

City of Cambridge, MA
Community Development Department
Department of Public Works
Traffic, Parking and Transportation Department



**Reconstruction of Blanchard Road
Post-Construction Evaluation Report**

Submitted by

HDR

April 3, 2012

Introduction and Project History

Blanchard Road is a residential roadway at the northwestern border of the City of Cambridge which accommodates a full cross-section of roadway users including motorists, transit riders, bicyclists and pedestrians. The roadway is under the jurisdiction of the City of Cambridge (“the City”). (See Figure 1 for location).

In 2004, in response to ongoing concerns expressed by residents about traffic safety on Blanchard Road between Grove Street and Concord Avenue, the City began a process to assess the problems and identify both short-term and long-term strategies for improvements. The firm of Vollmer Associates, LLP (Vollmer) was contracted to prepare a safety study documenting the existing conditions and examining short and long term solutions to be considered to address issues identified by the study and meet the goals developed with residents.

Vollmer provided their recommendations to the City in a memorandum dated December 9, 2005 (see Appendix A). The Vollmer recommendations were presented to the community¹, and received strong support, at a meeting conducted on December 15, 2005 (See Appendix B).

In 2006, the City implemented a number of the short-term improvements identified in the Vollmer study, including enhanced safety signage and markings, and clearance of roadside vegetation which had obscured sight distances at critical locations.

In the FY07 budget, the City allocated funding for the design of long-term roadway and sidewalk improvements and contracted with HDR, Inc. to perform additional studies and final design. In the FY08 budget, the City allocated \$1.5 million for the construction of the long-term improvements.

On July 31, 2007, HDR and the City presented three design alternatives to the community. A number of constructive comments were received and a second community meeting was held on September 11, 2007 to review the proposed final concept design. A general consensus was reached among the community members on this design. A follow-up community meeting was held on November 26, 2007 to review minor revisions to the plan.

The project was put out to bid for construction in August 2008, and construction was substantially completed in early 2010.

The remainder of this report provides additional details on the studies conducted, the community process, the selected design, and observed results in the Blanchard Road corridor since the completion of construction.

¹ It should be noted that the entire community process during planning, design, and construction was closely coordinated with the Town of Belmont, as the residences on one side of Blanchard Road are situated in Belmont. Belmont abutters, as well as Cambridge abutters, participated in all community meetings and outreach activities.



Figure 1 – Project Location Map
City of Cambridge – Blanchard Road

Development of Goals

In November, 2004, with improvements to the Grove Street/Blanchard Road/Washington Street intersection being developed, the residents of the Blanchard Road neighborhood felt there was an opportunity to address a history of crashes along Blanchard Road between Grove Street and Concord Avenue. In addressing these accidents a list of project goals was developed including:

- reduce vehicle speeds
- reduce crashes
- improve safety for all users and abutting residents
- improve accommodation for pedestrians and bicycles
- enhance street appearance

Pre-Construction Conditions

Geometric Conditions and Roadway Context

Blanchard Road begins at the intersection of Grove Street/Washington Street in Belmont, crosses immediately into Cambridge and continues in a generally northerly direction along the Belmont/Cambridge border before crossing into Belmont again at Wellington Brook. The study area was limited to the southern section of Blanchard Road between Grove Street and Concord Avenue, which is approximately 2,100 feet in length. It is of note that the roadway and the abutting properties on the south/east side are situated in Cambridge; while abutting properties on the north/west side are in Belmont.

This section of Blanchard Road is abutted by residential property, the Fresh Pond Golf Course, and a portion of one of the last remaining farms inside of the Route 128 beltway. The existing road provided a 28-foot travel-way with a 12-foot lane and a 2-foot shoulder in each direction, separated by a double yellow centerline. No striped bicycles lanes were provided. A bituminous asphalt sidewalk of variable width was provided on the easterly side from Grove Street to Concord Avenue, and on the western side from Concord Avenue to Glenn Road. These sidewalks were narrow with little to no room for pedestrians to pass each other, and did not meet State and Federal accessibility standards.

Regulatory signing along Blanchard Road consisted of two speed limit signs of 30 mph at each end of the study location. Curve warning signs were provided to alert motorists of a sharp curve in the alignment (see below). Additionally, chevrons were provided through the curve in both directions.

A compound curve² was located along the southern section of Blanchard Road approximately 350 feet from Grove Street. The curve was abutted by residential property on both sides of the road and farmland on the westerly side as well. Thick brush, tall trees, fences and stone walls also existed along the roadway edges. Long tangents existed on each end of the compound curve. This provided an opportunity for vehicles to gain speed on the approach to the curve, although conditions within the curve itself were not appropriate for high speed.

Based on GIS data provided by the City, the curve was estimated to be a triple compound curve with approximate radii of 560 feet, 450 feet and 210 feet going from north to south respectively. The 560 foot and 450 foot radii met AASHTO guidelines for a 35 mph design speed, while the 210 foot radius only met criteria for a 25 mph design speed. Additionally for compound curves, it is preferable by AASHTO standards for the ratio of the flatter radius to the sharper radius not exceed 2:1. The 450 feet radius to the 210 foot radius produced a ratio of 2.14 : 1. The compound curve and sight distances would become the focus of solutions proposed to meet the project goals.

Travel Speeds

A speed study was conducted in June 2004 to determine the existing travel speeds. Speeds were collected in both directions at five locations along Blanchard Road between Grove Street and Glenn Road (Figure 2) including:

- Tangent section, south of the curve
- Point of curvature at the south end of the curve
- Midpoint of the curve
- Point of tangency on the north end of the curve
- Tangent section, north of the curve.

The 85th percentile speeds calculated by Vollmer in their 2004/2005 study are shown below in Table 1.

Table 1
2004 85th Percentile Speeds

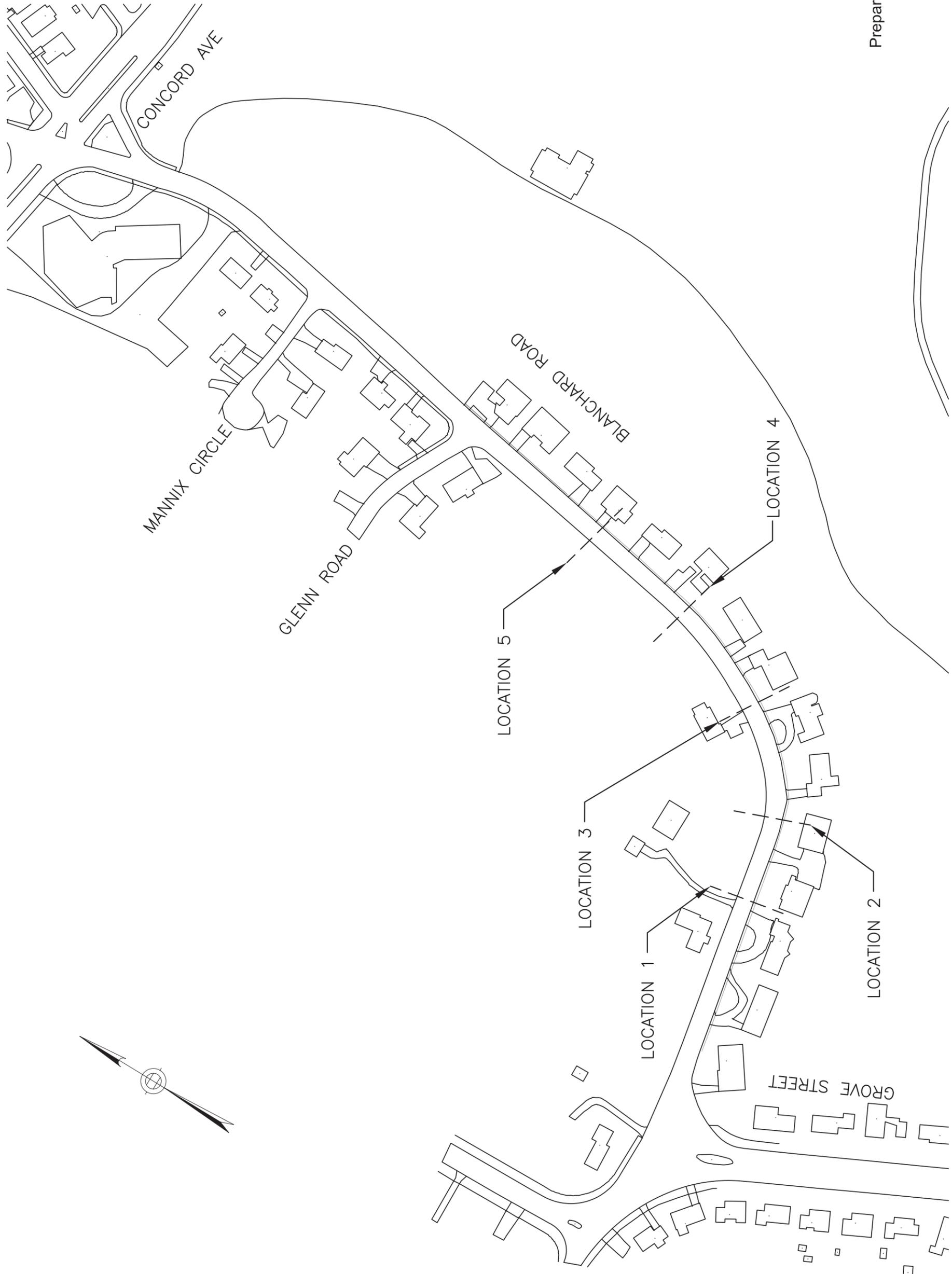
Location	2004 85 th Percentile Speeds	
	Northbound	Southbound
Tangent Section, South of Curve	29	29
Point of Curvature, South of Curve	36	37
Midpoint of Curve	33	34
Point of Tangent, North of Curve	38	40
Tangent Section, North of Curve	35	33

Vollmer also prepared graphics to show a breakdown of vehicle speeds greater and less than 30 MPH at each count location along Blanchard Road (Figure 3 through Figure 12).

² Compound curves are a series of two or more simple curves immediately adjacent to each other, with deflections in the same direction, but with different radii.

Figure 2

**Speed Data
Locations**



Prepared by:

Date:

March 16, 2005

Figure 3
Location 1 - Tangent, South of Curve
Speed Data - Northbound 6/8/04 & 6/9/04 (miles per hour)

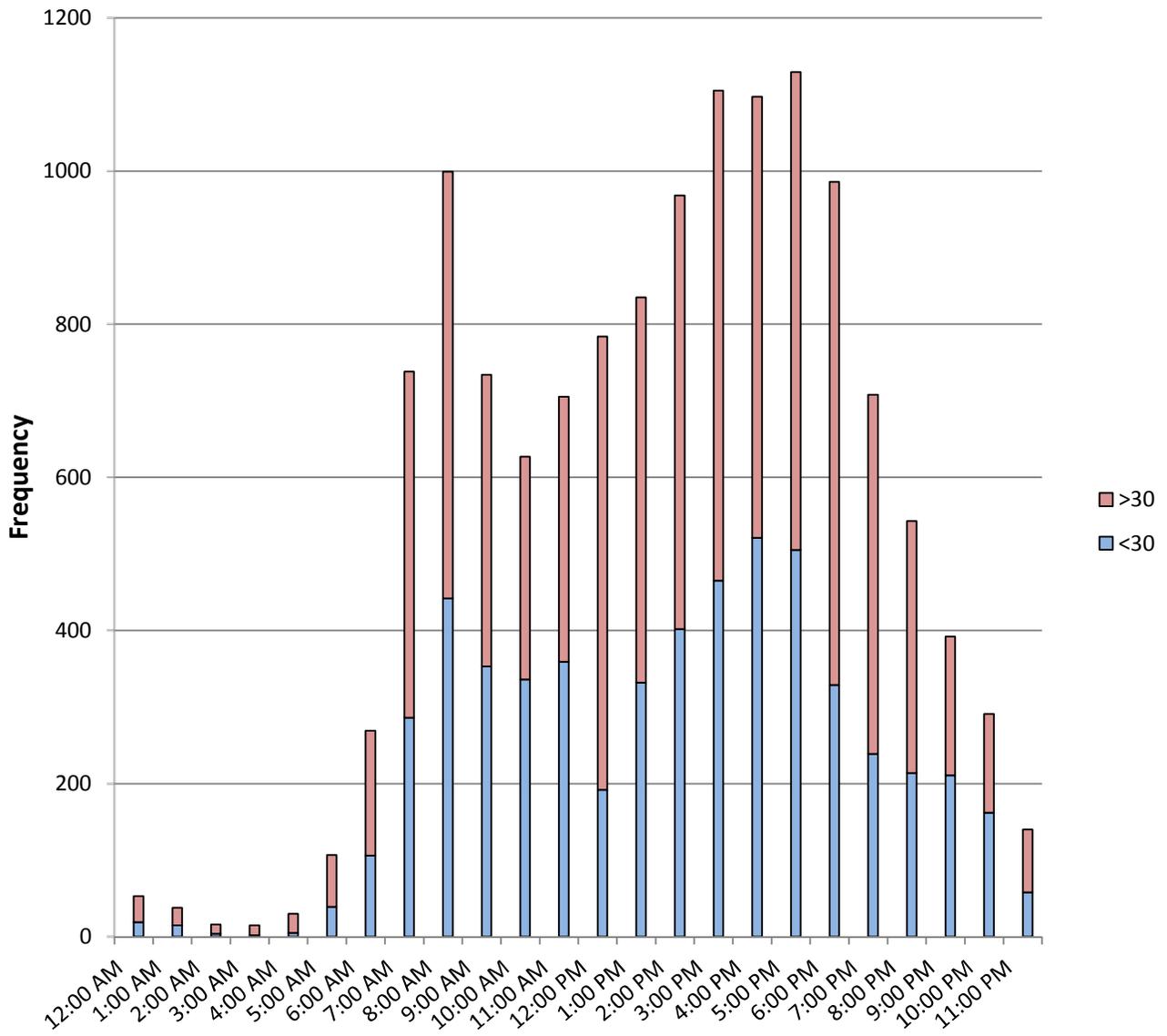


Figure 4
Location 1 - Tangent, South of Curve
Speed Data - Southbound 6/8/04 & 6/9/04 (miles per hour)

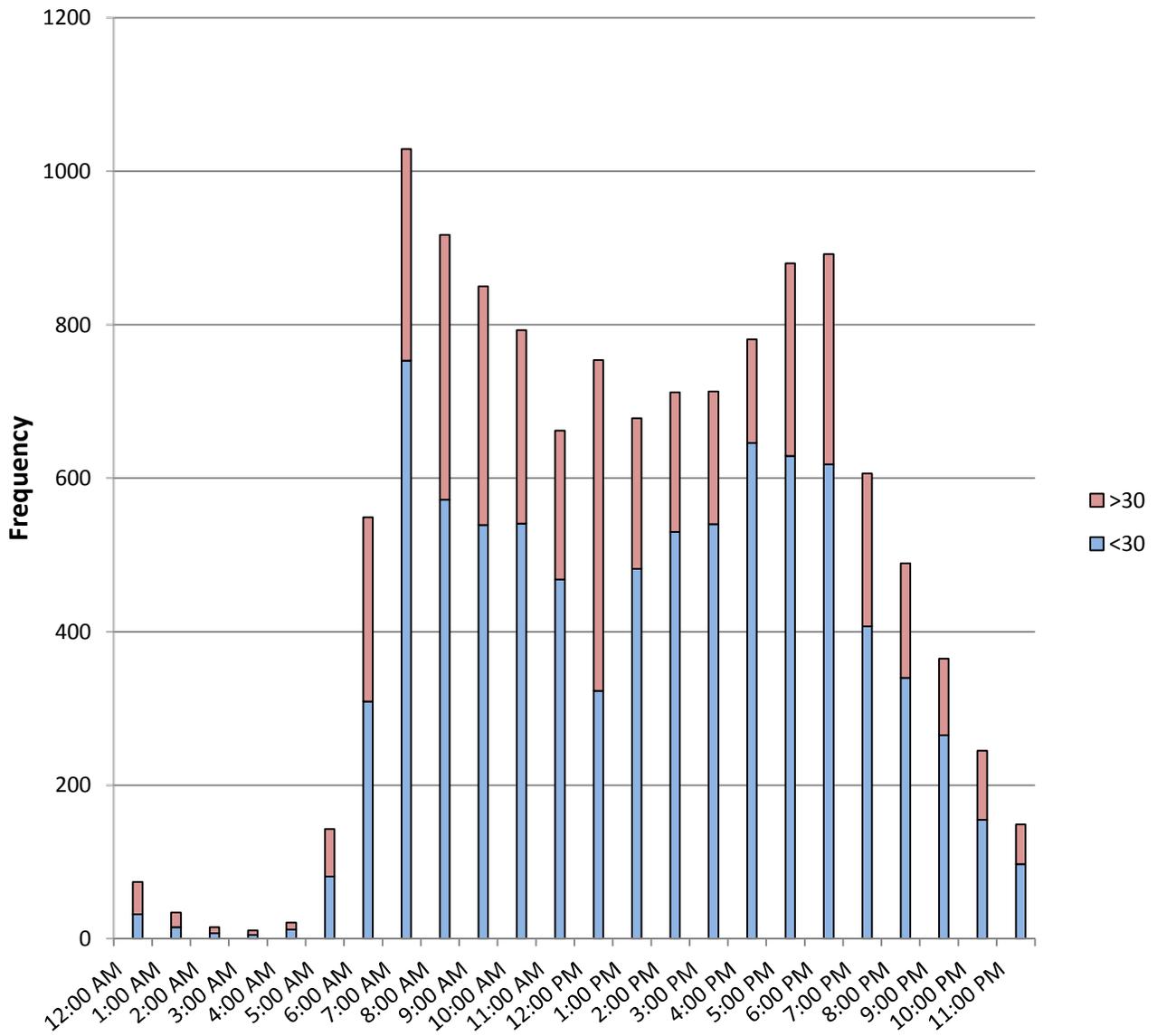


Figure 5
Location 2 - Point of Curvature, South of Curve
Speed Data - Northbound 6/8/04 & 6/9/04 (miles per hour)

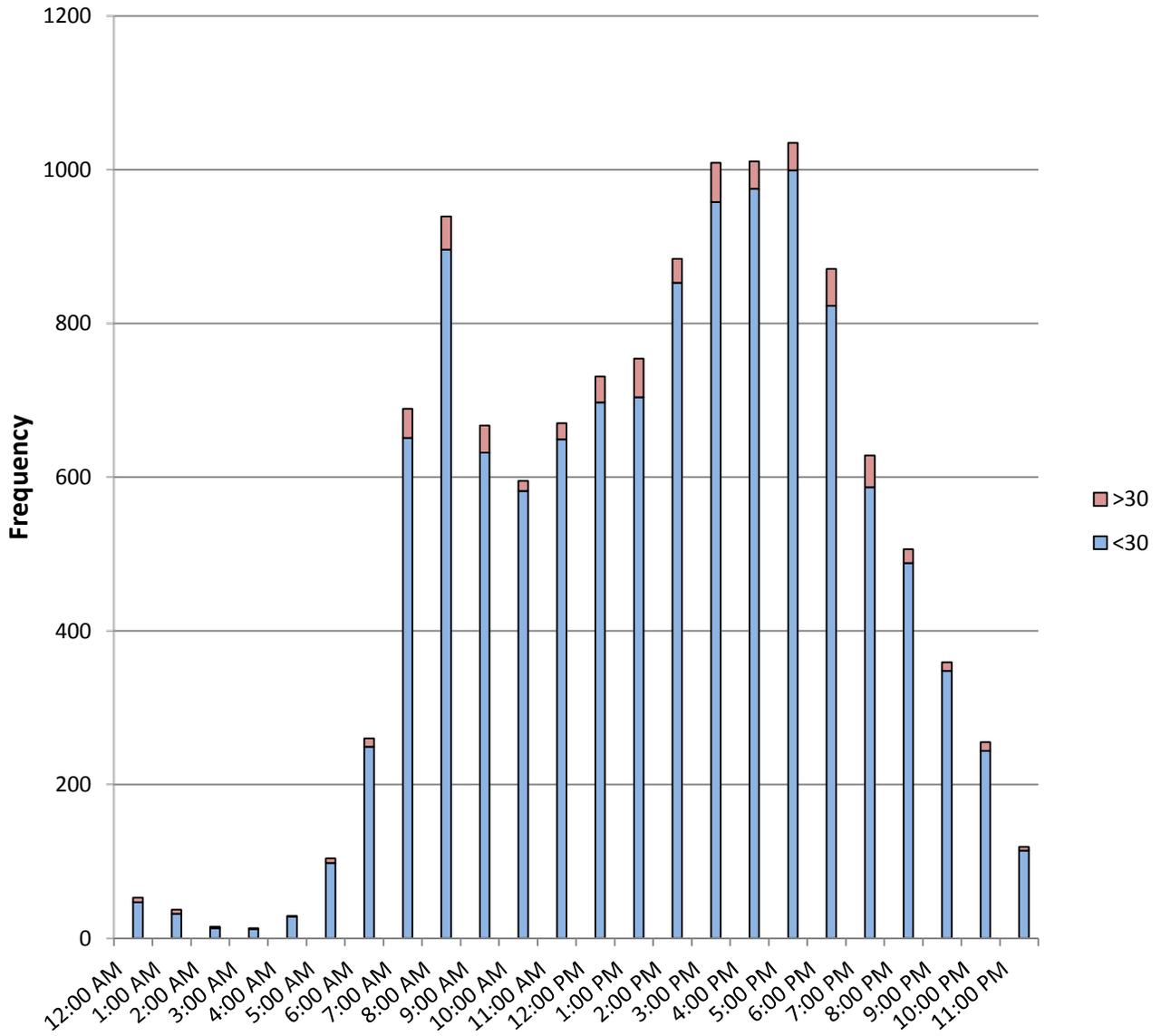


Figure 6
Location 2 - Point of Curvature, South of Curve
Speed Data - Southbound 6/8/04 & 6/9/04 (miles per hour)

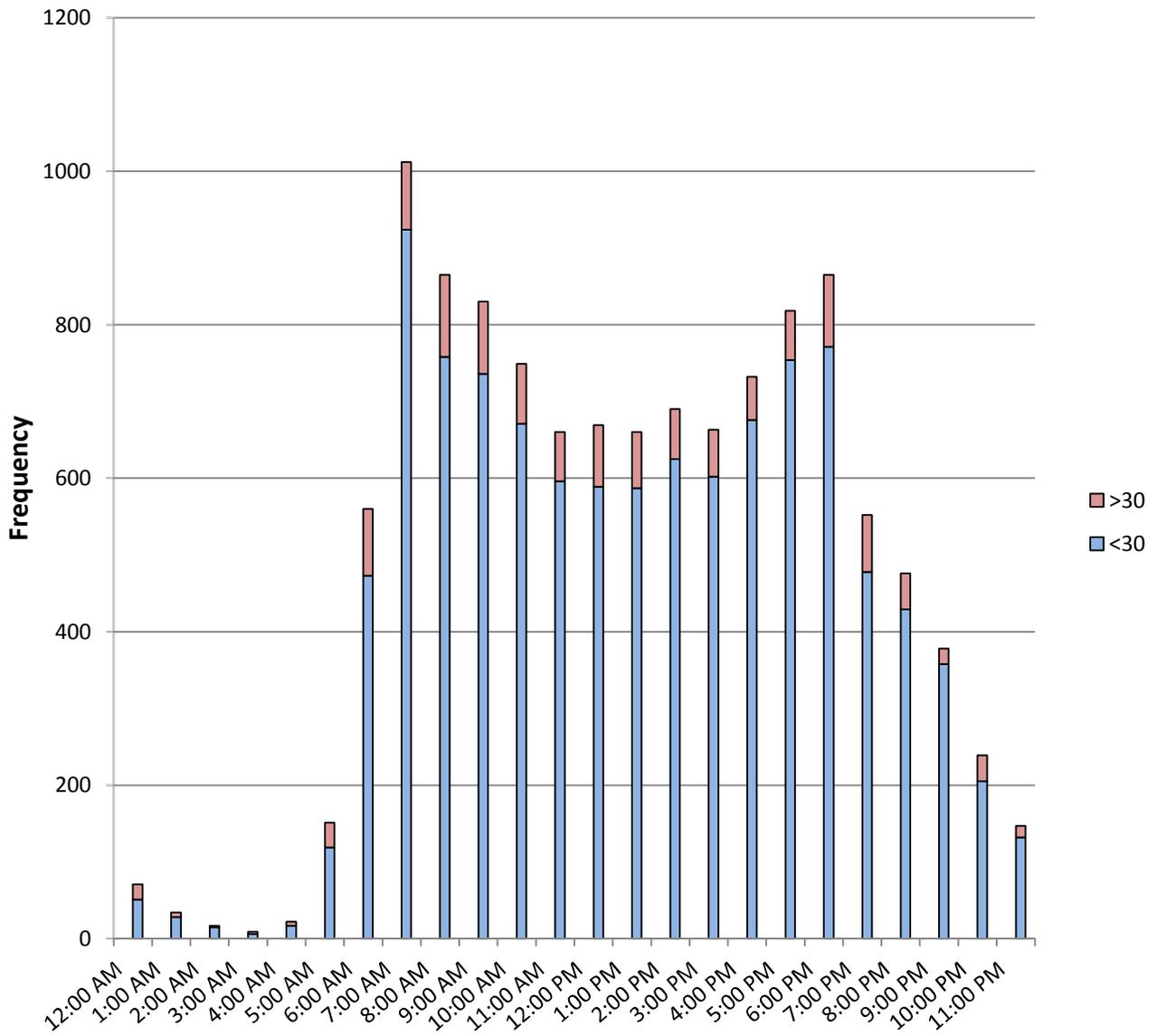


Figure 7
Location 3 - Midpoint of Curve
Speed Data - Northbound 6/8/04 & 6/9/04 (miles per hour)

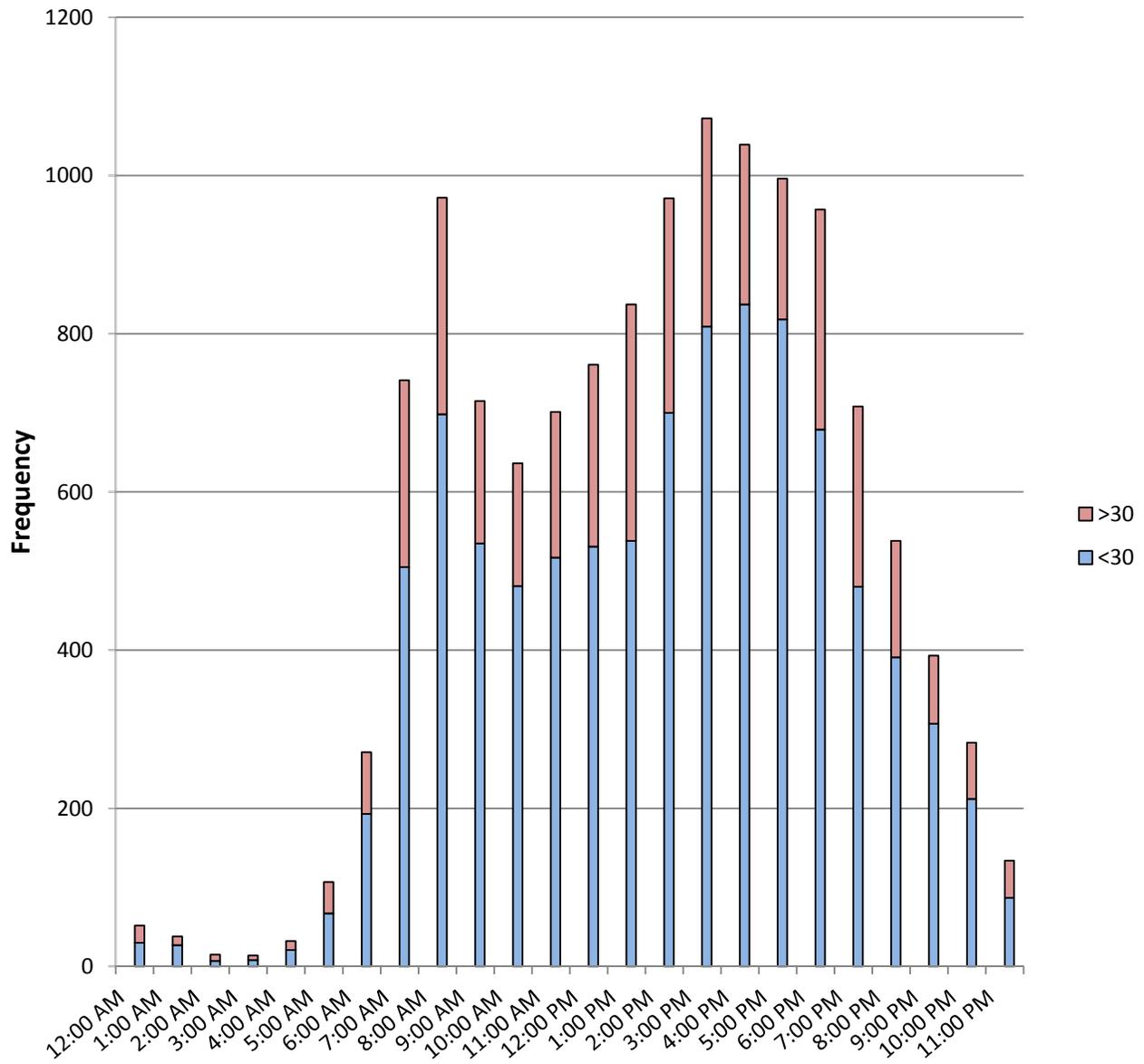


Figure 8
Location 3 - Midpoint of Curve
Speed Data - Southbound 6/8/04 & 6/9/04 (miles per hour)

