Parkway with the vehicles throughout the length of the couplet. This idea would be to add a permanent bike lane and narrow the driving lanes a small amount so that the bikers could have increased safety and the drivers would slow down due to narrower lanes. However, when the actual widths and dimensions of the lanes were examined more closely, we found that the lanes were already at the minimum of 10 feet and should not be narrowed further.

Traffic Calming Measures Used in Final Design

The following traffic calming methods will be used in the final design to help to reduce the 85th percentile speed, increase safety and commercial access. The four traffic calming methods are speed limit pavement markings, driver feedback, road narrowing, and textured pavements.

Speed Limit Pavement Markings

Transverse speed limit pavement markings are beneficial to the road design because they help to increase driver's awareness. On road speed limit pavement markings can be valuable; however an exploration of their effectiveness, cost, and past use was necessary to apply them correctly.



Effects

The desired effect of the transverse speed limit pavement marking is to help set apart this section of the road as a low speed zone. This would be advantageous for this site, as it will help increase drivers attention, and understanding of the speed limit change that occurs within the extents of the couplet. It is expected that other speed calming measures used in conjunction with the speed limit pavement markings will have an increased affect due to heightened driver awareness.

Application

Pavement markings have been used extensively in the United States in many cities and municipalities. Depending on the type of material used in installation they can last anywhere from nine months to eight years (MonteBello & Schroeder, 2000). The Federal Highway Administration in their Manual on Uniform Traffic Control Devices (MUTCD) specifies the use and design of transverse pavement markings, and stipulates in what situations they are appropriate (Federal Highway Administration, 2009). Further size and shape requirements for on road markings are specified within its subsections.

Cost

The cost of installation varies according to the number and size of the markings installed, the place of installment, and cost of labor. It is important to note the prices listed in Table 4 and Table 5 are average prices, and may be lower or higher than actual costs. Comparing costs it is possible to determine the least expensive material to use when installing transverse pavement markings. According to Montebello and Schroeder, one of the least expensive options is latex, costing only 3-5 cents per linear foot (Table

4). The Massachusetts Executive Office of Transportation shows that painting on markings is one of the cheaper options available at only $1.56 per sq foot (Table 5). When looking at both cost and maintenance however, it has been shown to most economical to use retro reflective pavement marking tape due to decreased maintenance, increased safety (McGregor, 2006), and better conformity to MUTCD standards for pavement markings.

Table 5: Speed Limit Pavement Markings Cost-Latex

	Cost per linear foot	Lifespan
Tape	1.50-2.65	4-8 years
Epoxy	.20-.30	4 years
Latex	.03-.05	.75-3 years

Table 6: Speed Limit Pavement Markings Cost- Other

Painted	$1.56 per sq foot
Surface Tape	$9.86 per sq foot
Thermoplastic	$3.92 per sq foot

Driver Feedback Signs

In high traffic areas where speed is of concern to the local citizens and enforcement agencies, driver feedback signs are often used as a proactive method for encouraging better driver-induced speed limit compliance. These signs are most frequently found in school and work zones where there is high concern for pedestrian safety. However, their use in other

areas is becoming increasingly common. They are now typically considered as options for areas in which there exists undesirably high speeds, significant variation in speeds; and as with traditional cases, apparent risk of pedestrian-vehicle conflicts. The available information on the effectiveness of these signs overwhelmingly indicates that they are able to deliver on the purposes for which they are used.

Effects

Driver feedback signs are found to reduce average speeds along roads where traffic typically exceeds posted speed limits and enhance speed uniformity. In a study conducted at the University of Virginia the effect of radar equipped driver feedback signs was analyzed at several work zones. The study found an average reduction in 85th percentile speeds of 13.3 mph over and average work zone length of 2760 ft. This study also found that speed variance and percentages of vehicles speeding were also reduced by about 5 mph and 5% respectively. (Smith, 1997) The Institute of Transportation Engineers (ITE) has gathered studies on the effectiveness of radar speed signs in multiple locations and has shown that, while signs are active, speed reductions of 25 percent can be obtained. This translates into a 9 mph speed reduction for a road where 35 mph represents the 85th percentile speed (ITE, 1999). In addition, the University of Nebraska – Lincoln has found that these signs produce statistically significant reductions in 85th percentile and average speeds, standard speed deviation, and increases in percentage of vehicles complying with a 55 mph speed limit over a long-term time period (5 weeks).

Application

The findings reported above offer persuasive evidence that the use of radar equipped driver feedback signs will produce reductions in 85th percentile speeds and speed variance. The cases discussed above each represent a different scenario which, taken alone, do not represent the situation found at the Daybreak Parkway couplet. However, their application to this area can be justified. Since the Daybreak

couplet area is under development, it is likely that construction will be taking place along the couplet for an extended period of time until complete. Therefore, until fully developed, this area can be considered a work zone and according to the study by the University of Virginia a radar equipped diver feedback sign would be warranted and would have similar effects as those reported in Virginia. The findings reported by ITE represent a broad study of many different locations, the details of which are not specifically outlined in the referenced publication. Even so, the broad nature of the publication give good reason to assume that the situations studied also represent a broad spectrum of situations in which the Daybreak couplet would be able to fit. The University of Nebraska's findings show that even at high speeds and likely along high volume roads the effectiveness of driver feedback signs is not negated.

Cost

The costs associated with driver feedback signs are highly variable according to the technology employed by the sign. Signs may be tied into a city power supply, fitted with a rechargeable battery, or make use of solar power. This design would recommend two solar powered signs located previous to the Kestrel Rise road crossing. The solar powered sign represents the most expensive option for a driver feedback sign with a cost of about $2,500, as priced by Traffic Logix inc., and therefore could be viewed as an upper bound for the cost of this type of traffic calming measure. The installation of solar powered driver feedback signs would not require laying new cables to tie into a power grid and would require minimal long term maintenance, making this type of sign ideal for this location.

Road Narrowing

Road narrowing is a general principal that is used in various forms in order to reduce speeds along a road. Road narrowing simply seeks to reduce the width of the motorway to increase the driver's

perceived speed relative to their surroundings. This generally should increase a driver's speed awareness and help to encourage them to slow down. One method for accomplishing this is to extend curbs out into the road. This method is referred to by a number of names; neck downs, bulb outs, curb extensions, etc. In this report our method will be referred to as curb extensions.

Effects

In a report on neighborhood traffic calming measures in place in Chicago curb extensions are described as typically being located at the entrance to a neighborhood or significant road within a neighborhood. The curbs are extended on either one side only or on both sides and can be filled with concrete, asphalt, or landscaping. (Smith, 1997) In an ITE report curb extensions are described as having an average speed reduction of 2.6 mph (ITE, 1999). The results found indicate that the effect of road narrowing with curb extensions by themselves may not produce large reductions in speed however they do seem appropriate for the design of the Daybreak Parkway couplet. Installation of curb extensions according to the report cited should give a lower speed and also will help to signal to drivers that they are entering a lower speed section of road. This will also increase pedestrian visibility at crosswalks allowing for better commercial access.

Application

The area contained within the Daybreak Parkway couplet is an area that, when fully developed, would serve a lot of pedestrian traffic. Curb extensions would help to signal drivers that they are entering an area that would require slower speeds and greater awareness of surroundings. Currently the section of road west of Kestrel Rise Rd. and in front of the Rio Tinto building is the area most likely to have the most pedestrian traffic. This area could easily be treated as a neighborhood, as in the cases reported by the city of Chicago discussed previously, and would therefore be an ideal place for the use of curb

extensions. In this case the curb extensions would be placed on the approach leg of Daybreak parkway at the Kestrel Rise road intersection. The curb extensions will extend into the road the same distance as the current side parking spaces and will be placed in the area kept empty to allow for appropriate intersection sight distance. The details of this component are located in the Design Specifications section.

Cost

According to the 1999 ITE report Traffic Calming: State of the Practice the cost for this type of curb extension would range from $7,000-$10,000. Estimating for today's prices would put the cost closer to $15,000-$20,000 per location or $30,000-$40,000 dollars for this design.

Textured Pavement

Textured pavement is a surface material on the roadway, such as brick, concrete pavers, and stamped asphalt, which is installed to produce small, constant changes in vertical alignment. These changes in vertical alignment create a rumbling sensation when driven over that is used as a signal to the driver. This rumbling along with changes in color not only signal to the driver that this section of road is different, they are also known to reduce speeds.

Effect

According to the Federal Highway Administration, textured pavements help to reduce the speed of traffic. This is accomplished by making the driver that they are in a traffic-restricted zone. The variations in color and texture as well as slight increases in noise create this impression for the drivers. Through the use of pavement textures the section of roadway around the daybreak couplet will be distinguished from the other arterial roadway sections. Using this textured pavement along the crosswalks also creates an increased visibility and safety for the pedestrians attempting to traverse the

road. The textured pavements also help to increase the driver's awareness of the crosswalk and of potential conflicts with pedestrians.

Application

There are no specific site requirements for the textured pavement to be installed. There are no reasons why this method could not be implemented at this site. One concern about using textured pavements for crosswalks is the negative effect that they can have on pedestrians and bikers. When used for crosswalks the bumps can make crossing more difficult for the elderly or people in wheelchairs. Also the roughness of the pavers can make it more uncomfortable for bikers. These effects however are minimal and while important to consider do not outweigh the benefits textured crosswalks would bring to the project.

Cost

The cost for textured pavement is variable depending on the type of pavement used. A few of standard materials that are generally used have been listed below, along with the type of pavement some of the properties of the material are also listed, including the durability, price range, and maintenance requirements.

Table 7: Textured Pavement Cost Estimates

Cobble Stone, Pavers and Brick

Durability	Lifetime & some pavers come with a warranty
Price range	$10 sq/ft - $60 sq/ft
Maintenance	Semi-annual washing & sealing, weed control yearly

Stamped and Colored Concrete

Durability	30-50 year life expectancy
Prince range	$5. sq/ft. - $24. sq/ft.
Maintenance	Semi-annual washing & sealing

Stamped and Colored Asphalt

Durability	10-30 year life expectancy
Prince range	$3. sq/ft. - $12. sq/ft.
Maintenance	Semi-annual washing & coloring

Design Specifications

This section contains the specifications and design outline of how each of these traffic calming methods will be implemented at the site. Each section includes details such as size, location and material of the respective traffic calming measure as well as a specific cost estimate for our final design.

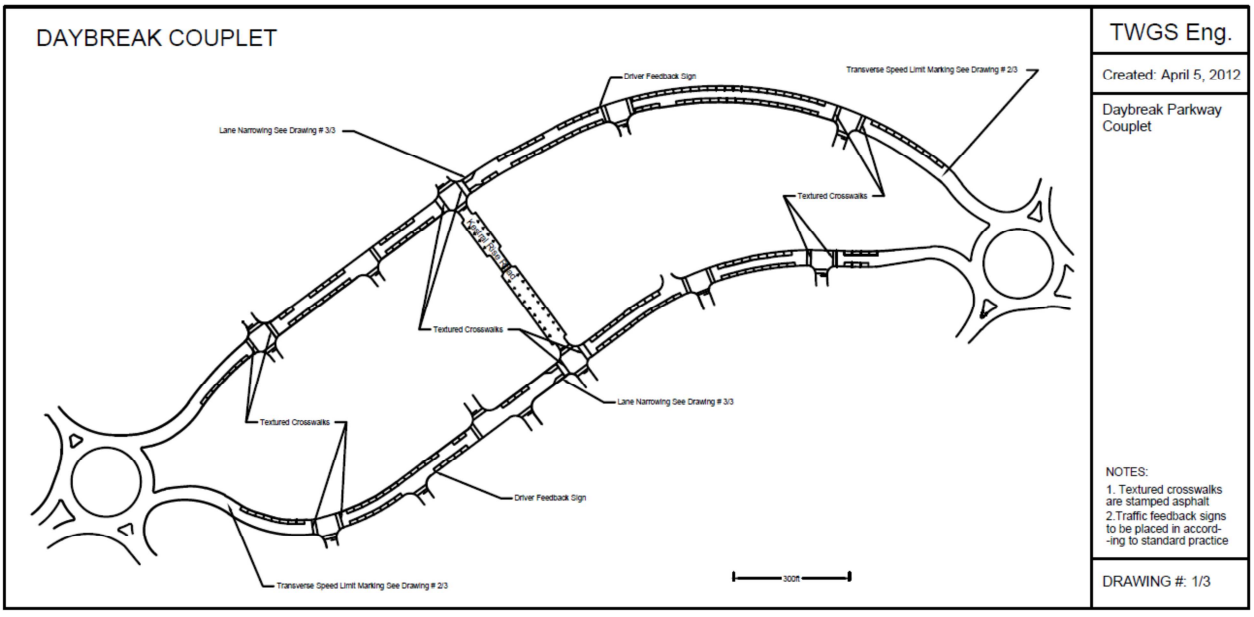


Figure 7: Design recommendation

Speed Limit Pavement Markings

The speed limit pavement markings should be sized to current MUTCD standards given in chapter three, specifically section 3B.15 which specifies the standards for transverse markings. Also according to the MUTCD the signs should not cross multiple lanes.

In order to comply with MUTCD and to meet the requirements of the site and design, the transverse speed signs shall be placed according to the following criteria. The signs will be placed at the beginning of couplet before the first parallel parking stall in either direction, one per lane. The signs shall be dimensioned according to the standard given in Standard Highway Signs and Markings section 10-1 through 10-25, being 5 ft. wide and 12.5 ft. long with .5 ft. of space between characters.

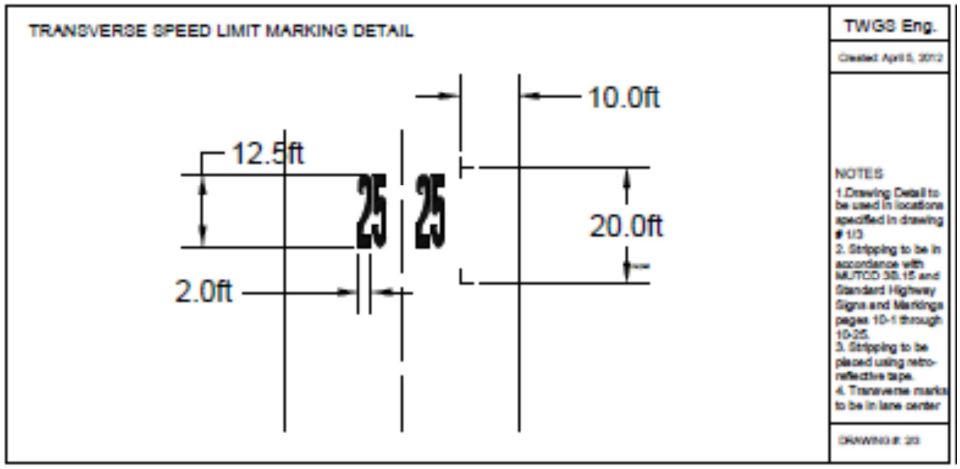


Figure 8: Transverse Speed Limit Marking Detail

Current striping research has shown that using tape on roads where snowplows will operate is cost effective to the owner. It does not at first appear cost effective due to its high initial price, but can be shown to increase the safety of the road dramatically over its lifetime (McGregor, 2006). For the purposes of this design project it is recommended that retro reflective tape be used for the road markings.

The cost of using this design, if done in conjunction with other striping projects here, will be approximately $1600. Regular paint, costing $25, appears cheaper but is less safe than the retro reflective tape.

Textured pavement

The design for the textured pavement will continue to use most of the current features and dimensions of the current crosswalks. The location and size of these new crosswalks will be the same. The crosswalks will be 10 ft. or 15 ft. in width as specified by the striping plane and span the entire roadway (approximately 40 feet in most locations). The crosswalks will be created using stamped asphalt. The color and texture of the stamped section will be specified by the client, Kennecott Land, but with some restrictions. The color should be noticeably different than the asphalt even after months of use. The texture should also be sufficient to provide the rumbling effect to the cars that travel over the section. The crosswalk will also be bordered by the same striping tape as specified in all of the other crosswalks.

Not all of the crosswalks will be textured for the new design. The first and last crosswalks on each side of Daybreak Parkway will be redesigned along with the crosswalks that cross over Daybreak Parkway along Kestrel Rise Road. The crosswalks at the ends of the couplet are to help signal to the driver that they are entering a speed restricted zone and to watch for pedestrians. The reason for texturing the crosswalks in the middle of the couplet at the intersection are to help reduce speed where there are the most pedestrians and cross traffic. For a visual representation of this design, the crosswalks will be placed at the location shown in Figure 7.

The cost of materials and labor for the crosswalks will range from $1200 to $5760 per crosswalk. For the 12 recommended crosswalks the cost would be approximately $60000. With the estimated lifetime of the stamped asphalt this should be an efficient way to reduce the speed along the couplet and set this section of roadway apart as a speed restricted area.

