



## MEMORANDUM

**DATE:** April 25, 2013

**TO:** John Lewis  
City of Oregon City

**FROM:** Dave Brokaw

**RE:** Gaffney Lane Conceptual Design  
Job No. 1348A

**EXHIBITS:** Planning Level Opinion of Cost  
Exhibit A – Existing Conditions  
Exhibit B - Gaffney Lane Realignment Conceptual Plan - Option 1  
Exhibit C - Gaffney Lane Realignment Conceptual Plan - Option 2  
Exhibit D - Gaffney Lane Sight Distance Check  
Exhibit E – Right of Way Adjustment  
Exhibit F – Hybrid Beacon Warrant and RRFB FHWA handout.

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This memorandum has been prepared to accompany the conceptual design options for Gaffney Lane.

### EXISTING CONDITIONS

Gaffney Lane at Glenview Court is currently constrained by the frontage to the property at 13445 Gaffney Lane. The roadway jogs pretty severely around the existing property at the intersection. Gaffney Lane is currently categorized as a Collector on the City TSP. A figure showing the existing site conditions is included in Exhibit A.

**Safety Concerns** - We noted several safety issues associated with the existing conditions:

- Lack of sidewalks - There is a lack of connectivity going east on Gaffney Lane across 13445 Gaffney Lane and from the termination of the sidewalk on the west side of Glenview Court. The project is adjacent to Gaffney Lane Elementary School and would provide accessible options for students from the neighborhood to safely get to the school.
- Vehicle Speed/Traffic Calming - The current configuration of Gaffney Lane does provide some measure of traffic calming. Several of the people we met during our site walkover

mentioned issues with high speed vehicles in the project area.

- Pedestrian crossing point - The current crossing point of Gaffney Lane at Glenview Court lacks ADA compliant landings and connects to an earth pathway on the south side.
- Offset Intersection - The location of S. McVey Lane relative to Glenview Court creates an offset intersection, presenting a challenge to drivers entering Gaffney Lane and pedestrians trying to cross. There are also impediments to the line of sight for drivers exiting from S McVey Lane.
- Vertical Sight Distance - There is a vertical crest curve just south of the proposed improvement site. This limits the ability of vehicles traveling east on Gaffney Lane to see pedestrians within the existing crosswalk. See Figure 1 below for a photo illustrating this condition.



**Figure 1: Vertical Curve On Gaffney**

**Existing Cross Section** - The existing street cross sections are listed in Table 1 below.

**Table 1: Existing Cross Section Dimensions**

<b>Street Section</b>	<b>Paved Roadway Width</b>	<b>Bike Lanes</b>	<b>Sidewalks</b>	<b>Parking on South Side</b>	<b>Parking on North Side</b>
Gaffney Lane South of 13445	36'	No	Both Sides	No	No
Frontage of 13445 Gaffney Lane	21'	No	None	No	No
Gaffney Lane North of 13445	43'	No	North Side only	No	Yes
Glenview Court	26'	No	West Side Only	No	No

**Right of Way** - A review of the City As-builts and Subdivision plats for the area revealed that actual right of way widths for Gaffney Lane throughout the project are difficult to confirm. The conclusions of this conceptual design are based on estimated locations of the Right of Way. We recommend that the City hire a Professional Surveyor to confirm property lines in order to determine the necessary right of way needs for this project. Based on our initial estimate, there do appear to be several issues with Right of Way through the improvement corridor including some locations where the existing pavement appears to extend beyond the City’s Right of Way. See exhibit E for assumed right of way requirements.

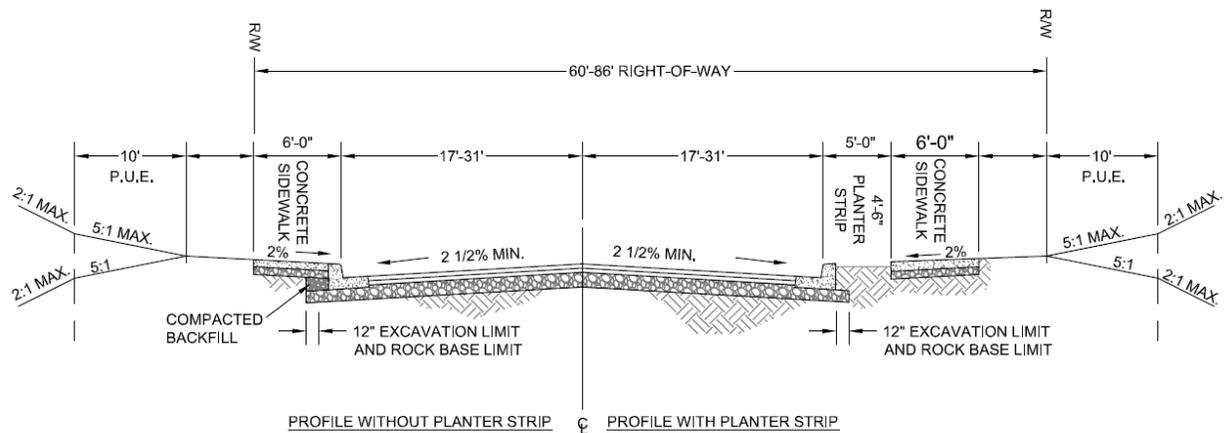
**Zoning** - The property at 13445 Gaffney Lane is currently zoned R-8. Minimum Setbacks for this property are 15’ front and 15’ side (due to this being a corner lot). A variance for reduced setback may be required.