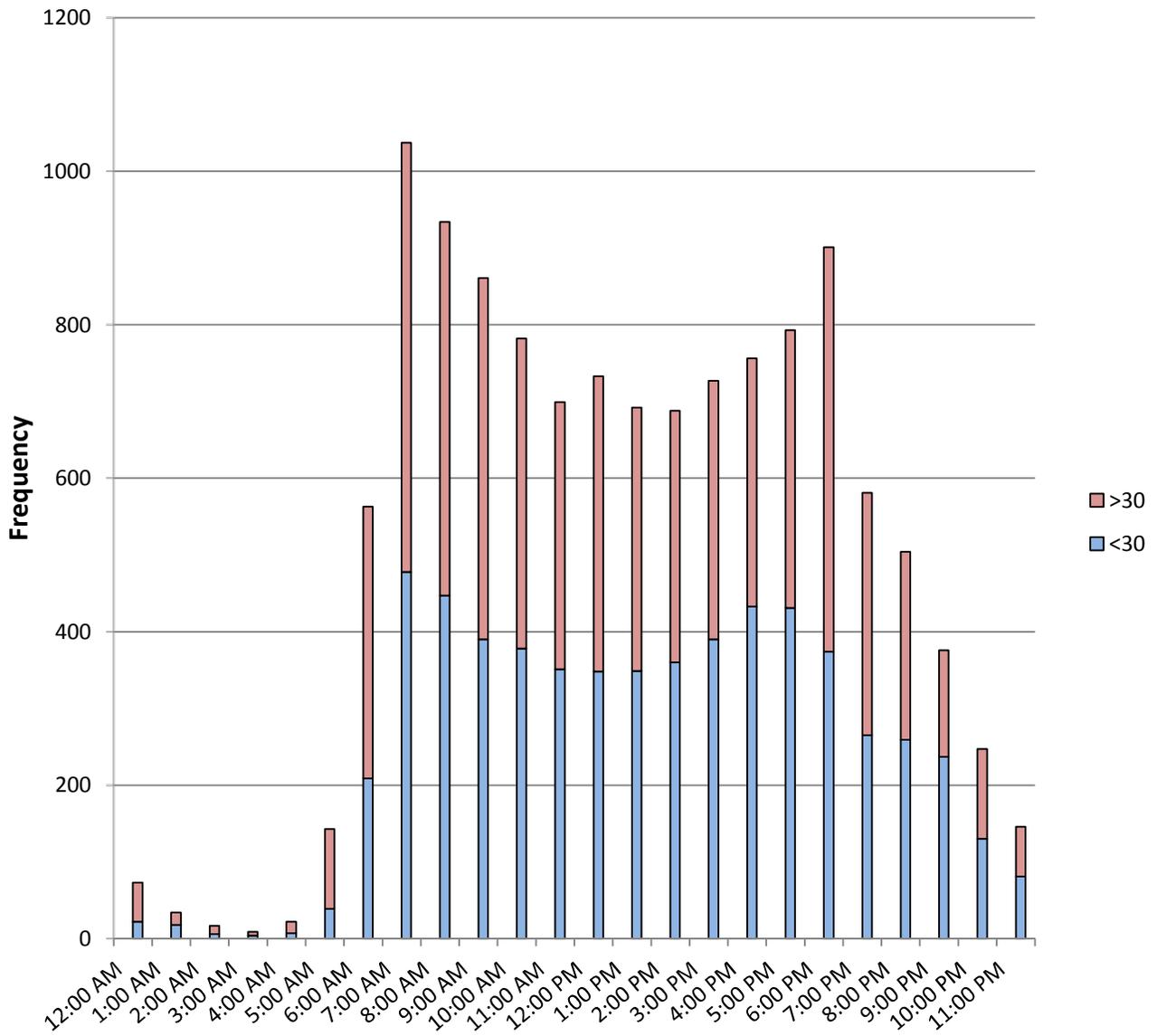


Figure 9
Location 4 - Point of Tangency, North of Curve
Speed Data - Northbound 6/8/04 & 6/9/04 (miles per hour)

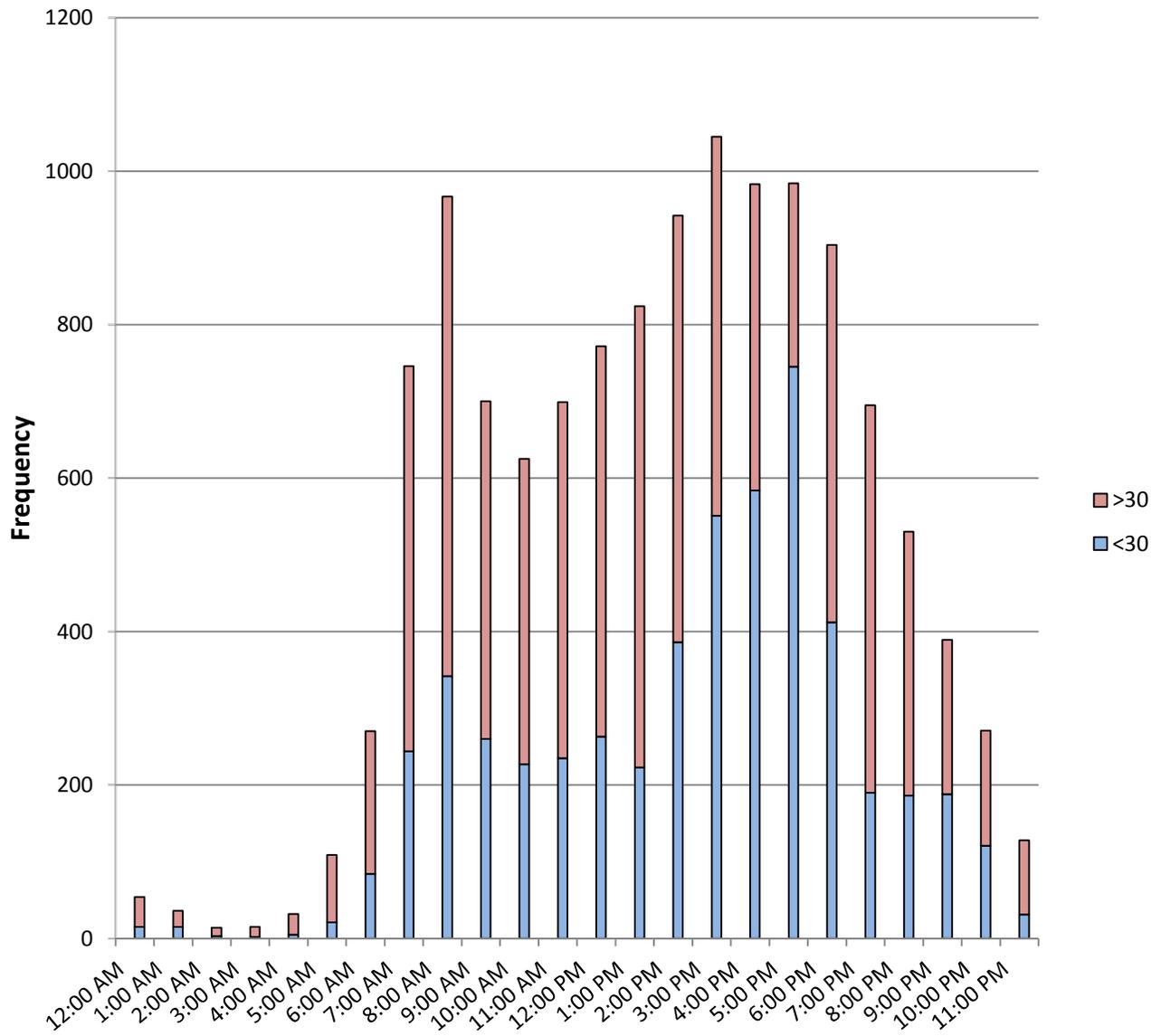


Figure 10
Location 4 - Point of Tangency, North of Curve
Speed Data - 6/8/04 & 6/9/04 (miles per hour)

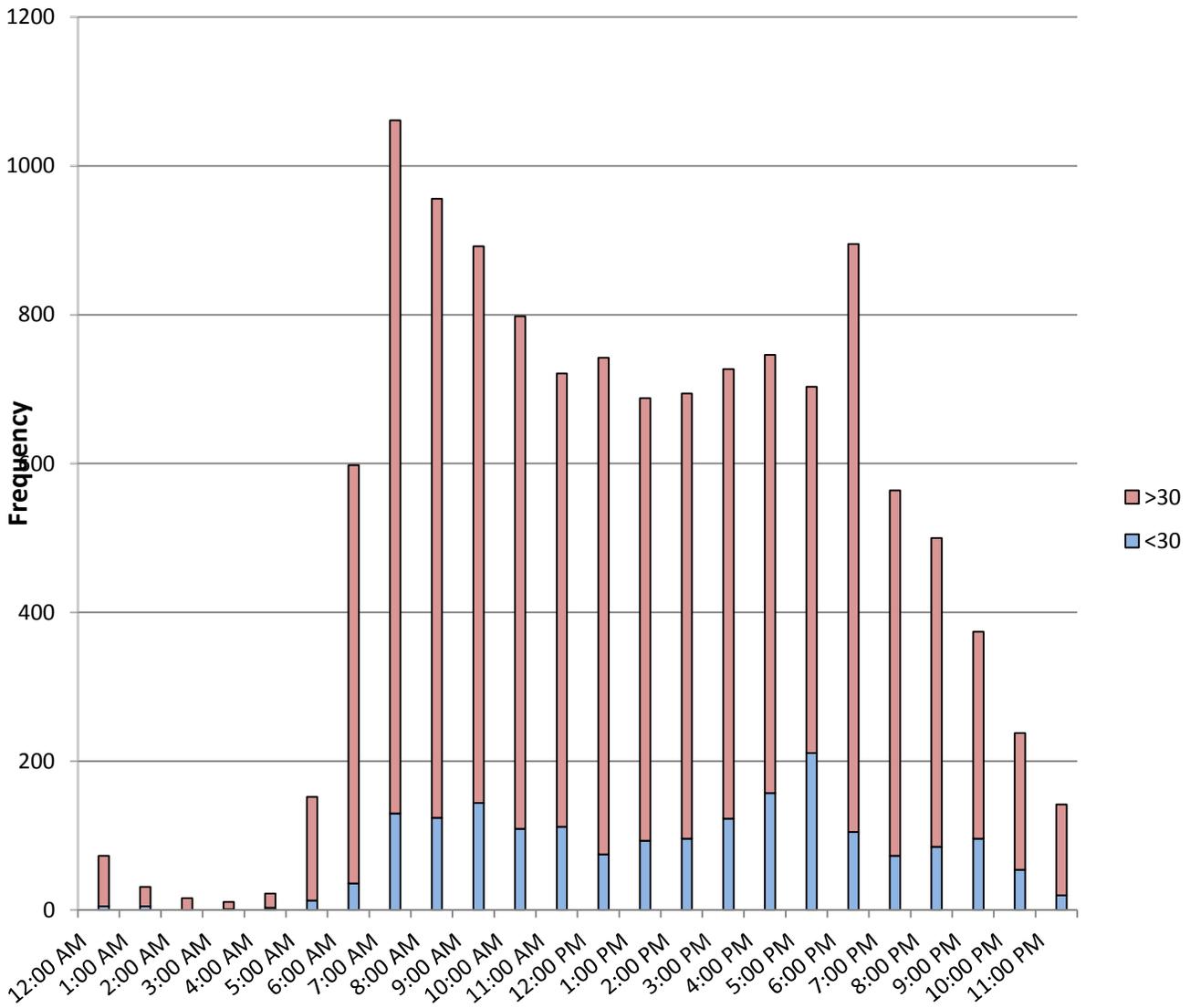


Figure 11
Location 5 - Tangent, North of Curve
Speed Data - Northbound 6/8/04 & 6/9/04 (miles per hour)

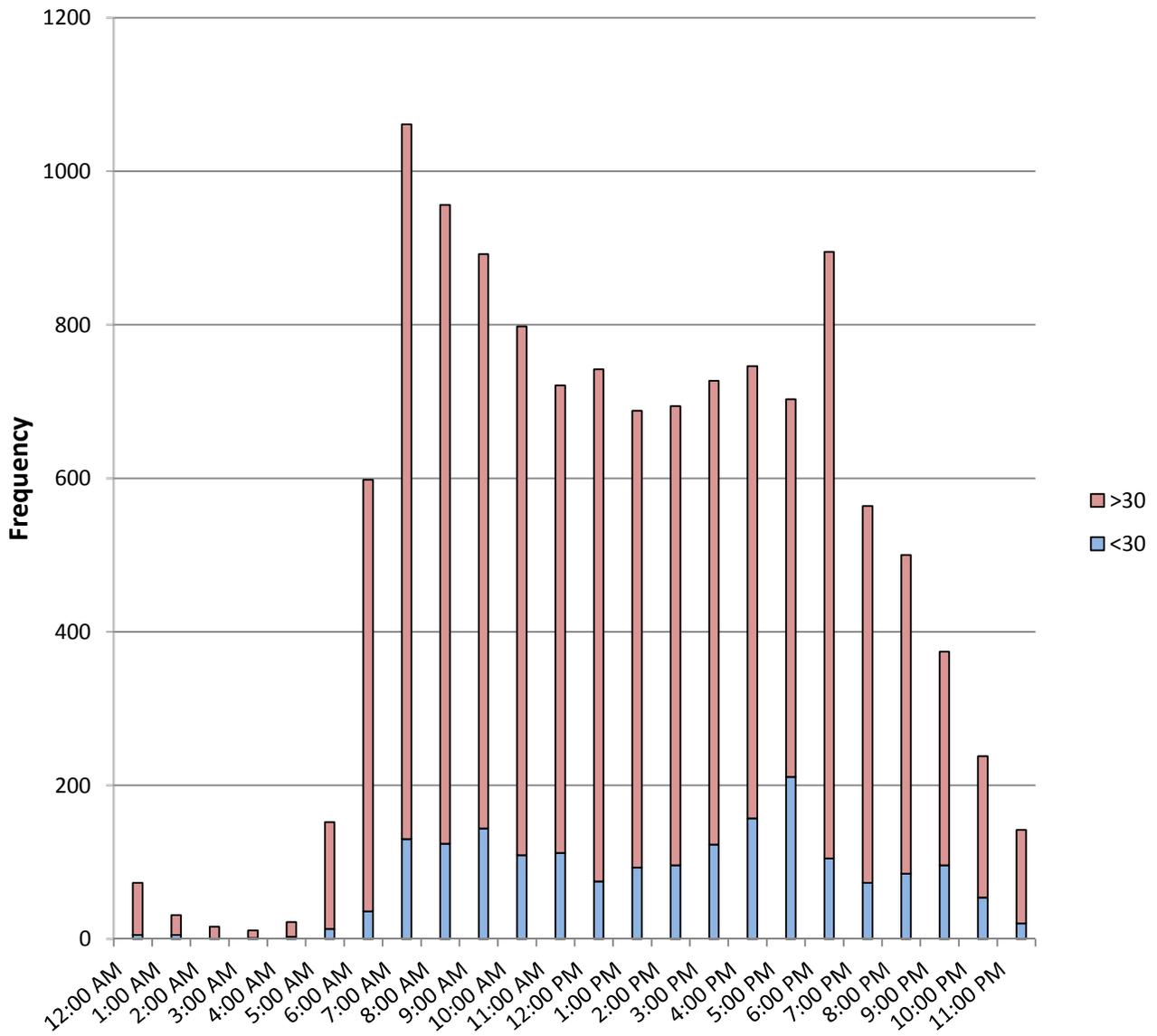
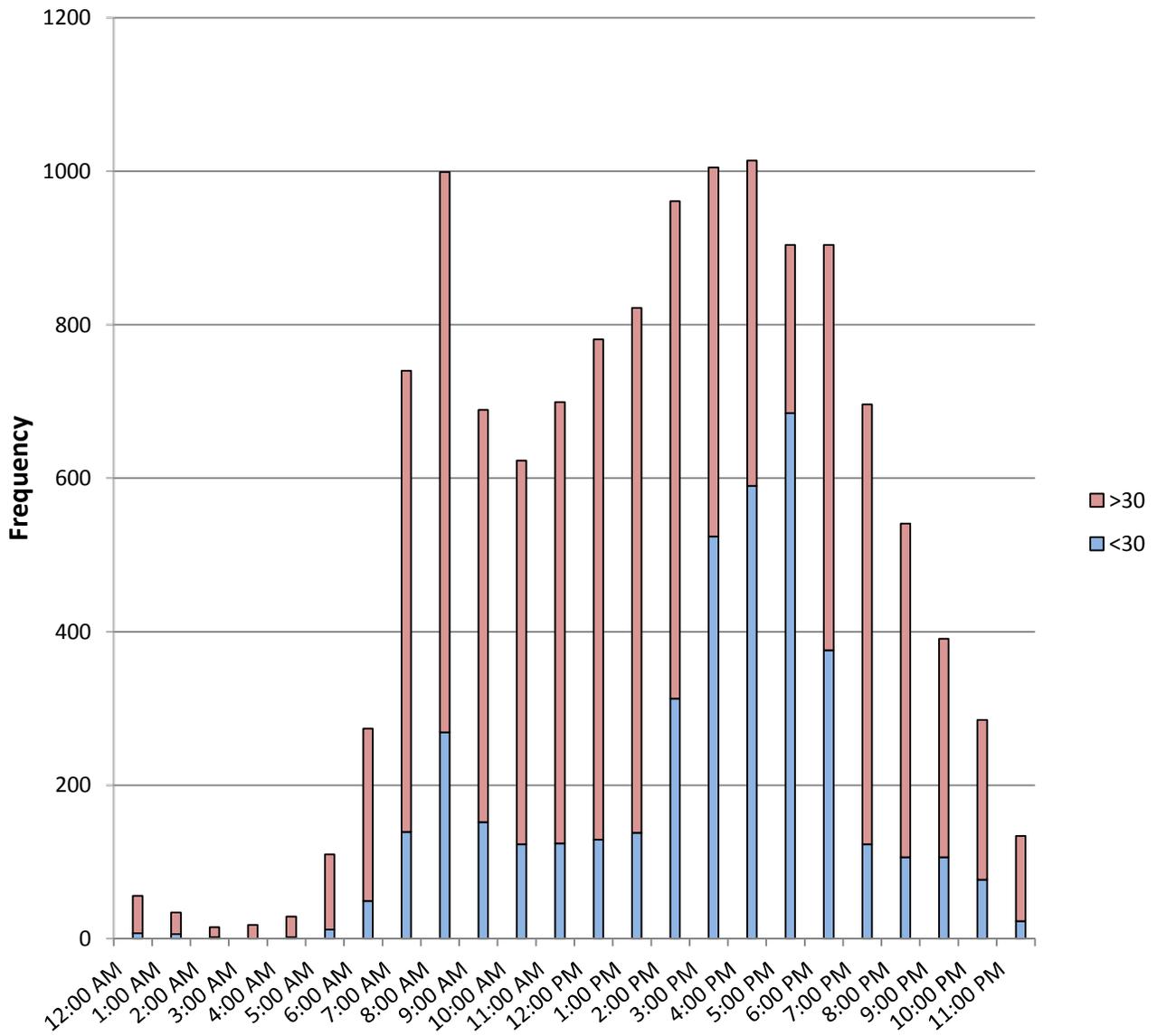


Figure 12
Location 5 - Tangent, North of Curve
Speed Data - Southbound 6/8/04 & 6/9/04 (miles per hour)



Crash History

Vollmer examined the crash history of Blanchard Road, collecting data from 2000 through 2002. Vollmer found that approximately 24 crashes occurred during this 3 year period. The majority of crashes occurred in the northbound direction and generally resulted in less than \$1,000 worth of damage.

Some severe crashes not included in the study were highlighted in a November 2004 letter to Belmont and Cambridge officials from the residents of the Blanchard Road neighborhood. One such accident crash not included in the Vollmer report was a May 2003 accident involving a speeding southbound Jeep that lost control and came to rest on top of a resident's parked vehicle.

Short Term Solutions

Vollmer identified short term solutions that could be implemented relatively quickly. These solutions were developed based on noticeable existing conditions that were observed, and included:

- Signage improvements
- Improved sight distance
- Traffic calming measures

Signage Improvements

Vollmer noted that although warning signs for the curve were present, their location, size and quantity rendered them ineffective in properly informing road users of the impending curve situation. Vollmer recommended relocating the existing signs as well as providing additional signs.

Improved Sight Distance

The overgrowth of nearby trees and vegetation had impacted the sight distance and also obscured the true edge of road (Figure 13). Vollmer determined that select clearing of vegetation would improve sight distance, define the edge of roadway and improve the effectiveness of roadway lighting for nighttime users of the roadway.



Figure 13 – Overgrowth of Trees, October 2004

Traffic Calming Measures

Vollmer noted poor conditions of existing pavement markings. As part of a re-design effort to slow vehicle speeds, Vollmer recommended restriping the existing two 12' travel lanes to two 10' foot travel lanes and two 4' foot shoulders. The restriping would require vehicles to exercise more caution to stay within the narrower lanes, resulting in a lower speed at the same time providing additional shoulder width for bicyclists. Additionally, pavement legends were recommended to call attention to the curve.

Raised reflective pavement markers were also suggested to enhance the definition of the travel lanes and the horizontal alignment during night time and times of reduced visibility due to weather conditions.

Raised rumble strips were also considered as a short term traffic calming measure which would provide audible and vibratory cues to alert motorists. It was recognized, however, that rumble strips can impede bicyclists, are subject to damage by snow plows, and create noise beyond the normal background noise of automobiles and so were not implemented.

Long Term Solutions

Vollmer proposed a series of long term improvements to be further studied including:

- Roadside barrier
- Geometric improvements
- Traffic calming measures

Roadside Barrier

Roadside barrier (guardrail) was recommended as a means to keep vehicles from entering private property in the case of crashes along the curve. The barrier was estimated to extend approximately 675 feet along the curve. Ultimately the guardrail was not implemented as there were numerous issues: first, it could present the image of a highway which could have the wrong consequence of encouraging higher speeds; it would have to have several breaks in it to provide access to driveways thereby creating blunt ends, it would create an unsafe obstacle for cyclists riding next to the road; the space required for the barrier would reduce the right-of-way width to such an extent as to make it impossible to provide a full size sidewalk. The negatives of the barrier were determined to far outweigh any perceived benefits.

Geometric Improvements

The Vollmer study also included three geometric alternatives to modify the curve to meet AASHTO design standards for 30 and 35-mph minimum design speed using a normal crown as well as preferred curve ratios. These alternatives included:

- A simple curve
- A compound curve
- A spiral curve³

Each geometric alternative came with impacts to abutting properties through either right-of-way acquisition or roadway relocation that in some cases moved the roadway significantly closer to existing dwellings.

Traffic Calming Measures

Traffic calming measures that were considered in the report included vertical curbing/sidewalks, bicycle lanes, crossing islands and roundabouts. It was predicted that vertical curbing and raised sidewalks would not only improve pedestrian accommodation, but when combined with a narrowed traveled way would also give the roadway a more urban character inducing motorists to reduce their speeds. Bicycle lanes would further narrow travel lanes as well as improve bicycle accommodation.

³ A spiral curve is a curve of gradually changing radius. A spiral curve is used to allow for a transitional path from tangent to circular curve, from circular curve to tangent, or from one curve to another which have substantially different radii.

A crossing island at the Glenn Road intersection was suggested to create a deflection in the roadway, causing motorists to reduce speed to navigate past the island. A crossing island would also improve pedestrian accommodations providing a temporary refuge and allowing pedestrians to cross one-half the roadway at a time.

A roundabout was also recommended as a means to reduce speeds. Similar to crossing islands, the deflection would slow motorists as they navigated the circle. Due to the size of the roundabout, additional right-of-way would likely have been required.

2005 Community Meeting

In December of 2005, a community meeting was held to discuss the findings of the Vollmer report. The residents reiterated their original goals and also expressed their desire for truck exclusion on Blanchard Road, citing the noise generated by trucks. In addition, community members inquired whether the posted speed limit on the roadway could be reduced below 30 mph.⁴

The residents showed support for the short term solutions and urged the City to pursue restriping Blanchard Road with narrower travel lanes. The City committed to implementing the short term solutions discussed in the report including signage changes, improving pavement markings and clearing vegetation.

In addition, residents showed strong support for moving forward with long term improvements. The long term improvements supported by the community would focus on:

- Improved curve radii
- Glenn Road treatment
- Bicycle lanes
- Improved sidewalks

Long Term Improvements

Improved Curve Radii

In June 2007, the HDR team further analyzed long term improvements discussed at the 2005 community meeting with a primary focus on improving the curve radii. In its analysis, HDR developed three compound curve concepts. The alternatives consisted of matching the existing curve, flattening the

⁴ In order to revise the posted speed limit on a roadway, a municipality must submit specific engineering data to the MassDOT Highway Division, who will in turn make the speed limit determination. MassDOT's decision is partially based upon the existing prevailing speed of vehicles on the roadway. The City suggested to the Community, therefore, that improvements first be constructed on Blanchard Road, and if post-construction analysis indicated that prevailing speeds had been reduced below 30 mph, the City would consider petitioning MassDOT for a reduced speed limit.

sharper curve, and re-aligning both curves. Each alternative consisted of a uniform cross section of 2-4' shoulders, 2-11' travel lanes and a 6' sidewalk along the easterly side of Blanchard Road.

Option 1 created the least impact to the surrounding environment as the curve would be matched as close as possible. HDR also estimated that this option would have the lowest construction cost. However, the existing compound curve of the proposed radii exceeded the 2:1 maximum allowable ratio allowable by AASHTO standards.

Option 2 flattened the sharp curve and shifted the curve to the west approximately 5 to 14 feet from the existing edge of pavement. Shifting the curve to the west would have also impacted an existing stone wall and required some tree removal. The flatter compound curve would require a 1.8:1 compound ratio (meeting AASHTO requirements of a 2:1 ratio) but would not have met Massachusetts Department of Transportation's (MassDOT) 1.5:1 ratio. This option also would have reduced truck encroachment into the shoulders / bicycle lanes.

Option 3 re-aligned both curves to provide a compound curve meeting both MassDOT and AASHTO ratios while providing a higher design speed than Option 1 but less than Option 2. This alternative had slightly greater abutter impacts than Option 2.

These alternatives were presented to the City and it was generally agreed that Option 2 was the most viable. The City requested that Option 2 be further developed to reduce the impacts to the inside of the curve. New Option 2a expanded to a triple compound curve with the curve ratios meeting MassDOT standards with a 30 MPH design speed. The option would require a low rate of positive superelevation⁵, requiring drainage modifications, but would have the least impact to abutters.

By flattening the curve under options 2, 2a and 3, the design intent was to increase the design speed of the curve and reduce the tangent speeds. Flattening the curve would provide a larger radii and smoother transition between tangents, increasing safety. A flatter curve would also improve visibility of the curve, giving motorists more visual warning of a previously unexpected condition.

2007 Community Meeting

The three options were presented to the community in July 2007. The City and HDR felt that these options addressed the various goals of the project in a way which minimized right-of-way impacts and collateral impacts such as noise (as from a raised traffic calming device, for example). The community, however, expressed concerns that the proposed designs were not aggressive enough with respect to the key project goal of reducing speeds. The community also stressed the importance of retaining the existing features of the roadway, specifically existing trees and a stone wall along the westerly edge of the curve. The community requested the City and HDR investigate the use of traffic calming measures similar to those deployed elsewhere in Cambridge, as a way to reduce speeds.

⁵ Superelevation is the banking of a roadway around a curve. The purpose of employing superelevation is to counter balance the centrifugal force of a vehicle traversing a horizontal curve.

Revised Roadway Alignment

After the 2007 community meeting, HDR looked at using traffic calming devices to lower travel speeds and enable the use of a lower design speed for the curve. Chicanes were introduced as a means of reducing speeds prior to entering and exiting the curve. HDR developed a concept where the chicanes would cause the roadway alignment to shift six feet to the left. After a few hundred feet the roadway would shift six feet back to the original alignment. This change in direction would require vehicles to reduce speed sufficiently to then safely navigate a lower-speed curve.

In order to minimize impacts to abutting properties and the stone wall, HDR developed a “sawtooth” pattern of chicanes that would keep the alignment of the roadway as close to the existing roadway as possible. Under this layout, chicanes would always require a shift to the left, and in the roadway segment “downstream” of a chicane, the alignment would slowly taper back to its original position before the next chicane.

With multiple chicanes in place, HDR calculated that speeds would be reduced to an extent that a modified curve could be designed with a 25 mph design speed. It was found that a curve meeting 25 MPH design speed could best fit in the alignment of the existing roadway and would minimize impacts to abutting property as well as trees and the stone wall.

Glenn Road Intersection

As there was not sufficient space for a sidewalk along the westerly edge of Blanchard Road between Grove Street and Glenn Road, a crossing island was proposed to provide pedestrian access from the west side to the east side where a sidewalk runs the length of the project area. A median island for pedestrians would not only provide refuge for pedestrians crossing the street, but would also alter the path of travel for vehicles and require them to reduce speed to navigate around the island. The proposed design extended this altered path through the intersection, requiring a second change in direction that would be closer to the curve, thus helping to maintain reduced speeds as vehicles approached the curve.

The City laid out the proposed median island with paint on the existing roadway to give residents an opportunity to see its impacts. Residents had difficulty maneuvering around the crossing island and asked for an alternative, recommending a raised intersection. The City expressed concern over the raised intersection as it felt that additional noise would be generated, particularly by loose loads in trucks. The consensus among residents, however, was that the benefits of a raised intersection would be an acceptable trade-off against any additional noise generated.

Bicycle Lanes

When developing the final roadway alignment, the pavement width was developed using narrower travel lanes to accommodate bicycle lanes. With a limited right of way, a minimum four foot bicycle lane was provided throughout the project. At the compound curve, the bicycle lane was increased to 5.25 feet to accommodate potential encroachment by trucks.

Sidewalks

In addition to the raised intersection/pedestrian crossing at the Glenn Road intersection, sidewalks were upgraded throughout the project. Where possible, a five foot sidewalk was provided. In some locations, particularly around the compound curve, the sidewalk was reduced to four feet for short stretches. Four foot sidewalk width was only utilized when the necessary right of way was not available and existing abutter features such as fences, hedges and walls would be impacted. The sidewalk design was in compliance with all applicable accessibility requirements, as adequate passing spaces a minimum of five feet in width were provided as required.

Construction

The Project was bid and awarded to Newport Construction. Construction began in the spring of 2010 and was substantially completed in the late fall 2011.

The Town of Belmont rebuilt the intersection at Grove/Blanchard/Washington starting in the summer of 2006 and completed construction in the fall of 2006, creating a roundabout. The town subsequently made additional changes to the roundabout to build up the inner apron to address concerns about trucks running over the curb.