Driver Feedback Signs

Two driver feedback signs will be used for the couplet, one for each direction. The driver feedback signs will be placed within the first half of each of the legs of the Daybreak Parkway couplet. Specifically the north sign will be placed just west of the fourth crosswalk (second intersection) coming from the east. The southern sign will be placed just east of the intersection with Overshine Lane. Both of these locations are shown on the map of the final design in Figure 7.

These signs shall be solar powered so as to facilitate easy installation and potential relocation to other areas of the Daybreak community if necessary. These sign will be the solar model manufactured by Traffic Logix or approved equal. This puts the cost of this method at approximately $5,000 for two signs.

Road Narrowing

The curb extensions used for road narrowing shall be placed on both sides of Daybreak Parkway before the intersections with Kestrel Rise Road. These areas will be 20 ft. long, 10 ft. wide with a 30 degree angle cut out of the end pointing toward the traffic. This will allow the parked cars to exit their stall without having to back out. The curbs will extend to the edge of the existing crosswalk. The design will include a 1 ft. wide gutter between the existing curb and the proposed curb extensions to allow storm water to pass through and enter the existing drain. The curb extensions will be constructed using concrete curbs. These curbs will be constructed according to Kennecott's standard dimensions. The interior maybe filled with whatever material the Client wishes. TWGS Engineering recommends landscaping in order to maintain aesthetic appeal of the location. The final cost estimate for the four curb extensions is approximately $30,000 - $40,000.

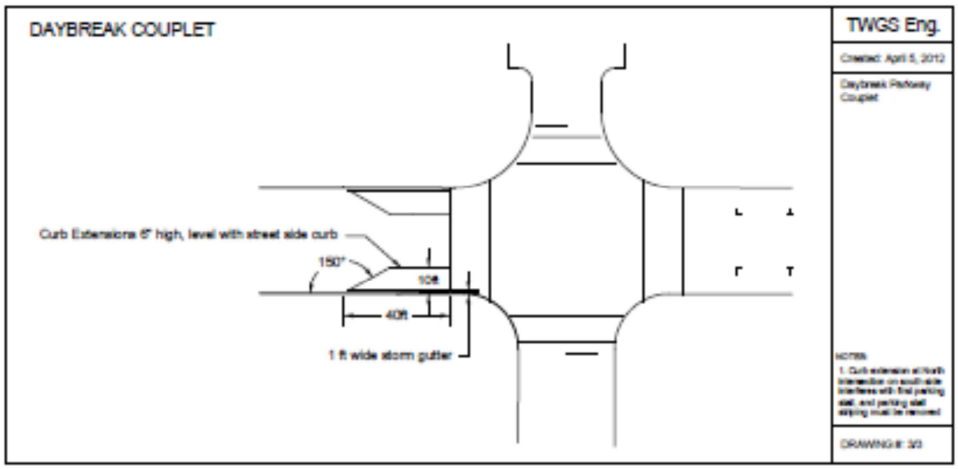


Figure 9: Road narrowing detail

Conclusions

Cost Analysis

It is understood that the client, Kennecott Land, may decide that it does not make financial sense to implement all aspects of TWGS Engineering's design for the Daybreak Parkway Couplet at once. To assist in the decision making process regarding implementation, TWGS has analyzed the possible costs for all of the options that could be considered using the four traffic calming measures that make up the final design. These costs range from $1,600 to $101,600 to install all of the aspects of the design. A summary of these costs can be found in Table 8 below. The prices included in these estimates include labor for installation and maintenance. TWGS Engineering recommends the entire final design as explained previously. However, if only pieces of the design are implemented, it should be considered that the the driver feedback signs and the road narrowing are the methods that will have the most effect on driver speed while the textured crosswalks and pavement markings are primarily to set this area apart from the rest of the road.

Table 8: Cost Matrix

Combination	Driver Feedback Signs	Pavement Markings	Textured Crosswalks	Road Narrowing	Price
1	X				$5,000
2		X			$1,600
3			X		$60,000
4				X	$35,000
5	X	X			$6,600
6	X		X		$65,000
7	X			X	$40,000
8		X	X		$61,600
9		X		X	$36,600
10			X	X	$95,000
11	X	X	X		$66,600
12	X	X		X	$41,600
13	X		X	X	$100,000
14		X	X	X	$96,600
Recommended	X	X	X	X	$101,600

Projected Effect

TWGS has developed a design that we believe accomplishes the goals outlined in the scope of this project. Each aspect of the design has a role that it will play to ensure that this couplet is safe for pedestrians and vehicles. As a driver enters the couplet from either roundabout the first thing they will see is the large pavement markings indicating that the speed limit has changed from 35 mph to 25 mph. TWGS Engineering felt that it was important to be able to set this section of business and residential road apart from the rest of the more arterial Daybreak Parkway. Along with the pavement markings, the textured crosswalks will be a visual and sensory reminder that this is a high pedestrian zone and different than the rest of Daybreak Parkway.

Being able to set this section of road apart is very helpful but it is not enough. The driver would then approach the two main traffic calming methods, driver feedback signs and road narrowing. The driver feedback signs have also shown strong results in that speeds have been reduced from 5 to 9 mph. With

the relatively low speeds that we are already working with it is safe to assume that applications to this site would be closer to 5 mph. The road narrowing method has shown in the past to slow drivers down approximately 2.6 mph.

TWGS Engineering believes that if all four aspects of the final design were implemented at the site, Kennecott Land would be able to reduce the speed limit to 25 miles per hour. The exact decrease in average speeds is too complex to be calculated but the engineered aspects of the design along with the drivers' desire to obey the law will be sufficient to keep the average speed within the desired range.

Review

TWGS Engineering was given the task of re-designing the Daybreak Parkway couplet in South Jordan, UT in order to reduce the 85th percentile speed enough to lower the speed limit back to the original goal of 25 mph. Speed studies were conducted to determine the current conditions of the road and the average speeds we found were found to be between 31 and 32 mph. The volume studies were performed and the level of service for the couplet was found to be no lower than a C, no traffic lights are warranted at either of the intersections and the stopping sight distance was found to be sufficient. Many different traffic calming devices were considered in an effort to reduce the speed of traffic. The four methods selected for the final design are speed limit pavement markings, road narrowing, colored/textured crosswalks, and radar equipped driver feedback signs. These methods were strategically placed throughout the couplet to achieve maximum effect. The cost estimate for the installation of the final design is $106,300. To the best of TWGS Engineering's judgment, this design is the best option to reduce vehicle speeds to the desired 25 mph in the most economical and pedestrian friendly way.

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Appendix

Speed Study Locations

Speed Study Summary

Analysis Results

Standard Deviation Test

Summary Histograms

85% Graphs

Volume Study Locations

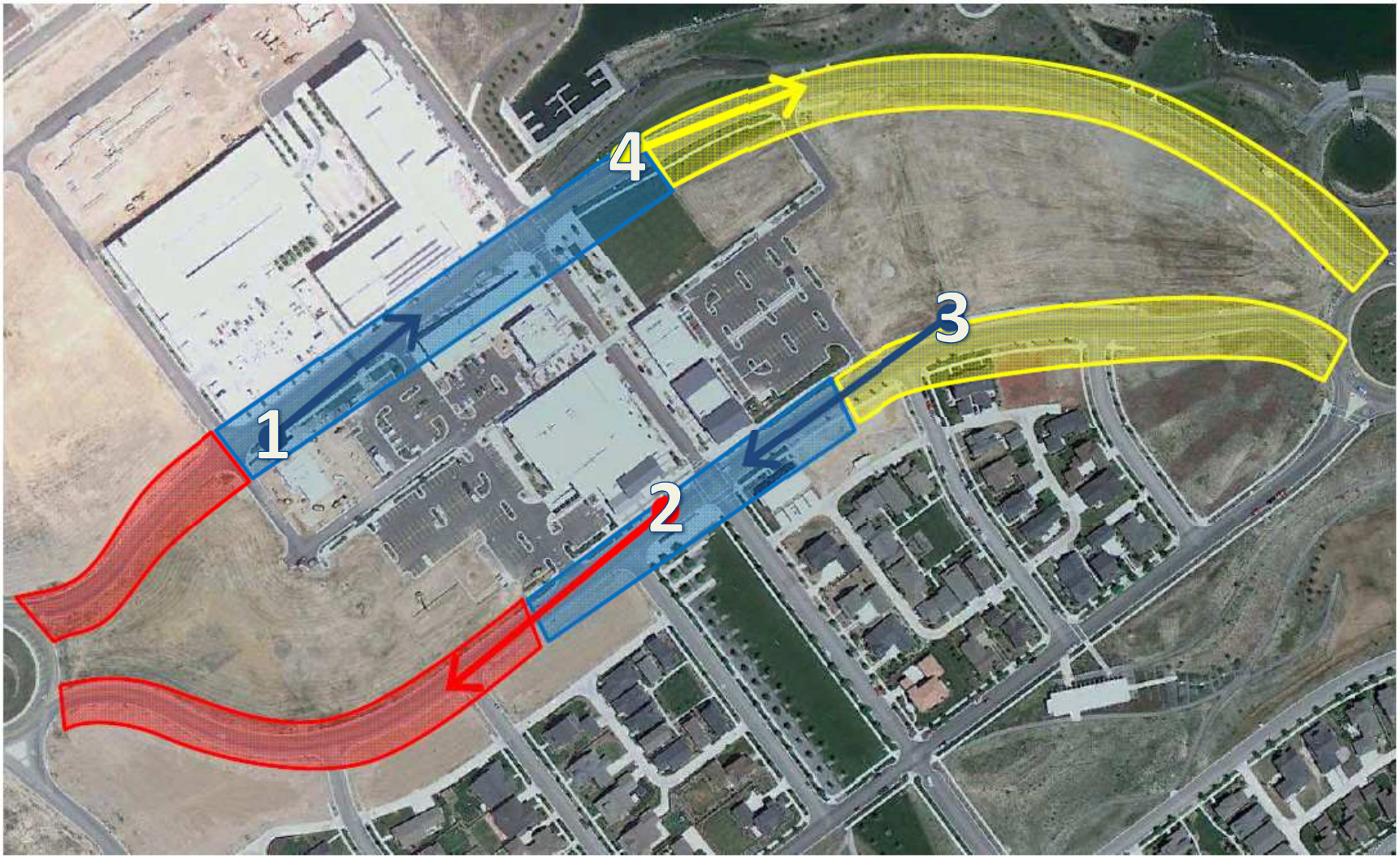
Volume Study Results

HCS+ Results

Stopping Sight Distance Results

Final Design

Design details



Speed Study Data Collection Locations - Radar

Location 1

WB Daybreak Parkway in front of RioTinto Corp Center

	Kennecott Data		TWGS Data			
Date:	11/2/2011		2/4/2012		2/9/2012	
Time Period:	12:30 - 1:30 pm		3:23pm -		5:03pm -	
Total # of Observations:	337		100		100	
# of Buses:	1		N/A		N/A	
# of Trucks:	32		N/A		N/A	
Mean Speed:	29.7	mph	30.5	mph	31.67	mph
85% Speed:	34	mph	35	mph	36	mph
Highest Observed:	50	- 1 vehicles	40	1-vehicles	45	1-vehicles
Lowest Observed:	16	- 3 vehicles	18	2-vehicles	17	1-vehicles

Location 2

EB Daybreak Parkway near Lake Run Rd

Date:	11/1/2011		2/4/2012		2/10/2012	
Time Period:	4:25 - 4:55 pm		4:00pm -		7:15am -	
Total # of Observations:	291		100		100	
# of Buses:	5		N/A		N/A	
# of Trucks:	1		N/A		N/A	
Mean Speed:	38.9	mph	28.7	mph	33.79	mph
85% Speed:	42	mph	34	mph	37.85	mph
Highest Observed:	54	- 1 vehicle	37	2-vehicles	46	1-vehicles
Lowest Observed:	25	- 1 vehicle	15	1-vehicles	25	2-vehicles

Location 3

EB Daybreak Rim Way near Kestrel Rise Rd Area

Date:	11/1/2011		2/4/2012		2/10/2012	
Time Period:	3:20 - 4:20 pm		4:45pm -		7:45am -	
Total # of Observations:	550		100		100	
# of Buses:	4		N/A		N/A	
# of Trucks:	11		N/A		N/A	
Mean Speed:	33.3	mph	31.1	mph	34.1	mph
85% Speed:	36	mph	35	mph	38	mph
Highest Observed:	44	- 3 vehicles	44	1-vehicles	42	2-vehicles
Lowest Observed:	25	- 3 vehicles	13	1-vehicles	28	2-vehicles

Location 4

WB Daybreak Parkway East of SoDa Row Area

Date:	11/1/2011		2/4/2012		2/9/2012	
Time Period:	2:10 - 3:10 pm		5:23pm -		5:38pm -	
Total # of Observations:	409		100		100	
# of Buses:	10		N/A		N/A	
# of Trucks:	11		N/A		N/A	
Mean Speed:	35.1	mph	31.7	mph	33.36	mph
85% Speed:	38	mph	37	mph	37	mph
Highest Observed:	45	- 2 vehicles	44	1-vehicles	45	1-vehicles
Lowest Observed:	20	- 1 vehicle	17	1-vehicles	24	1-vehicles

WB Daybreak Parkway in front of RioTinto Corp Center - 1

Kennecott Data

Speed	Frequency	Cumulative Frequency	Cumulative %	Speed Percentile	
16	3	3	0.89%		
17	1	4	1.19%		
18	1	5	1.48%		
19	1	6	1.78%		
20	6	12	3.56%		
21	1	13	3.86%		
22	7	20	5.93%		
23	11	31	9.20%		
24	10	41	12.17%		
25	20	61	18.10%		
26	20	81	24.04%		
27	24	105	31.16%		
28	24	129	38.28%		
29	25	154	45.70%	**50%**	
30	37	191	56.68%	**50%**	**Mode**
31	28	219	64.99%		
32	29	248	73.59%		
33	24	272	80.71%		
34	13	285	84.57%	**85%**	
35	21	306	90.80%		
36	12	318	94.36%		
37	7	325	96.44%		
38	6	331	98.22%		
39	2	333	98.81%		
40	1	334	99.11%		
41	1	335	99.41%		
42	1	336	99.70%		
50	1	337	100.00%		

Mean Speed: 29.7 mph

TWGS, BYU Capstone data

Date: 9 February, 2012

Weekday

Speed	Frequency	Cumulative Frequency	Cumulative %	Speed Percentile	
17	1	1	1.00%		
18	0	1	1.00%		
19	0	1	1.00%		
20	0	1	1.00%		
21	1	2	2.00%		
22	0	2	2.00%		
23	1	3	3.00%		
24	1	4	4.00%		
25	0	4	4.00%		
26	4	8	8.00%		
27	5	13	13.00%		
28	7	20	20.00%		
29	7	27	27.00%		
30	10	37	37.00%		
31	10	47	47.00%	**50%**	
32	15	62	62.00%	**50%**	**Mode**
33	7	69	69.00%		
34	8	77	77.00%		
35	6	83	83.00%	**85%**	
36	7	90	90.00%		
37	4	94	94.00%		
38	1	95	95.00%		
39	2	97	97.00%		
40	2	99	99.00%		
41	0	99	99.00%		
42	0	99	99.00%		
43	0	99	99.00%		
44	0	99	99.00%		
45	1	100	100.00%		

Mean Speed: 31.7 mph

TWGS, BYU Capstone data

Date: 4 February, 2012

Weekend

Speed	Frequency	Cumulative Frequency	Cumulative %	Speed Percentile	
17	0	0	0.00%		
18	2	2	2.00%		
19	0	2	2.00%		
20	0	2	2.00%		
21	1	3	3.00%		
22	0	3	3.00%		
23	2	5	5.00%		
24	4	9	9.00%		
25	8	17	17.00%		
26	1	18	18.00%		
27	6	24	24.00%		
28	4	28	28.00%		
29	12	40	40.00%		**Mode**
30	7	47	47.00%	**50%**	
31	7	54	54.00%	**50%**	
32	12	66	66.00%		**Mode**
33	11	77	77.00%		
34	7	84	84.00%	**85%**	
35	5	89	89.00%		
36	4	93	93.00%		
37	2	95	95.00%		
38	3	98	98.00%		
39	1	99	99.00%		
40	1	100	100.00%		

Mean Speed: 30.5 mph

EB Daybreak Parkway near Lake Run Rd - 2

Kennecott Data

Speed	Frequency	Cumulative Frequency	Cumulative %	Speed Percentile	
29	1	1	0.34%		
31	2	3	1.03%		
32	4	7	2.41%		
33	7	14	4.81%		
34	13	27	9.28%		
35	19	46	15.81%		
36	17	63	21.65%		
37	31	94	32.30%		
38	32	126	43.30%	**50%**	
39	34	160	54.98%	**50%**	
40	44	204	70.10%		**Mode**
41	29	233	80.07%		
42	19	252	86.60%	**85%**	
43	13	265	91.07%		
44	11	276	94.85%		
45	4	280	96.22%		
46	4	284	97.59%		
47	3	287	98.63%		
48	1	288	98.97%		
49	2	290	99.66%		
54	1	291	100.00%		