**Utility Concerns** – There are a number of public and private utilities within the improvement corridor which may require adjustment. These include:

- PGE - There is currently a PGE power pole (PGE Pole #3681) located along the frontage of 13445 Gaffney Lane. The pole will need to be relocated to accommodate changes to the roadway alignment.
- Sanitary Sewer - The property at 13445 Gaffney Lane does not currently appear to be serviced by a public sanitary sewer service. The existing sanitary main line dead ends at a manhole approximately 120 feet south of the property.
- Utility box adjustments - Approximately four water meters and one water valve will need to be adjusted as part of the improvements.

## DESIGN CONSTRAINTS

We have based the minimum cross section in our preliminary design upon the City's typical cross section for a collector street included as figure 2 below.



**Figure 2: Typical collector Street Cross Section**

Per the standard detail, the collector streets are required to have six foot wide bike lanes on either side of the roadway, six foot wide sidewalks, and a minimum drive aisle width of eleven feet.

## DESIGN OPTION DISCUSSION

We have prepared two conceptual plan options for improvements along Gaffney Lane which address the above concerns. Option 1 shows an extension of the existing curb lines of Gaffney Lane west of 13445 Gaffney Lane past the intersection and then jogs the centerline back to existing east of McVey Lane. Option 2 shifts the curb lines and centerline from Gaffney Lane west of 13445 Gaffney Lane to the south and installs a bulb out at the corner adjacent to the Elementary School. In both options, the pedestrian crossing point has been relocated to the west side of the intersection with Glenview Court. Conceptual plans of Options 1 and 2 are included in exhibits B and C, respectively. The design improvements address right of way, safety, utility modification and parking as described in the following paragraphs.

### ***Right Of Way:***

Depending on the preferred option and actual right of way locations, the property lines of the following properties may require adjustment:

- 13445 Gaffney Lane
- 13440 Gaffney Lane
- 19541 Glenview Court

- 13482 Gaffney Lane
- 13488 Gaffney Lane

Exhibit E includes additional details.

***Safety:***

*Lack of sidewalks* - Both options address sidewalk connectivity issues. Option 2 presents greater challenges in providing a sidewalk extension on the south side of Gaffney Lane due to the proximity to existing trees. An extension of sidewalks for both options would be possible from Glenview Court north along the south side of Gaffney Lane to a connection at S Stillmeadow Drive. This extension could be completed at a later date or as part of any redevelopment of these properties.

*Traffic Calming* – Both options keep Gaffney Lane relatively narrow through the intersection, which should help to keep speeds low. Option 2 maintains the jog in the existing centerline of Gaffney Lane west of the improvements; this will slow eastbound traffic prior to the pedestrian crossing point. For Option 1, the jog in the centerline is less pronounced and occurs to the east of the intersection. The addition of speed humps (Figure 3) or speed tables (Figure 4) could be considered for both options to greater lower traffic speeds. An Institute of Traffic Engineers (ITE) discussion of speed humps states that “Speed humps are generally not recommended for use on bus routes”. A speed table incorporating the crossing location may be a more appropriate solution. A speed table has been shown on Option 1 in Exhibit B and a speed hump has been shown on Option 2 in Exhibit C for reference.



**Figure 3: Speed Hump**



**Figure 4: Speed Table**

*Vertical Sight Distance* - Stopping sight distance for the new crossing location was determined based upon City as-builts for Gaffney Lane. The new crossing point meets minimum criteria for stopping site distance per AASHTO. See Exhibit D - Gaffney Lane Sight Distance Check for details.

*Rectangular Rapid Flashing Beacon (RRFB)* – The City has requested the consideration in preliminary design of installing an RRFB device to alert drivers to the presence of pedestrians entering the crosswalk. An illustration of a typical RRFB is included below in Figure 5. This device would be installed adjacent to the crosswalk on both sides of Gaffney Lane. RRFB's are often installed using attached solar power panels for electrical power. However, due to the presence of large trees adjacent to this crossing, the RRFB's would require connection to another power source. The RRFB would be mounted on the "School Crossing" warning signs and activated by pushbuttons attached to these sign. Should the City wish to install crosswalks on all four corners of the intersection, they may want to consider an alternative to the RRFB. The Manual on Uniform Traffic Control Devices (MUTCD) provides a guideline for the installation of these beacons on low-speed roadways. The current intersection does not appear to meet the warrant for beacon installation. See Exhibit F for details. An informative summary on the RRFB devices published by the Federal Highway Administration (FHWA) is also provided as part of this exhibit.