Post Construction Evaluation

Upon completion of the reconstruction of Blanchard Road, a post construction evaluation was performed that included gathering post construction data where available and feedback from residents. The evaluation investigated whether the goals of the project were met including:

- reduced vehicle speeds
- reduced crashes
- improved safety for all users and abutting residents
- improved accommodation for pedestrians and bicycles
- enhanced roadway appearance.

As part of evaluating whether the project goals were met, post construction data was compared to pre-construction data and answers to a web based survey were solicited from residents.

Resident Feedback

In March 2011, the City conducted a primarily on-line survey of Blanchard Road residents, soliciting their opinion about various aspects of the project, including both the planning/design/construction process and the ultimate achievement of project goals. (See Appendix C for Survey and result summaries) and additional comments by residents. Surveys were sent to approximately 35 households, and responses were received from ten.

Although the survey sample is small, the responses received indicate that residents appear to be generally pleased with both the way in which the Blanchard Road project was conducted, and with its outcome.

Goal: Reduce Vehicle Speeds

As part of the post construction evaluation, HDR collected traffic data in April of 2010 and compared the data to the Vollmer data from June 2004 (Table 2).

	Northbound			Southbound		
	2004	2010	% Change	2004	2010	% Change
Tangent, South of Curve	29	32	10%	29	30	3%
P.C., South of Curve	36	34	-5%	37	31	-16%
Midpoint of Curve	33	30	-9%	34	32	-6%
P.T., North of Curve	38	33	-13%	40	33	-18%
Tangent, North of Curve	35	31	-11%	33	31	-6%
Tangent, North of Glenn Road	-	33	-	-	35	-

Table 2 – 85th Percentile Pre & Post Speed Comparison

Overall, the goal for reducing the vehicle speeds was met. The first location on the tangent south of the curve showed an increase in travel speed, however, this particular location had not been considered a problem area. The remaining four locations showed a significant decrease in travel speeds, particularly the section just to the north of the curve. A sixth location located north of Glenn Road was added as part of the post construction evaluation for reference purposes. No 2004 data was available for comparison.

Similar to the graphics prepared by Vollmer, HDR prepared graphics comparing the number of vehicles traveling less than and greater than 30 MPH and combined this data with the 2004 Vollmer graphics for comparison (Figures 14 through 23). The graphics indicated an increase in the amount of vehicles travelling less than 30 MPH when compared to the 2004 data.

A majority (60%) of resident surveys also indicated that they felt speeds were reduced.

Figure 14
Location 1 - Tangent, South of Curve, Northbound Direction
Speed Data Comparison
April 2010 vs. June 2004

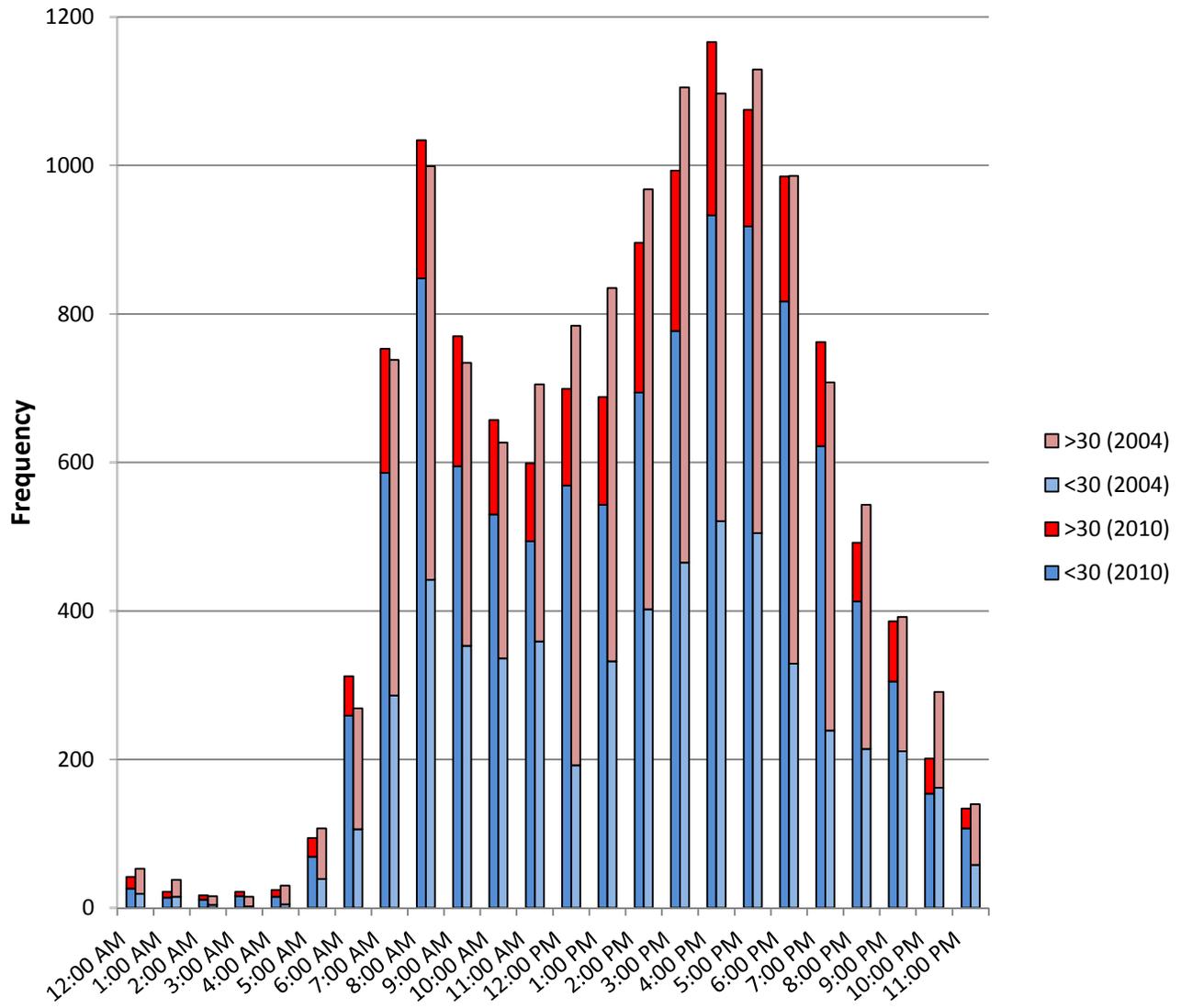


Figure 15
Location 1 - Tangent, South of Curve, Southbound Direction
Speed Data Comparison
April 2010 vs. June 2004

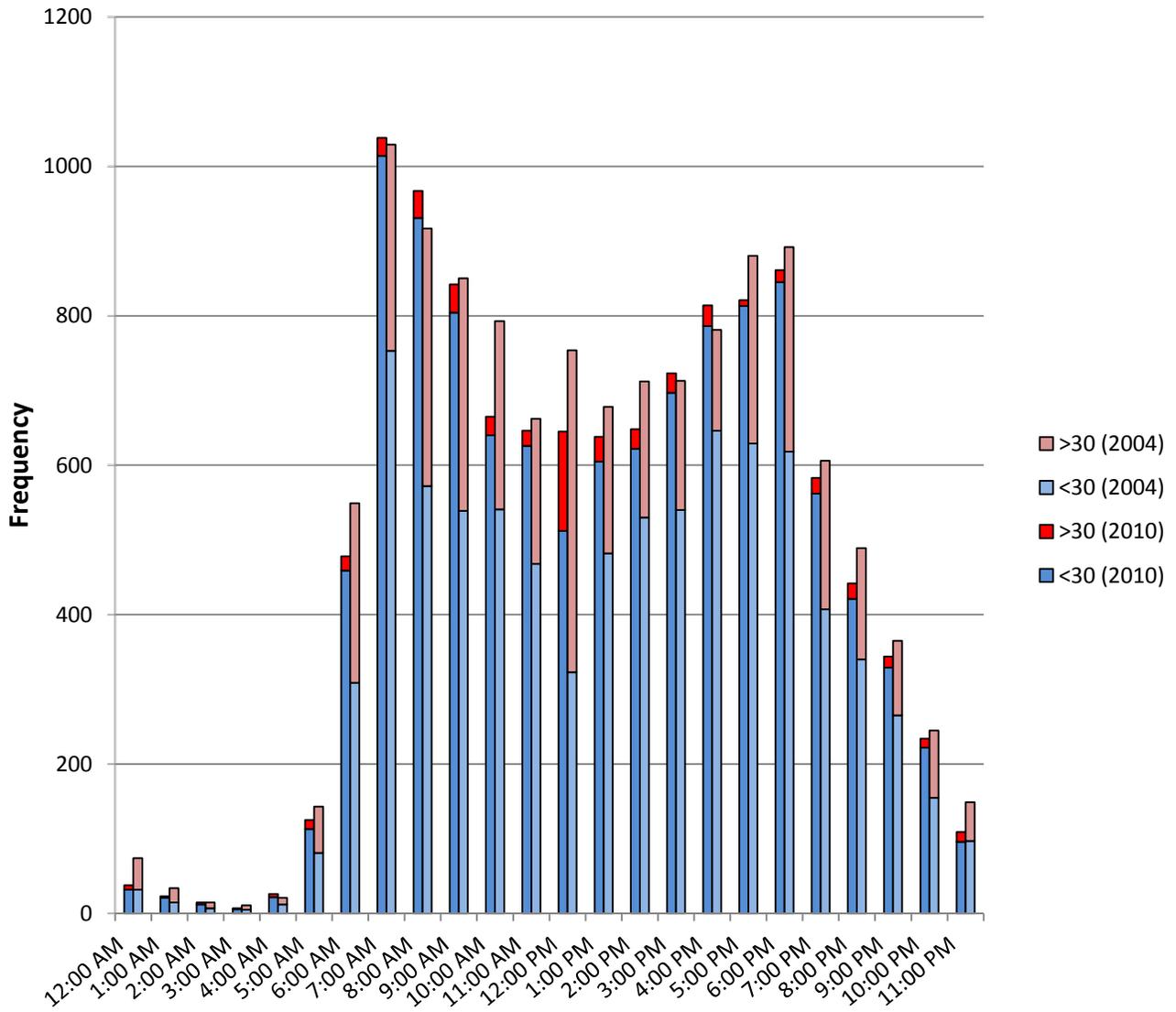


Figure 16
Location 2 - Point of Curvature, South of Curve, Northbound Direction
Speed Data Comparison
April 2010 vs. June 2004

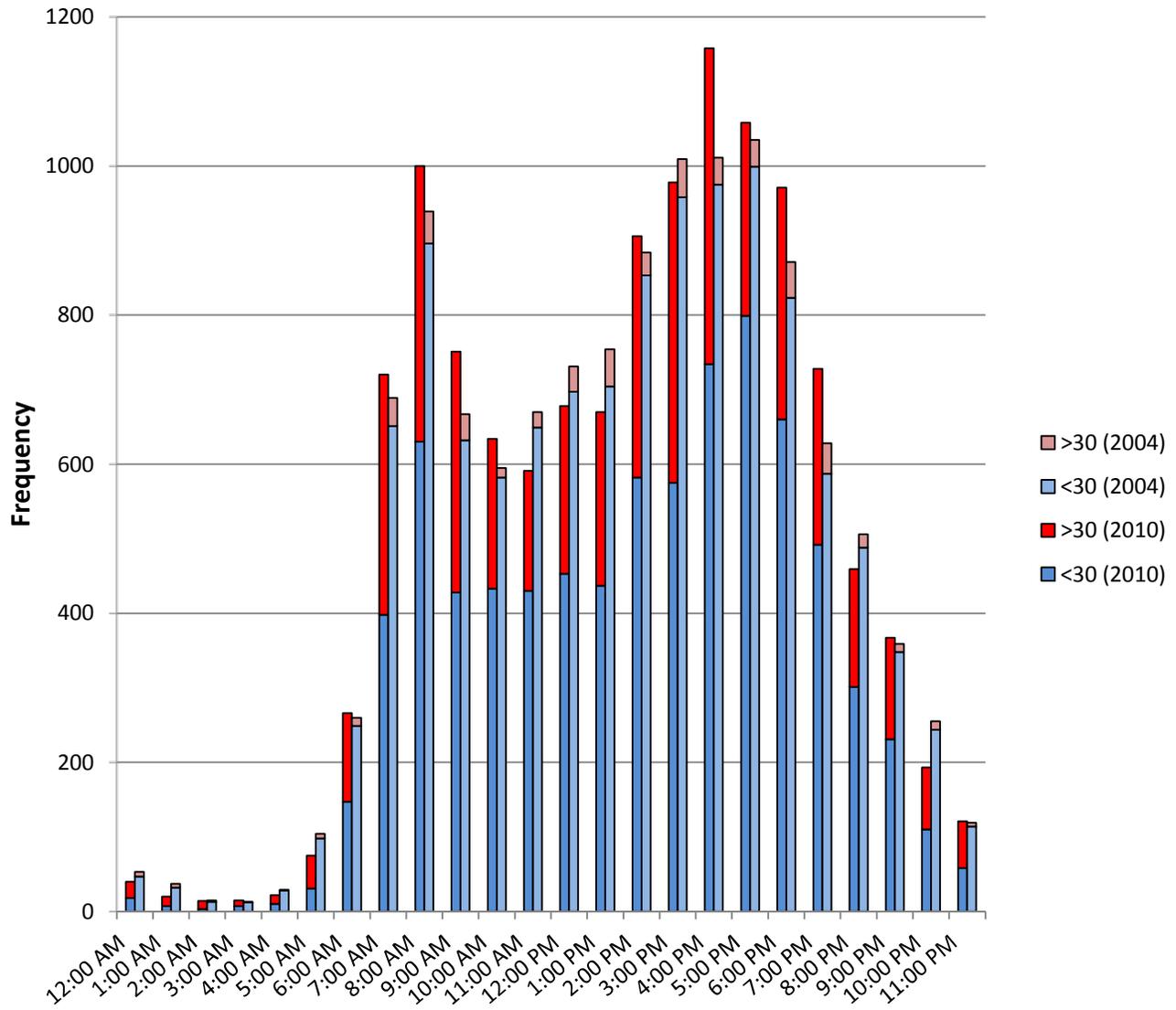


Figure 17
Location 2 - Point of Curvature, South of Curve, Southbound Direction
Speed Data Comparison
April 2010 vs. June 2004

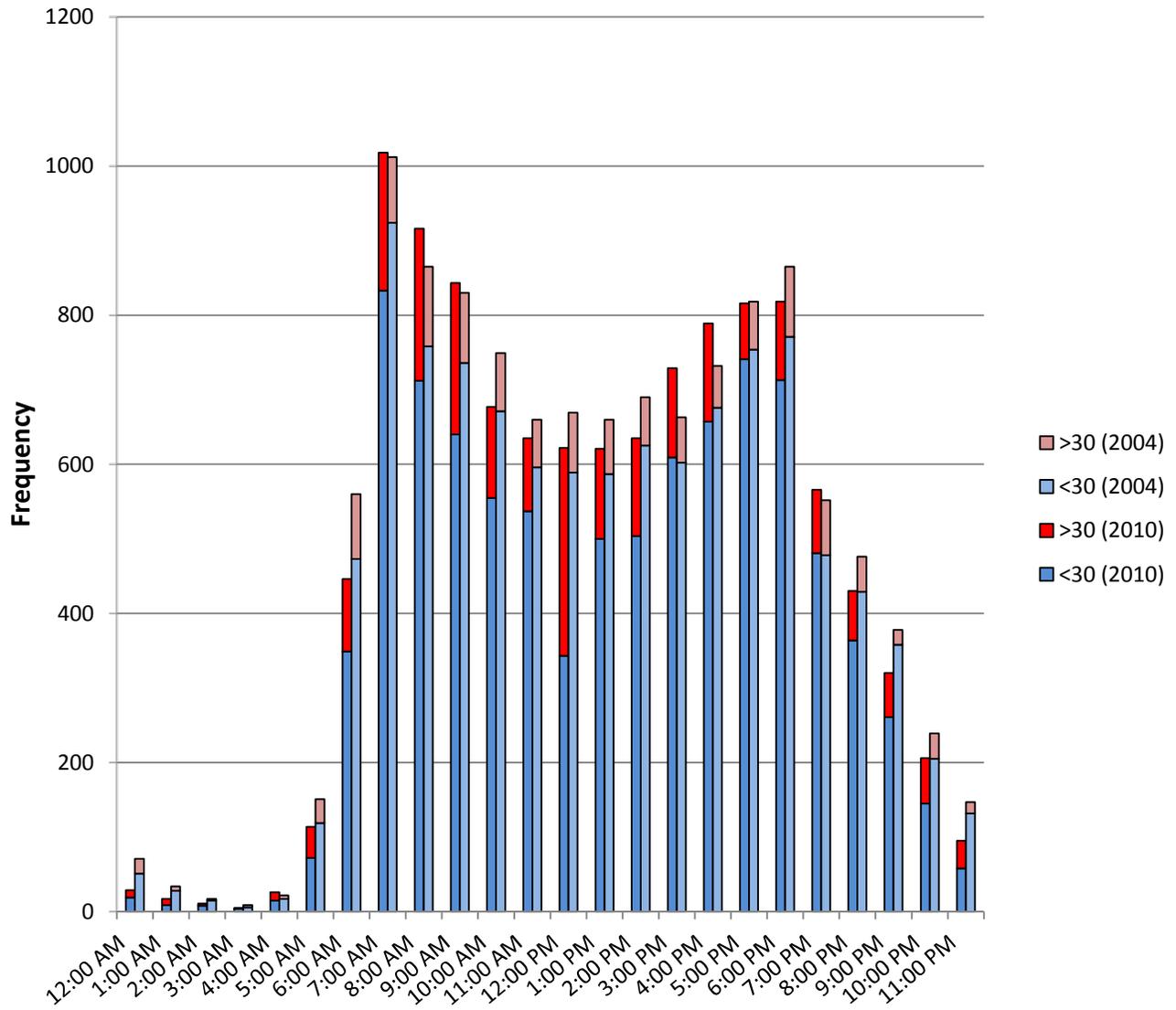


Figure 18
Location 3 - Midpoint of Curve, Northbound Direction
Speed Data Comparison
April 2010 vs. June 2004

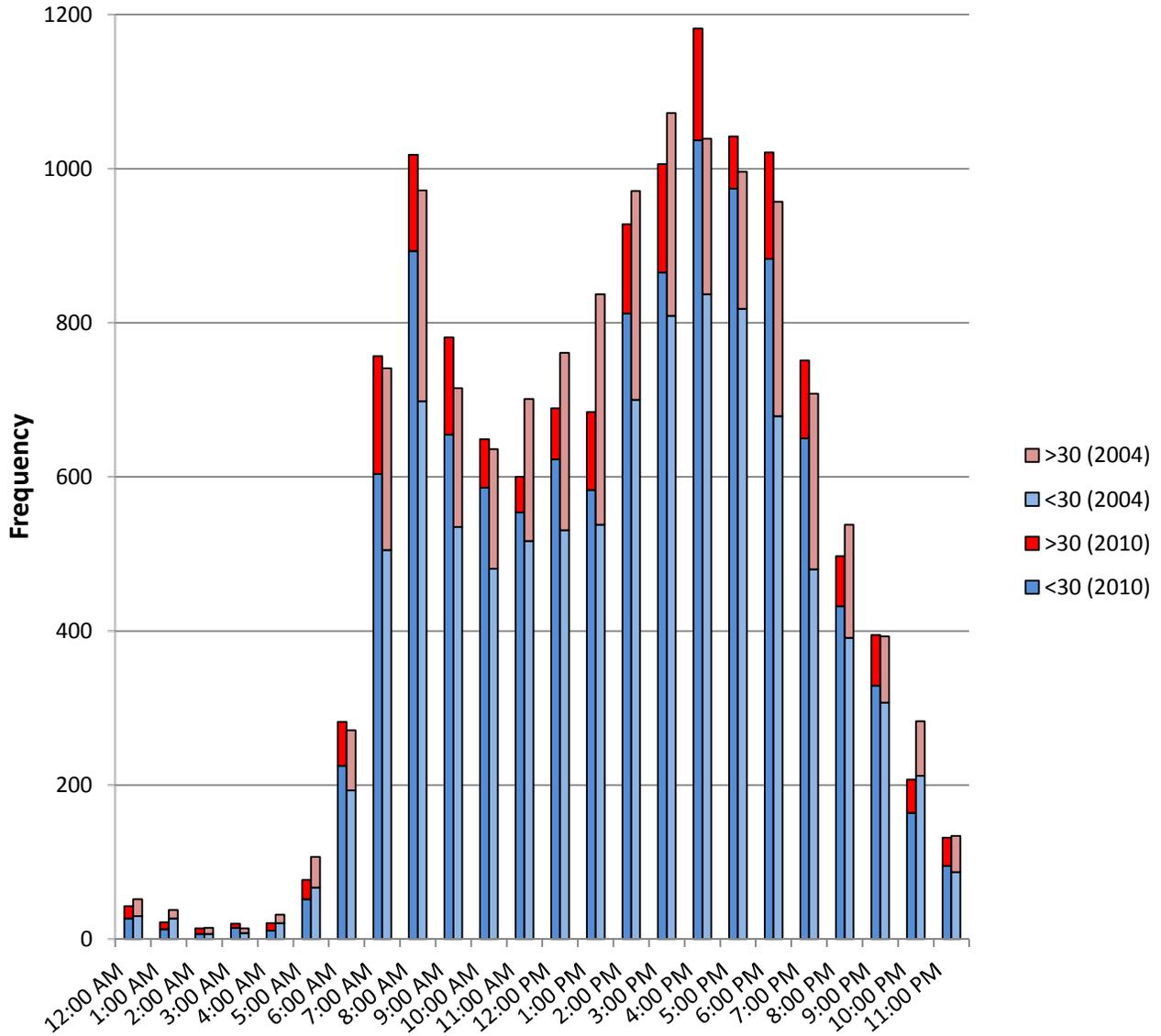


Figure 19
Location 3 - Midpoint of Curve, Southbound Direction
Speed Data Comparison
April 2010 vs. June 2004

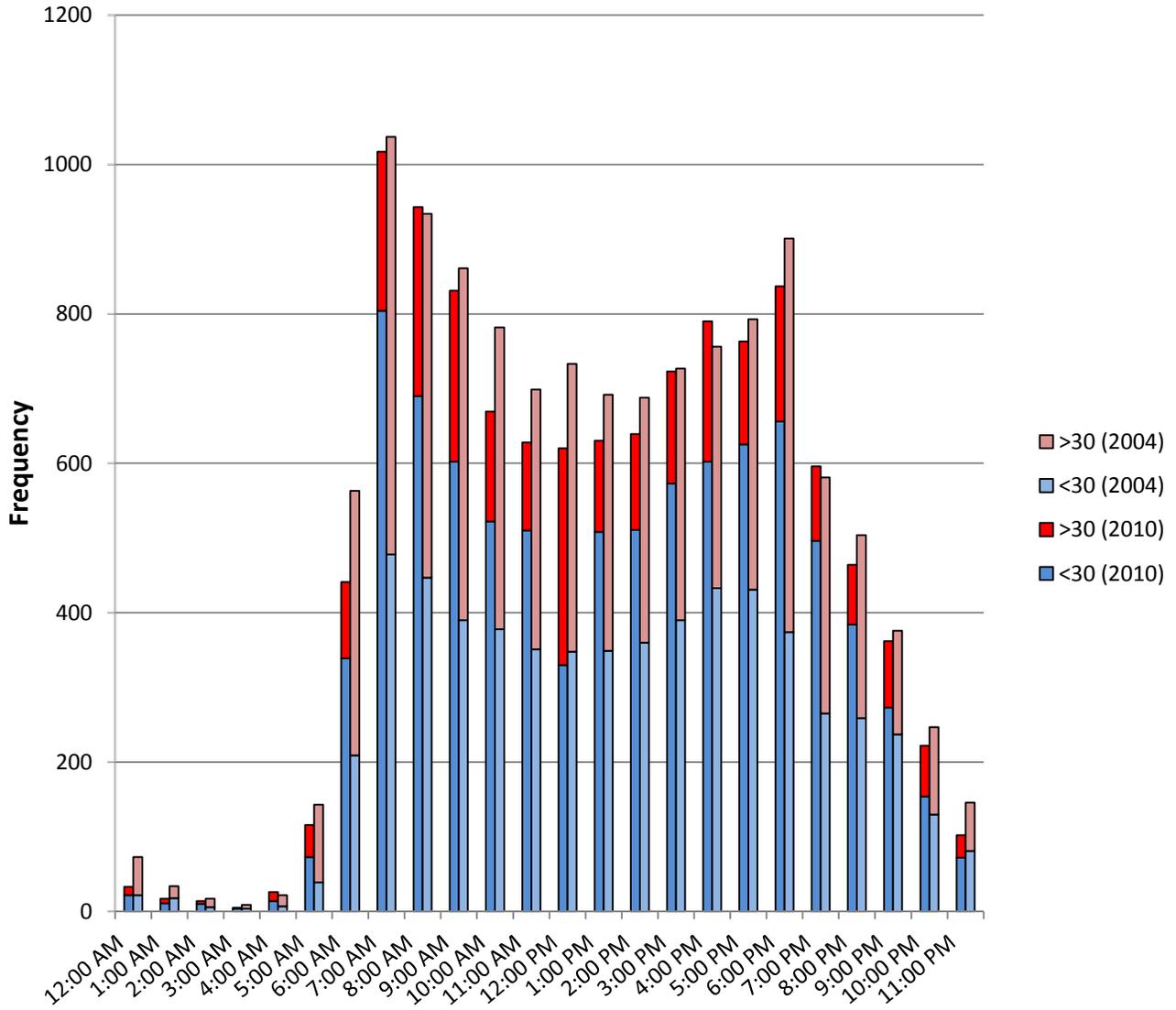


Figure 20
Location 4 - Point of Tangency, North of Curve, Northbound Direction
Speed Data Comparison
April 2010 vs. June 2004

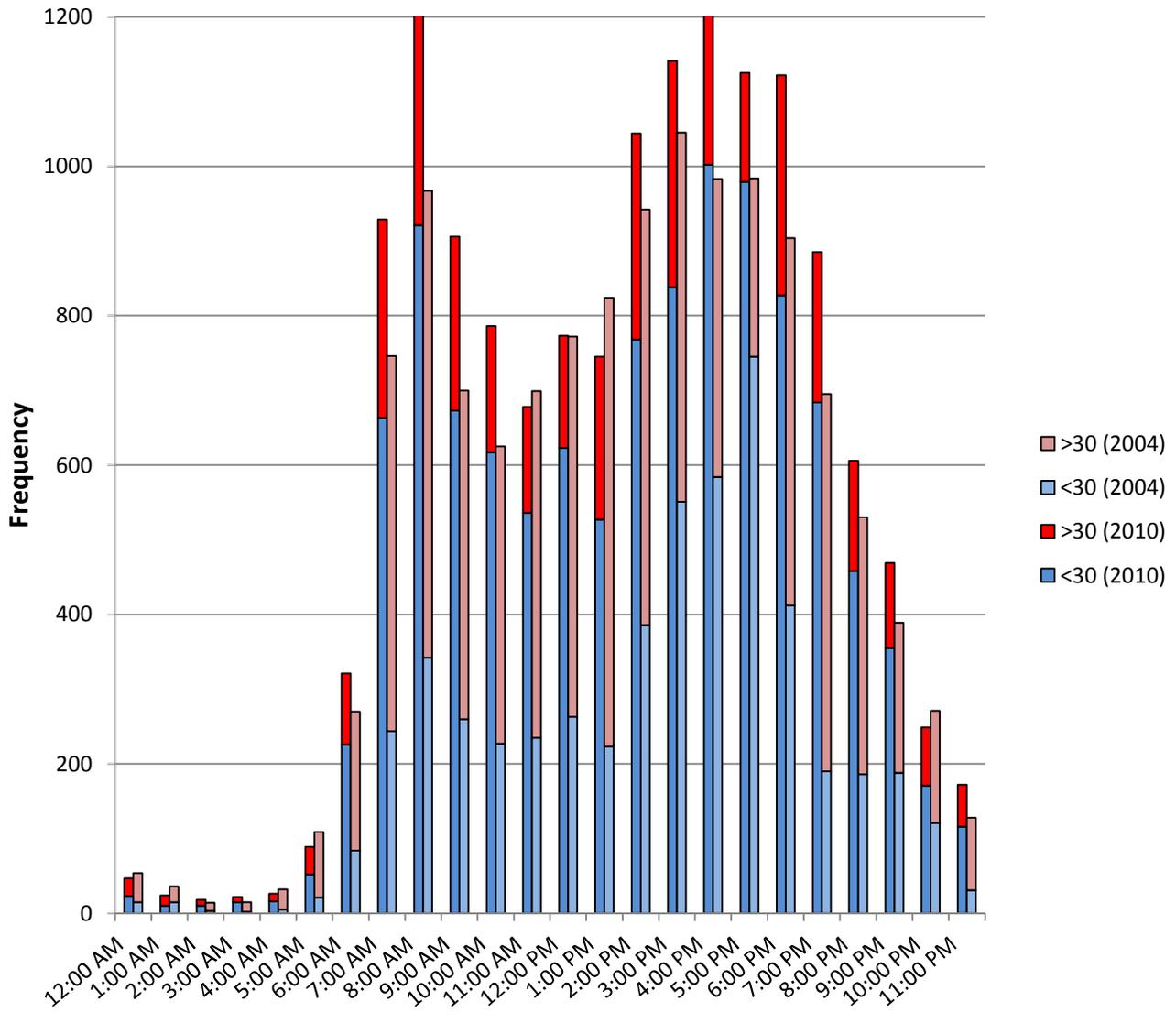


Figure 21
Location 4 - Point of Tangency, North of Curve, Southbound Direction
Speed Data Comparison
April 2010 vs. June 2004