Mean Speed: 38.9 mph

TWGS, BYU Capstone data

Date: 10 February, 2012

Weekday

Speed	Frequency	Cumulative Frequency	Cumulative %	Speed Percentile	
25	2	2	2%		
26	0	2	2%		
27	2	4	4%		
28	1	5	5%		
29	3	8	8%		
30	11	19	19%		
31	6	25	25%		
32	15	40	40%		**Mode**
33	9	49	49%	**50%**	
34	11	60	60%	**50%**	
35	12	72	72%		
36	9	81	81%		
37	4	85	85%	**85%**	
38	5	90	90%		
39	1	91	91%		
40	5	96	96%		
41	0	96	96%		
42	3	99	99%		
43	0	99	99%		
44	0	99	99%		
45	0	99	99%		
46	1	100	100%		

Mean Speed: 33.79

TWGS, BYU Capstone data

Date: 4 February, 2012

Weekend

Speed	Frequency	Cumulative Frequency	Cumulative %	Speed Percentile	
15	1	1	1%		
16	0	1	1%		
17	0	1	1%		
18	1	2	2%		
19	2	4	4%		
20	6	10	10%		
21	1	11	11%		
22	2	13	13%		
23	4	17	17%		
24	3	20	20%		
25	6	26	26%		
26	6	32	32%		
27	6	38	38%		
28	4	42	42%		
29	8	50	50%	**50%**	
30	8	58	58%		
31	8	66	66%		
32	10	76	76%		**Mode**
33	3	79	79%		
34	9	88	88%	**85%**	
35	6	94	94%		
36	4	98	98%		
37	2	100	100%		

Mean Speed: 28.73

EB Daybreak Rim Way near Kestrel Rise Rd Area - 3

Kennecott Data

Speed	Frequency	Cumulative Frequency	Cumulative %	Speed Percentile	
25	4	4	0.73%		
26	8	12	2.18%		
27	10	22	4.00%		
28	9	31	5.64%		
29	18	49	8.91%		
30	55	104	18.91%		
31	56	160	29.09%		
32	65	225	40.91%	**50%**	
33	70	295	53.64%	**50%**	**Mode**
34	67	362	65.82%		
35	60	422	76.73%		
36	44	466	84.73%	**85%**	
37	38	504	91.64%		
38	18	522	94.91%		
39	10	532	96.73%		
40	8	540	98.18%		
41	1	541	98.36%		
42	6	547	99.45%		
44	3	550	100.00%		

Mean Speed: 33.3 mph

TWGS, BYU Capstone data

Date: 4 February, 2012

Weekend

Speed	Frequency	Cumulative Frequency	Cumulative %	Speed Percentile	
13	1	1	1.00%		
14	0	1	1.00%		
15	0	1	1.00%		
16	0	1	1.00%		
17	0	1	1.00%		
18	0	1	1.00%		
19	1	2	2.00%		
20	1	3	3.00%		
21	0	3	3.00%		
22	0	3	3.00%		
23	0	3	3.00%		
24	0	3	3.00%		
25	2	5	5.00%		
26	3	8	8.00%		
27	5	13	13.00%		
28	12	25	25.00%		
29	9	34	34.00%		
30	11	45	45.00%	**50%**	
31	8	53	53.00%	**50%**	
32	13	66	66.00%		**Mode**
33	12	78	78.00%		
34	6	84	84.00%	**85%**	
35	6	90	90.00%		
36	2	92	92.00%		
37	1	93	93.00%		
38	1	94	94.00%		
39	0	94	94.00%		
40	4	98	98.00%		
41	0	98	98.00%		
42	1	99	99.00%		
43	0	99	99.00%		
44	1	100	100.00%		
45	0	100	100.00%		

Mean Speed: 31.1 mph

TWGS, BYU Capstone data

Date: 10 February, 2012

Weekday

Speed	Frequency	Cumulative Frequency	Cumulative %	Speed Percentile	
28	2	2	2.00%		
29	2	4	4.00%		
30	8	12	12.00%		
31	6	18	18.00%		
32	13	31	31.00%		
33	11	42	42.00%	**50%**	
34	16	58	58.00%	**50%**	**Mode**
35	16	74	74.00%		**Mode**
36	9	83	83.00%		
37	1	84	84.00%	**85%**	
38	8	92	92.00%		
39	3	95	95.00%		
40	2	97	97.00%		
41	1	98	98.00%		
42	2	100	100.00%		

Mean Speed: 34.1 mph

WB Daybreak Parkway East of SoDa Row Area - 4

Kennecott Data

Speed	Frequency	Cumulative Frequency	Cumulative %	Speed Percentile	
20	1	1	0.24%		
23	1	2	0.49%		
24	2	4	0.98%		
25	1	5	1.22%		
26	2	7	1.71%		
27	3	10	2.44%		
28	7	17	4.16%		
29	2	19	4.65%		
30	12	31	7.58%		
31	19	50	12.22%		
32	33	83	20.29%		
33	45	128	31.30%		
34	45	173	42.30%	**50%**	
35	49	222	54.28%	**50%**	**Mode**
36	42	264	64.55%		
37	44	308	75.31%		
38	39	347	84.84%	**85%**	
39	17	364	89.00%		
40	17	381	93.15%		
41	12	393	96.09%		
42	10	403	98.53%		
43	3	406	99.27%		
44	1	407	99.51%		
45	2	409	100.00%		

Mean Speed: 35.1 mph

TWGS, BYU Capstone data

Date: 9 February, 2012

Weekday

Speed	Frequency	Cumulative Frequency	Cumulative %	Speed Percentile	
24	1	1	1%		
25	1	2	2%		
26	0	2	2%		
27	3	5	5%		
28	6	11	11%		
29	6	17	17%		
30	5	22	22%		
31	11	33	33%		
32	11	44	44%	**50%**	
33	7	51	51%	**50%**	
34	7	58	58%		
35	13	71	71%		**Mode**
36	13	84	84%		**Mode**
37	3	87	87%	**85%**	
38	3	90	90%		
39	6	96	96%		
40	1	97	97%		
41	0	97	97%		
42	1	98	98%		
43	1	99	99%		
44	0	99	99%		
45	1	100	100%		

Mean Speed: 33.36

TWGS, BYU Capstone data

Date: 4 February, 2012

Weekend

Speed	Frequency	Cumulative Frequency	Cumulative %	Speed Percentile	
17	1	1	1%		
18	0	1	1%		
19	0	1	1%		
20	2	3	3%		
21	1	4	4%		
22	0	4	4%		
23	2	6	6%		
24	3	9	9%		
25	0	9	9%		
26	1	10	10%		
27	4	14	14%		
28	7	21	21%		
29	10	31	31%		
30	12	43	43%		**Mode**
31	6	49	49%	**50%**	
32	9	58	58%	**50%**	
33	11	69	69%		
34	2	71	71%		
35	4	75	75%		
36	4	79	79%		
37	8	87	87%	**85%**	
38	7	94	94%		
39	3	97	97%		
40	1	98	98%		
41	0	98	98%		
42	1	99	99%		
43	0	99	99%		
44	1	100	100%		
45	0	100	100%		

Mean Speed: 31.7

Date: Feburary 9, 2012			Feburary 10, 2012		Feburary 4 ,2012			
Weather: Overcase, Cloudy			Cloudy, dry		Clear, Dry, Dusk		Clear, Dry	
Location:	1	4	2	3	3	4	1	2
Time:	5:03:00 PM	5:38:00 PM	7:15:00 AM	7:45:00 AM	4:45:00 PM	5:23:00 PM	4:00:00 PM	3:23:00 PM
Speeds:								
1	23	35	36	34	34	38	32	30
2	39	39	31	33	29	30	18	31
3	32	28	35	30	31	39	29	31
4	27	31	27	30	26	35	24	29
5	32	28	25	38	31	30	25	32
6	32	29	35	32	36	33	38	32
7	31	24	32	34	28	32	33	31
8	33	29	30	31	33	31	31	34
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15	31	36	34	36	33	32	35	34
16	37	35	30	34	29	32	29	22
17	32	31	35	38	30	29	24	30
18	34	28	34	31	44	30	31	27
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20	30	33	37	32	30	44	32	20
21	37	29	34	32	27	31	36	19
22	34	34	35	35	28	30	31	32
23	28	39	30	33	29	30	27	35
24	17	32	32	36	40	28	32	31
25	27	39	32	33	38	30	33	26
26	29	35	40	35	36	29	34	23
27	33	36	36	29	33	27	33	35
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29	31	33	38	34	30	27	33	32
30	27	32	30	32	20	29	34	31
31	30	37	35	36	27	37	31	36
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33	30	33	42	30	29	39	39	22
34	39	45	39	28	34	37	32	37
35	32	36	36	33	40	32	32	20
36	36	34	32	30	32	38	29	32
37	29	36	32	35	34	33	27	19
38	28	31	36	33	13	33	27	15
39	26	31	29	33	28	30	25	23
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42	27	32	37	39	32	37	37	31
43	30	31	36	32	30	35	38	34
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46	30	38	42	35	32	31	29	36
47	26	29	32	35	34	38	29	25
48	30	28	35	35	32	36	25	33
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50	32	35	36	35	29	30	30	26
51	32	36	40	34	30	32	35	20
52	28	28	34	31	25	28	30	29
53	34	42	34	34	40	35	28	28
54	32	31	37	38	40	29	26	35
55	31	30	36	36	37	28	29	33
56	24	34	40	35	34	28	32	26
57	35	32	38	40	30	36	34	34
58	36	36	30	42	30	29	29	18

59	33	35	42	36	42	30	35	30
60	32	34	38	34	35	33	25	26
61	34	30	35	41	34	33	29	34
62	34	36	32	38	33	33	29	32
63	29	33	35	38	32	30	30	29
64	36	30	32	38	31	31	29	32
65	31	32	36	35	31	35	34	30
66	31	31	37	36	30	34	28	34
67	33	36	35	31	33	28	30	36
68	32	40	30	30	33	29	32	35
69	30	39	30	30	33	23	31	31
70	26	37	34	35	32	38	30	32
71	29	36	34	34	28	27	25	32
72	33	33	33	30	26	31	38	29
73	29	31	35	35	31	24	34	24
74	28	33	29	38	27	29	32	20
75	31	36	32	33	28	29	25	30
76	30	35	35	33	31	37	36	30
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79	35	36	30	39	27	17	31	34
80	36	32	32	34	35	23	29	32
81	33	30	33	29	32	24	34	29
82	32	29	31	34	31	37	33	26
83	40	27	29	32	32	37	36	23
84	31	27	34	35	32	38	37	25
85	30	25	34	42	26	39	35	25
86	29	27	40	36	30	30	30	35
87	34	32	33	34	28	24	25	29
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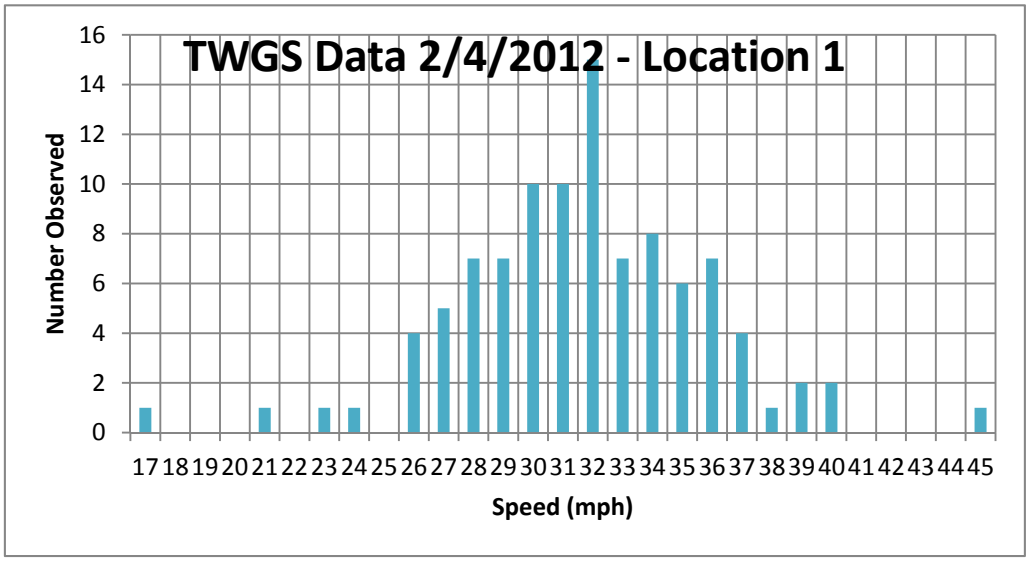
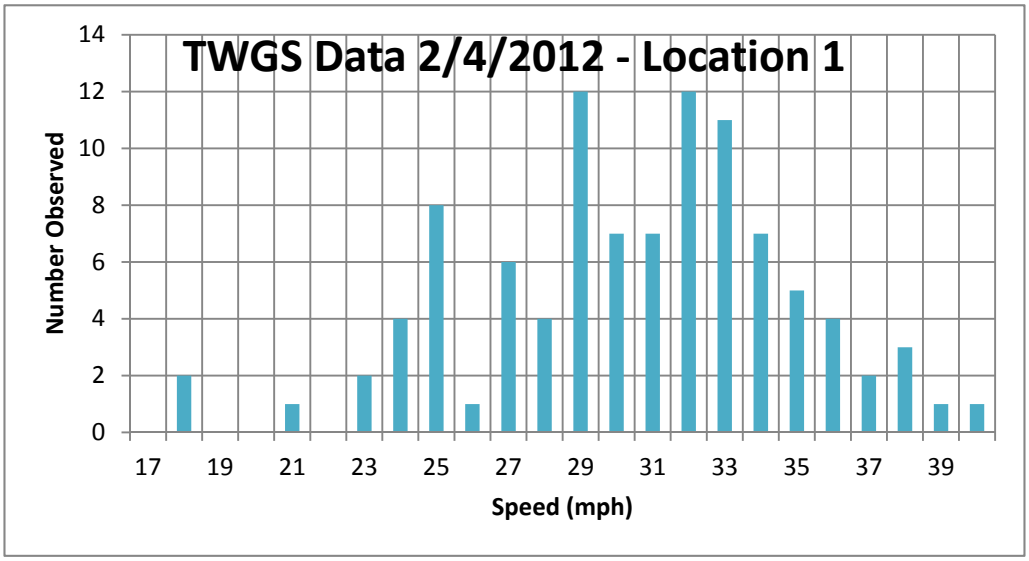
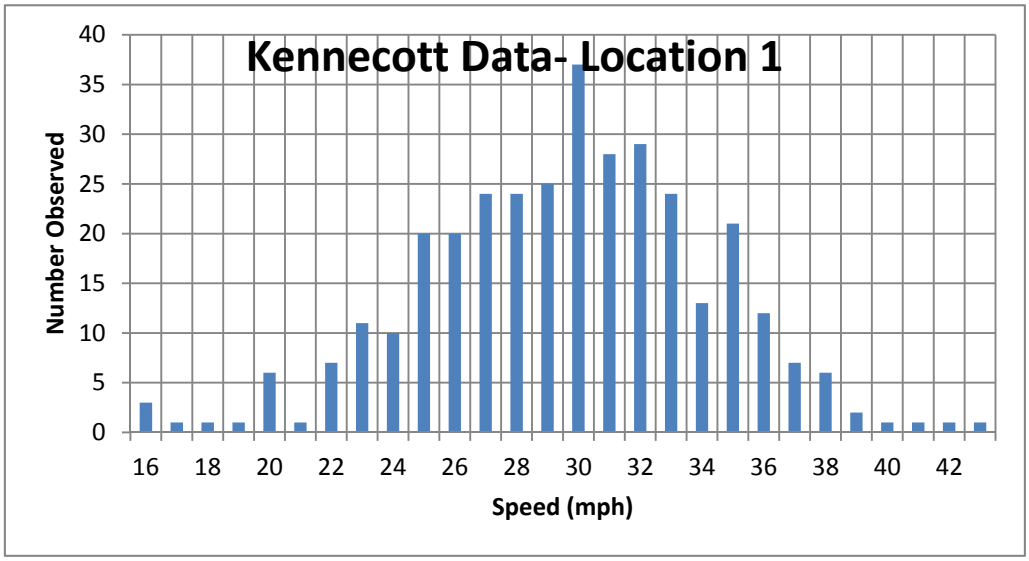
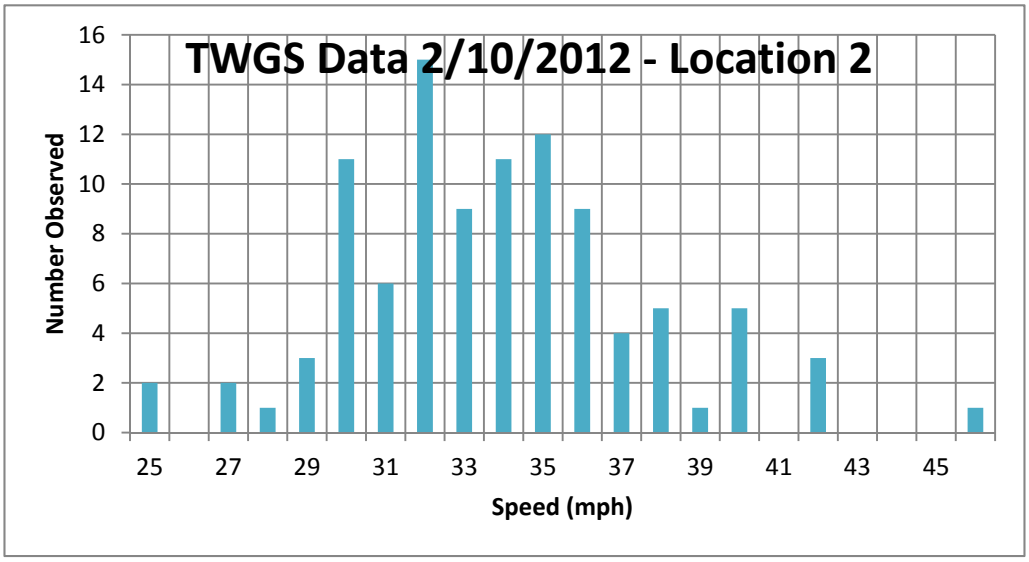
92	38	35	30	35	27	20	32	28
93	34	29	32	32	35	20	33	24
94	31	35	27	40	35	31	23	27
95	31	34	31	36	28	34	21	24
96	32	36	31	34	33	40	33	28
97	21	39	33	34	35	38	36	25
98	28	32	46	32	28	37	35	25
99	35	32	35	35	35	27	31	33
100	32	31	31	30	33	33	32	27