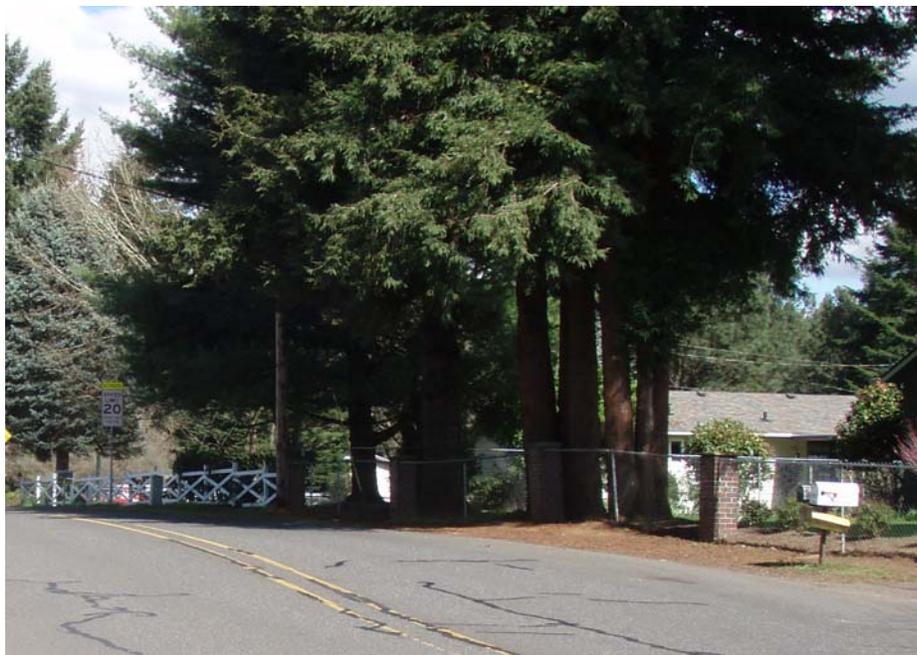
**Figure 5: RRFB**

***Power Pole Relocation:***

Toby Anderson of PGE was contacted in order to discuss options for relocating PGE's poles to accommodate the proposed improvements. Relocated poles will need to be located a minimum of four feet from the property line to provide space for the overhead lines. The relocated poles would be installed in the sidewalk a minimum of 1-2 feet back from the curb. Provision must be made for adequate clearance behind the pole to comply with ADA requirements. The PGE reference number for this project is 717174. Mr. Anderson stated that his current assumption is that the design and relocation of the poles would be a no cost item for the City unless there were agreements in place of which he was not aware.

***Tree Protection:***

Within the project area there are a number of trees that could be impacted as a result of the proposed improvements. Photos of these trees are included as Figures 6 and 7 below. Along the Gaffney lane frontage of 13440 Gaffney Lane and 19541 Glenview Court, there is a row of redwood and cedar trees that could be impacted by the improvements. Both proposed conceptual design options propose improvements within the existing drip lines of these trees. Option 1 provides approximately five feet additional distance between the trees and the proposed sidewalk, and an additional 11 feet of setback from the street improvements as compared to Option 2.



**Figure 6: Redwood Trees at 13440 Gaffney Lane**

On the Northwest corner of the property at 13482 Gaffney Lane there are a pair of cedar trees that would be impacted by any sidewalk extension or crossing at this corner. One of the trees

is located on the right of way side of the property fence and has a mounded base. The other tree is about 6 feet away on the private side of the fence. Sidewalk improvements would likely damage the root structure of the streetside tree and the removal of this tree would negatively impact the tree adjacent to it.



**Figure 7: Cedar Trees at NW corner of 13482 Gaffney Lane**

An arborist should be consulted to determine impacts and possible construction methods for trees adjacent to the proposed improvements.

***Utility Modifications:***

*Sanitary Sewer* - The property at 13445 Gaffney Lane does not appear to have public sanitary sewer service. A 120 foot length of sanitary sewer pipe could be installed to connect this property to the system. This improvement has been added to the cost estimate.

*Water Systems* – The water meters for 13445 Gaffney Lane and the properties North of Gaffney Lane along McVey Lane are located within the proposed street footprint for both conceptual options and will need to be relocated.

***Parking:***

Space for perpendicular parking currently exists only along the north side of Gaffney Lane along the frontage of Gaffney Lane Elementary School. There is currently no provision for parking along the south side of Gaffney Lane. Both proposed options show the installation of bike lanes on both sides of the Gaffney Lane to the east and west of the intersection as required by City Standards.