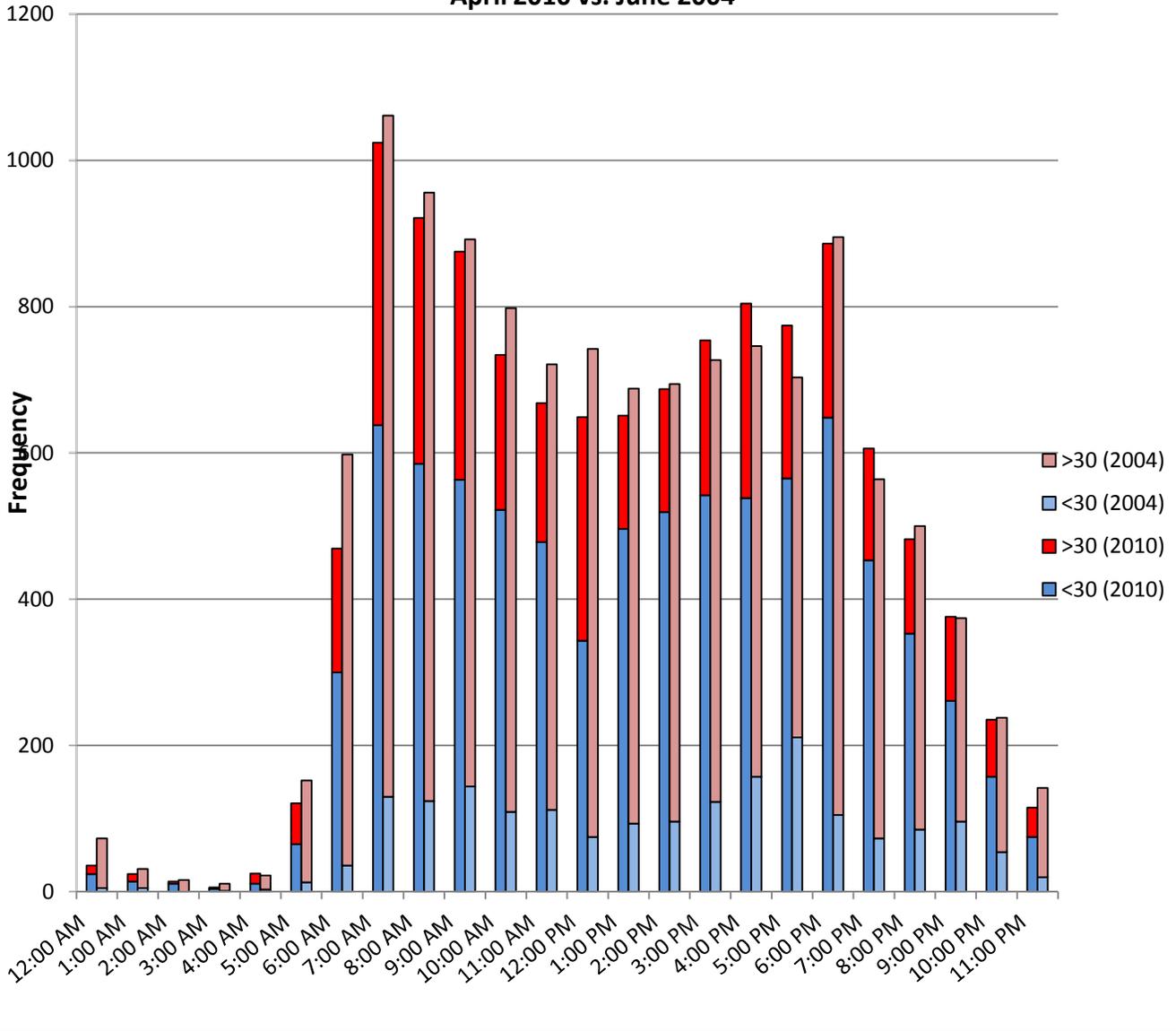


Figure 22
Location 5 - Tangent, North of Curve, Northbound Direction
Speed Data Comparison
April 2010 vs. June 2004

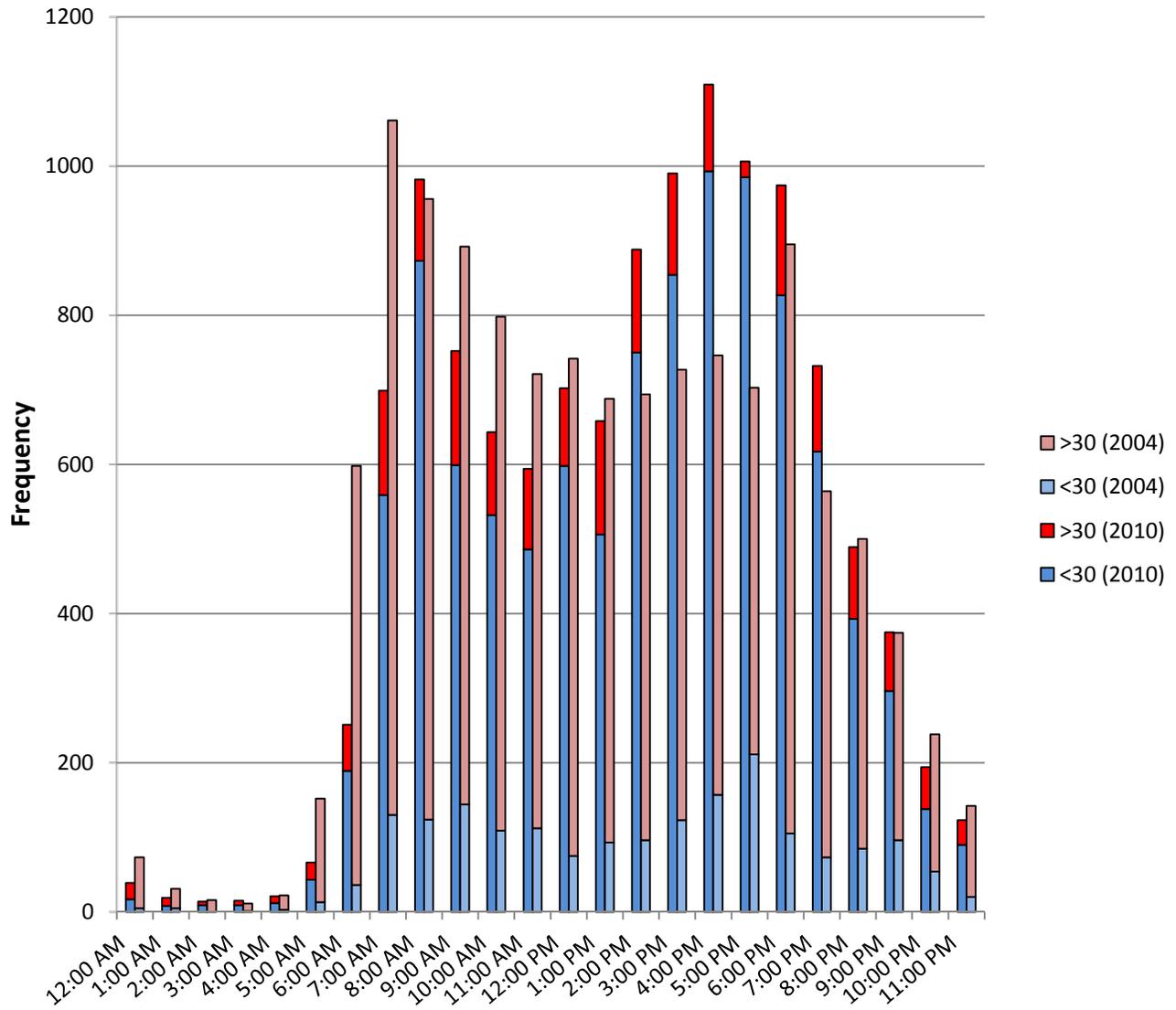
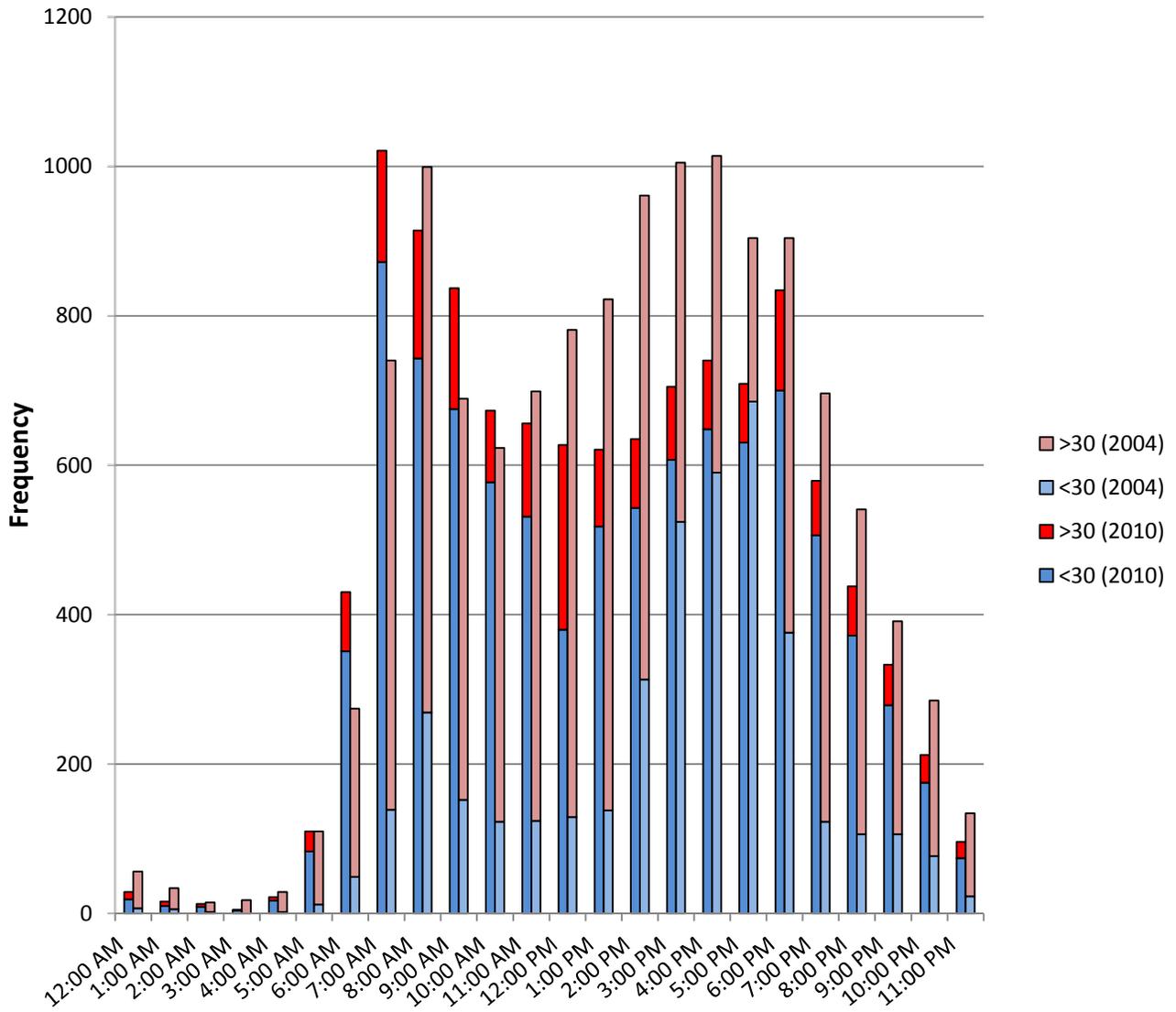


Figure 23
Location 5 - Tangent, North of Curve, Southbound Direction
Speed Data Comparison
April 2010 vs. June 2004



Goal: Reduce Accident Rate

Currently, sufficient time has not passed to collect meaningful crash data to compare to pre-construction data, therefore it is unknown if the accident rate has increased or decreased. A 3 year time frame free of construction activity is needed to make the comparison. The crash review can be performed in 2015. Given the significant decrease in travel speeds, it is anticipated that the severity and number of speed related crashes would decrease. No significant crashes have occurred since construction was completed.

Goal: Improve Safety/Accommodation for All Users

Safety and accommodation for all users was improved through the use of several techniques, including:

- Narrower travel lanes to reduce vehicle speeds. In addition to increasing safety for motorists negotiating the curve, this also increases the comfort for bicyclists and pedestrians using Blanchard Road
- Wider, defined bicycle lanes provide dedicated space for cyclists and may reduce the need for drivers to cross the centerline to pass cyclists
- Wider sidewalks and ADA-compliant curb ramps and driveways make the sidewalks more useable to a range of pedestrians and gives additional space so pedestrians do not have to walk so close to the curb.

An example of these changes can be seen in Figure 24 comparing bicyclists using the road in pre and post-construction conditions.

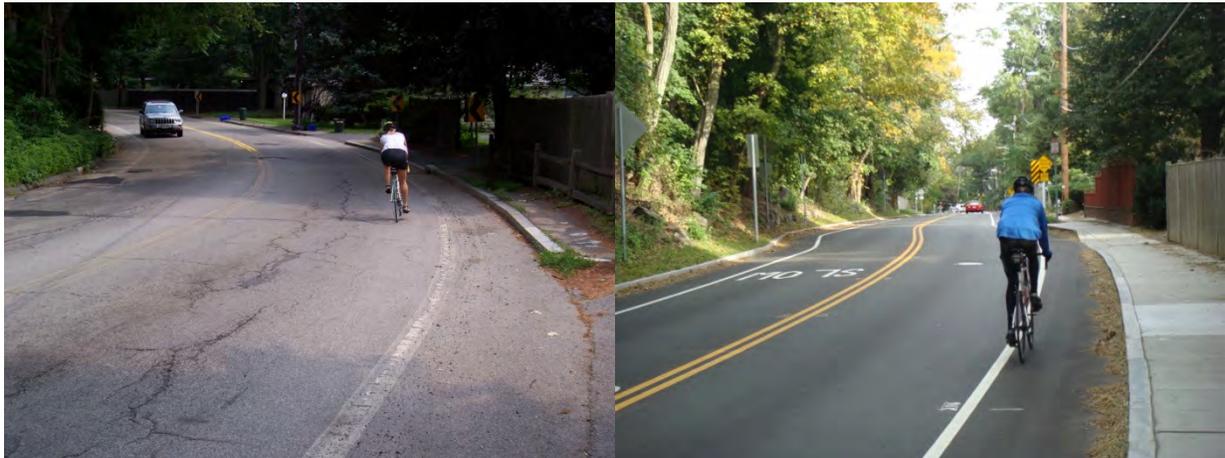


Figure 24 – Improved Accommodation Features

Residents also indicated that they felt safety for children, pedestrians, cyclists and vehicles had improved. (See Appendix C for Survey and Result Summaries)

Goal: Enhance Roadway Appearance

Upon the completion of the project, 90% of respondents to the survey indicated that the overall “atmosphere/look” of Blanchard Road improved, making it more inviting for all users, with well defined features. The narrowing of the roadway and introduction of the



Figure 25 – Blanchard Road near Concord Ave

chicanes provided opportunities for distinctive landscaping, including native grasses. The new concrete sidewalk provides more visual contrast with the roadway than the former asphalt walk, and will require less maintenance. High-visibility crosswalks and special paving at the Glenn Road intersection provide visual cues to motorists that pedestrians are present. Utility poles have been relocated to provide unobstructed walking paths. Preconstruction and post construction photos at similar locations are shown below to highlight this enhanced street appearance (Figure 25 through Figure 28).



Figure 26 – Blanchard Road at Glenn Road



Figure 27 – Blanchard Road at Curve



Figure 28 – Blanchard Road North of Curve

APPENDIX A

BLANCHARD ROAD SAFETY STUDY

VOLLMER ASSOCIATES, 2005



Engineers
Architects
Landscape Architects
Surveyors
Planners

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MEMORANDUM

TO: Ms. Susan Clippinger
City of Cambridge

FROM: William P. Mertz, PE
Paul Bakis
Vollmer Associates, LLP

DATE: December 9, 2005

RE: Blanchard Road Safety Study

Vollmer Associates LLP was contracted by the City of Cambridge to examine safety improvement alternatives on the section of Blanchard Road located between the intersections of Concord Avenue and Grove Street. The purpose of the study is to identify and evaluate alternative measures, including engineering modifications and traffic calming applications to reduce speeds on Blanchard Road. The objectives to be achieved include the following:

- reduce vehicle speeds
- reduce accident rate
- improve safety for all users and abutting residents
- improve accommodation for pedestrians and bicycles
- enhance street appearance

Existing Conditions

Blanchard Road begins at the intersection of Grove Street and continues in a generally north direction ending at Brighton Street at the Belmont town line. The focus of this study is on the southern section of Blanchard Road located between Grove Street and Concord Avenue, which is 2,100 feet in length. Blanchard Road is an urban collector providing access for the residences in the area to and from Concord Avenue. Blanchard Road is abutted by residential property, farmland and the Fresh Pond Golf Course. Speed limit signs of 30 mph are posted in each direction at the beginning of the project study area.

Based on plans provided by the City of Cambridge, Blanchard Road lies within a 40' right-of-way (ROW). The road provides a 28-foot travelway with a 12-foot lane and a 2-foot shoulder in each direction, separated by a double yellow centerline. No striped



bicycle lanes are provided. A sidewalk of variable width is provided on the easterly side from Grove Street to Glenn Road. From Glenn Road to Concord Avenue a variable width sidewalk is provided along the westerly side, as well. Based on GIS data provided by the City, the existing sidewalk does not meet ADA requirements. The existing roadway pavement shows signs of deterioration and is cracked throughout the study area.

Horizontal Alignment

A compound curve is located along the southern section of Blanchard Road approximately 350 feet from Grove Street. The curve is abutted by residential property on both sides of the road. Thick brush and tall trees also exist along both edges of roadway. Based on GIS data provided by the City, the curve is estimated to be a triple compound curve with approximate radii of 560 feet, 450 feet and 210 feet going from north to south respectively. The 560 foot and 450 foot radii meet AASHTO¹ guidelines for a 35 mph design speed, while the 210 foot radius only meets a 25 mph design speed.

Signing

Regulatory signing along Blanchard Road consists of two speed limit signs of 30 mph at each end of the study location. Curve warning signs are provided to alert motorists of the impending curve in each direction. Additionally, chevrons are provided through the curve in both directions. Locations of the existing signs are shown in Figures 12 and 13.

Issues and Concerns

Several issues and concerns have been raised by the community including roadway conditions, operations and safety. These issues include:

- Speeding - travel speeds greater than the posted speed limit.
- Accident Rate – frequency of accidents
- Type & Severity of accident – fatalities, injuries, damage to residential property
- Roadside Protection – pedestrian safety, residential property protection
- Pedestrian/Bicycle accommodations

¹ American Association of State Highway and Transportation Officials. (2001). A Policy on Geometric Design of Highways and Streets. Washington D.C.



Data Collection and Findings

Travel Speed

Speed data was collected at five (5) locations along Blanchard Road. Data recorded at each location included 48 hours of data recorded on June 8, 2004 and June 9, 2004 in both the northbound and southbound direction. From this data, a speed profile of Blanchard Road along the curve was developed. Figure 1 shows the location of the data collection points. These locations include:

1. On the tangent piece, south of the curve
2. At the point of curvature at the south end of the curve
3. At the midpoint of the curve
4. At the point of tangency on the north end of the curve
5. On the tangent piece, north of the curve

A breakdown of the speed data is shown in Figures 2 through 11 showing the frequency of each speed range. The 85th percentile speed was used as the benchmark for analysis. The 85th percentile speed is the speed at or below which 85 percent of the traffic is traveling. It was determined that at four out of the five data collection locations, the 85th percentile speed was above the posted speed limit of 30 mph. In the northbound direction, the speed data shows the 85th percentile speed to be over the 30 mph speed limit approaching the curve before slowing to 30 mph at the beginning of the curve. Once in the curve, northbound vehicles accelerate to 35 mph at the midpoint of the curve then to 40 mph as vehicles proceed towards Concord Ave. In the southbound direction, the speed data shows the 85th percentile speed to be at 40 mph approaching the curve and continuing to over the 30 mph speed limit through the curve before reducing to 30 mph at the end of the curve. Once past the curve, the 85th percentile speed then increases to 35 mph. The speed data shows that northbound vehicles slow to negotiate the initial part of the curve before accelerating once into the curve. Southbound vehicles do not slow to properly negotiate the curve until after they are past the midpoint of the curve. A summary of the 85th percentile speed at each location is summarized in Table 1.

Table 1 – Existing 85th Percentile Speeds

Location	85 th Percentile Speed (mph)	
	Northbound	Southbound
1 - Tangent, South of Curve	35	35
2 - Point of Curvature, South of Curve	30	30
3 - Midpoint of Curve	35	35
3 - Point of Tangency, North of Curve	40	40
5 - Tangent, North of Curve	40	40



Traffic Volumes

Using the speed data, traffic volumes were also compiled and are summarized in Table 2 below.

Table 2 – Traffic Volumes

	Direction	
	Northbound	Southbound
Average Daily Traffic	6650	6200
AM Peak Hour Volume	500	460
PM Peak Hour Volume	440	565

Accident History

Accident data was collected from the Massachusetts Highway Department (MHD) for the years 2000 through 2002. Over the three-year period, a total of 28 accidents occurred within the project area. After reviewing the data it was observed that there are no obvious environmental factors contributing to the accidents. Sixteen (16) of the 24 accidents, or 67%, occurred under daylight conditions, fifteen (15) of the 24 accidents, or 63%, occurred under clear conditions and 20 of the 24 accidents, or 83%, occurred on dry pavement. Using accident reports provided by the City, a more in depth breakdown of accidents, shown in Table 3, along the curve was also examined. Northbound accidents account for approximately 63% of total accidents along the curve. Eight percent of accidents along the curve resulted in injury, 21% resulted in substantial property damage (greater than \$1,000) and 71% resulted in minor property damage (less than \$1,000). While not noted in any of the accident reports, excessive speed is assumed to be a factor in some of the accidents and reported property damage.

Mitigation Measures

Mitigation alternatives were considered to reduce travel speeds, improve safety and enhance accommodations for pedestrians and bicycles. The alternatives considered short and long-term mitigation using both physical engineering modifications and traffic calming measures. Short term, or immediate mitigation measures, include superficial type improvements that are considered to be functionally effective, cost efficient and can be readily implemented in a few months. Long term measures include modifications to the existing roadway alignment and infrastructure, or new infrastructure that are considered to be functionally effective. However, these long term improvements would require further study and design development for incorporation into the City's capital programming for construction.

Table 3 - Accident Breakdown by Direction/Type/Severity

LOCATION	No. of Accidents	Type					Severity*		
		Rear End	Angle	Head-On	Fixed Object	Unknown	Injury	Damage >\$1000	Damage <\$1000
Blanchard Road/Concord Ave	13	2	5	0	1	5	1	3	9
Blanchard Road/Grove Street	1					1			1
South of Curve									
Northbound Direction	1		1				1		
Southbound Direction									
North of Curve									
Northbound Direction	2	1	1					1	1
Southbound Direction	2	1	1						2
Blanchard Road (Unknown Location/Direction)	2	2						1	1
Northbound Direction	2	1	1						2
Southbound Direction	1	1							1

* No fatalities were reported in the information reviewed by Vollmer. Damage not reported was assumed to have less than \$1,000 worth of damage.

Direction Distribution

Northbound Travel: 63%
 Southbound Travel: 37%

Severity Distribution

Injury: 8%
 Damage >\$1000: 21%
 Damage <\$1000: 71%



Short Term Improvements

Engineering Modifications

Signing

Signing modifications include the relocation of existing signs and installation of new signs to improve sight lines and visibility and reinforce advance warning. Signing improvements include:

- In the southbound direction, relocating the existing speed limit sign away from the Concord Avenue intersection would increase the line of sight to the sign for motorists turning onto Blanchard Road.
- Curve warning and supplemental speed signs (W1-1, W13-1) could be relocated a sufficient distance from the curve that will provide adequate deceleration length (30 mph to the advisory speed of 20 mph) at the approach to the curve. Based on driver perception and reaction time, a distance of 150 feet from the beginning of the curve would allow sufficient distance for a motorist to decelerate to the advisory speed of 20 mph. In the southbound direction, the existing curve warning sign is located approximately 350 feet from the beginning of the curve. Although this provides sufficient distance to decelerate to the advisory speed of 20 mph, it could be located in closer proximity to the curve. In the northbound direction, the existing curve warning sign is located approximately 75 feet from the beginning of the curve. This location does not provide sufficient distance to decelerate to the advisory speed of 20 mph. This sign is also located behind a utility pole and is not visible until the motorist is upon the sign. Relocating this sign to approximately 150 feet in advance of the curve will improve visibility and provide sufficient distance for deceleration. Signing modifications are shown on Figure 12.
- The installation of additional and larger chevrons would reinforce warning to the motorist of the impending curve. The existing chevrons are placed properly in accordance with MUTCD recommended spacing such that two chevrons be in the motorist's view throughout the curve. However, a study² showed that increasing the number of chevrons in view to three causes a slower travel speed through curves than if there were two chevrons. The study also developed recommended spacing of chevrons based on the radius of the curve. Using the existing curve radius data provided by the City and the spacing recommendations in the study, additional chevrons are recommended to be spaced approximately 40 feet apart along the 210 foot radius. The current number and location of the chevrons on

² Rose E. and Carlson P. 2004. Spacing Chevrons on Horizontal Curves. TRB 2005 Annual Meeting.



the larger curve are consistent with the study recommendations and require no change. The additional chevron locations are shown in Figure 13.

Clear Vegetation

The removal of excessive vegetation growth and overhang to improve sight distance along the roadway, particularly approaching and through the curved section is also recommended. Clearing/trimming along the roadway edge would also improve sight lines for signing and roadway lighting.

Traffic Calming Measures

Pavement Markings

Re-stripping travel lanes would reinforce travel lane widths and highlight the curvature of the roadway. Two options were examined, re-stripping the roadway using the current travel way width and shoulders and re-stripe the roadway with narrower lanes.

- Re-stripping the travel lanes to the existing 12-foot lanes and two-foot shoulder widths would define the travel lanes and accent the curve. The current pavement markings, particularly the edge lines are faded in many places. The faded pavement markings can give the driver a false sense of lane and roadway width, inviting higher travel speeds.
- Re-stripping travel lanes using two ten-foot travel lanes and two four-foot shoulders requires more caution by the driver to remain within the narrower travel lanes and could result in a lower speed. Expanding to four foot shoulders would also provide sufficient width for bike lanes.

Additional pavement markings such as “SLOW CURVE” placed on the pavement before the curve may also help call attention to the curvature of the roadway.

Raised / Reflective Pavement Markers

Raised / reflective pavement markers which are embedded in the pavement can be used to supplement the existing pavement markings to help define or delineate the curvature of the roadway. The reflective markers will enhance the visibility of the curve at night or in times when visibility is reduced due to weather conditions.

Raised Rumble Strips (Thermoplastic)

Rumble strips are measures that produce audible and vibratory effects to alert motorists to take greater care. Two case studies of installations in England were examined to determine the effectiveness of using $\frac{1}{2}$ - $\frac{3}{4}$ " high thermoplastic rumble

strips. The first case study³ was conducted in a rural area, on a stretch of two-way roadway with a 30-mph speed limit. Before the installation, vehicles would travel between 45 and 50 mph. Upon installation the speeds were reduced to 32-37 mph. One month after installation however, speeds continued to rise to a level of 38-42 mph. It was noticed that after installation some motorists increased their speeds to minimize the effects of the rumble strips.

The second case study⁴ was conducted in a residential area. The road contained street trees and sidewalks on both sides of the roadway. Table 4 shows the results of five (5) streets monitored before and after the installation of the thermoplastic strips. In each case, the rumble strips initially reduced speeds between two and six mph. However, it was noted in the case study that after a period of time, travel speeds returned to their original levels. The primary issues associated with rumble strips include noise, maintenance (damage due to snow plowing), and their impediment to other modes of travel, particularly bicycling and in-line skating.

Table 4 – Before & After 85th Percentile Speeds

Location	85 th Percentile Speed (mph)	
	Before	After
Christchurch Road	36.4	31.4
Glenmore Road	39.6	35.2
New Road	45.2	38.9
Palmeria Road	37.6	35.0
Wendover Road	34.3	28.7

Long Term Improvements

Long term alternatives could have an impact on the existing 40-foot right-of-way. When examining long term improvements, impact to right-of-way was taken into account. Using the existing right of way, edge of road, and dwelling location information provided by the City, the approximate location of the right of way was located on a plan shown in Figure 14. After locating the approximate right of way on the plan, it was noted that some existing dwellings on the easterly side of Blanchard

³ Wakefield Metropolitan District Council. 1994. *Traffic Calming in Practice*. Case Study 33, West Yorkshire: West Bretton

⁴ Bexley London Borough. 1994. *Traffic Calming in Practice*. Case Study 60, Bexley, Christchurch Road Area



Road are located as close as 10 feet from the existing right of way and 20 feet from the existing edge of pavement.

Engineering Modifications

Geometric Improvements

Horizontal alignment alternatives to simplify the curve (reduce the number of compound curves), increase the radius of the non-conforming curve and to improve the transition ratio between compound curves were investigated and are discussed below.

Three replacement curves were examined as potential alternatives. These curves include a simple, compound, and spiral curve. The curves are selected to meet AASHTO design standards for 30-mph minimum design speed using a normal crown for low speed urban streets, avoid or minimize right of way impacts, and minimize encroachment on residential dwellings. The existing 28-foot travel way configuration, including two 12-foot travel lanes and two two-foot shoulders, was used in analyzing impacts to right-of-way and does not include sidewalks. Several constraints were identified when examining the three replacement curves and are shown on each figure referenced below. The constraints include maintaining the existing edge of road along the easterly side of the curve, maintaining the westerly edge of pavement along the right-of-way north of the curve, and maintaining edge the of pavement within the right-of way across driveways west of the curve. When the constraints could not be met, impacts to the constraints were minimized to the extent possible.