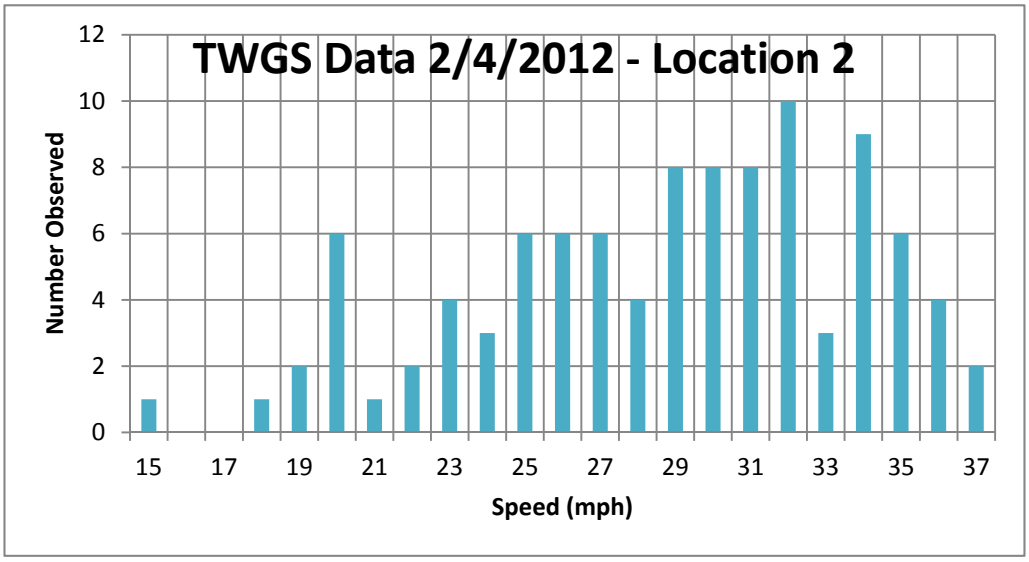
AVE:	31.67	33.36		33.79	34.1		31.09	31.7	30.45	28.73
85th	36	37		37.85	38		35	37	35	34
Stand. Dev.	4.1561807	3.8599733		3.720798763	2.9797295		4.415525868	4.9205814	4.3748016	5.022887

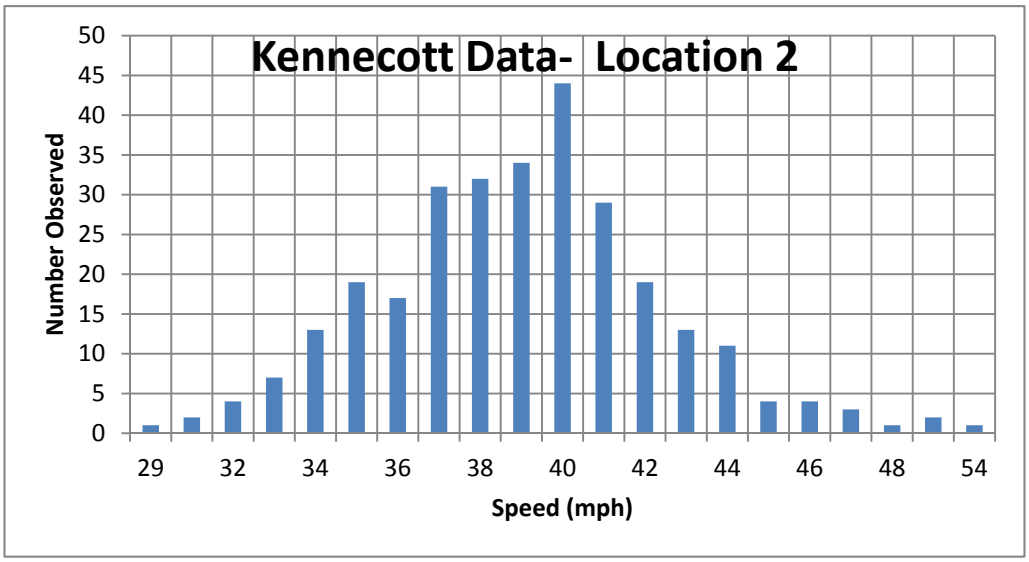

TWGS Data 2/4/2012 - Location 1
Number Observed
0 2 4 6 8 10 12 14 16
17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45
Speed (mph)

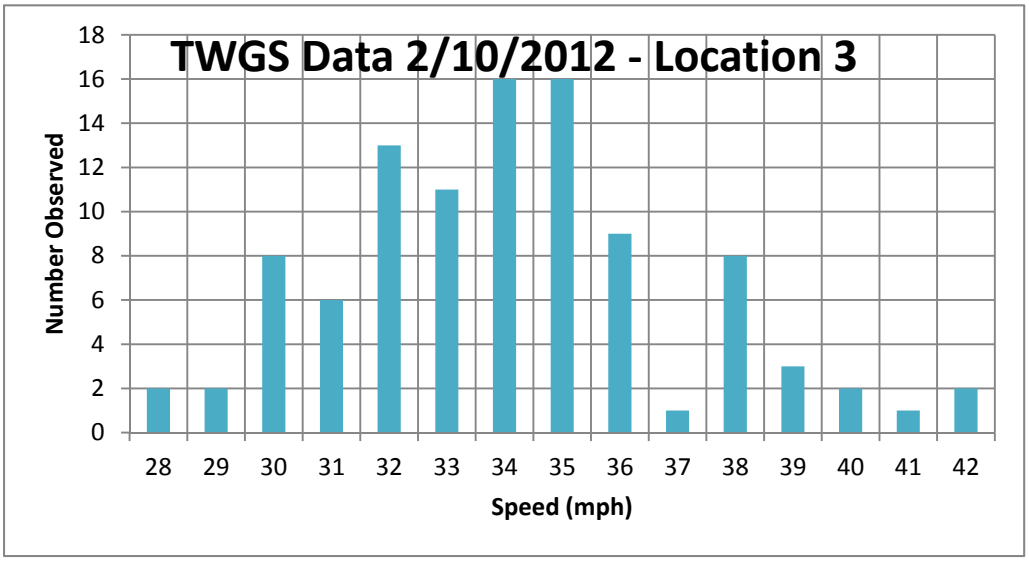

TWGS Data 2/4/2012 - Location 1
Number Observed
0 2 4 6 8 10 12 14
17 19 21 23 25 27 29 31 33 35 37 39
Speed (mph)

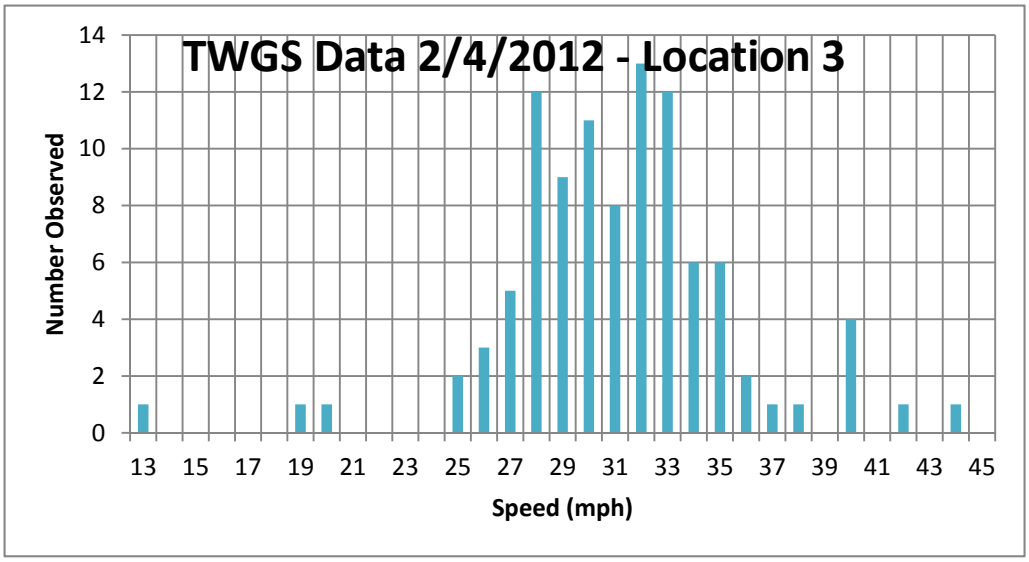

Kennecott Data- Location 1
Number Observed
0 5 10 15 20 25 30 35 40
16 18 20 22 24 26 28 30 32 34 36 38 40 42
Speed (mph)

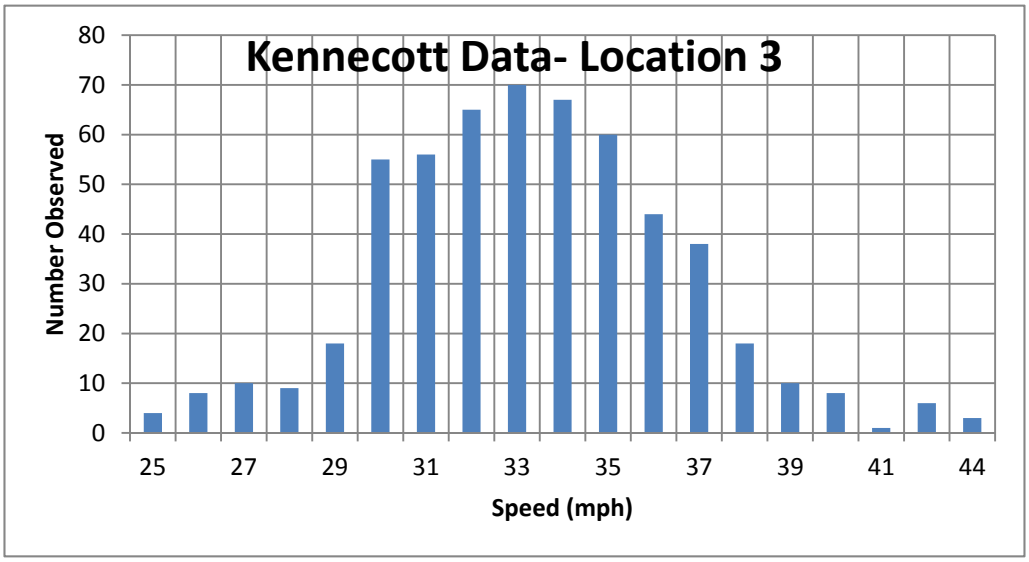

TWGS Data 2/10/2012 - Location 2
Number Observed
0
2
4
6
8
10
12
14
16
25
27
29
31
33
35
37
39
41
43
45
Speed (mph)

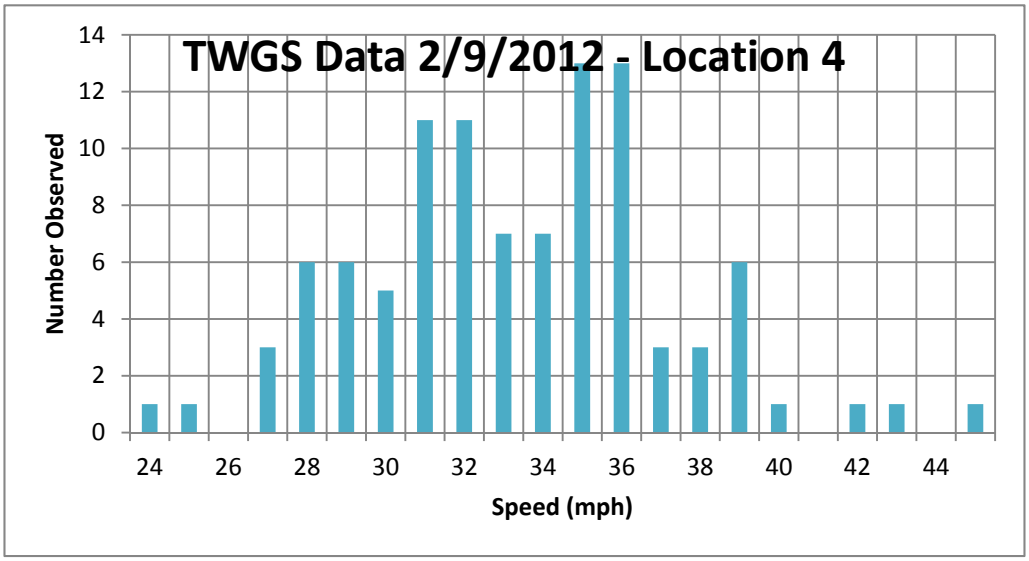

TWGS Data 2/4/2012 - Location 2
Number Observed
0
2
4
6
8
10
12
15
17
19
21
23
25
27
29
31
33
35
37
Speed (mph)

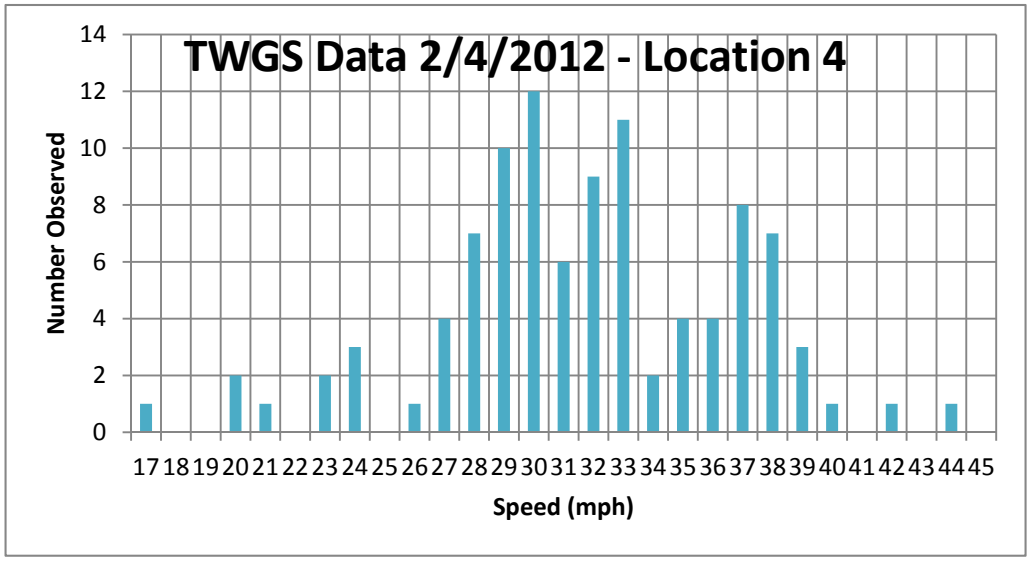

Kennecott Data- Location 2
Number Observed
0
5
10
15
20
25
30
35
40
45
50
29
32
34
36
38
40
42
44
46
48
54
Speed (mph)