Option 1 would result in the loss of approximately 100 feet of parking (about five stalls) along the school frontage. Option 2 would have no effect on the school's street parking. An

option to provide parking on the south side of Gaffney lane opposite the school was not included in the provided option drawings. The addition of parking in this location would result in additional right of way requirements and have additional cost implications.

***Other options not considered:***

The following design options were not considered as part of this design effort:

- Realigning S McVey Lane to remove the intersection offset. This would require relocation of the existing building.
- Moving the building at 13445 Gaffney Lane back from the street to an appropriate setback from the widened roadway.

**OPINION OF COST DISCUSSION**

The two options have relatively similar rough costs. A single planning level opinion of cost is included for reference. We have included a least cost alternative with additional add alternate options to include at the City's discretion. The attached estimate does not include costs for lighting, landscaping or costs associated with private utility relocation.

**Least Cost Option** – This includes only paving and sidewalk improvements in front of 13445 Gaffney Lane, 13440 Gaffney Lane, 19541 Glenview Court and at the corner adjacent to the Elementary school.

**Additional Option 1** - Additional costs to continue improvements as needed in front of 13482 Gaffney Lane. This cost assumes the minimum improvements to provide pedestrian crossing points at all four corners of the intersection. Additional sidewalk extensions continuing north on Gaffney Lane are not included.

**Additional Option 2** – Installation of a Rectangular Rapid Flashing Beacon (RRFB) system at a single crossing point. This cost would include connection to private power due to lack of solar exposure at the intersection.

**Additional Option 3** – Installation of a speed hump or speed table on Gaffney Lane.

**Right of Way** - The assumed costs for Right of Way adjustment are listed in the cost estimate. These costs are highly variable, and properties would need to be assessed by an appraiser for actual value.

**Planning Level Opinion of Cost - Gaffney Lane**

Date Updated: 4/17/2013

Prepared by Wallis Engineering, DCB  
Prepared for Oregon City

<b>Street Improvements - Least Cost Option</b>					
Item No.	Item Description	Quantity	Unit	Unit Price	Total Price
1.	Mobilization	1	LS	\$15,000.00	\$15,000
2.	Flaggers and Spotters	100	HR	\$40.00	\$4,000
3.	Erosion Control	1	LS	\$1,000.00	\$1,000
4.	Project Temporary Traffic Control	1	LS	\$1,500.00	\$1,500
5.	Clearing and Grubbing	1	LS	\$4,000.00	\$4,000
6.	General Excavation Including Haul, Subgrade Preparation, Scarification, Watering, and Compaction	300	CY	\$20.00	\$6,000
7.	3/4 Inch - 0 Aggregate Base	250	CY	\$45.00	\$11,250
8.	Level 3, 1/2 Inch Dense MHMAC	150	TON	\$90.00	\$13,500
9.	Concrete Curbs, Standard Curb	250	LF	\$20.00	\$5,000
10.	Concrete Curbs, Curb and Gutter	200	LF	\$20.00	\$4,000
11.	Concrete Walks	3100	SF	\$5.00	\$15,500
12.	Signing and Striping	1	LS	\$10,000.00	\$10,000
13.	12" Diam. PVC Sanitary Sewer	120	LF	\$55.00	\$6,600
14.	48" Sanitary Sewer Manhole	1	EA	\$3,000.00	\$3,000
15.	Water system adjustments	1	LS	\$5,000.00	\$5,000

Subtotal	\$105,350.00
Right of Way Acquisition	\$20,000.00
Contingency @ 20%	\$21,070.00
<b>Construction Total</b>	<b>\$146,420.00</b>

<b>Add Alternate Option 1 - Frontage improvements for 13482 Gaffney Lane</b>					
Item No.	Item Description	Quantity	Unit	Unit Price	Total Price
1.	General Excavation Including Haul, Subgrade Preparation, Scarification, Watering, and Compaction	100	CY	\$20.00	\$2,000
2.	3/4 Inch - 0 Aggregate Base	50	CY	\$45.00	\$2,250
3.	Level 3, 1/2 Inch Dense MHMAC	50	TON	\$90.00	\$4,500
4.	Concrete Curbs, Standard Curb	100	LF	\$20.00	\$2,000
5.	Concrete Walks	450	SF	\$5.00	\$2,250

**Subtotal - add alternate 1 \$13,000.00**

<b>Add Alternate Option 2 - RRFB Installation</b>					
Item No.	Item Description	Quantity	Unit	Unit Price	Total Price
1.	RRFB with connection to private power	1	LS	\$20,000.00	\$20,000