- A simple curve, consisting of a constant radius, was designed at both 30 and 35-mph design speeds. The 30-mph simple curve alignment would result in minor impacts to abutting properties on the westerly side of the curve. It would also require shifting the roadway approximately three feet to the east whereby bringing the edge of pavement as close as ten feet to existing dwellings on the easterly side of Blanchard Road, but still within the existing right-of-way. The 35-mph simple curve would require a substantially larger radius and have a significant impact to the abutting properties on the westerly side of the curve. The 35-mph simple curve would not require shifting of the roadway to the east. The alignments and associated impacts are illustrated on Figures 15 and 16.
- A compound curve contains multiple constant radii within a curve. The compound curve alignment was designed for 25 and 30 mph. The 25 mph curve would use radii of 250 feet, 375 feet and 550 feet. These radii would meet AASHTO guidelines for 25-mph design speed using a normal crown. If the roadway was to be superelevated at 2 percent across the entire roadway cross section, these same radii would meet a 30 mph design speed. When using compound curves, it is also recommended by AASHTO that the ratio between curves be 1.5:1 with a maximum of 2:1. Under the existing compound curve, the 450-foot and 210 foot



radii produce a ratio of 2.1:1. The proposed radii produce a ratio of 1.5:1. The 30 mph curve would use radii of 350 feet and 450 feet. This produces a ratio of 1.3:1. The 30-mph compound curve alignment would result in significant impact to abutting properties on the westerly side of the curve. The compound curve would require minor shifting of less than one foot to the east. The alignments and associated impacts are illustrated in Figure 17 and 18.

- A spiral curve provides changing radii throughout a curve. The radii decrease to a minimum radius in the middle of the curve, then increase to the end of the curve. The spiral curve alignment was designed for a 30-mph design speed. The proposed alignment would result in significant impacts to the abutting properties on the westerly side of the curve. It would also require shifting the roadway approximately two feet to the east, bringing the edge of pavement to as close as 18 feet to existing dwellings on the easterly side of Blanchard Road but still within the existing right-of-way. The alignments and associated impacts are illustrated in Figure 19.

Roadside Barrier

The installation of a roadside barrier on the outside of the curve would protect pedestrians on the sidewalk as well as abutting property. The barrier would be approximately 675 feet in length and would need to be interrupted at driveways. The roadside barrier would be placed approximately two feet from the edge of pavement, resulting in the existing sidewalk being relocated/expanded to incorporate the space needed for pedestrian access. The barrier would also impact the sidewalks at driveway locations. Curved guardrail sections would need to be installed along the driveway entrance to avoid blunt end collisions. This would require re-routing the sidewalk onto what is currently private property. Recognizing that the aesthetic impacts are always a major issue with barriers, options other than MassHighway's Steel Beam GR, including wood are available, should the City and the community consider this to be a desirable alternative. Figure 20 shows the approximate barrier location along the curve.

Traffic Calming Measures

Vertical curbing/sidewalks

Roadway reconstruction to include vertical curbing and sidewalks would enhance the roadway environment but also better define the edge of road for vehicles. Defining edge of roadway through vertical curb and sidewalks will change the character of the roadway and give the appearance of an urban roadway. It will also give the appearance of a narrower travelway causing motorists to slow down. Sidewalks on both sides of the roadway would also improve accommodations for pedestrians. A



schematic cross-section of crosswalks on one and both sides of the road is shown in Figures 21 and 22.

Bicycle Lanes

Bicycle lanes would not only enhance the roadway environment for other users, but would also better define vehicle travel lanes. This alternative is recommended to be used in conjunction with narrow lanes and vertical curbing to optimize the effect on vehicle travel.

Crossing Islands

Crossing islands employ narrow travel lanes and raised center “islands” in the roadway to create a deflection in the travelway, causing motorists to slow down to navigate that section of roadway. Located at intersections, crossing islands can also provide a temporary pedestrian refuge for pedestrians crossing the street. Crossing islands are typically raised and constructed using vertical curb or mountable curb (for truck traffic on narrow roads).

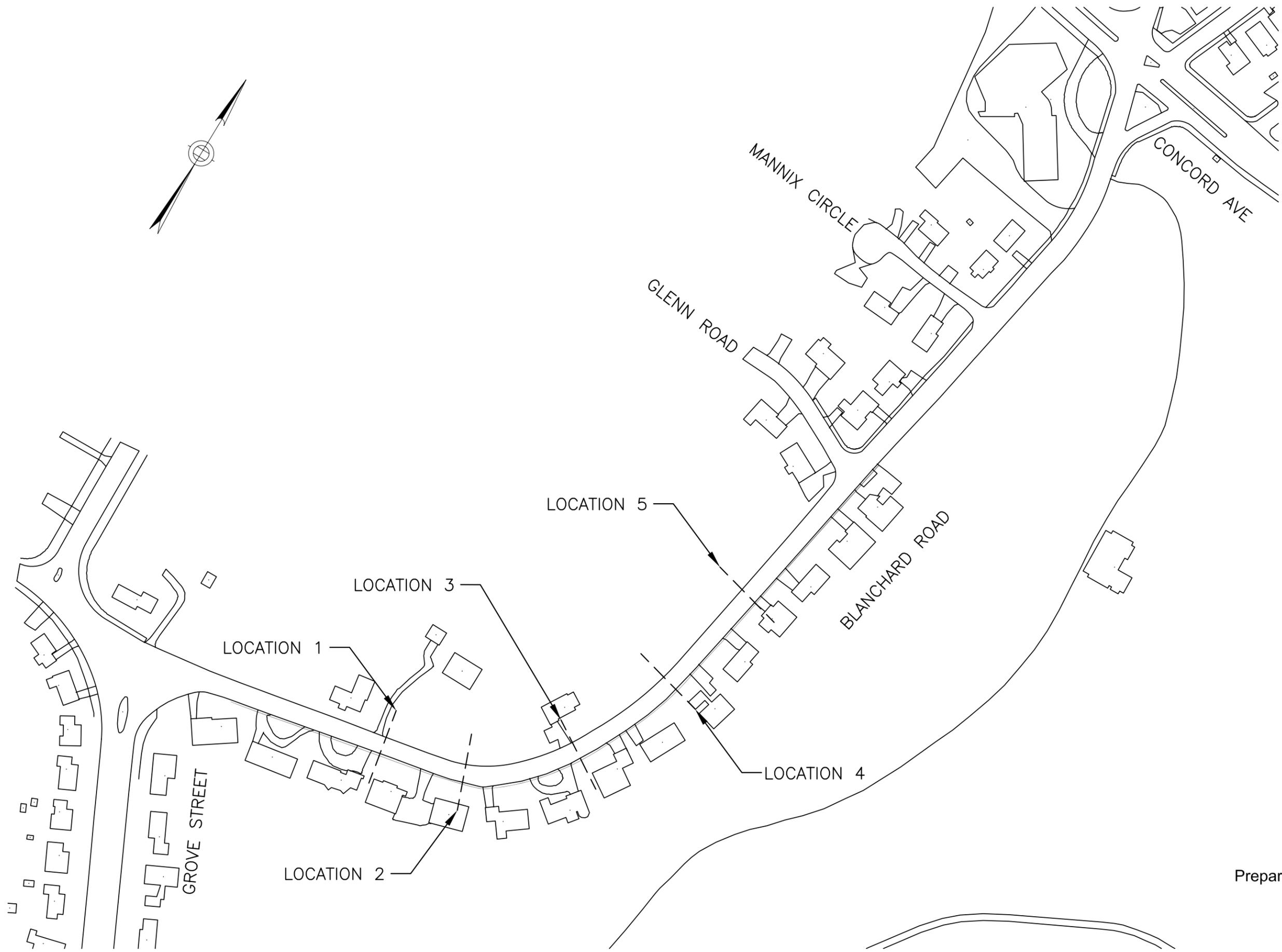
Construction of the crossing islands with bicycle lanes and sidewalks is feasible within the existing 40’ right-of-way. A schematic cross section of a crossing island is shown in Figure 23. A plan view of a crossing island at the Glenn Road intersection is shown in Figure 24.

Roundabouts

Roundabouts utilize a raised circular center island to encourage motorists to reduce speeds in order to navigate the circle. Roundabouts are typically raised and constructed using vertical curb/mountable curb as well as a truck apron along narrow roads. Due to the size of the roundabout, additional right-of-way would likely be required. A schematic of a roundabout at the Glenn Road/Blanchard Road intersection is shown in Figure 25.

Figure 1

Speed Data Locations



Prepared by:



Date:

March 16, 2005

Figure 2
Location 1 - Tangent, South of Curve
Speed Data - Northbound 6/8/04 & 6/9/04 (miles per hour)

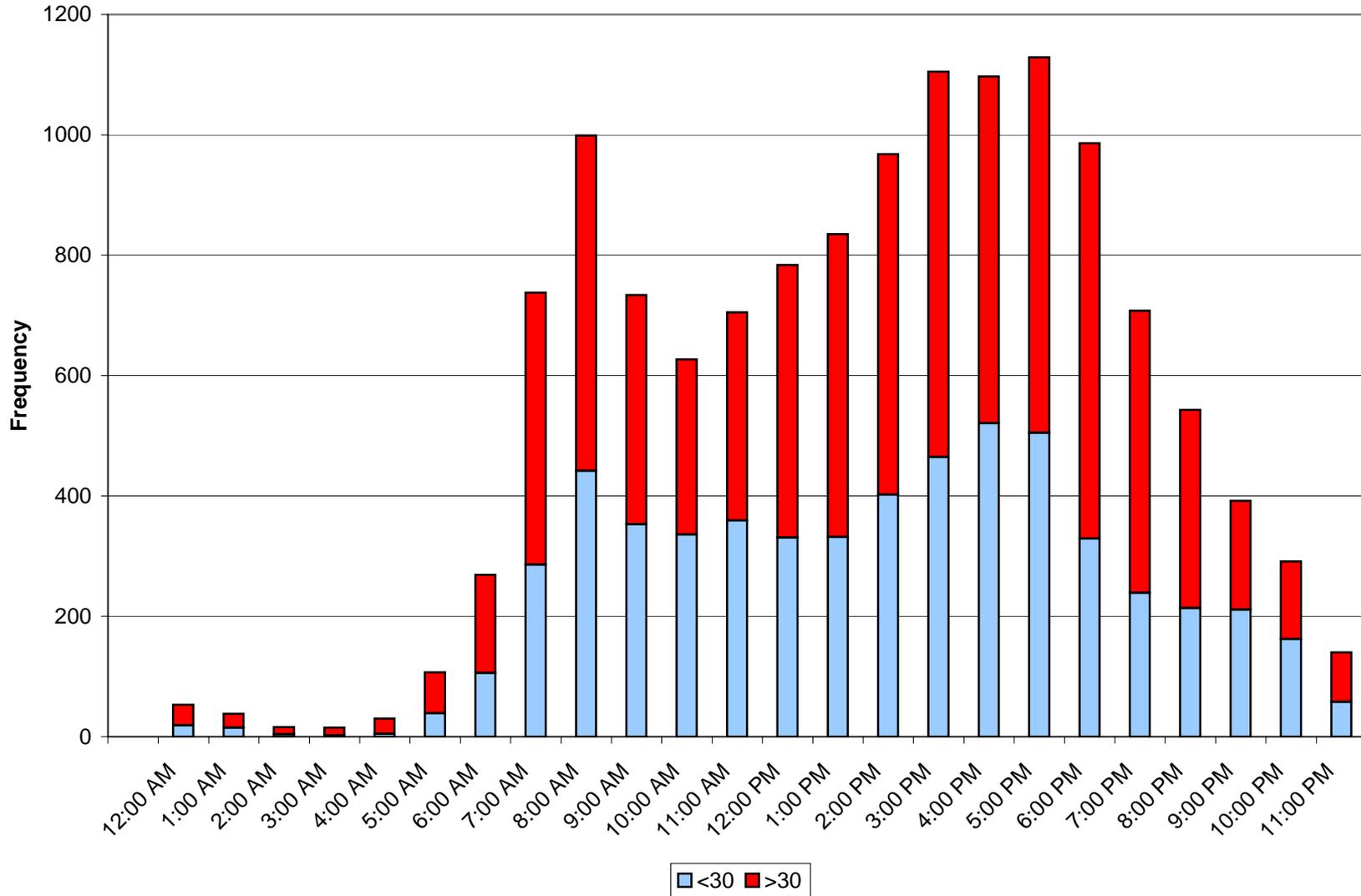


Figure 3
Location 1 - Tangent, South of Curve
Speed Data - Southbound 6/8/04 & 6/9/04 (miles per hour)

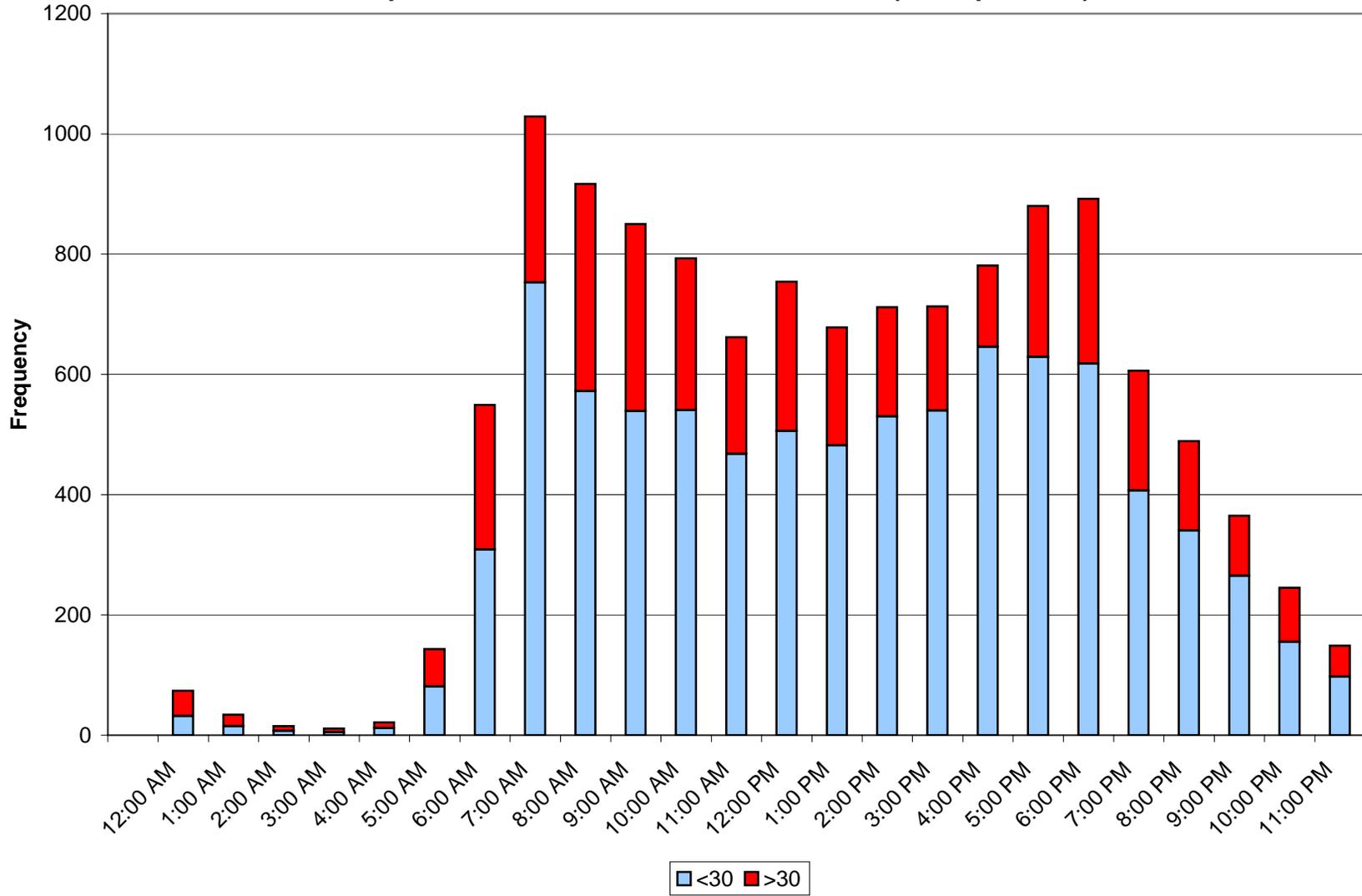


Figure 4
Location 2 - Point of Curvature, South of Curve
Speed Data - Northbound 6/8/04 & 6/9/04 (miles per hour)

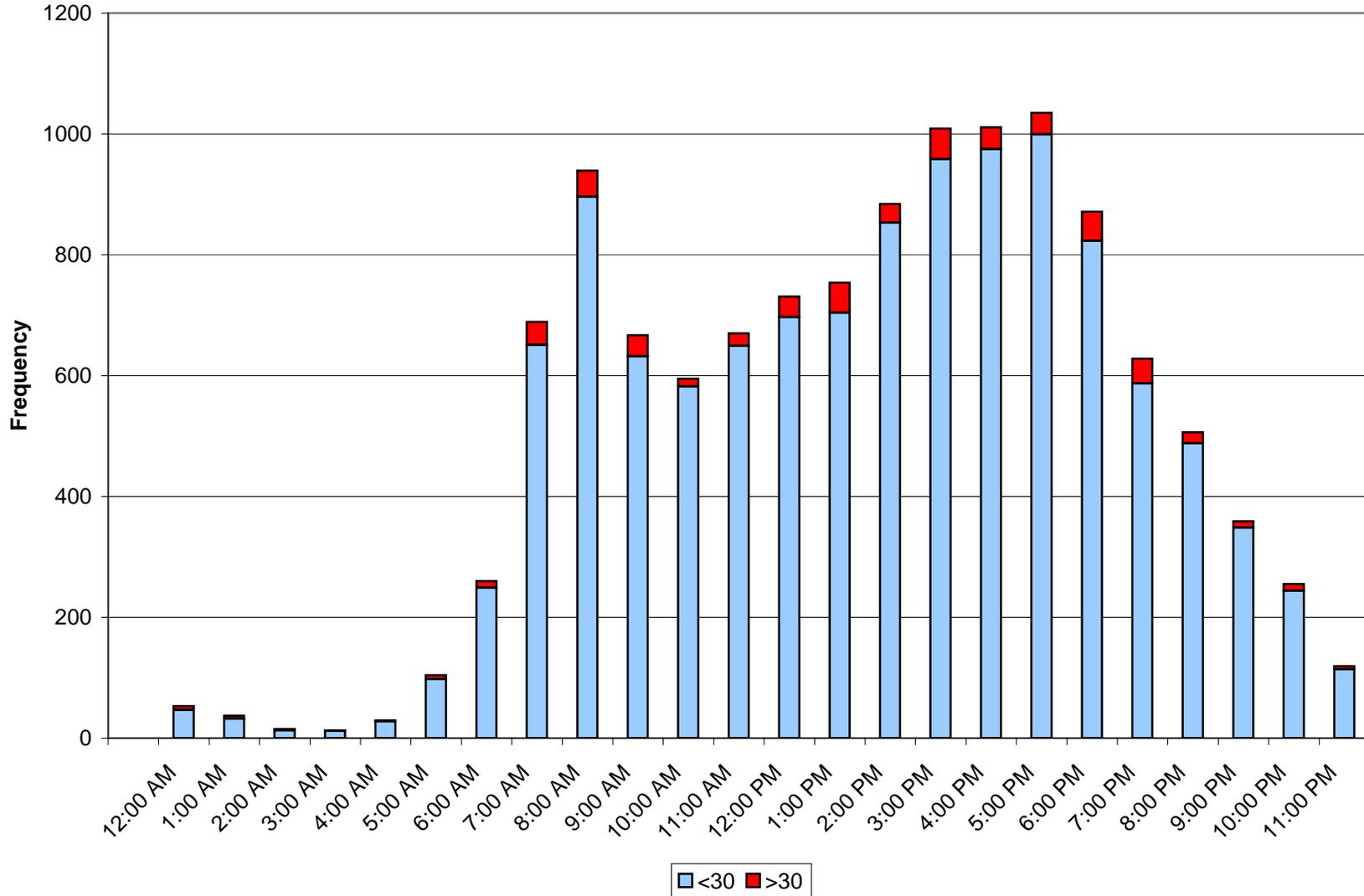


Figure 5
Location 2 - Point of Curvature, South of Curve
Speed Data - Southbound 6/8/04 & 6/9/04 (miles per hour)

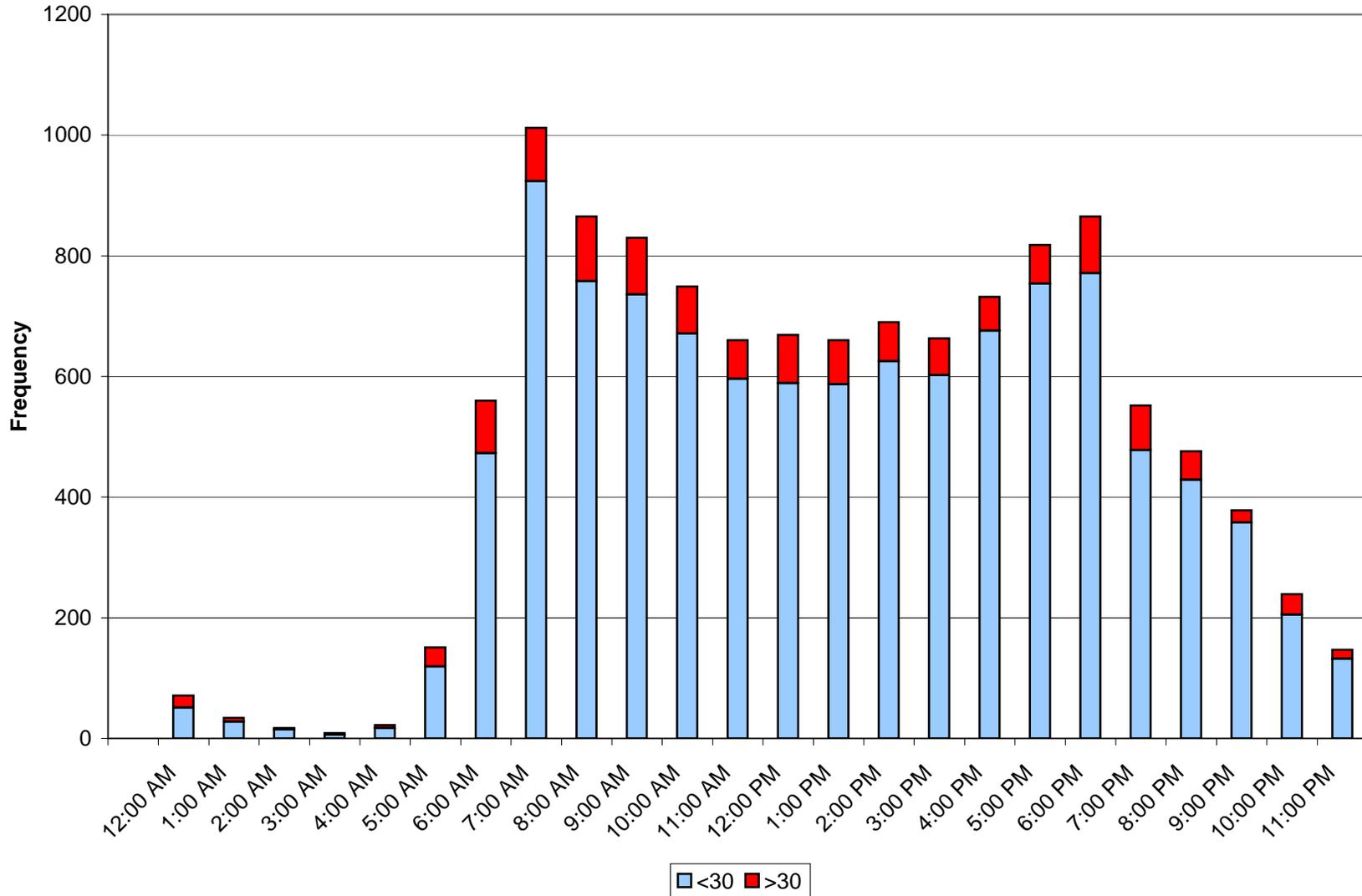


Figure 6
Location 3 - Midpoint of Curve
Speed Data - Northbound 6/8/04 & 6/9/04 (miles per hour)

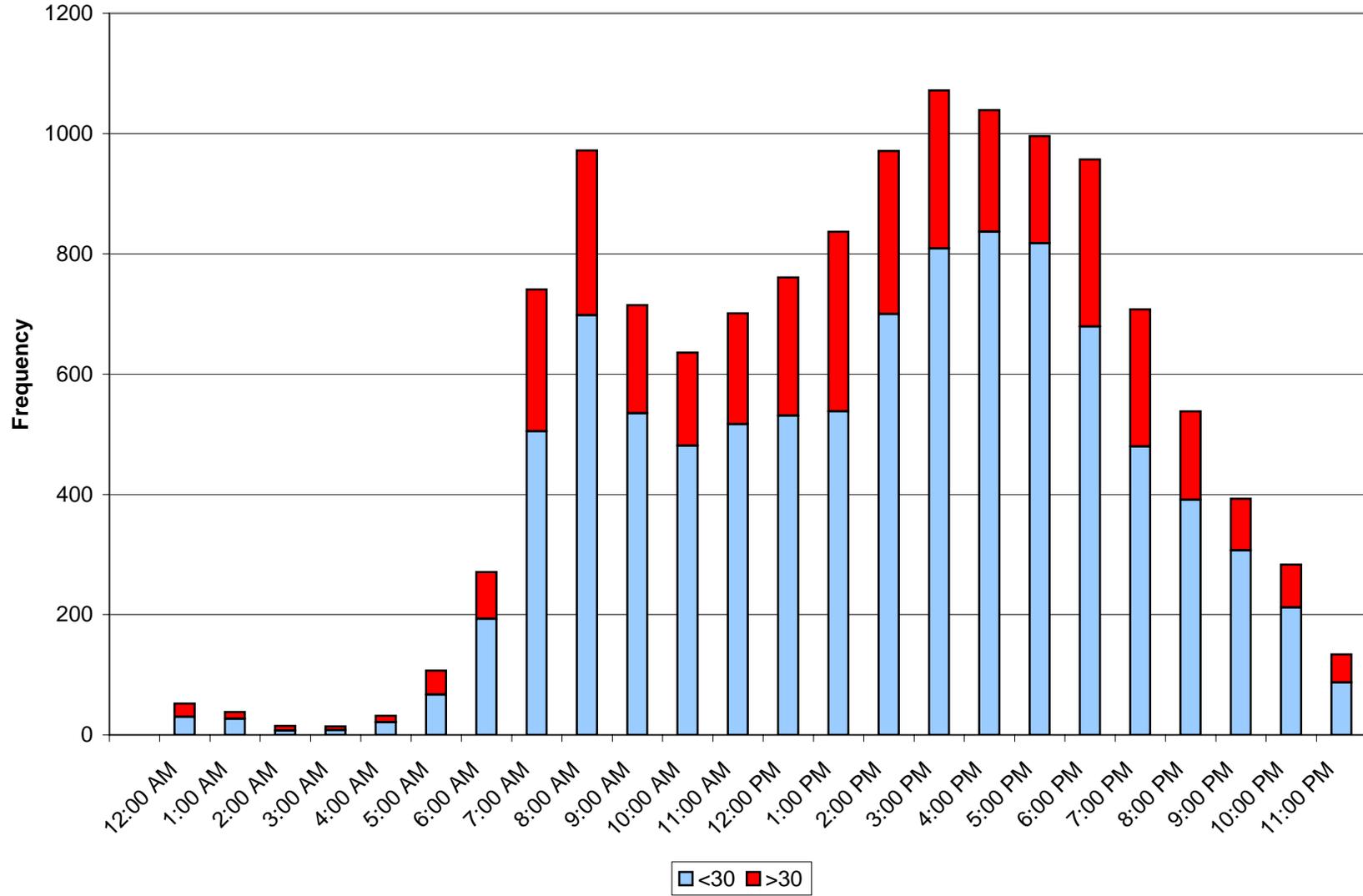


Figure 7
Location 3 - Midpoint of Curve
Speed Data - Southbound 6/8/04 & 6/9/04 (mph)

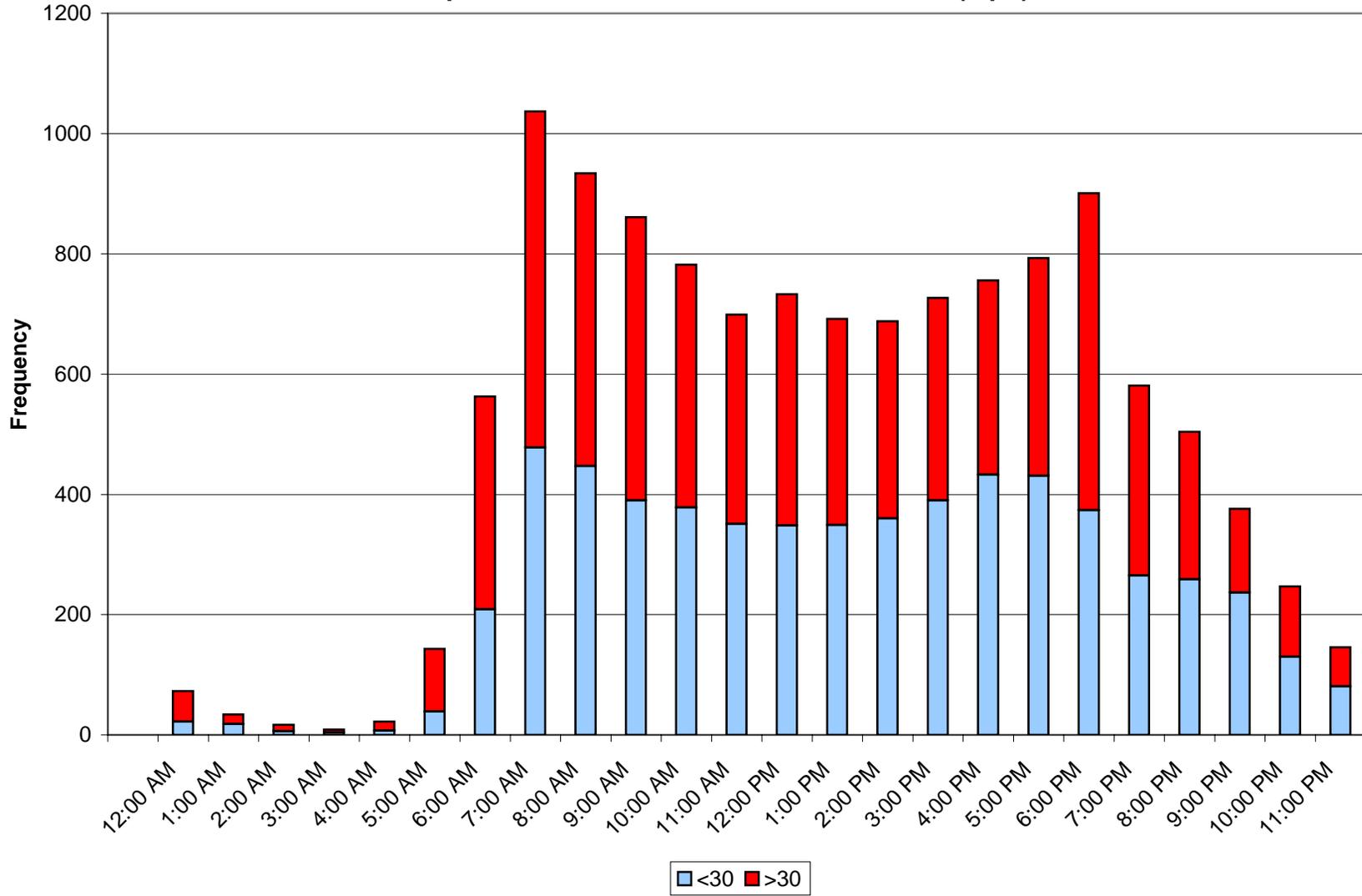


Figure 8
Location 4 - Point of Tangency, North of Curve
Speed Data - Northbound 6/8/04 & 6/9/04 (miles per hour)