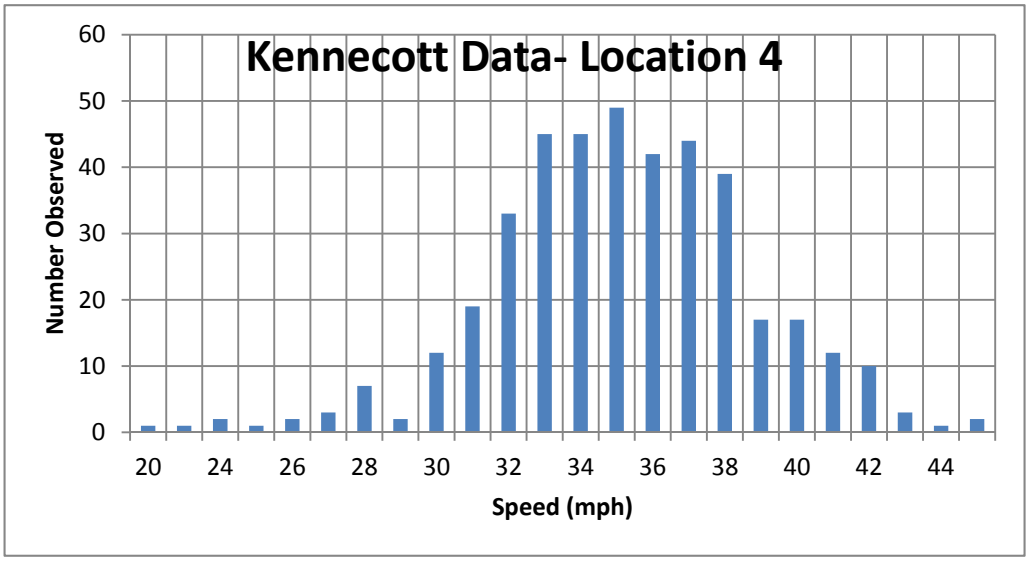

TWGS Data 2/10/2012 - Location 3
Number Observed
0
2
4
6
8
10
12
14
16
18
28 29 30 31 32 33 34 35 36 37 38 39 40 41 42
Speed (mph)


TWGS Data 2/4/2012 - Location 3
Number Observed
0
2
4
6
8
10
12
14
13 15 17 19 21 23 25 27 29 31 33 35 37 39 41 43 45
Speed (mph)


Kennecott Data- Location 3
Number Observed
0
10
20
30
40
50
60
70
80
25 27 29 31 33 35 37 39 41 44
Speed (mph)


TWGS Data 2/9/2012 - Location 4
Number Observed
0
2
4
6
8
10
12
14
24
26
28
30
32
34
36
38
40
42
44
Speed (mph)


TWGS Data 2/4/2012 - Location 4
Number Observed
0
2
4
6
8
10
12
14
17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45
Speed (mph)


Kennecott Data- Location 4
Number Observed
0
10
20
30
40
50
60
20
24
26
28
30
32
34
36
38
40
42
44
Speed (mph)

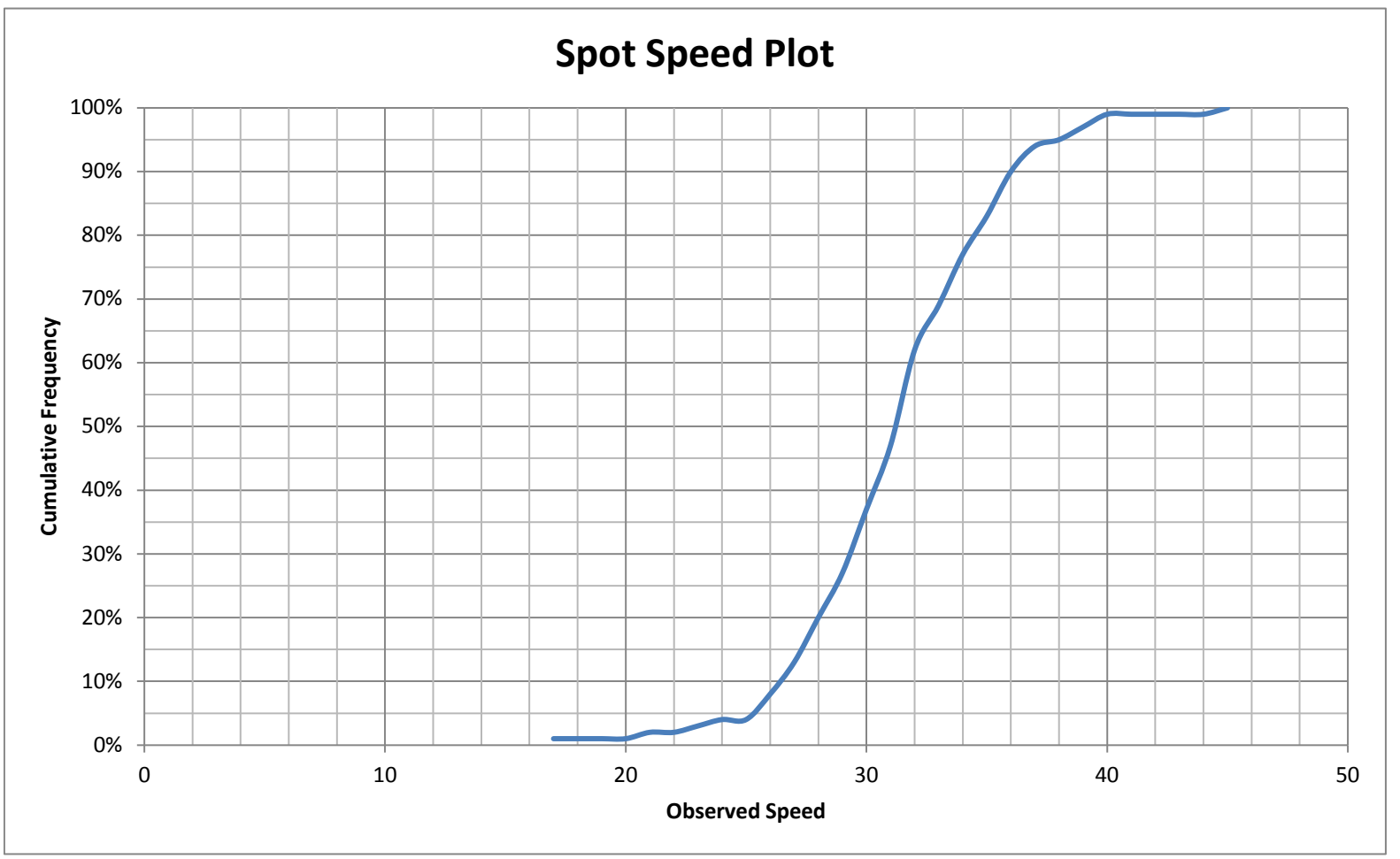
Data Analysis Spreadsheet

Location: 1 **Time:** 5:03 PM

Date: 9 February, 2012 **Team Members:** Shawn, Alex

Conditions: Overcast, Cloudy **Method:** both lanes, every third

Speed Groups (1)	Number Observed (2)	Frequency (3)	Cumulative Frequency (4)	Plotted Speed (5)
17	1	1%	1%	17
18	0	0%	1%	18
19	0	0%	1%	19
20	0	0%	1%	20
21	1	1%	2%	21
22	0	0%	2%	22
23	1	1%	3%	23
24	1	1%	4%	24
25	0	0%	4%	25
26	4	4%	8%	26
27	5	5%	13%	27
28	7	7%	20%	28
29	7	7%	27%	29
30	10	10%	37%	30
31	10	10%	47%	31
32	15	15%	62%	32
33	7	7%	69%	33
34	8	8%	77%	34
35	6	6%	83%	35
36	7	7%	90%	36
37	4	4%	94%	37
38	1	1%	95%	38
39	2	2%	97%	39
40	2	2%	99%	40
41	0	0%	99%	41
42	0	0%	99%	42
43	0	0%	99%	43
44	0	0%	99%	44
45	1	1%	100%	45


Spot Speed Plot
Cumulative Frequency
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
10
20
30
40
50
Observed Speed

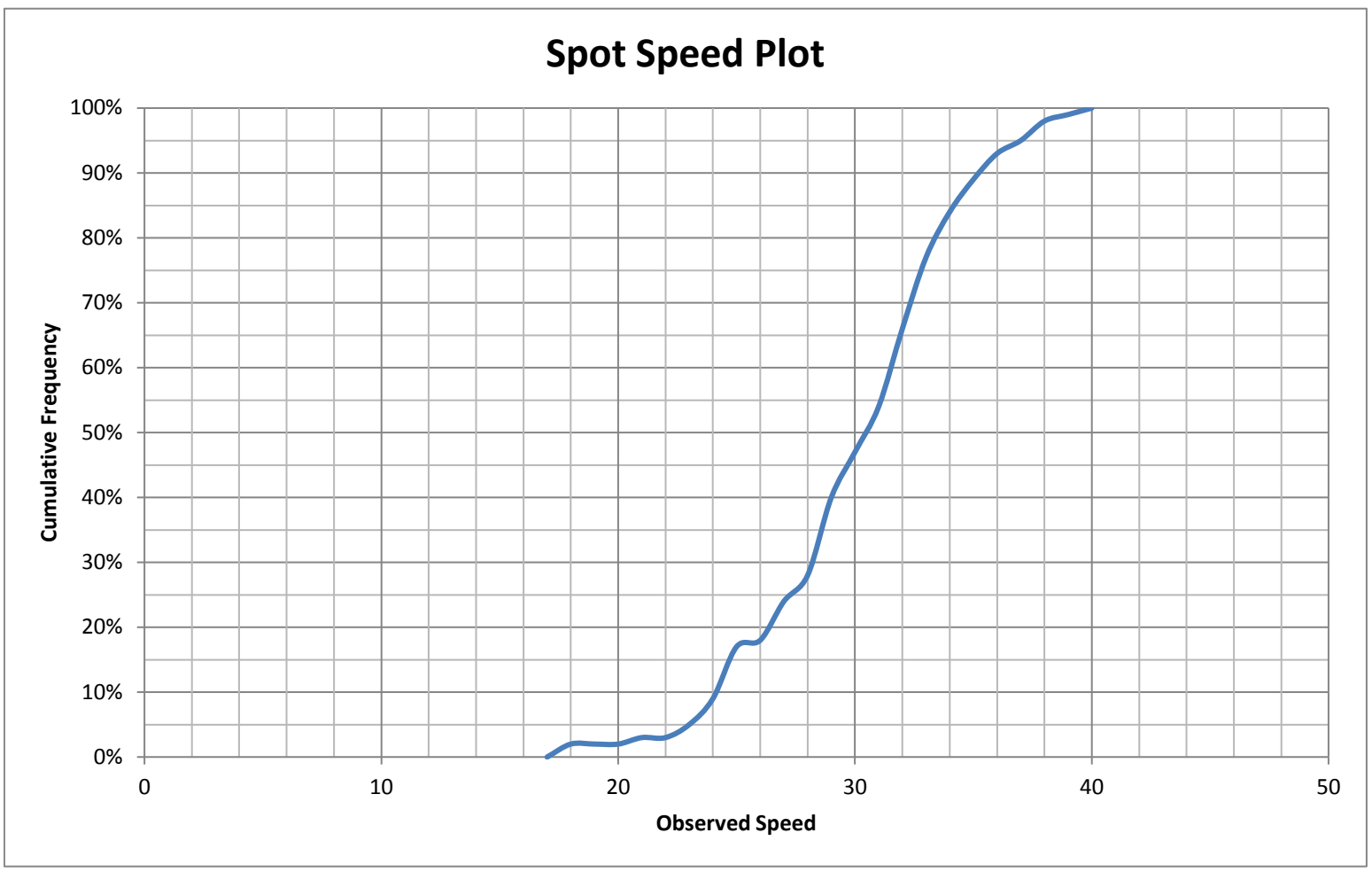
Data Analysis Spreadsheet

Location: 1 **Time:** 3:23 PM

Date: 4 February, 2012 **Team Members:** Shawn, Alex

Conditions: Clear, Dry **Method:** outside lane, every car

Speed Groups (1)	Number Observed (2)	Frequency (3)	Cumulative Frequency (4)	Plotted Speed (5)
17	0	0%	0%	17
18	2	2%	2%	18
19	0	0%	2%	19
20	0	0%	2%	20
21	1	1%	3%	21
22	0	0%	3%	22
23	2	2%	5%	23
24	4	4%	9%	24
25	8	8%	17%	25
26	1	1%	18%	26
27	6	6%	24%	27
28	4	4%	28%	28
29	12	12%	40%	29
30	7	7%	47%	30
31	7	7%	54%	31
32	12	12%	66%	32
33	11	11%	77%	33
34	7	7%	84%	34
35	5	5%	89%	35
36	4	4%	93%	36
37	2	2%	95%	37
38	3	3%	98%	38
39	1	1%	99%	39
40	1	1%	100%	40


Spot Speed Plot
Cumulative Frequency
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
10
20
30
40
50
Observed Speed

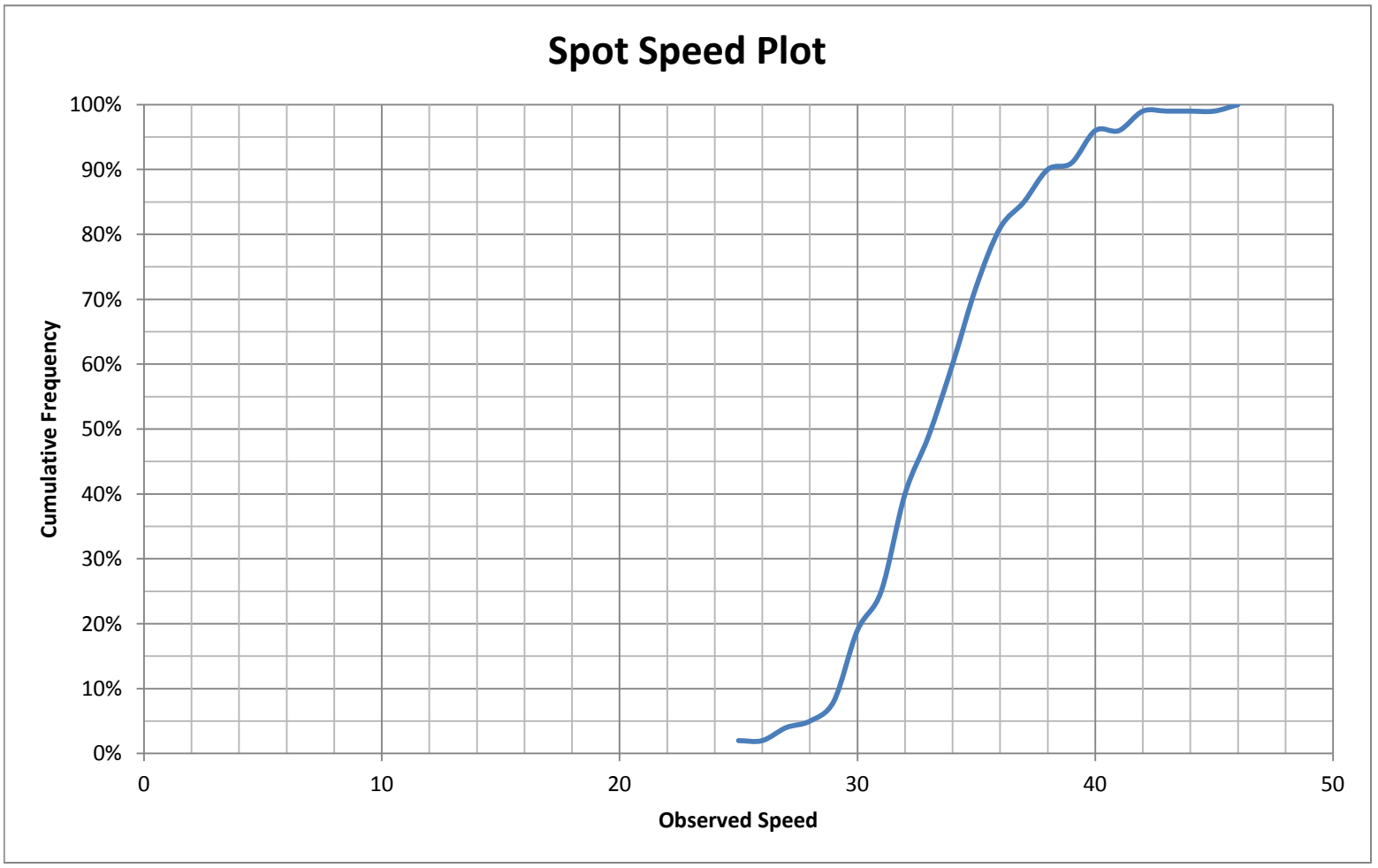
Data Analysis Spreadsheet

Location: 2 **Time:** 7:15 AM

Date: 10 February, 2012 **Team Members:** Ken, Brad

Conditions: Cloudy, dry **Method:** both lanes, every third

Speed Groups (1)	Number Observed (2)	Frequency (3)	Cumulative Frequency (4)	Plotted Speed (5)
25	2	2%	2%	25
26	0	0%	2%	26
27	2	2%	4%	27
28	1	1%	5%	28
29	3	3%	8%	29
30	11	11%	19%	30
31	6	6%	25%	31
32	15	15%	40%	32
33	9	9%	49%	33
34	11	11%	60%	34
35	12	12%	72%	35
36	9	9%	81%	36
37	4	4%	85%	37
38	5	5%	90%	38
39	1	1%	91%	39
40	5	5%	96%	40
41	0	0%	96%	41
42	3	3%	99%	42
43	0	0%	99%	43
44	0	0%	99%	44
45	0	0%	99%	45
46	1	1%	100%	46