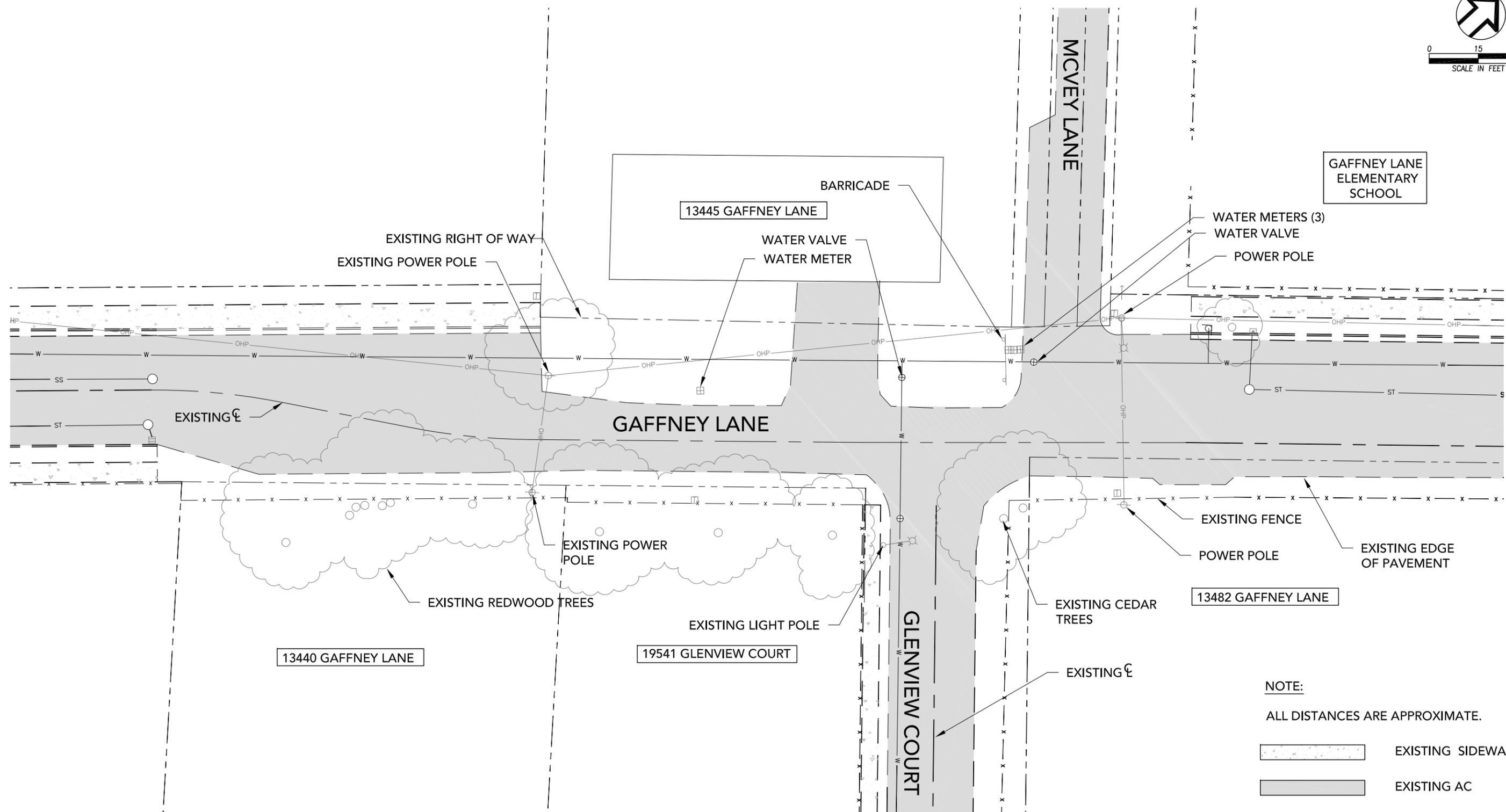
**Subtotal - add alternate 2 \$20,000.00**

<b>Add Alternate Option 3 - Speed Hump</b>					
No.	Item Description	Quantity	Unit	Unit Price	Total Price
1.	Speed Hump / Speed Table	1	LS	\$4,000.00	\$4,000