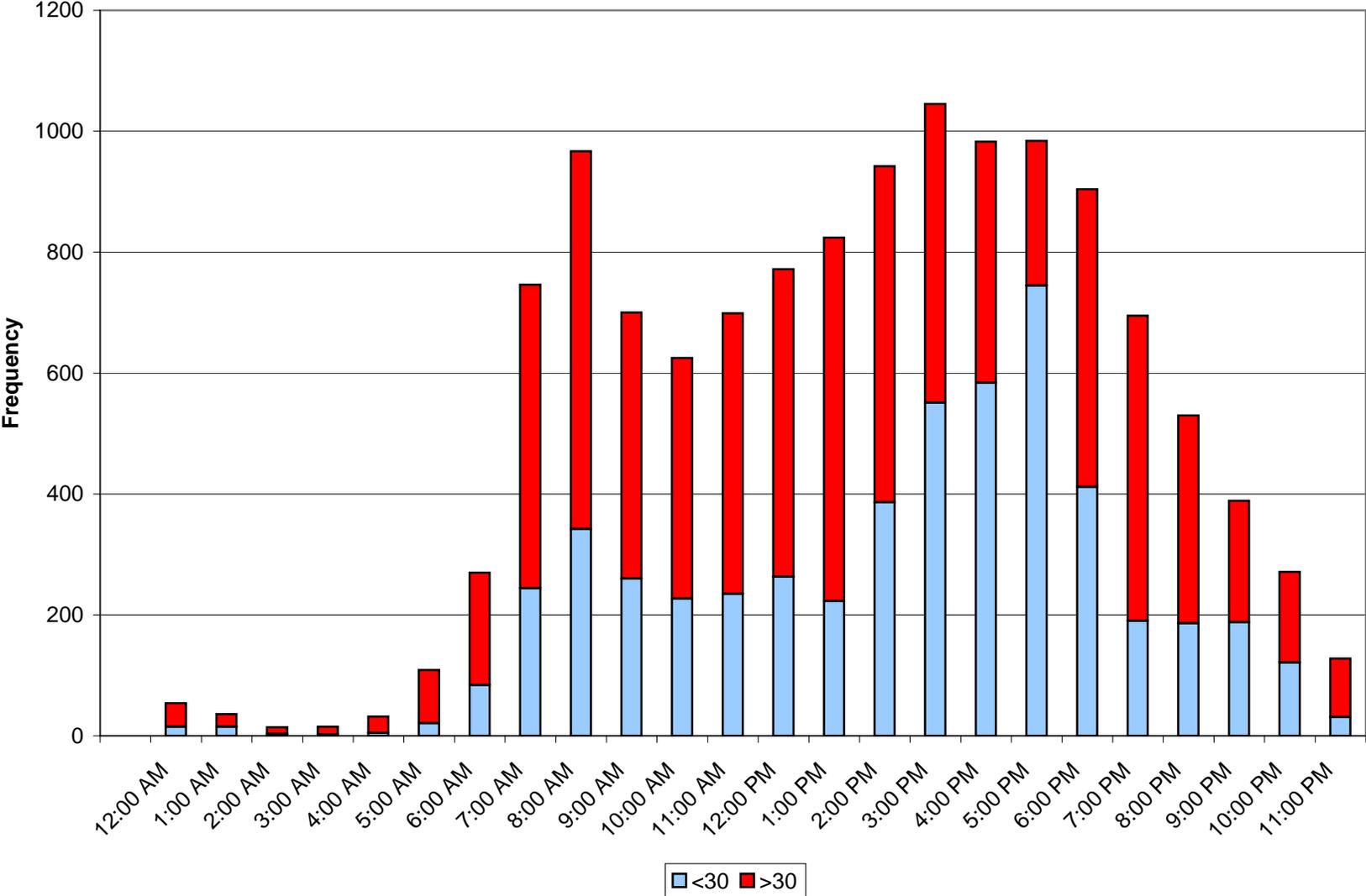


Figure 9
Location 4 - Point of Tangency, North of Curve
Speed Data - Southbound 6/8/04 & 6/9/04 (miles per hour)

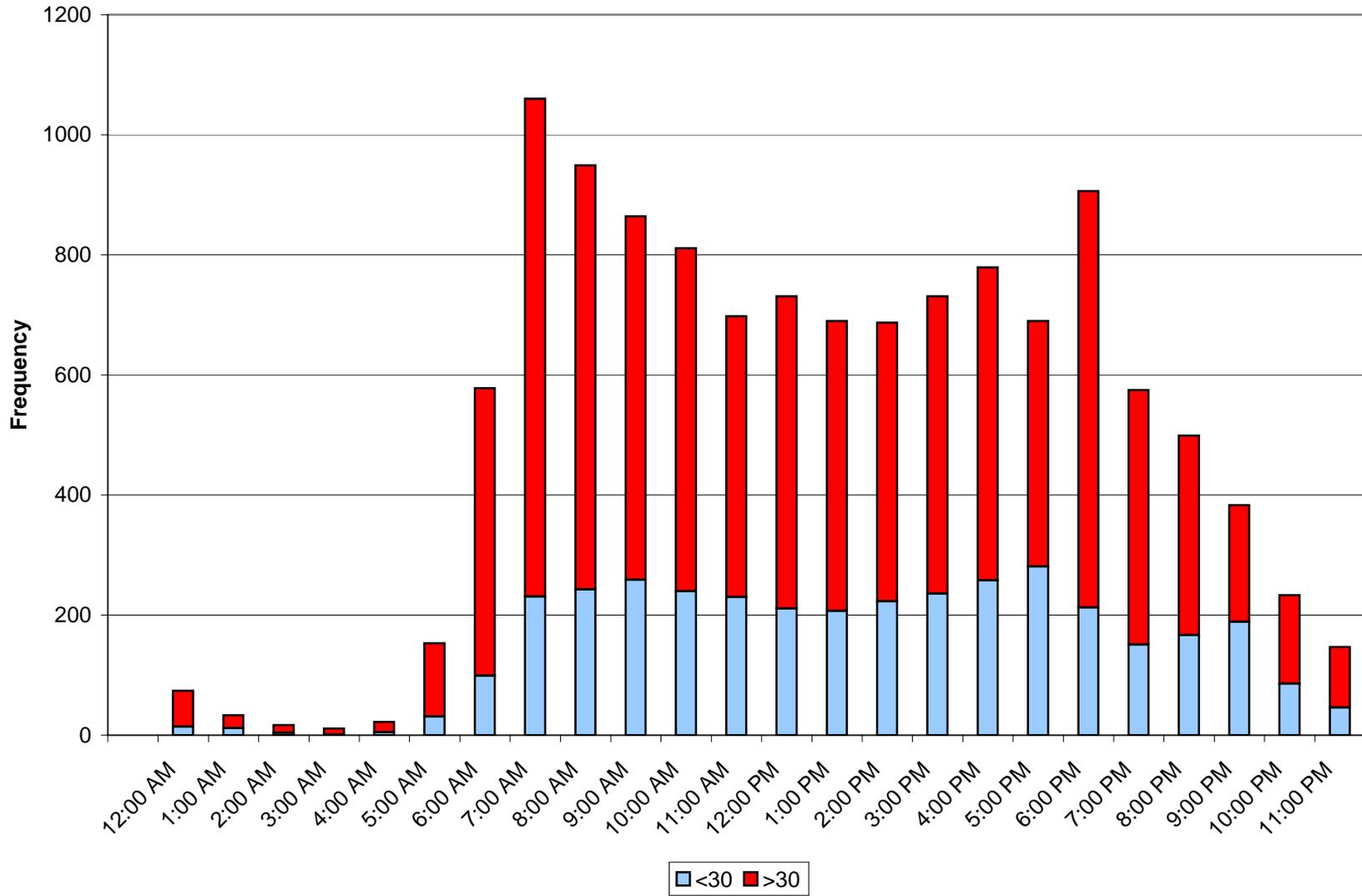


Figure - 10
Location 5 - Tangent, North of Curve
Speed Data - Northbound 6/8/04 & 6/9/04 (miles per hour)

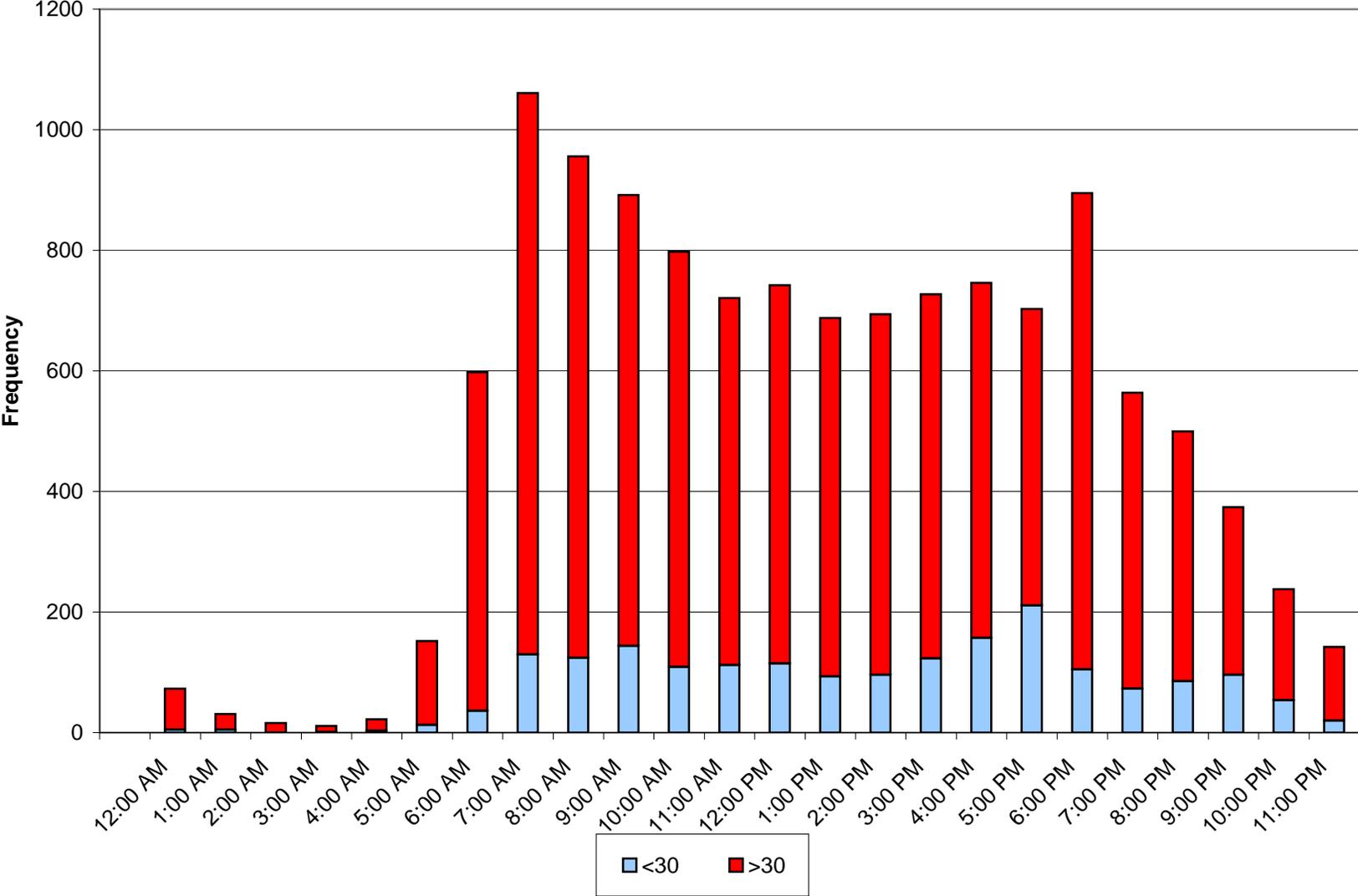


Figure 11
Location 5 - Tangent, North of Curve
Speed Data - Southbound 6/8/04 & 6/9/04 (miles per hour)

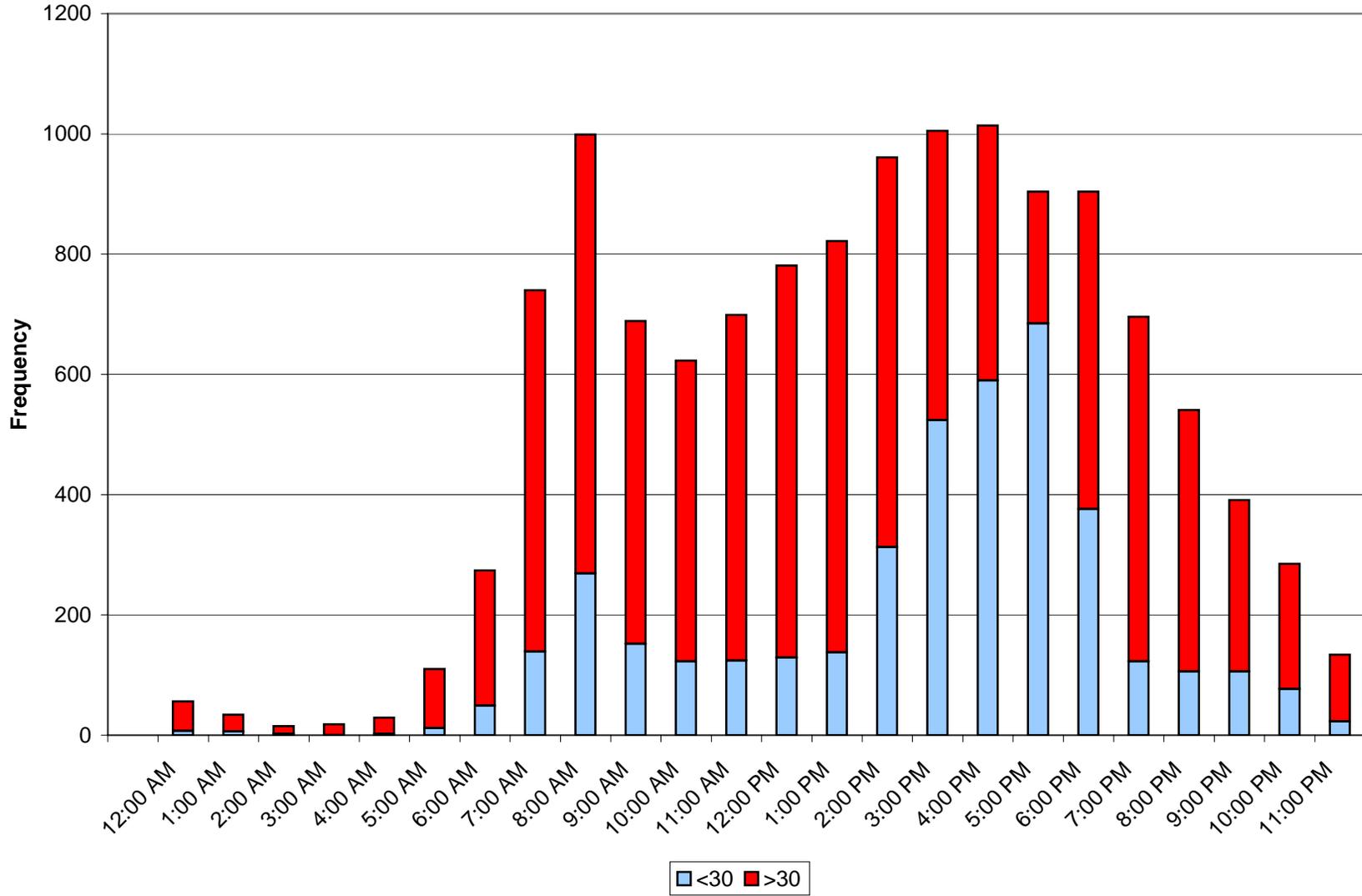
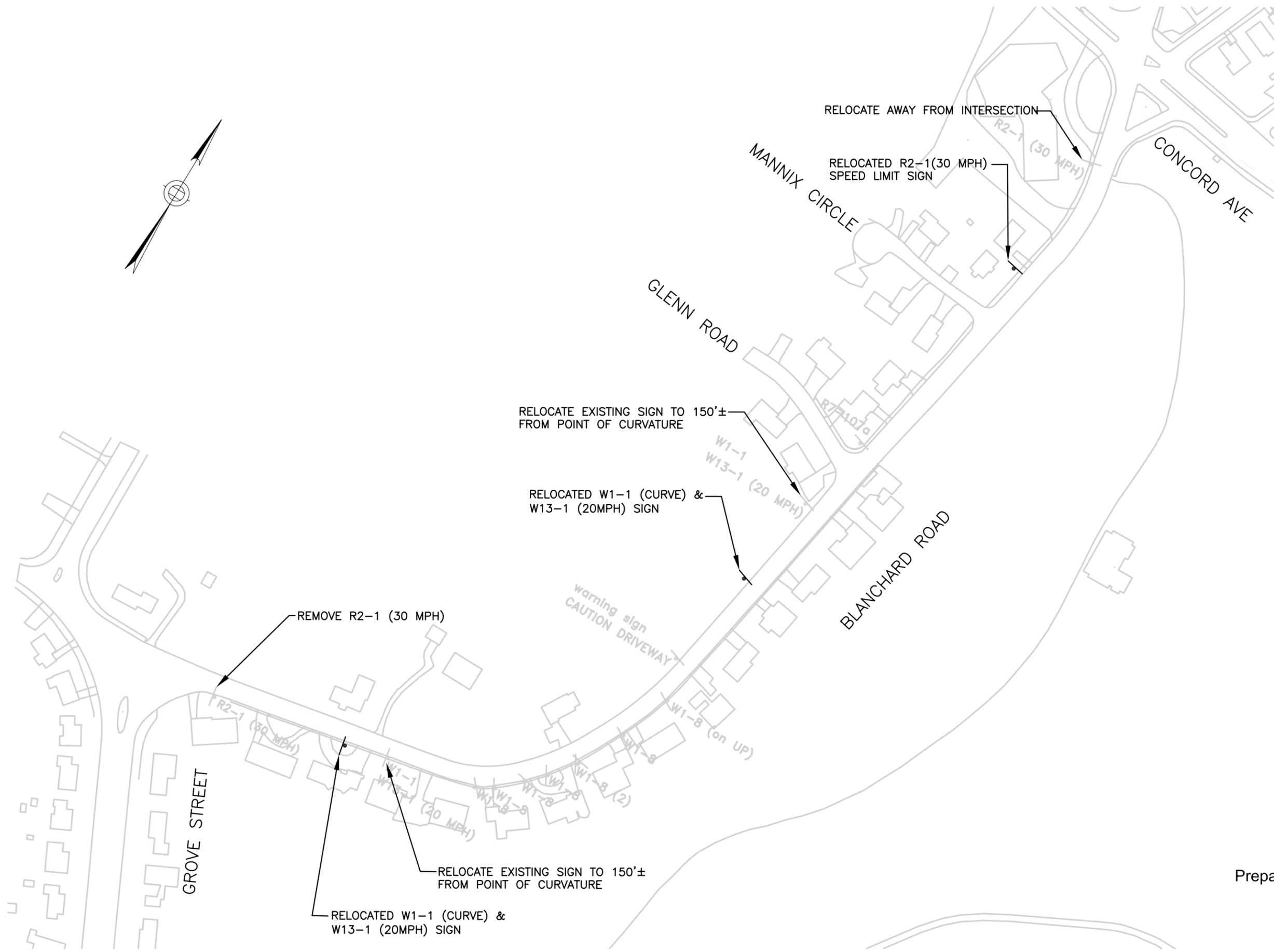


Figure 12

Proposed Signing Location



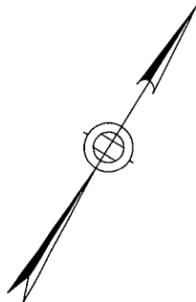
Prepared by:



Date:

March 16, 2005

Figure 13
Proposed Chevron
Signing Location



PROPOSED NORTHBOUND CHEVRON ON P5 POST
(ARROW POINTS LEFT)

warning sign
CAUTION DRIVEWAY

W1-8 (on UP)

W1-1
W13-1 (20 MPH)

W1-8 (2)

PROPOSED SOUTHBOUND CHEVRON ON P5 POST
(ARROW POINTS RIGHT)

EXISTING CHEVRON ON P5 POST (TYP.)

PROPOSED SOUTHBOUND CHEVRON ON P5 POST (ARROW
POINTS RIGHT)

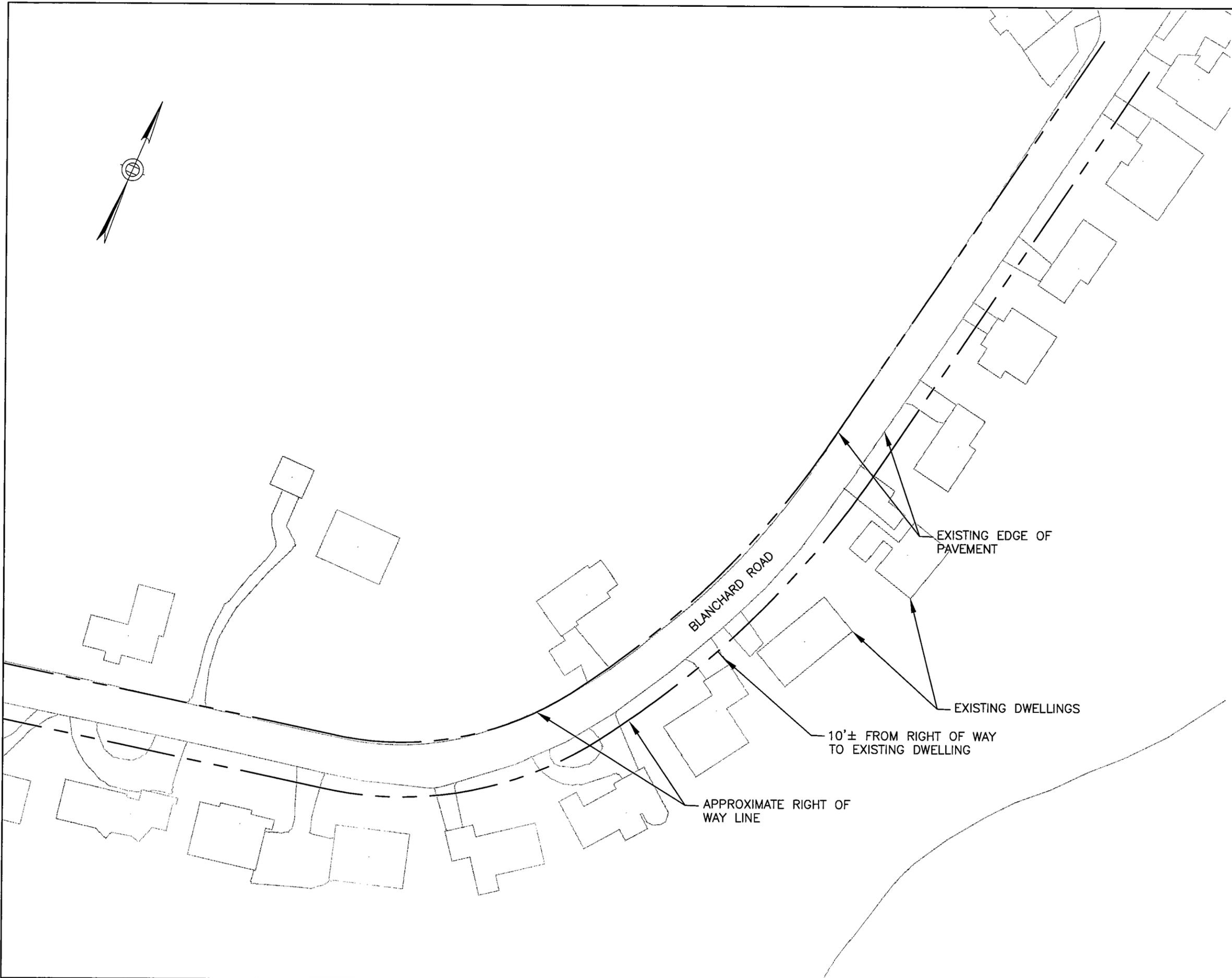
Prepared by:



Date:

March 16, 2005

Figure 14
Blanchard Road
Right-of-Way



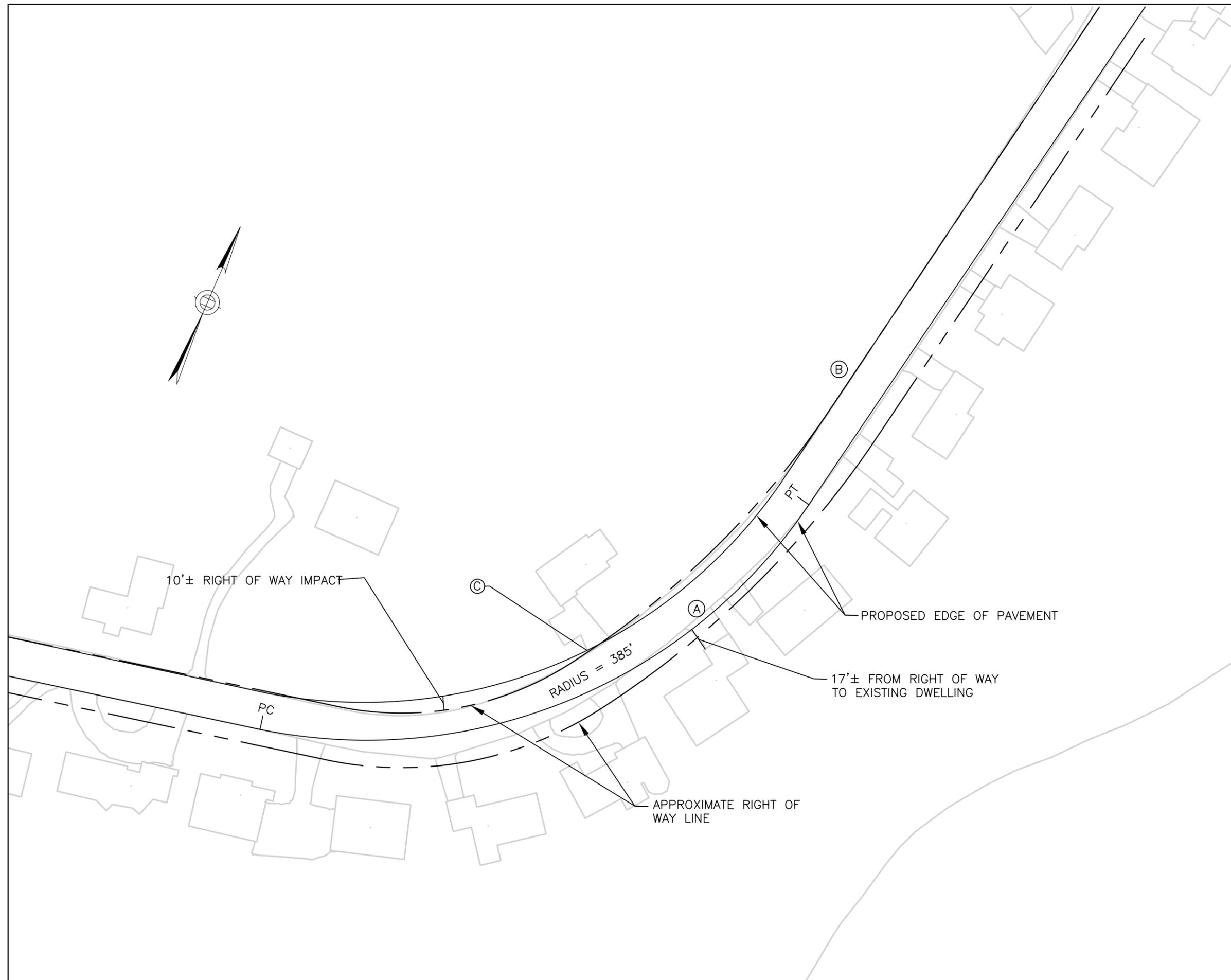
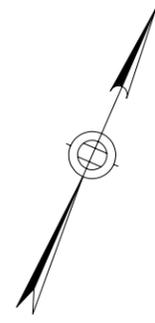
Prepared by:  VOLLMER ASSOCIATES LLP
Date: March 16, 2005

Figure 15

Simple Curve 30 mph Design Speed

CONSTRAINTS:

- Ⓐ MAINTAIN EXISTING EDGE OF PAVEMENT
- Ⓑ MAINTAIN TANGENT ALONG RIGHT-OF-WAY NORTH OF CURVE
- Ⓒ MAINTAIN EDGE OF PAVEMENT WITHIN RIGHT OF WAY AT DRIVEWAY



Prepared by:



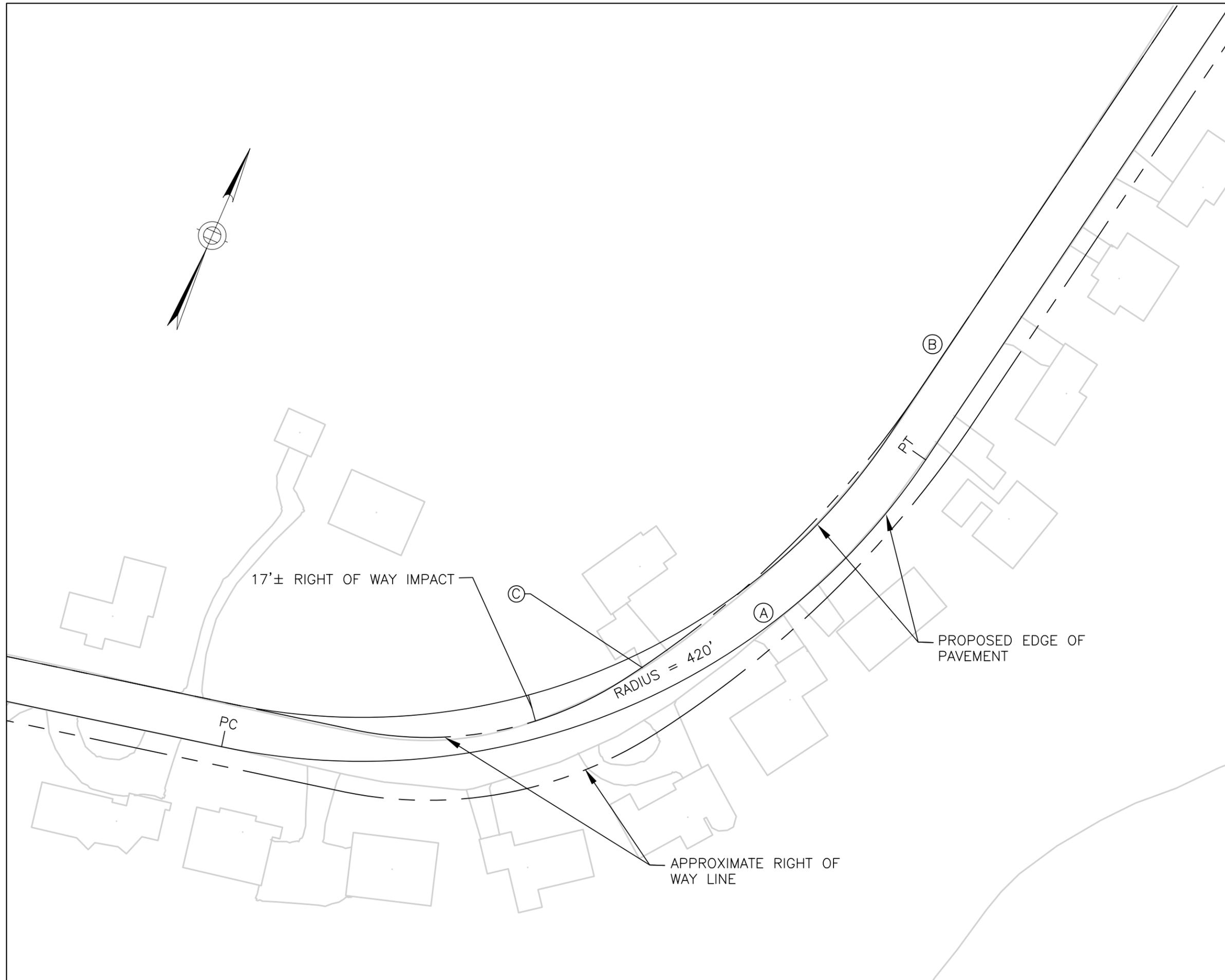
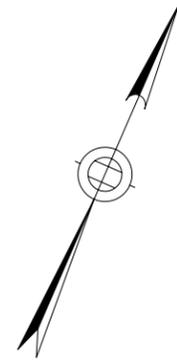
Date: March 16, 2005

Figure 16

Simple Curve 35 mph Design Speed

CONSTRAINTS:

- Ⓐ MAINTAIN EXISTING
EDGE OF PAVEMENT
- Ⓑ MAINTAIN TANGENT
ALONG RIGHT-OF-WAY
NORTH OF CURVE
- Ⓒ MAINTAIN EDGE OF
PAVEMENT WITHIN RIGHT
OF WAY AT DRIVEWAY



Prepared by:



Date:

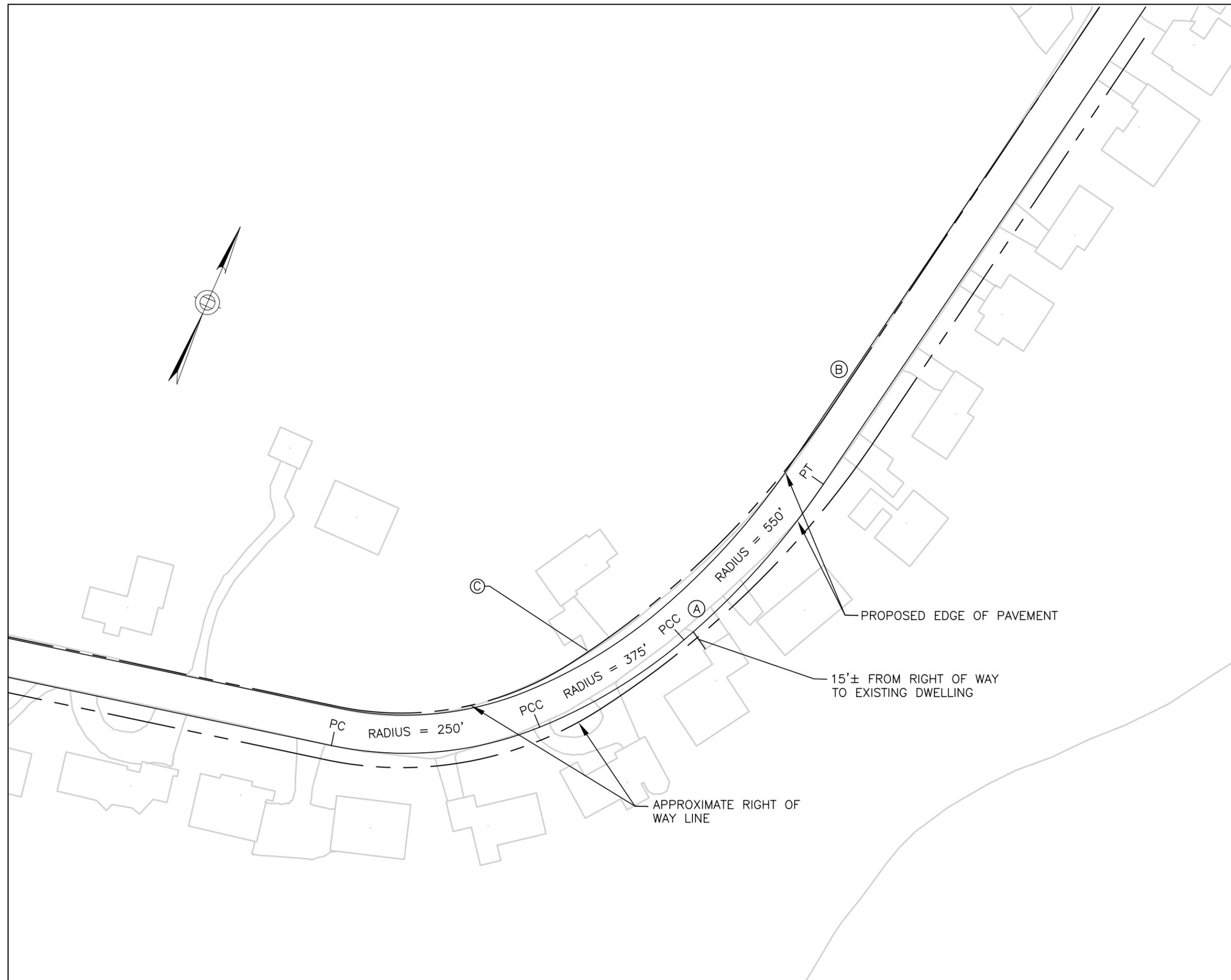
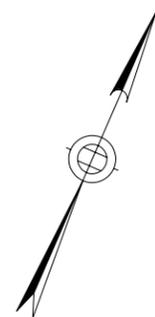
March 16, 2005

Figure 17

Compound Curve 25 mph Design Speed

CONSTRAINTS:

- Ⓐ MAINTAIN EXISTING
EDGE OF PAVEMENT
- Ⓑ MAINTAIN TANGENT
ALONG RIGHT-OF-WAY
NORTH OF CURVE
- Ⓒ MAINTAIN EDGE OF
PAVEMENT WITHIN RIGHT
OF WAY AT DRIVEWAY



Prepared by:



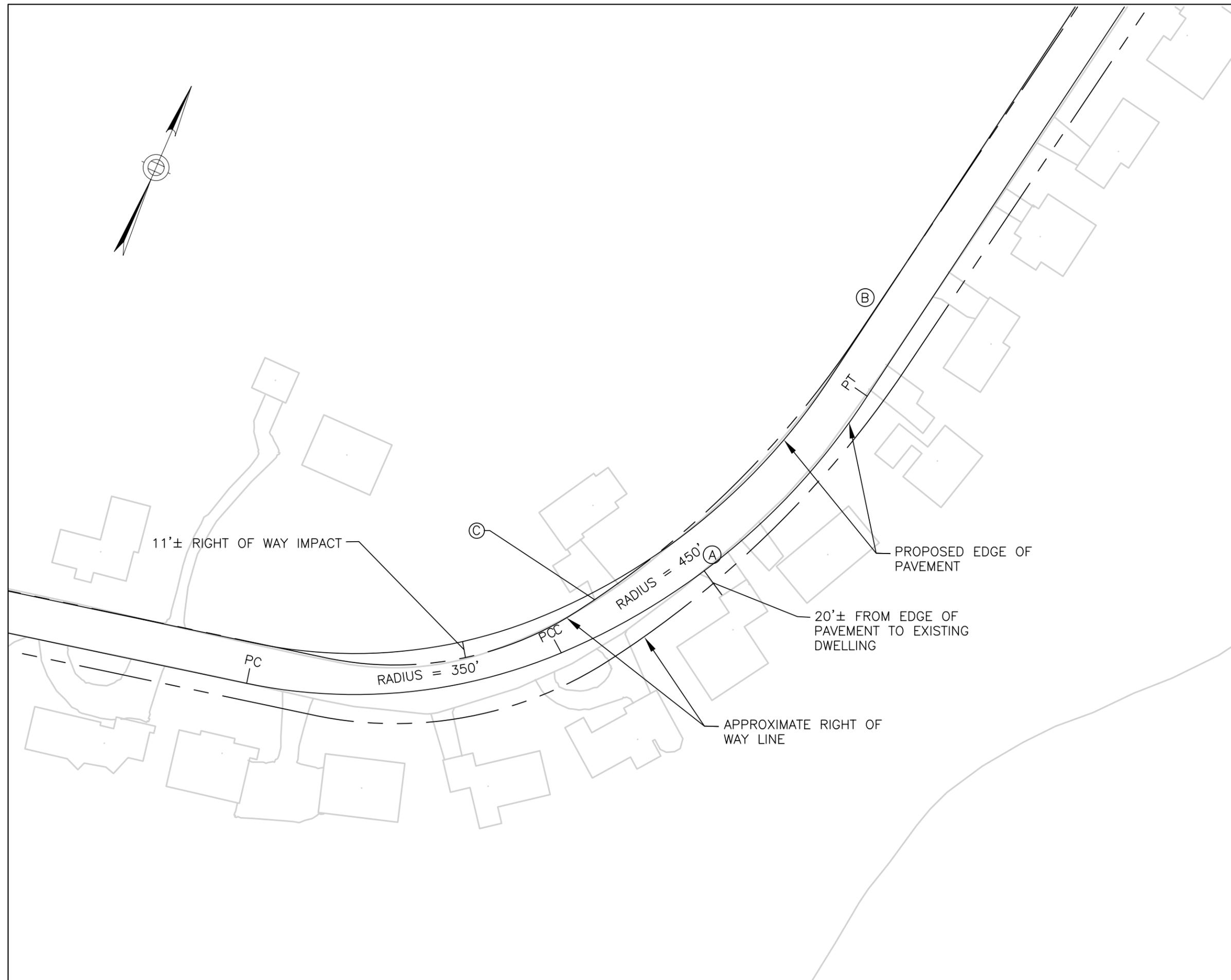
Date: December 8, 2005

Figure 18

Compound Curve 30 mph Design Speed

CONSTRAINTS:

- Ⓐ MAINTAIN EXISTING
EDGE OF PAVEMENT
- Ⓑ MAINTAIN TANGENT
ALONG RIGHT-OF-WAY
NORTH OF CURVE
- Ⓒ MAINTAIN EDGE OF
PAVEMENT WITHIN RIGHT
OF WAY AT DRIVEWAY



Prepared by:



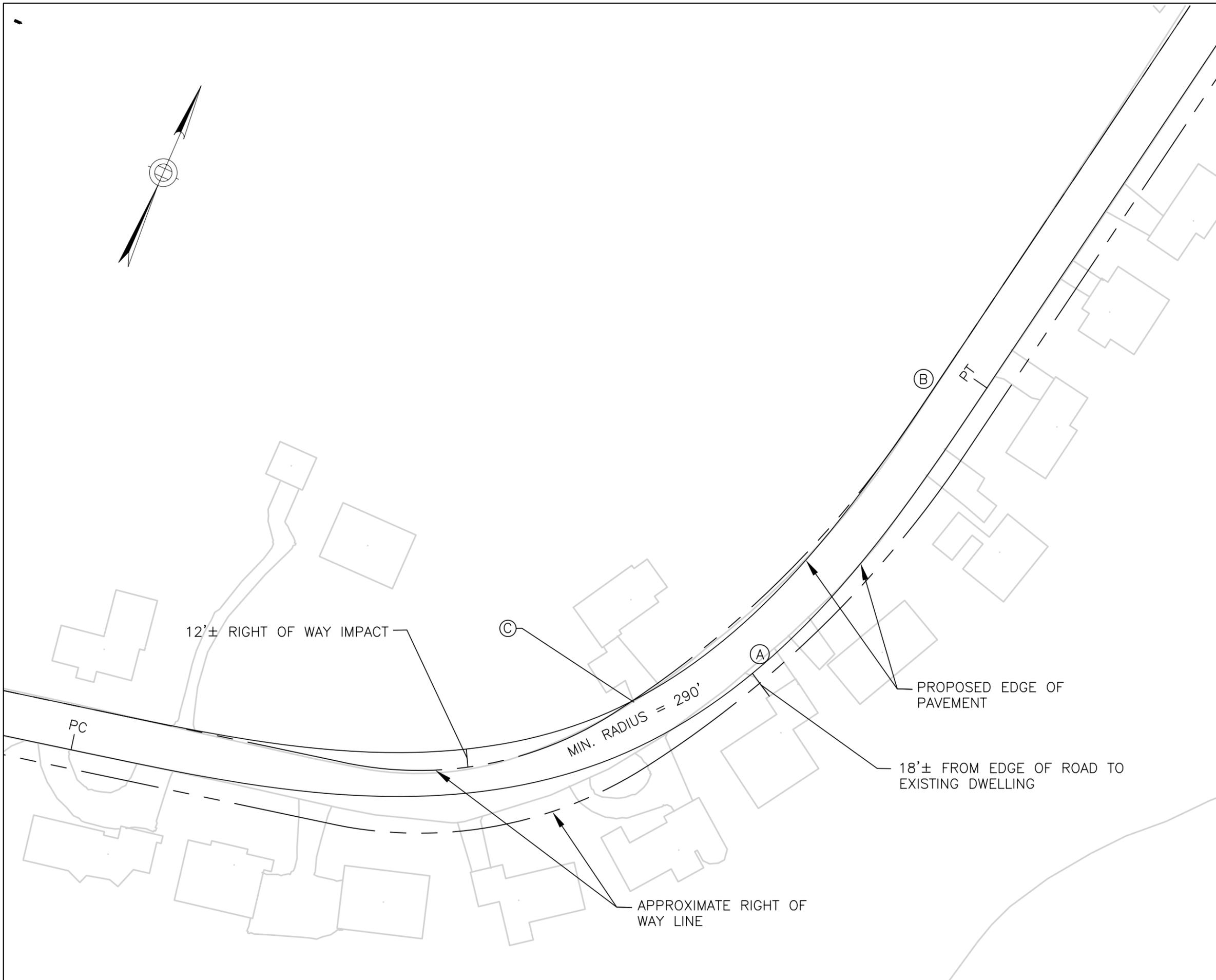
Date: March 16, 2005

Figure 19

Spiral Curve 30 mph Design Speed

CONSTRAINTS:

- Ⓐ MAINTAIN EXISTING
EDGE OF PAVEMENT
- Ⓑ MAINTAIN TANGENT
ALONG RIGHT-OF-WAY
NORTH OF CURVE
- Ⓒ MAINTAIN EDGE OF
PAVEMENT WITHIN RIGHT
OF WAY AT DRIVEWAY



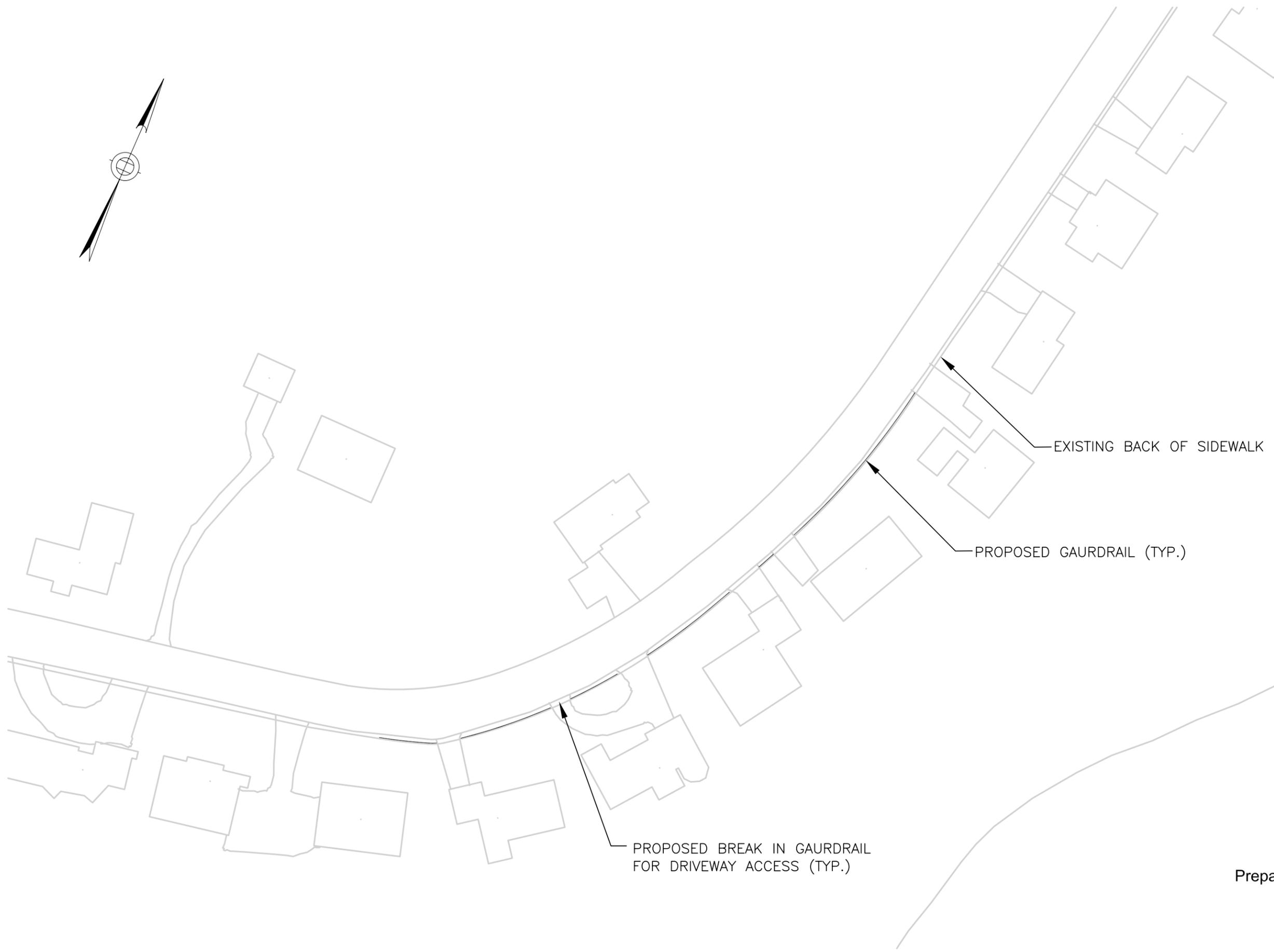
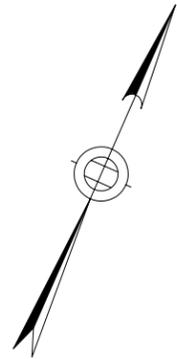
Prepared by:



Date: March 16, 2005

Figure 20

Proposed Guardrail Location



EXISTING BACK OF SIDEWALK

PROPOSED GAURDRAIL (TYP.)

PROPOSED BREAK IN GAURDRAIL
FOR DRIVEWAY ACCESS (TYP.)

Prepared by:

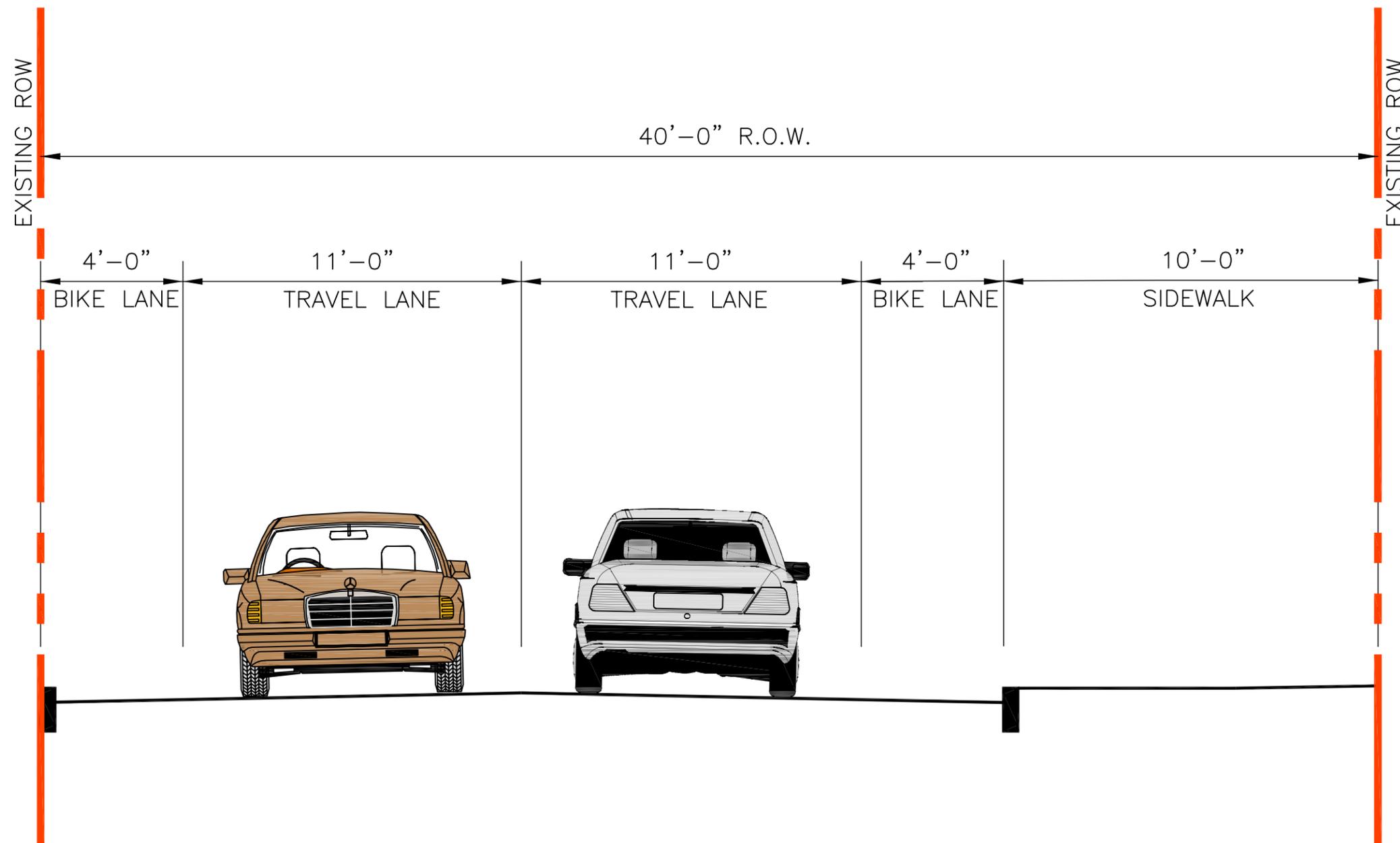


Date:

March 16, 2005

Figure 21

One 10' Sidewalk Schematic Cross Section



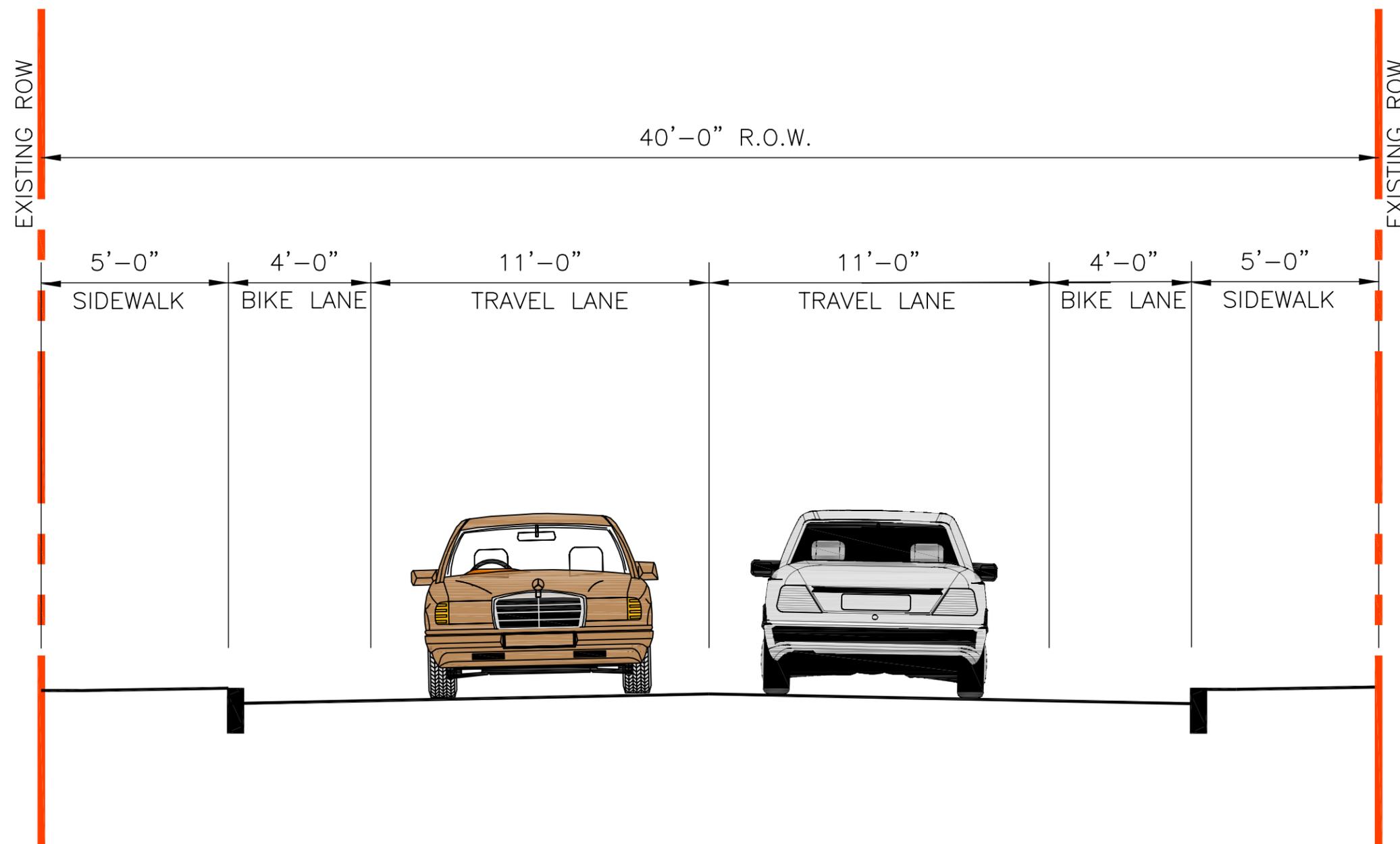
Prepared by:



Date: December 8, 2005

Figure 22

Two 5' Sidewalks Schematic Cross Section

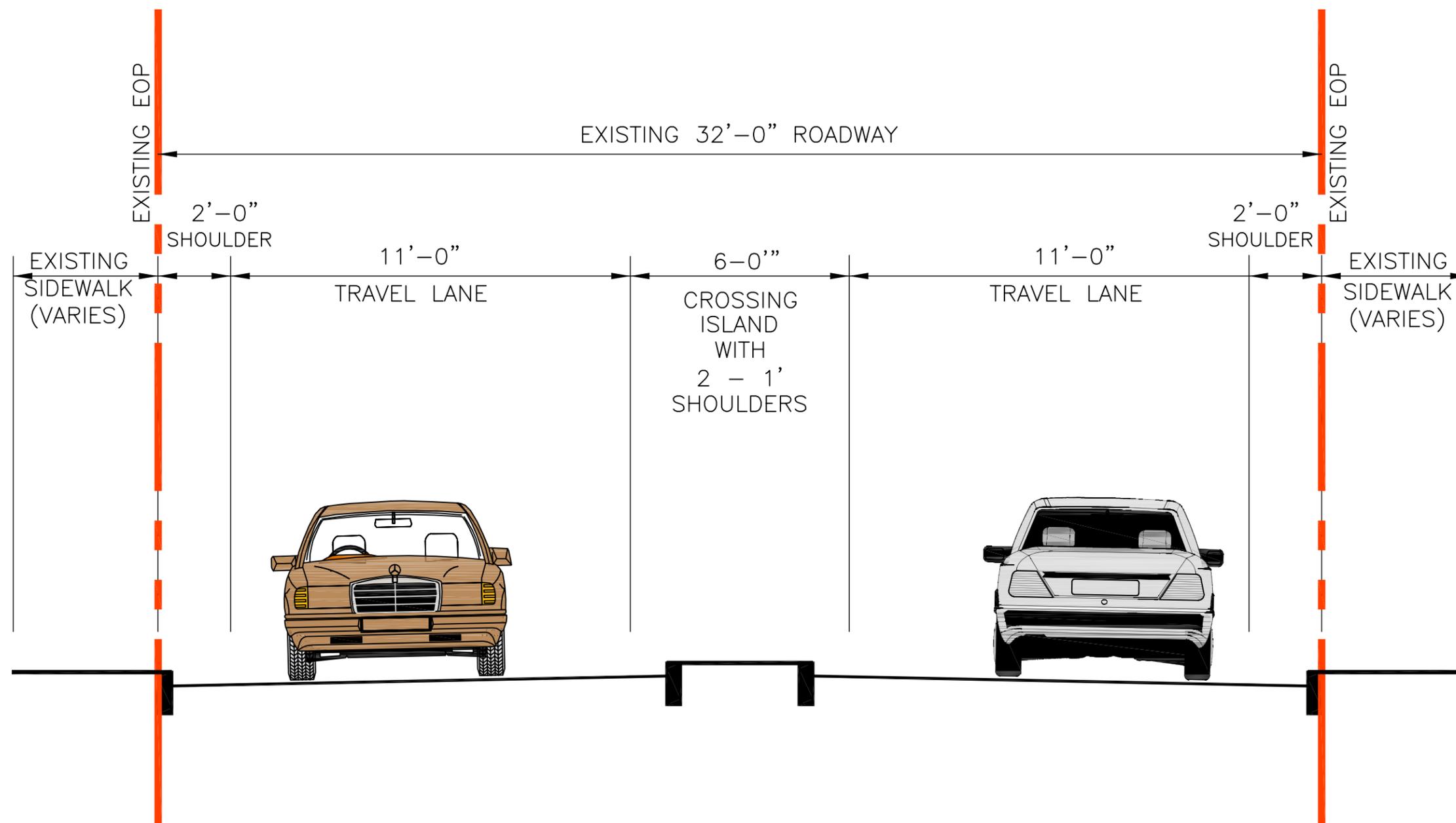


Prepared by:



Date: December 8, 2005

Figure 23
Crossing Island Schematic Cross Section



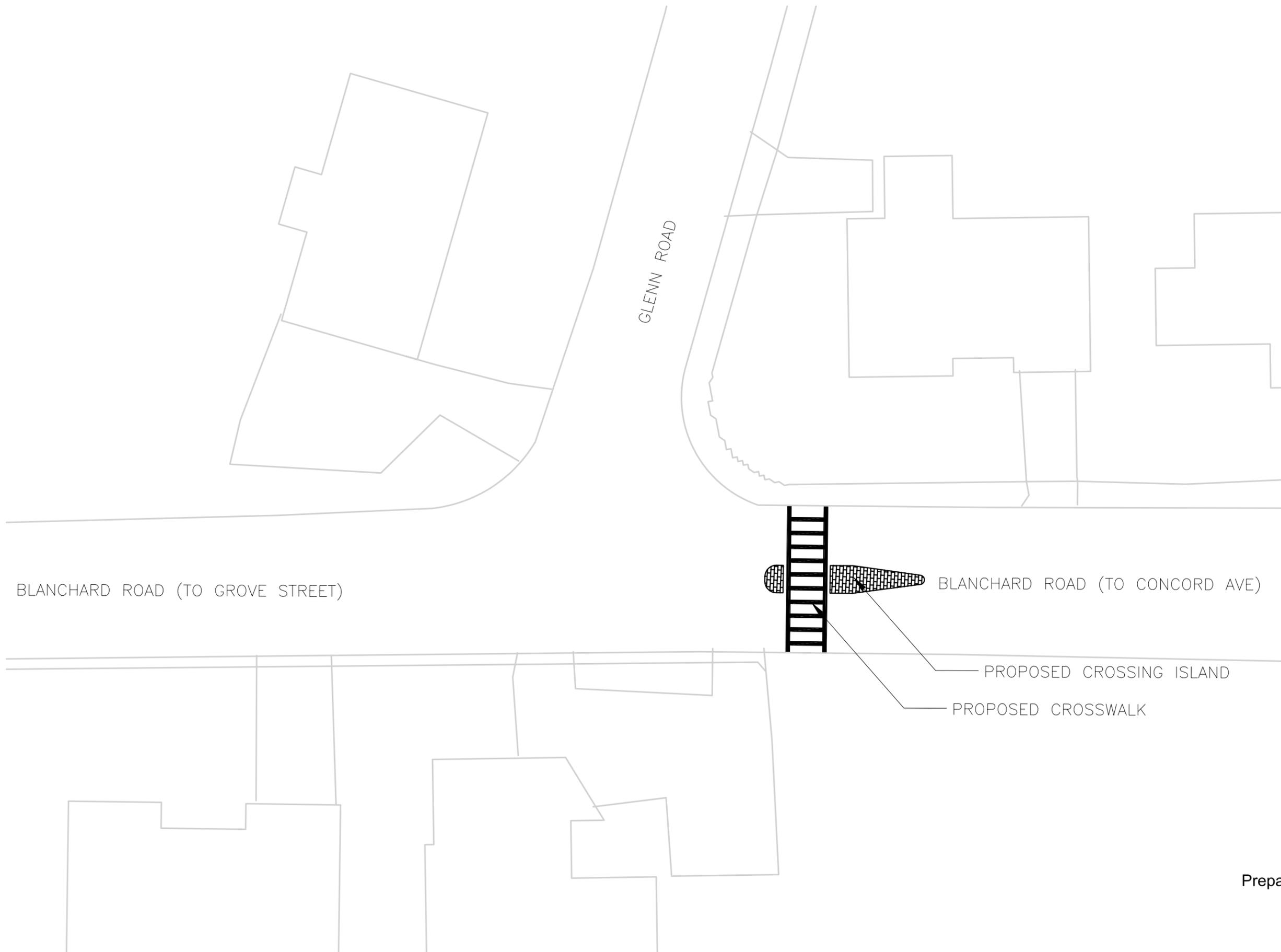
Prepared by:



Date: December 8, 2005

Figure 24

Crossing Island at Glenn Road



Prepared by:

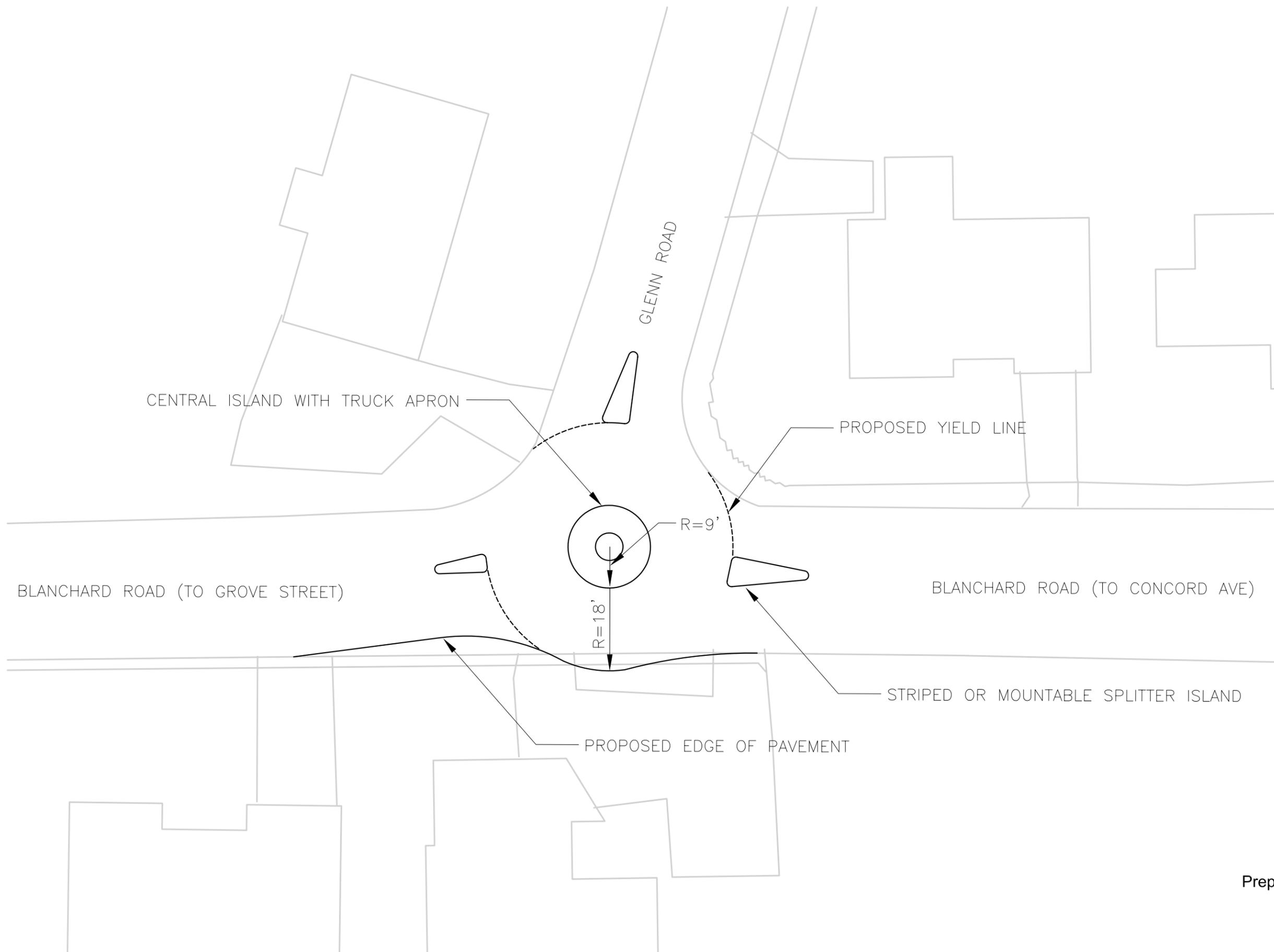


Date:

December 8, 2005

Figure 25

Roundabout at Glenn Road



Prepared by:



Date:

March 16, 2005

APPENDIX B

BLANCHARD ROAD COMMUNITY MEETING NOTES

DECEMBER 15, 2005

Blanchard Road Community Meeting – December 15, 2005

Concerns:

- Truck traffic at night –volume of heavy trucks high 2-6AM
 - 30 MPH Speed limit is too high
 - Need pedestrian crossing (marked) at Glenn Road to match bus stop
 - Lack of attention from City re. maintenance/repair and policing
 - Inside curb not maintained
 - Worst crashes = drunk drivers
 - Problem is that it is too hard to decelerate from 40 MPH to 30 mph in short distance (even though curve can be done safely @ 30 mph)
 - Look at street lights: clean, re-lamp, trim bushes
-

Comments:

- Need additional meeting
- Like proposed narrowing street, bike lanes
- Can we restrict truck traffic (night only may be easier)?
- Short term: enforcement; project needs to be high priority because of frequency / severity of accidents
- Crosswalk at Glenn Rd should be raised
- Raised intersections on Rindge successful
- Why not make Blanchard Road one-way with a raised crosswalk at Glenn Road and wider sidewalks?
- Lighted sign indicating speed of vehicle
- Heavy congestion between 3- 4:30PM
- Get 25 mph designation
- Narrow travel lane to 10'-11' to give more room for bikes and wider sidewalks
- A lot of joggers use Blanchard Road
- Widen sidewalk, make it accessible
- At Blanchard Rd #1A and #1 utility pole and hedge blocks sidewalks
- Changing visual character of the street will serve to reduce speeds; presence of additional pedestrians plus bikes would too
- Re-time light at Concord/Blanchard (but will likely not affect speed)
- Empty Mabardy trucks on Blanchard in early AM, also UPS trucks, and fuel trucks
- Collect data to determine if eligible for truck exclusion from the state
- State Rep. Anne Paulsen: willing to assist with state permitting – look at issues such as “context sensitive design”
- Truck exclusion requires showing what the alternate route would be

Next Steps – Short Term:

- Do topographic survey (asap)
- Make signage changes (*note: completed first week of January*)
- Road markings (spring, when temperature > 50 degrees)
- Vegetation (over winter)
- Enforcement (focus at Glenn Road at night)
- Speed trailer (is there room?)
- Submit request to Mass Highway to reduce the speed limit from 30 mph to 25 mph
- Collect the required data to determine if Blanchard Road is eligible for a truck ban. If so, work with Belmont to submit request to Mass Highway.

Long Term Improvements:

- There was strong support for making long term improvements to Blanchard Road. These improvements cannot move forward until funding is obtained to reconstruct Blanchard Road, see below for more information on funding.
- Additional community meetings will be held after funding is obtained and before a design plan for Blanchard Road is developed. There was strong support for incorporating the following elements into a redesigned Blanchard Road:
 - Proper crown through the curve section
 - Improved curve radii
 - Narrower travel lanes
 - Bicycle lanes
 - Concrete sidewalks
 - Crossing island at Glenn Road
 - Strong pavement markings, including in-ground raised pavement markings.

Funding:

- Design money
- Construction money
- Submit FY07 budget request. The earliest funding could potentially be available is July 2006.

Communication:

- Send periodic e-mails
- Post notes from meeting on web
- Meet in spring once outcome of budget request is known

Data Collection:

- Topographic Survey (over the winter, depending on weather)
- Truck volumes, which are required before a request for a truck exclusion can be submitted to the state (winter)

APPENDIX C
BLANCHARD ROAD RESIDENT SURVEY AND RESULTS
MARCH 2011

Blanchard Road Survey

Created: May 19, 2010,

Blanchard Road Survey

Page 1 - Question 1 - Choice - Multiple Answers (Bullets)

How do you use the street? (check all that apply)

- Drive
 - Walk
 - Bike
 - Other, please specify
-

Page 2 - Question 2 - Choice - One Answer (Bullets)

How do you think the project has affected the traffic speed?

- Decreased
- Increased
- No Change
- Don't Know

Page 3 - Question 3 - Choice - One Answer (Bullets)

How do you think the project has affected the traffic noise level?

- Decreased
- Increased
- No Change
- Don't Know

Page 4 - Question 4 - Choice - One Answer (Bullets)

How do you think the project has affected the safety of pedestrians?

- Better
- Worse
- No Change
- Don't Know

Page 5 - Question 5 - Choice - One Answer (Bullets)

How do you think the project has affected the safety of bicyclists?

- Better
- Worse
- No Change
- Don't Know

How do you think the project has affected the safety of motorists?

- Better
- Worse
- No Change
- Don't Know

How do you think the project has affected the safety of children?

- Better
- Worse
- No Change
- Don't Know

How do you think the overall atmosphere / look of the street has changed?

- Better
- Worse
- No Change
- Don't Know

Do you think the City did a good job of involving the neighborhood in the planning stages of this project?

- Yes
 - No
 - Don't Know
 - Suggestions?
-

What is your overall view of the project?

- Like It
- Neutral
- Don't Like It
- Don't Know

Would you like to see more projects like this around Cambridge?

- Yes
- No
- Don't Know

Page 12 - Question 12 - Open Ended - One Line

What street do you live on?

Page 12 - Question 13 - Open Ended - One Line

How long have you lived there?

Page 12 - Question 14 - Choice - One Answer (Bullets)

Do you rent or own your home?

- Rent
- Own

Page 13 - Question 15 - Yes or No

Do you own a car?

- Yes
- No

Page 13 - Question 16 - Choice - One Answer (Bullets)

If yes, how many?

- 1
- 2
- 3
- 4 or more

Page 13 - Question 17 - Yes or No

Do you have a driveway or other private parking space for your car(s)?

- Yes
- No

Page 14 - Question 18 - Yes or No

Do you have children that live in your home?

- Yes
- No

Page 14 - Question 19 - Choice - One Answer (Bullets)

What is your gender?

- Male
- Female

How do you think the City handled the construction phase of this project? Please explain.

What do you like best about the project? Why?

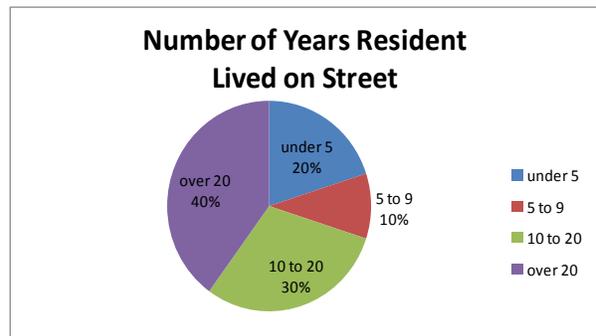
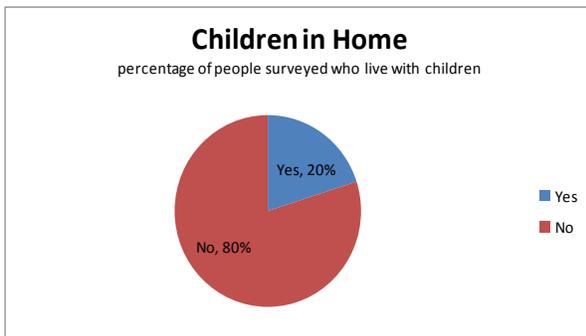
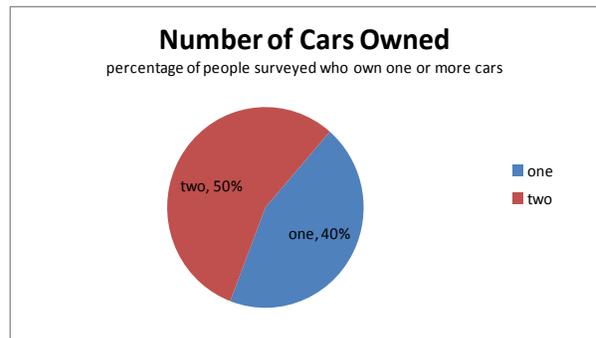
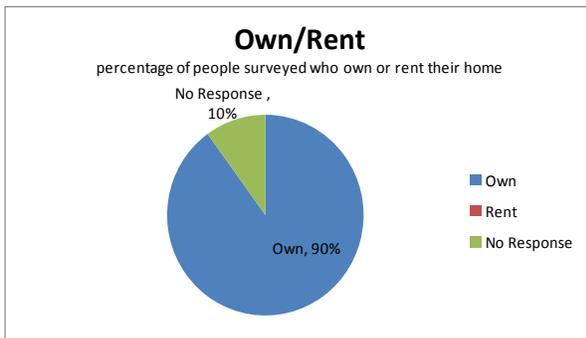
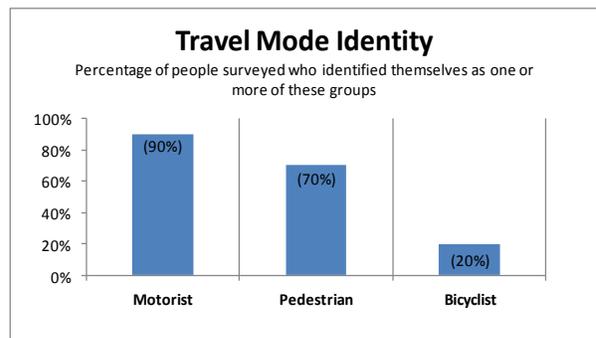
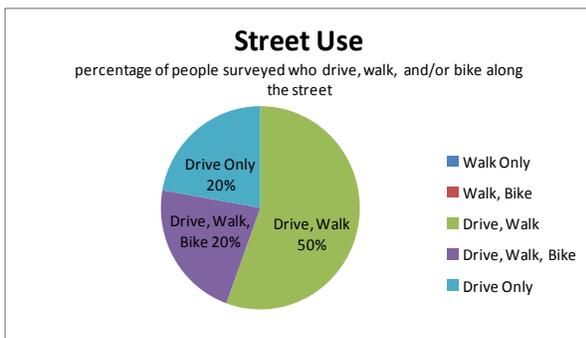
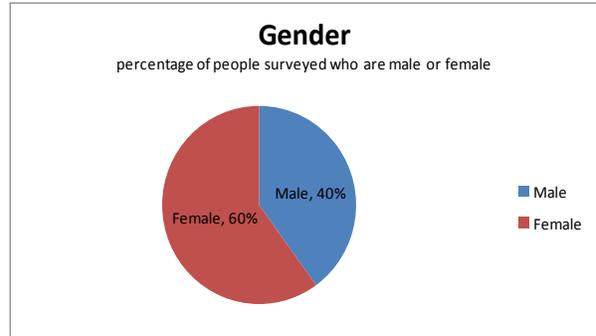
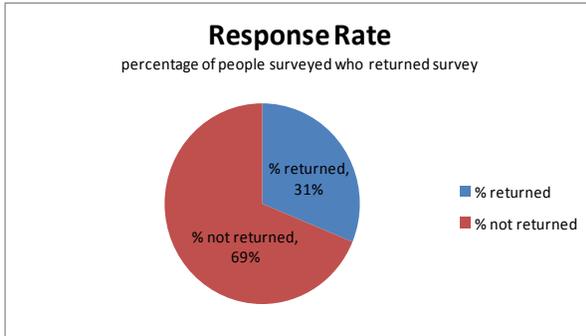
What do you like least about the project? Why?

Optional:

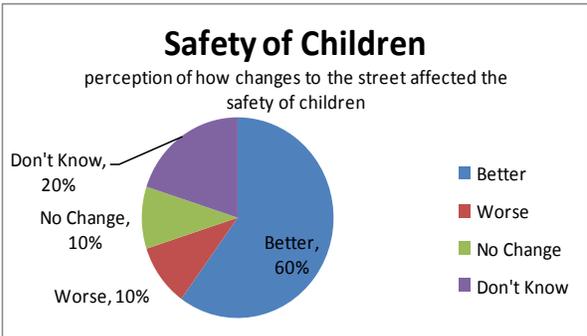
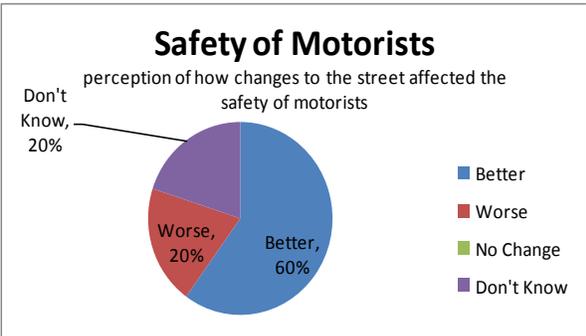
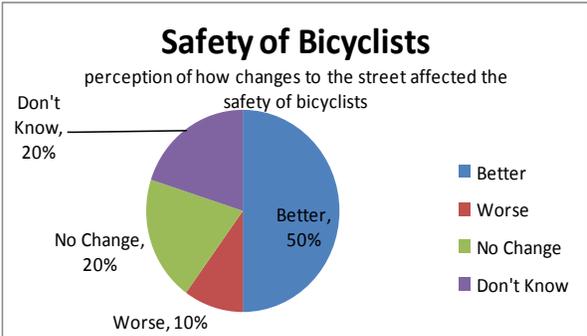
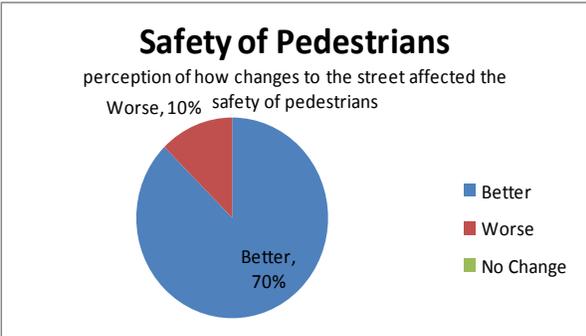
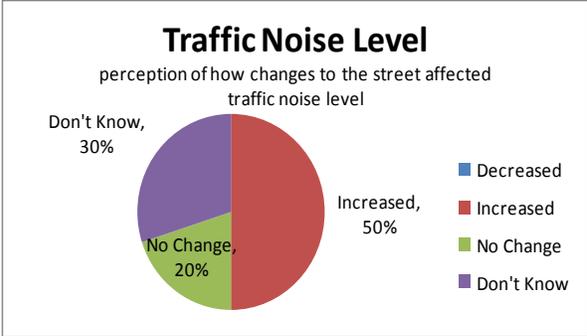
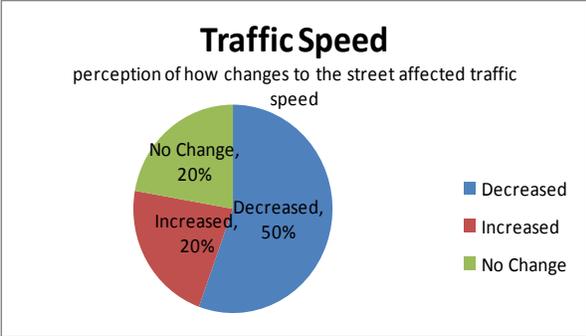
- Name
- Company
- Address
- City
- State
- Zip

Standard

Blanchard Road Demographic Charts



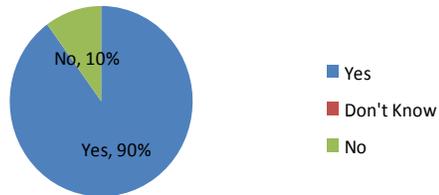
Blanchard Road Opinion Charts



Blanchard Road Opinion Charts

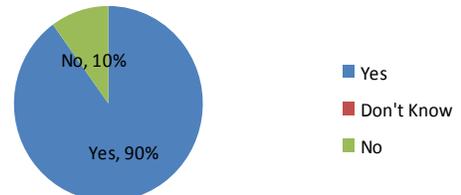
City Involvement of Residents

Did the City do a good job involving the neighborhood during the planning stages of this project?



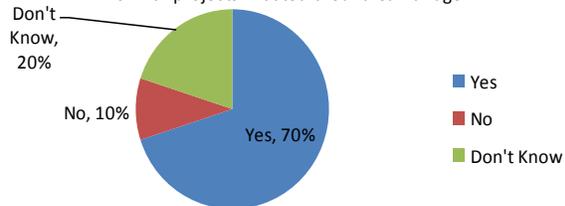
Handling of Construction

Did the City do a good job handling the construction phase of this project?



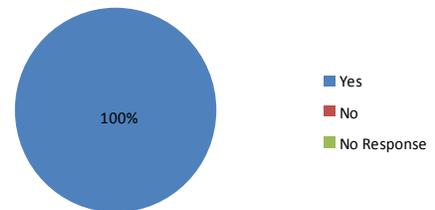
More Similar Projects?

percentage of people surveyed who would like to see similar projects initiated around Cambridge



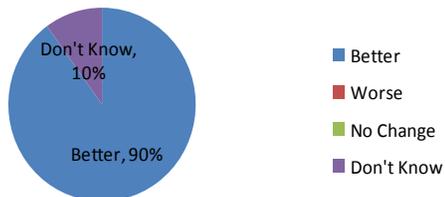
Own Car

percentage of people surveyed who own at least one car



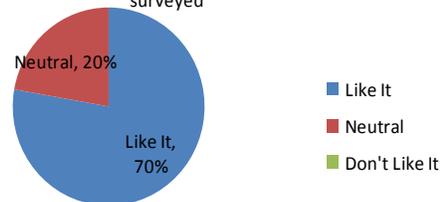
Overall Atmosphere

perception of how changes to the street affected the overall atmosphere of the neighborhood



Overall View of Project

overall perception of the project from the people surveyed



Blanchard Road – responses to open-ended survey questions
4/5/2011

9. Do you think the City did a good job of involving the neighborhood in the planning stages of this project?

Response

1. large trucks are causing many problems

But we need to establish the truck ban that used to exist on Blanchard Road; noise produced by

2. speed bump is high when trucks bottom out on it and new rotary is too small for large trucks to navigate safely.

3. City could be responsive to continuing traffic issues

20. What do you like best about the project? Why?

Response

1. Improved the appearance of the intersections. Created sidewalks making it safer for our children coming to and from school.

2. The way it looks

The wider sidewalks are much safer -- and make snow removal much easier (more room for shoveling a path inside the snowplow pile). The crosswalks, particularly near the traffic circle at Grove St. make it much safer to cross the street.

3. traffic calming with the exception of the large trucks. They do not obey the speed limits and create excessive noise speeding over the table.

4. flower beds, traffic bump to slow cars

5. New sidewalks, areas for planting on the sidewalk, repaving of street

6. Sidewalks. They are wider and feel more safe to walk on.

7. Wide sidewalks and strips

8. Safety improvements and the City's apparent interest in soliciting the residents' continuing concerns with this survey and will hopefully respond with actions.

21. What do you like least about the project? Why?

Response

1. noise and delays in finishing the project.

2. Car traffic has not been reduced and speeds seem far faster because they have a new surface to speed on. The truck traffic continues to increase with speed and noise and danger.

3. The raised bump at Glenn Road doesn't seem to serve much purpose.
4. Speeding trucks.
5. water still pools at the bottom of the street near 136 Blanchard. there is still not enough capacity to keep the street from flooding, still dangerous for drivers
New speed bump, which causes lots of noise in front of our house due to commercial trucks and pick-up trucks bottoming out on the bump. Trucks need to be banned from Blanchard Road and re-routed to Rte. 16.
- 6
- 7 The cars/trucks that refuse to slow down over the raised sections of the roadway sometimes lose control of there vehicles and increases the amount of noise in this area. Unfortunately, it appears that the project did not solve the problem.
- 8 no bike lane on both sides
- 9 not enough cross walks for pedestrians
- 10 That the City has not yet followed up on its assurances that it would assist in addressing continuing concerns about traffic issues which still pose safety concerns.