Spot Speed Plot
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Cumulative Frequency
0
10
20
30
40
50
Observed Speed

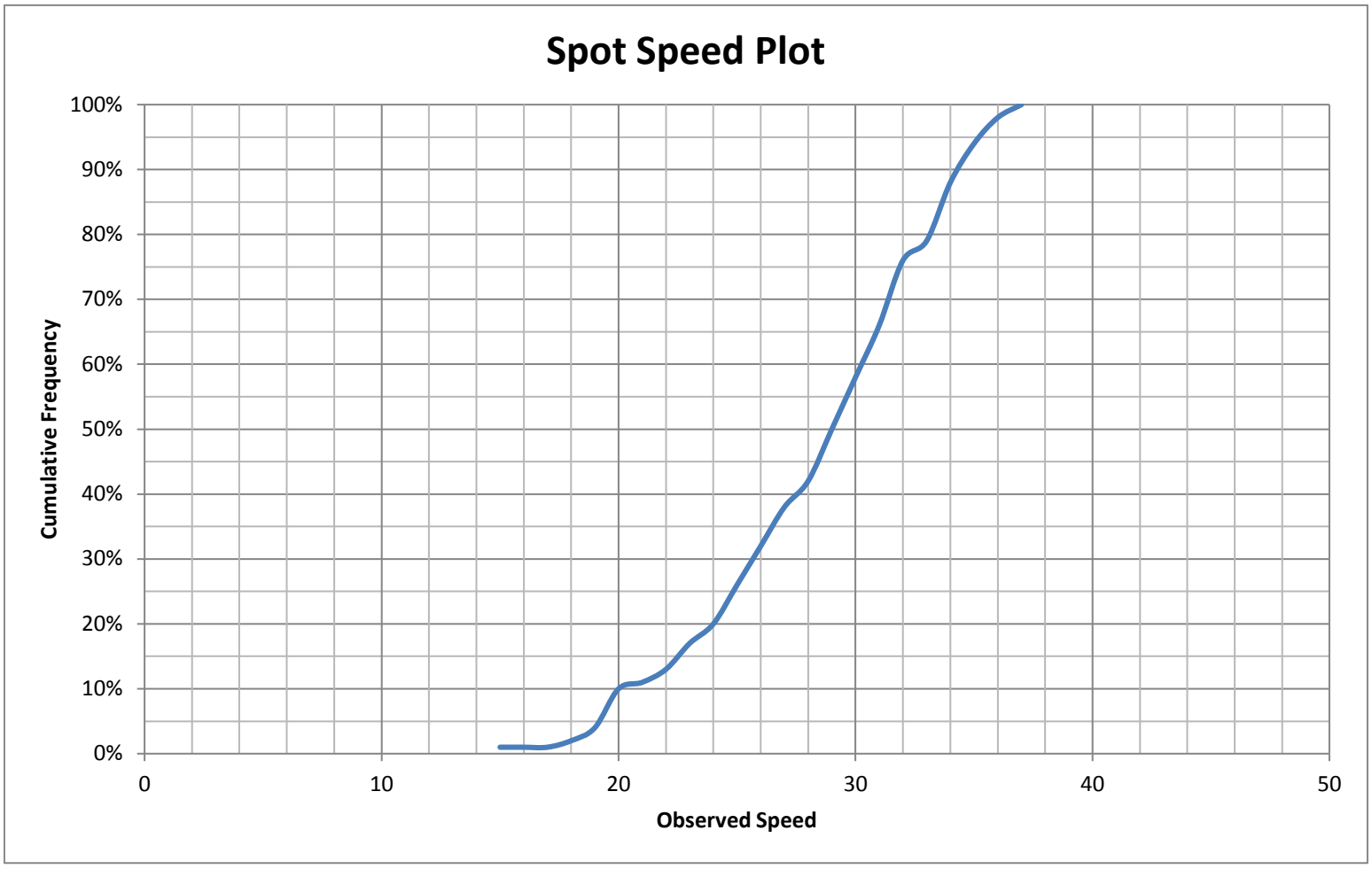
Data Analysis Spreadsheet

Location: 2 **Time:** 4:00 PM

Date: 4 February, 2012 **Team Members:** Alex, Shawn

Conditions: Clear, Dry **Method:** inside lane, every car

Speed Groups (1)	Number Observed (2)	Frequency (3)	Cumulative Frequency (4)	Plotted Speed (5)
15	1	1%	1%	15
16	0	0%	1%	16
17	0	0%	1%	17
18	1	1%	2%	18
19	2	2%	4%	19
20	6	6%	10%	20
21	1	1%	11%	21
22	2	2%	13%	22
23	4	4%	17%	23
24	3	3%	20%	24
25	6	6%	26%	25
26	6	6%	32%	26
27	6	6%	38%	27
28	4	4%	42%	28
29	8	8%	50%	29
30	8	8%	58%	30
31	8	8%	66%	31
32	10	10%	76%	32
33	3	3%	79%	33
34	9	9%	88%	34
35	6	6%	94%	35
36	4	4%	98%	36
37	2	2%	100%	37


Spot Speed Plot
Cumulative Frequency
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
10
20
30
40
50
Observed Speed

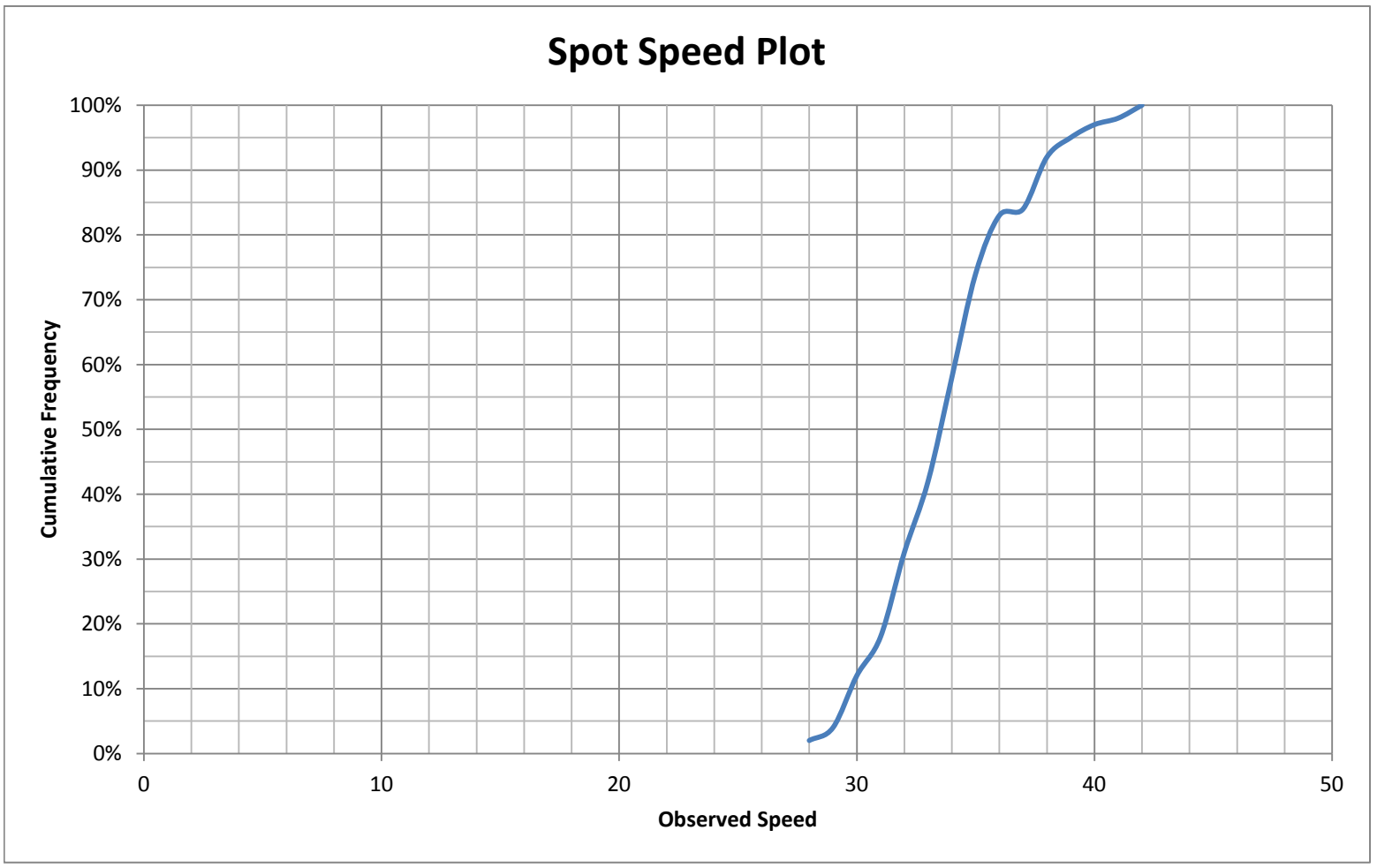
Data Analysis Spreadsheet

Location: 3 **Time:** 7:45 AM

Date: 10 February, 2012 **Team Members:** Ken, Brad

Conditions: Cloudy, dry **Method:** both lanes, every third

Speed Groups (1)	Number Observed (2)	Frequency (3)	Cumulative Frequency (4)	Plotted Speed (5)
28	2	2%	2%	28
29	2	2%	4%	29
30	8	8%	12%	30
31	6	6%	18%	31
32	13	13%	31%	32
33	11	11%	42%	33
34	16	16%	58%	34
35	16	16%	74%	35
36	9	9%	83%	36
37	1	1%	84%	37
38	8	8%	92%	38
39	3	3%	95%	39
40	2	2%	97%	40
41	1	1%	98%	41
42	2	2%	100%	42


Spot Speed Plot
Cumulative Frequency
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
10
20
30
40
50
Observed Speed

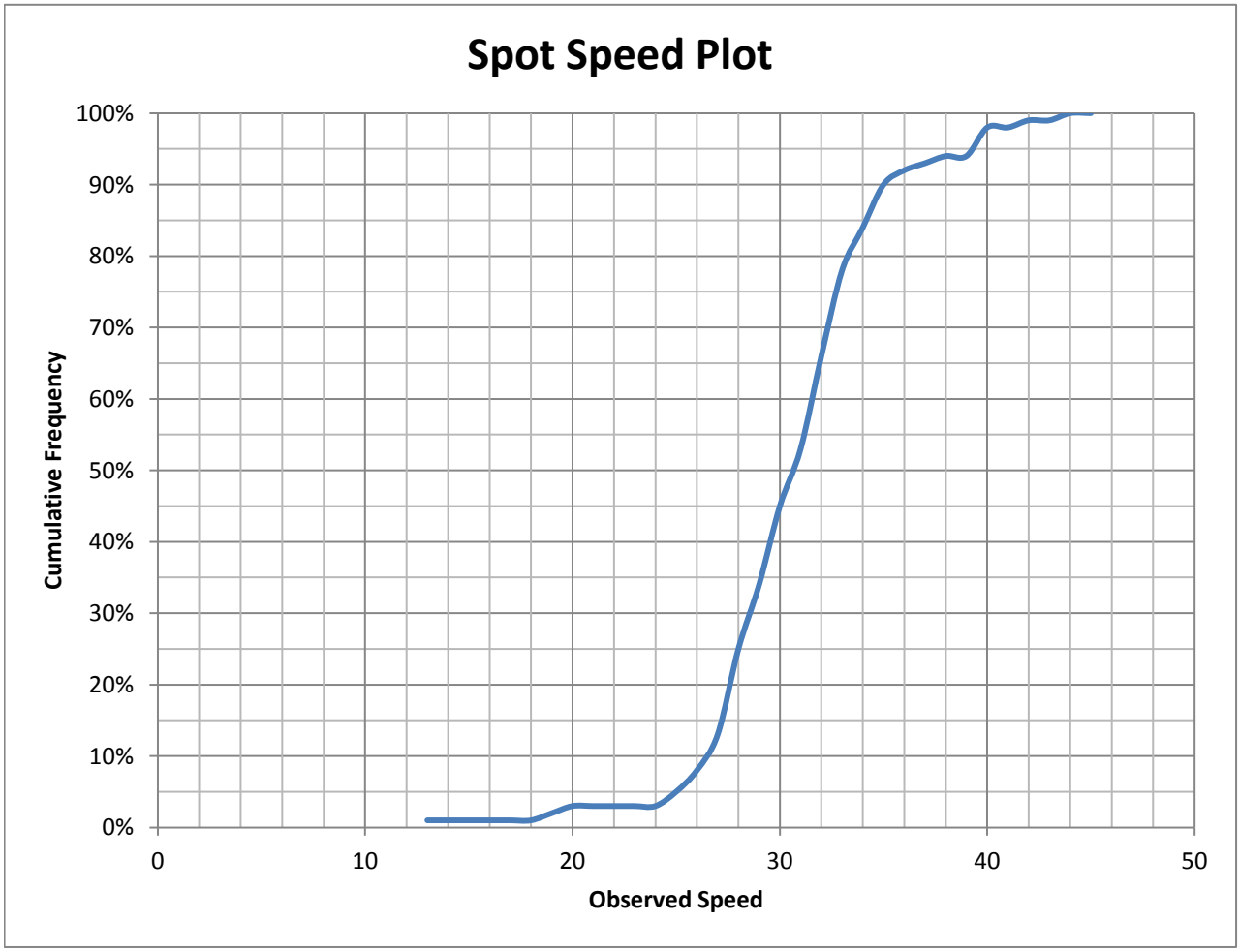
Data Analysis Spreadsheet

Location: 3 **Time:** 4:45 PM

Date: 4 February, 2012 **Team Members:** Brad, Ken

Conditions: Clear, Dry **Method:** inside lane, every car

Speed Groups (1)	Number Observed (2)	Frequency (3)	Cumulative Frequency (4)	Plotted Speed (5)
13	1	1%	1%	13
14	0	0%	1%	14
15	0	0%	1%	15
16	0	0%	1%	16
17	0	0%	1%	17
18	0	0%	1%	18
19	1	1%	2%	19
20	1	1%	3%	20
21	0	0%	3%	21
22	0	0%	3%	22
23	0	0%	3%	23
24	0	0%	3%	24
25	2	2%	5%	25
26	3	3%	8%	26
27	5	5%	13%	27
28	12	12%	25%	28
29	9	9%	34%	29
30	11	11%	45%	30
31	8	8%	53%	31
32	13	13%	66%	32
33	12	12%	78%	33
34	6	6%	84%	34
35	6	6%	90%	35
36	2	2%	92%	36
37	1	1%	93%	37
38	1	1%	94%	38
39	0	0%	94%	39
40	4	4%	98%	40
41	0	0%	98%	41
42	1	1%	99%	42
43	0	0%	99%	43
44	1	1%	100%	44
45	0	0%	100%	45


Spot Speed Plot
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Cumulative Frequency
0
10
20
30
40
50
Observed Speed