**Subtotal - add alternate 3 \$4,000.00**



0 15 30  
SCALE IN FEET



**NOTE:**  
 ALL DISTANCES ARE APPROXIMATE.

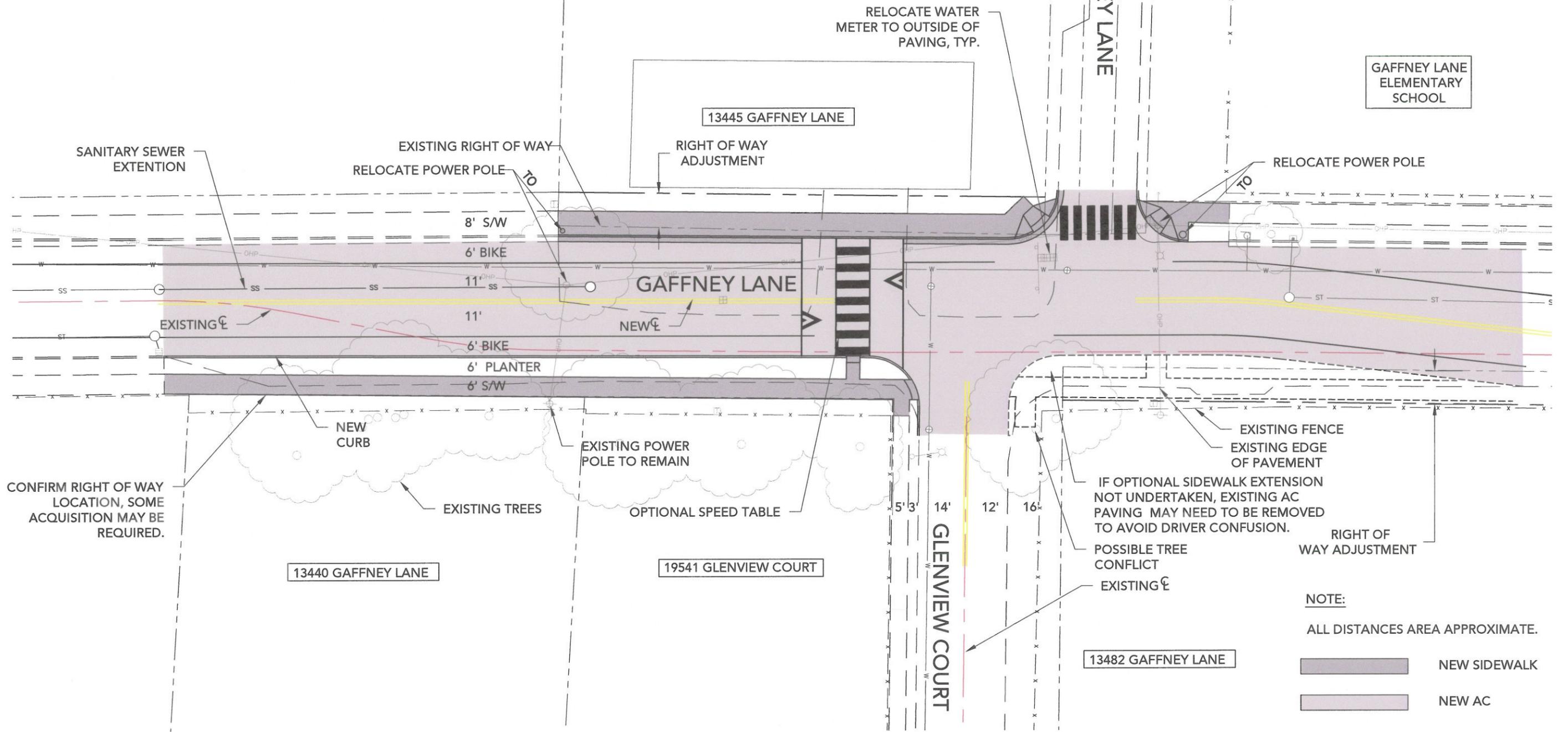
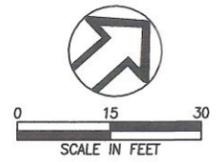
 EXISTING SIDEWALK