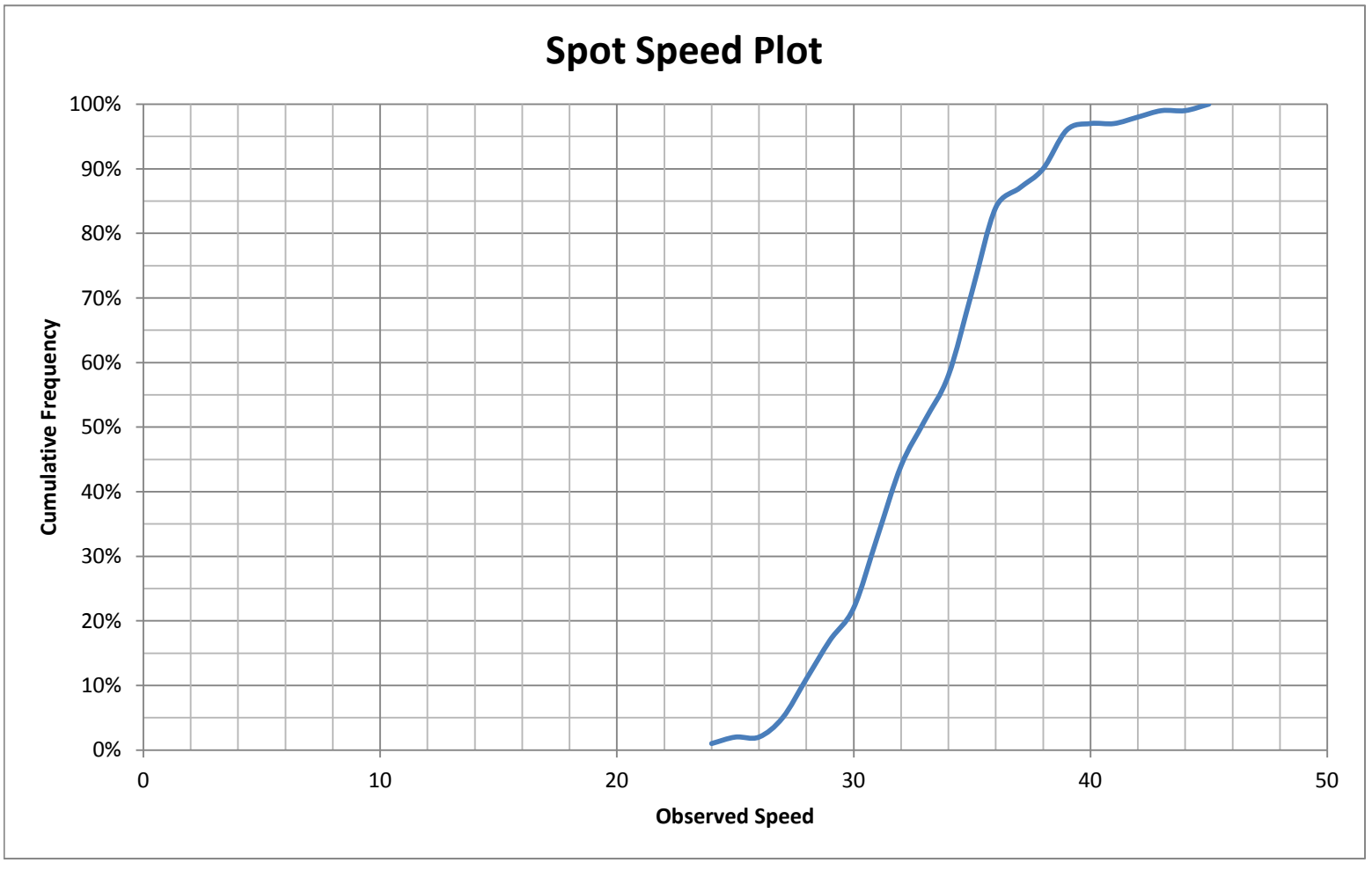
Data Analysis Spreadsheet

Location: 4 **Time:** 5:38PM

Date: 9 February, 2012 **Team Members:** Shawn, Alex

Conditions: Overcast, Cloudy **Method:** both lanes, every third

Speed Groups (1)	Number Observed (2)	Frequency (3)	Cumulative Frequency (4)	Plotted Speed (5)
24	1	1%	1%	24
25	1	1%	2%	25
26	0	0%	2%	26
27	3	3%	5%	27
28	6	6%	11%	28
29	6	6%	17%	29
30	5	5%	22%	30
31	11	11%	33%	31
32	11	11%	44%	32
33	7	7%	51%	33
34	7	7%	58%	34
35	13	13%	71%	35
36	13	13%	84%	36
37	3	3%	87%	37
38	3	3%	90%	38
39	6	6%	96%	39
40	1	1%	97%	40
41	0	0%	97%	41
42	1	1%	98%	42
43	1	1%	99%	43
44	0	0%	99%	44
45	1	1%	100%	45


Spot Speed Plot
Cumulative Frequency
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
10
20
30
40
50
Observed Speed

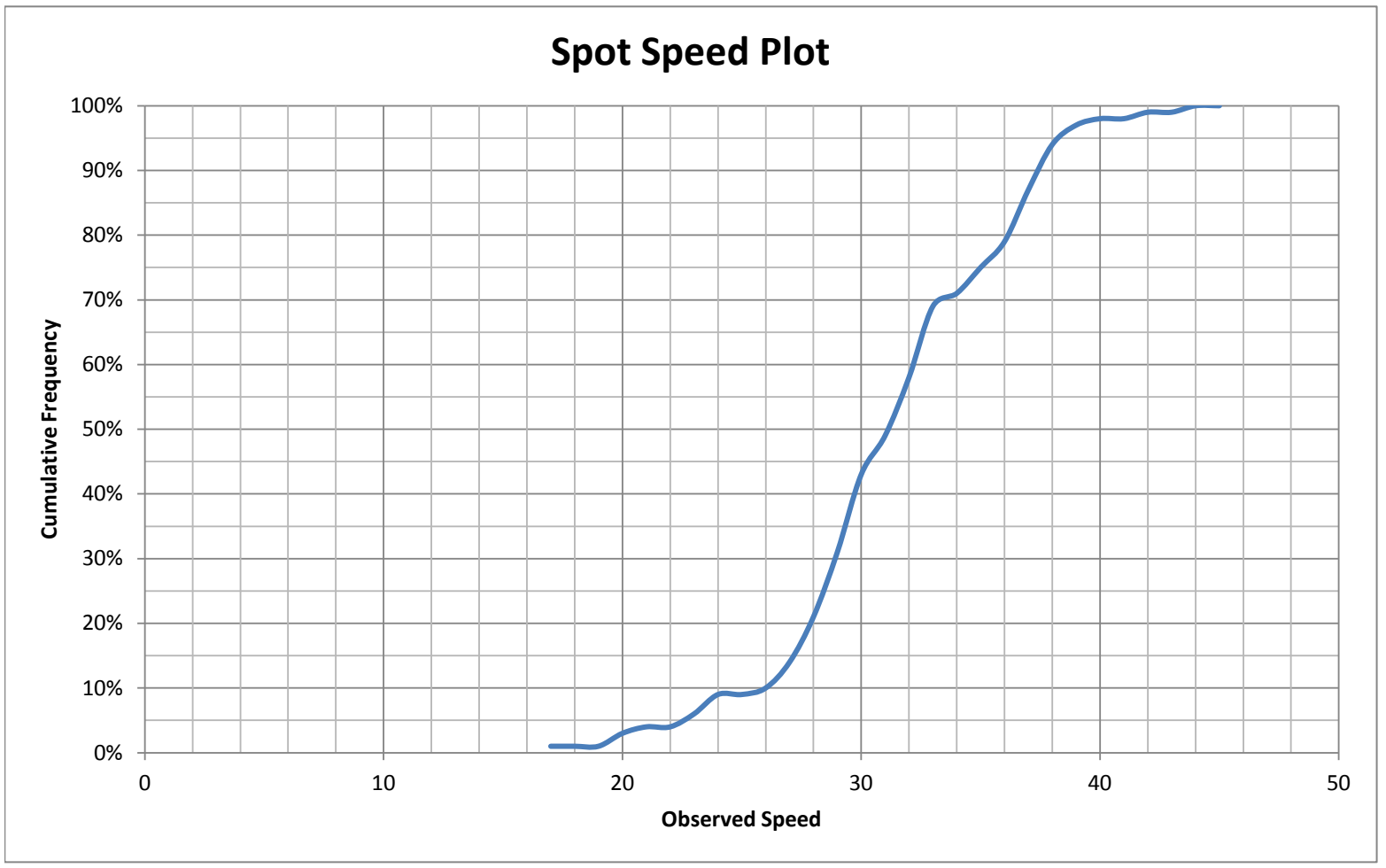
Data Analysis Spreadsheet

Location: 4 **Time:** 5:23 PM

Date: 4 February, 2012 **Team Members:** All

Conditions: Clear, Dry **Method:** outside lane, every car

Speed Groups (1)	Number Observed (2)	Frequency (3)	Cumulative Frequency (4)	Plotted Speed (5)
17	1	1%	1%	17
18	0	0%	1%	18
19	0	0%	1%	19
20	2	2%	3%	20
21	1	1%	4%	21
22	0	0%	4%	22
23	2	2%	6%	23
24	3	3%	9%	24
25	0	0%	9%	25
26	1	1%	10%	26
27	4	4%	14%	27
28	7	7%	21%	28
29	10	10%	31%	29
30	12	12%	43%	30
31	6	6%	49%	31
32	9	9%	58%	32
33	11	11%	69%	33
34	2	2%	71%	34
35	4	4%	75%	35
36	4	4%	79%	36
37	8	8%	87%	37
38	7	7%	94%	38
39	3	3%	97%	39
40	1	1%	98%	40
41	0	0%	98%	41
42	1	1%	99%	42
43	0	0%	99%	43
44	1	1%	100%	44
45	0%	0%	100%	45


Spot Speed Plot
Cumulative Frequency
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
10
20
30
40
50
Observed Speed


5
6

Start Date 2/9/2012
Start Time 17:00
Site Code Daybreak View Pkwy and S Kestrel Rise Rd.

Street Nam	Westbound				Northbound				Eastbound				Southbound					MAJOR STREET	MINOR STREET	Pedestrian Volume
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds				
5:00 PM	2	57	2	0	5	0	0	4	0	0	0	4	0	5	1	1		61	11	9
5:05 PM	1	53	1	0	3	0	0	4	0	0	0	0	0	1	0	0		55	4	4
5:10 PM	3	59	1	0	3	0	0	5	0	0	0	0	0	5	1	0		63	9	5
5:15 PM	2	47	0	1	4	0	0	2	0	0	0	0	0	8	0	0		49	12	3
5:20 PM	0	53	3	0	2	1	0	0	0	0	0	0	0	10	0	4		56	13	4
5:25 PM	1	53	2	0	2	0	0	0	0	0	0	0	0	3	0	0		56	5	0
5:30 PM	2	54	2	0	0	0	0	0	0	0	0	1	0	7	0	1		58	7	2
5:35 PM	0	53	1	1	0	1	0	0	0	0	0	0	0	5	1	1		54	7	2
5:40 PM	2	53	1	6	5	0	0	0	0	0	0	0	0	4	1	0		56	10	6
5:45 PM	3	57	3	0	1	1	0	0	0	0	0	0	0	3	0	2		63	5	2
5:50 PM	4	56	2	0	1	0	0	0	0	0	0	0	0	4	0	0		62	5	0
5:55 PM	3	66	5	0	5	0	0	0	0	0	0	0	0	9	0	1		74	14	1
6:00 PM	6	70	3	1	4	0	0	0	0	0	0	0	0	6	0	1		79	10	2
6:05 PM	3	44	3	0	1	0	0	0	0	0	0	0	0	4	0	0		50	5	0
Total	32	775	29	9	36	3	0	15	0	0	0	5	0	74	4	11	Total	836	117	40
																	Peak Hour	725	101	31

Start Date 2/4/2012
Start Time 15:15
Site Code Daybreak View Pkwy and S Kestrel Rise Rd.

Street Nam	Southbound				Westbound				Northbound				Eastbound				MAJOR STREET	MINOR STREET	PEDESTRIAN
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds			
3:15 PM	0	2	0	0	3	31	4	3	2	3	0	4	0	0	0	0	38	7	7
3:20 PM	0	4	2	0	2	31	1	0	9	0	0	2	0	0	0	0	34	15	2
3:25 PM	0	0	1	3	5	34	2	0	1	2	0	0	0	0	0	0	41	4	3
3:30 PM	0	0	1	0	3	36	5	0	3	2	0	0	0	0	0	0	44	6	0
3:35 PM	0	2	1	2	5	39	1	1	6	0	0	0	0	0	0	0	45	9	3
3:40 PM	0	3	0	0	9	30	0	1	3	1	0	0	0	0	0	0	39	7	1
3:45 PM	0	1	1	0	5	39	0	1	6	0	0	0	0	0	0	0	44	8	1
3:50 PM	0	4	0	0	2	28	1	3	1	1	0	0	0	0	0	4	31	6	7
3:55 PM	0	0	0	0	1	31	2	2	3	1	0	5	0	0	0	0	34	4	7
4:00 PM	0	2	0	0	6	49	0	0	2	2	0	0	0	0	0	6	55	6	6
4:05 PM	0	5	0	6	3	43	2	0	2	1	0	6	0	0	0	0	48	8	12
4:10 PM	0	1	2	1	3	31	1	0	2	1	0	0	0	0	0	0	35	6	1
4:15 PM	0	4	1	0	6	34	0	1	3	2	1	0	0	0	0	1	40	11	2
4:20 PM	0	3	0	0	6	40	1	5	2	0	0	4	0	0	0	0	47	5	9
4:25 PM	0	2	1	3	7	28	3	2	1	1	0	2	0	0	0	0	38	5	7
4:30 PM	0	1	1	1	3	25	3	0	0	0	0	2	0	0	0	0	31	2	3
4:35 PM	0	2	0	2	5	38	2	1	1	2	0	1	0	0	0	0	45	5	4
4:40 PM	0	2	0	0	3	29	1	2	6	2	0	0	0	0	0	0	33	10	2
4:45 PM	0	1	0	0	4	32	1	1	1	1	0	0	0	0	0	0	37	3	1
4:50 PM	0	1	2	0	3	36	2	0	2	0	0	0	0	0	0	0	41	5	0
4:55 PM	0	1	0	0	2	27	1	2	2	1	0	2	0	0	0	0	30	4	4
5:00 PM	0	1	0	0	6	32	1	0	4	0	0	0	0	0	0	0	39	5	0
5:05 PM	0	3	0	0	3	44	4	0	4	0	0	0	0	0	0	0	51	7	0
																Total	920	148	82
																Peak Hour	480	70	51

Start Date 2/4/2012
Start Time 15:20
Site Code W Daybreak Rim Way and S Kestrel Rise Rd

Street Nam	Southbound				Westbound				Northbound				Eastbound				MAJOR STREET	MINOR STREET	PEDESTRAIN
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds			
3:20 PM	2	3	0	3	0	0	0	1	0	4	0	0	3	46	0	4	49	6	8
3:25 PM	4	4	0	1	0	0	0	0	1	2	0	0	2	33	1	5	36	9	6
3:30 PM	3	4	0	0	0	0	0	1	0	2	4	1	2	53	1	1	56	8	3
3:35 PM	3	2	0	3	0	0	0	2	0	3	1	3	1	40	1	0	42	7	8
3:40 PM	6	2	0	4	0	0	0	0	0	2	3	0	6	50	0	3	56	8	7
3:45 PM	10	2	0	2	0	0	0	7	0	4	1	1	4	30	2	6	36	19	16
3:50 PM	9	2	0	1	0	0	0	1	0	2	2	2	0	32	0	2	32	12	6
3:55 PM	3	0	0	2	0	0	0	5	0	0	6	0	4	22	1	1	27	8	8
4:00 PM	3	2	0	1	0	0	0	2	0	4	3	0	1	33	2	0	36	7	3
4:05 PM	2	2	0	1	0	0	0	0	0	4	0	0	4	34	1	4	39	4	5
4:10 PM	5	0	0	1	0	0	0	0	0	1	1	0	2	38	1	0	41	5	1
4:15 PM	4	3	0	1	0	0	0	0	0	2	0	0	1	41	0	6	42	7	7
4:20 PM	6	3	0	3	0	0	0	3	0	1	2	2	1	29	0	6	30	12	14
4:25 PM	10	2	0	0	0	0	0	2	0	3	1	0	1	28	2	4	31	14	6
4:30 PM	3	0	0	4	0	0	0	0	0	1	1	1	1	32	2	3	35	3	8
4:35 PM	3	2	0	2	0	0	0	0	0	3	2	2	2	44	0	1	46	5	5
4:40 PM	6	2	0	6	0	0	0	3	0	6	2	0	1	42	1	8	44	11	17
4:45 PM	3	0	0	0	0	0	0	0	0	1	0	0	1	51	1	2	53	3	2
4:50 PM	4	0	1	7	0	0	0	12	0	0	0	0	2	22	0	0	24	17	19
4:55 PM	4	0	0	3	0	0	0	1	0	4	1	0	2	37	3	2	42	5	6
5:00 PM	2	2	0	3	0	0	0	4	0	2	1	0	3	52	2	0	57	8	7
5:05 PM	4	2	0	4	0	0	0	0	0	2	1	0	0	36	2	4	38	6	8
5:10 PM	9	1	0	0	0	0	0	2	0	4	0	0	0	38	1	0	39	12	2
																	Total	931	196	172
																	Peak Hour	484	94	97