 EXISTING AC

### EXHIBIT A

## GAFFNEY LANE REALIGNMENT EXISTING CONDITIONS

4-17-13



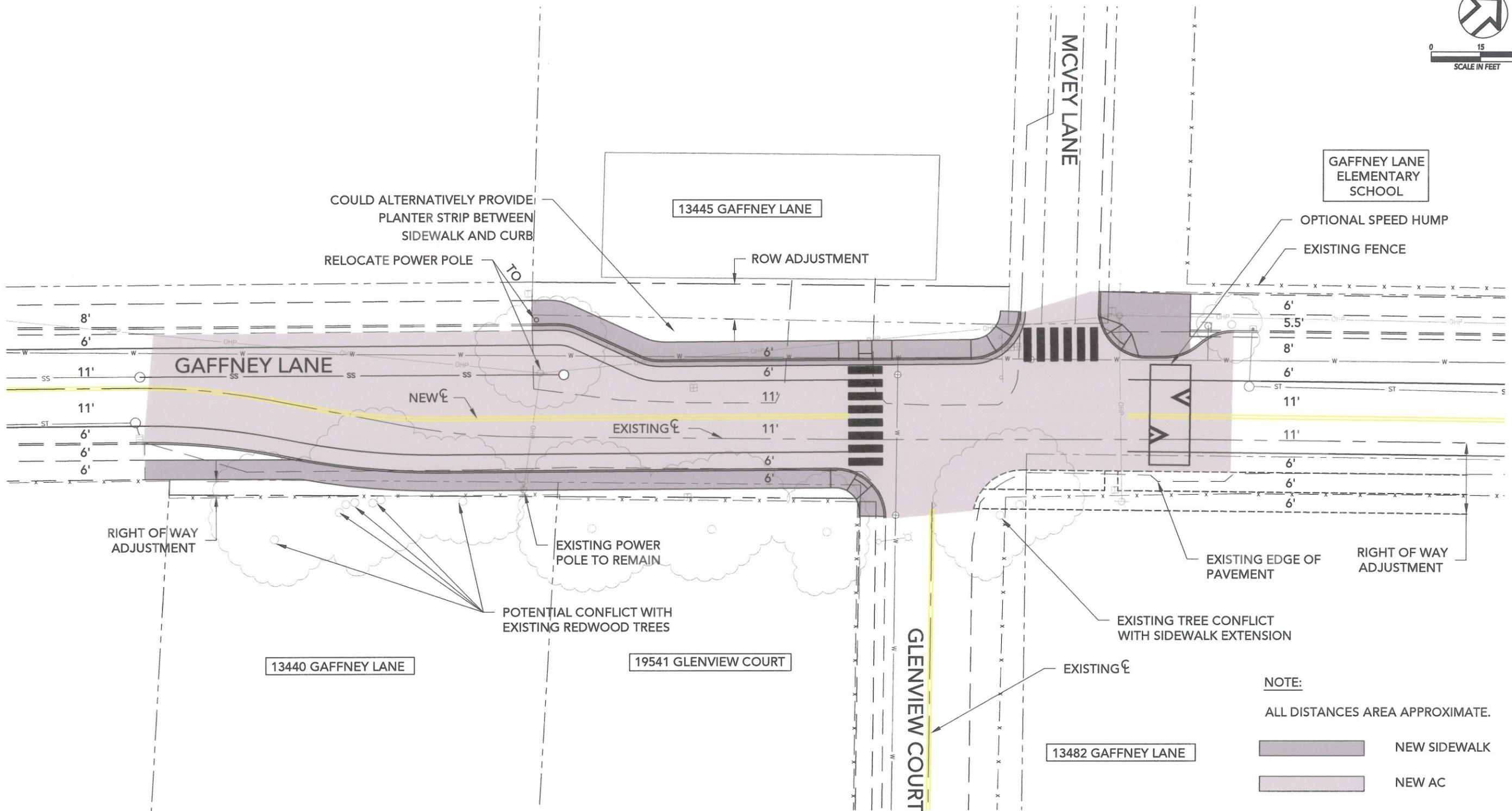
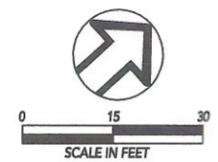
**NOTE:**  
 ALL DISTANCES AREA APPROXIMATE.