Start Date	2/10/2012																						
Start Time	7:15																						
Site Code	W Daybreak Rim Way and S Kestrel Rise Rd																						
Street Name	Westbound				Northbound				Eastbound				Southbound								MAJOR STREET	MINOR STREET	PEDESTRAIN
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds							
7:15 AM	0	0	0	0	0	1	0	0	3	54	0	0	0	0	0	0					57	1	0
7:20 AM	0	0	0	0	0	3	0	0	1	51	0	0	3	0	0	0					52	6	0
7:25 AM	0	0	0	0	0	1	0	0	0	48	0	0	3	0	0	0					48	4	0
7:30 AM	0	0	0	0	0	3	1	0	2	51	0	0	2	0	0	0					53	6	0
7:35 AM	0	0	0	0	0	4	1	0	2	66	0	0	1	0	0	0					68	6	0
7:40 AM	0	0	0	0	0	5	1	0	2	69	1	0	2	1	0	0					72	9	0
7:45 AM	0	0	0	0	0	5	0	0	0	60	0	0	5	0	0	0					60	10	0
7:50 AM	0	0	0	0	0	4	0	0	2	63	0	0	5	0	0	0					65	9	0
7:55 AM	0	0	0	0	0	4	0	0	4	64	0	0	5	1	0	0					68	10	0
8:00 AM	0	0	0	0	0	2	0	0	1	44	1	0	2	1	0	0					46	5	0
8:05 AM	0	0	0	0	0	4	0	0	1	57	1	0	2	0	0	0					59	6	0
Total	0	0	0	0	0	36	3	0	18	627	3	0	30	3	0	0		Total			648	72	0
																		Peak Hour			648	72	0

TWO-WAY STOP CONTROL SUMMARY

General Information

Analyst	*Shawn Larson*
Agency/Co.	
Date Performed	*2/21/2012*
Analysis Time Period	

Site Information

Intersection	*North Couplet Intersection*
Jurisdiction	
Analysis Year	*2012*

Project Description

East/West Street: *Daybreak View Pkwy* | North/South Street: *S Kestrel Rise Rd.*

Intersection Orientation: *East-West* | Study Period (hrs): *1.00*

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)				*32*	*775*	*29*
Peak-Hour Factor, PHF	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*
Hourly Flow Rate, HFR (veh/h)	*0*	*0*	*0*	*32*	*775*	*29*
Percent Heavy Vehicles	*0*	--	--	*0*	--	--
Median Type	*Undivided*					
RT Channelized			*0*			*0*
Lanes	*0*	*0*	*0*	*0*	*2*	*0*
Configuration				*LT*		*TR*
Upstream Signal		*0*			*0*	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	*36*	*3*	*4*	*0*	*74*	*0*
Peak-Hour Factor, PHF	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*
Hourly Flow Rate, HFR (veh/h)	*36*	*3*	*4*	*0*	*74*	*0*
Percent Heavy Vehicles	*0*	*0*	*0*	*0*	*0*	*0*
Percent Grade (%)		*0*			*0*	
Flared Approach		*N*			*N*	
Storage		*0*			*0*	
RT Channelized			*0*			*0*
Lanes	*0*	*1*	*0*	*0*	*1*	*0*
Configuration		*LTR*			*LTR*	

Delay, Queue Length, and Level of Service

Approach	Eastbound	Westbound	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		*LT*		*LTR*			*LTR*	
v (veh/h)		*32*		*43*			*74*	
C (m) (veh/h)		*1626*		*392*			*281*	
v/c		*0.02*		*0.11*			*0.26*	
95% queue length		*0.06*		*0.37*			*1.06*	
Control Delay (s/veh)		*7.3*		*15.3*			*22.4*	
LOS		*A*		*C*			*C*	
Approach Delay (s/veh)	--	--	*15.3*			*22.4*		
Approach LOS	--	--	*C*			*C*		

TWO-WAY STOP CONTROL SUMMARY

General Information

Analyst	*Shawn Larson*
Agency/Co.	
Date Performed	*2/21/2012*
Analysis Time Period	

Site Information

Intersection	*South Couplet Intersection*
Jurisdiction	
Analysis Year	*2012*

Project Description

East/West Street: *W Daybreak Rim Way* | North/South Street: *S Kestrel Rise Rd*

Intersection Orientation: *East-West* | Study Period (hrs): *0.92*

Vehicle Volumes and Adjustments

Major Street	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)				*18*	*621*	*3*
Peak-Hour Factor, PHF	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*
Hourly Flow Rate, HFR (veh/h)	*0*	*0*	*0*	*18*	*621*	*3*
Percent Heavy Vehicles	*0*	--	--	*0*	--	--
Median Type	*Undivided*					
RT Channelized			*0*			*0*
Lanes	*0*	*0*	*0*	*0*	*2*	*0*
Configuration				*LT*		*TR*
Upstream Signal		*0*			*0*	

Minor Street	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	*0*	*36*	*3*	*30*	*3*	*0*
Peak-Hour Factor, PHF	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*	*1.00*
Hourly Flow Rate, HFR (veh/h)	*0*	*36*	*3*	*30*	*3*	*0*
Percent Heavy Vehicles	*0*	*0*	*0*	*0*	*0*	*0*
Percent Grade (%)		*0*			*0*	
Flared Approach		*N*			*N*	
Storage		*0*			*0*	
RT Channelized			*0*			*0*
Lanes	*0*	*1*	*0*	*0*	*1*	*0*
Configuration		*LTR*			*LTR*	

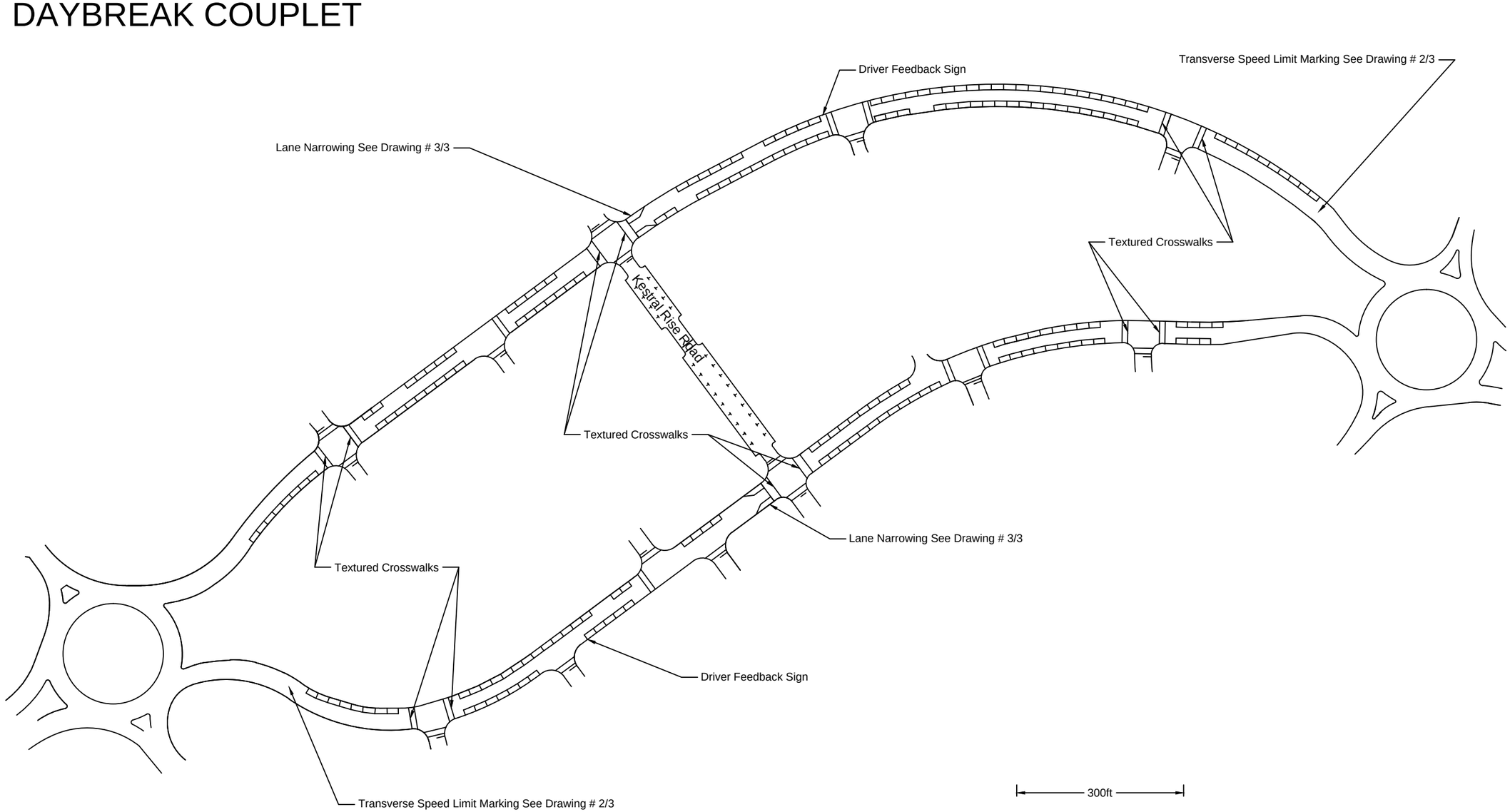
Delay, Queue Length, and Level of Service

Approach	Eastbound	Westbound	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration		*LT*		*LTR*			*LTR*	
v (veh/h)		*18*		*39*			*33*	
C (m) (veh/h)		*1636*		*402*			*343*	
v/c		*0.01*		*0.10*			*0.10*	
95% queue length		*0.03*		*0.32*			*0.32*	
Control Delay (s/veh)		*7.2*		*14.9*			*16.6*	
LOS		*A*		*B*			*C*	
Approach Delay (s/veh)	--	--	*14.9*			*16.6*		
Approach LOS	--	--	*B*			*C*		

HCS+™ Version 5.2

Generated: 3/3/2012 2:57 PM

DAYBREAK COUPLET



TWGS Eng.

Created: April 5, 2012

Daybreak Parkway Couplet

NOTES:

1. Textured crosswalks are stamped asphalt
2. Traffic feedback signs to be placed in accord--ing to standard practice

DRAWING #: 1/3

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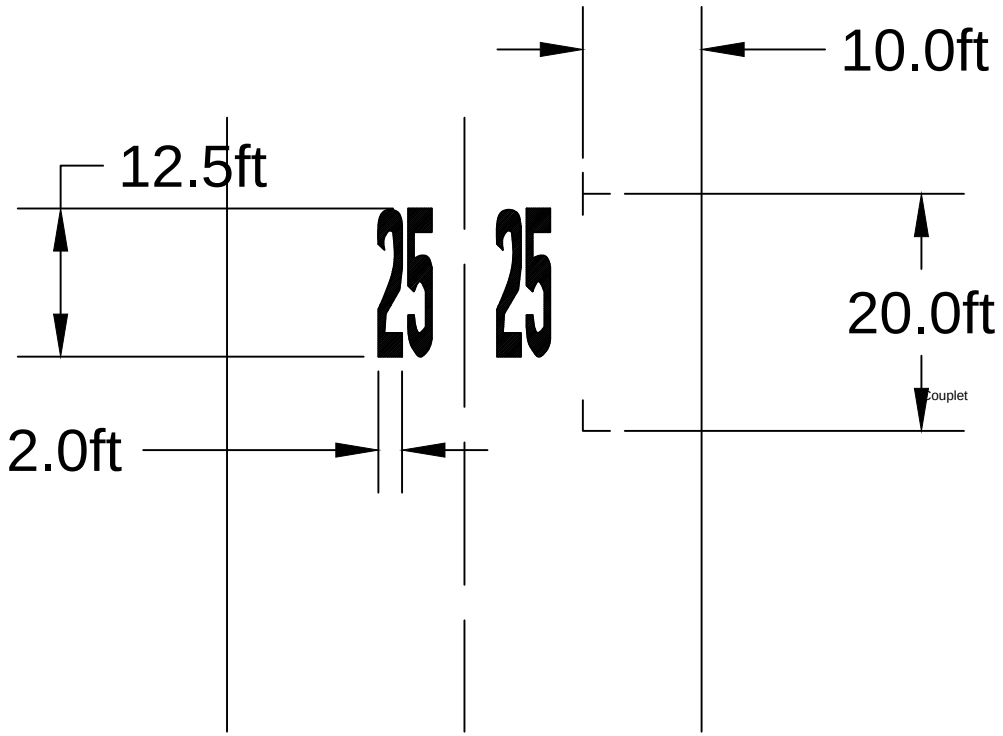
TRANSVERSE SPEED LIMIT MARKING DETAIL



TWGS Eng.

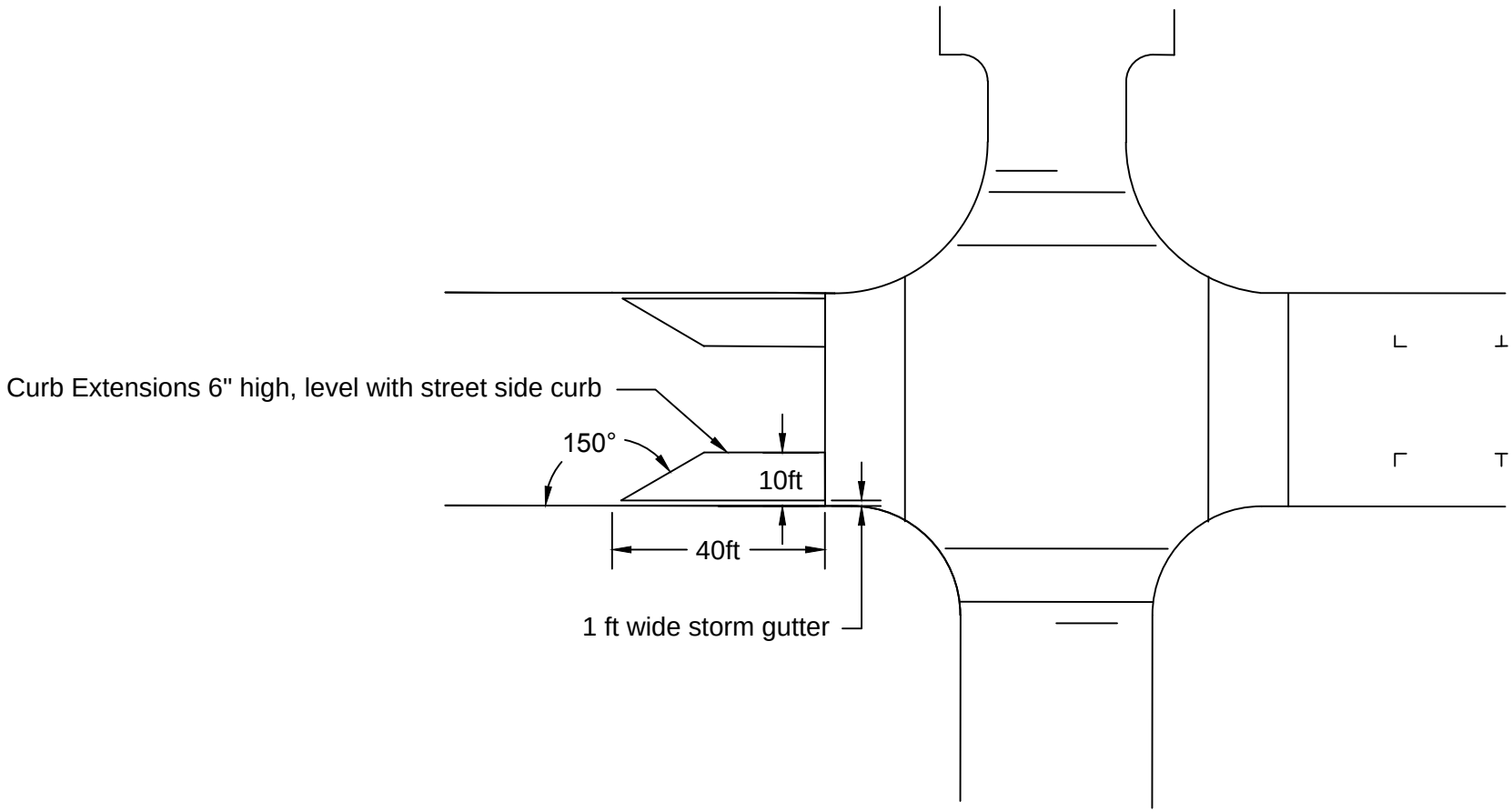
Created: April 5, 2012

NOTES

1.Drawing Detail to be used in locations specified in drawing # 1/3
2. Stripping to be in accordance with MUTCD 3B.15 and Standard Highway Signs and Markings pages 10-1 through 10-25.
3. Stripping to be placed using retro-reflective tape.
4. Transverse marks to be in lane center

DRAWING #: 2/3

DAYBREAK COUPLET



TWGS Eng.

Created: April 5, 2012

Daybreak Parkway Couplet

NOTES:

1. Curb extension at North intersection on south side interferes with first parking stall, and parking stall striping must be removed

DRAWING #: 3/3

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