NEW SIDEWALK  
 NEW AC

**EXHIBIT B**

**GAFFNEY LANE REALIGNMENT  
 CONCEPTUAL PLAN - OPTION 1  
 4-22-13**





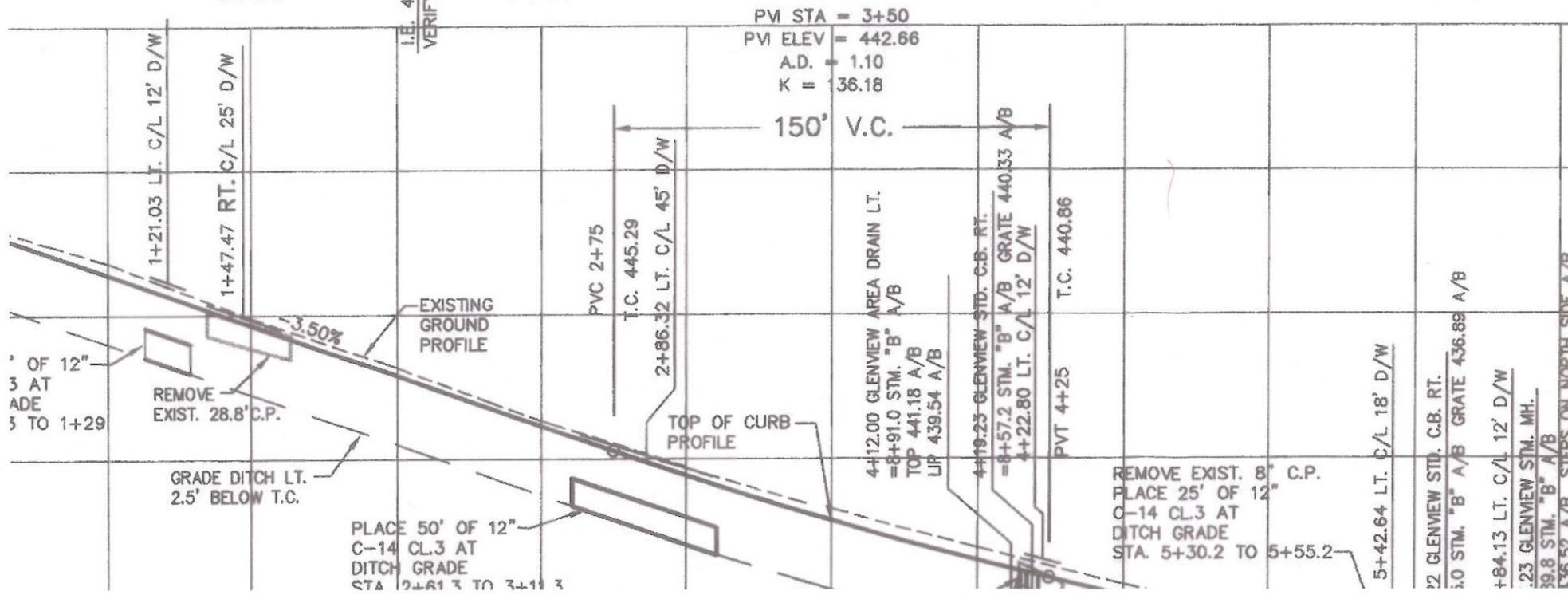
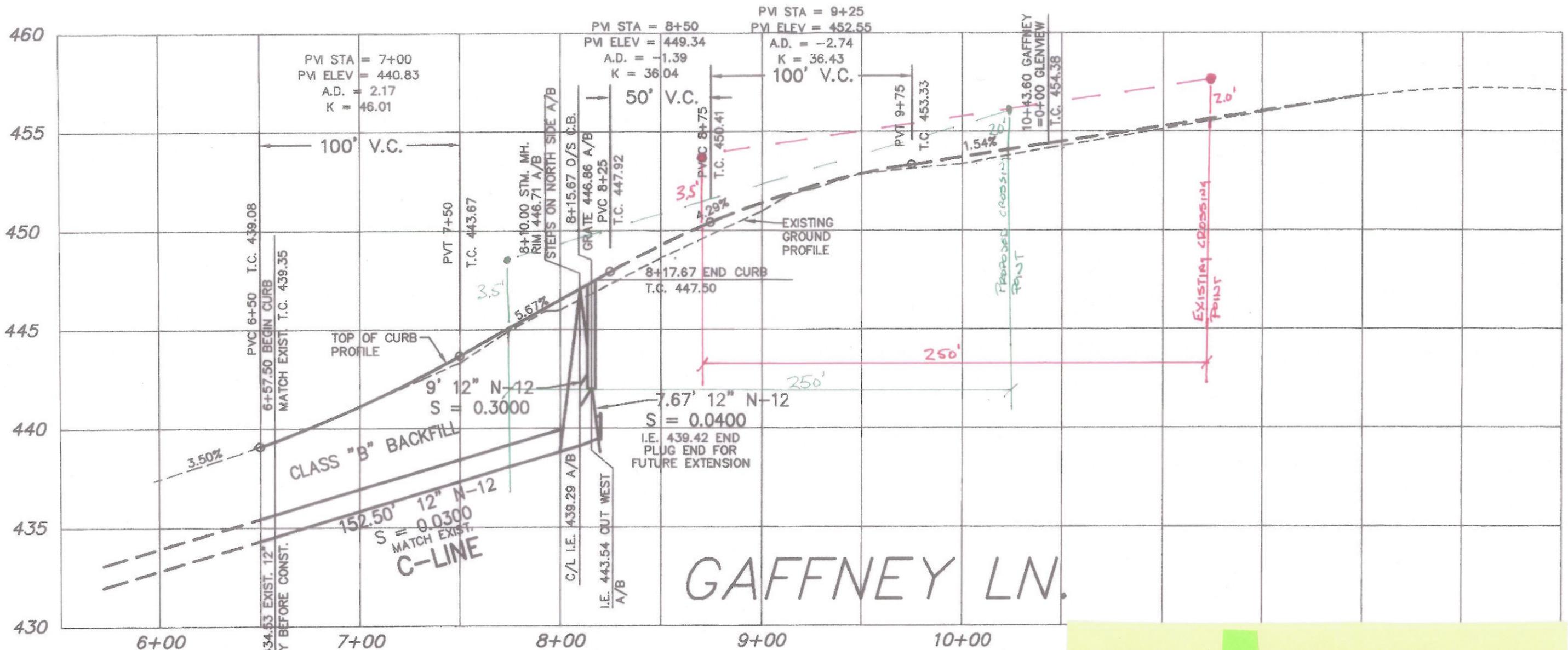
**NOTE:**  
 ALL DISTANCES AREA APPROXIMATE.

NEW SIDEWALK  
 NEW AC

**EXHIBIT C**

**GAFFNEY LANE REALIGNMENT  
 CONCEPTUAL PLAN - OPTION 2**

4-22-13



**EXHIBIT D - GAFFNEY LANE**

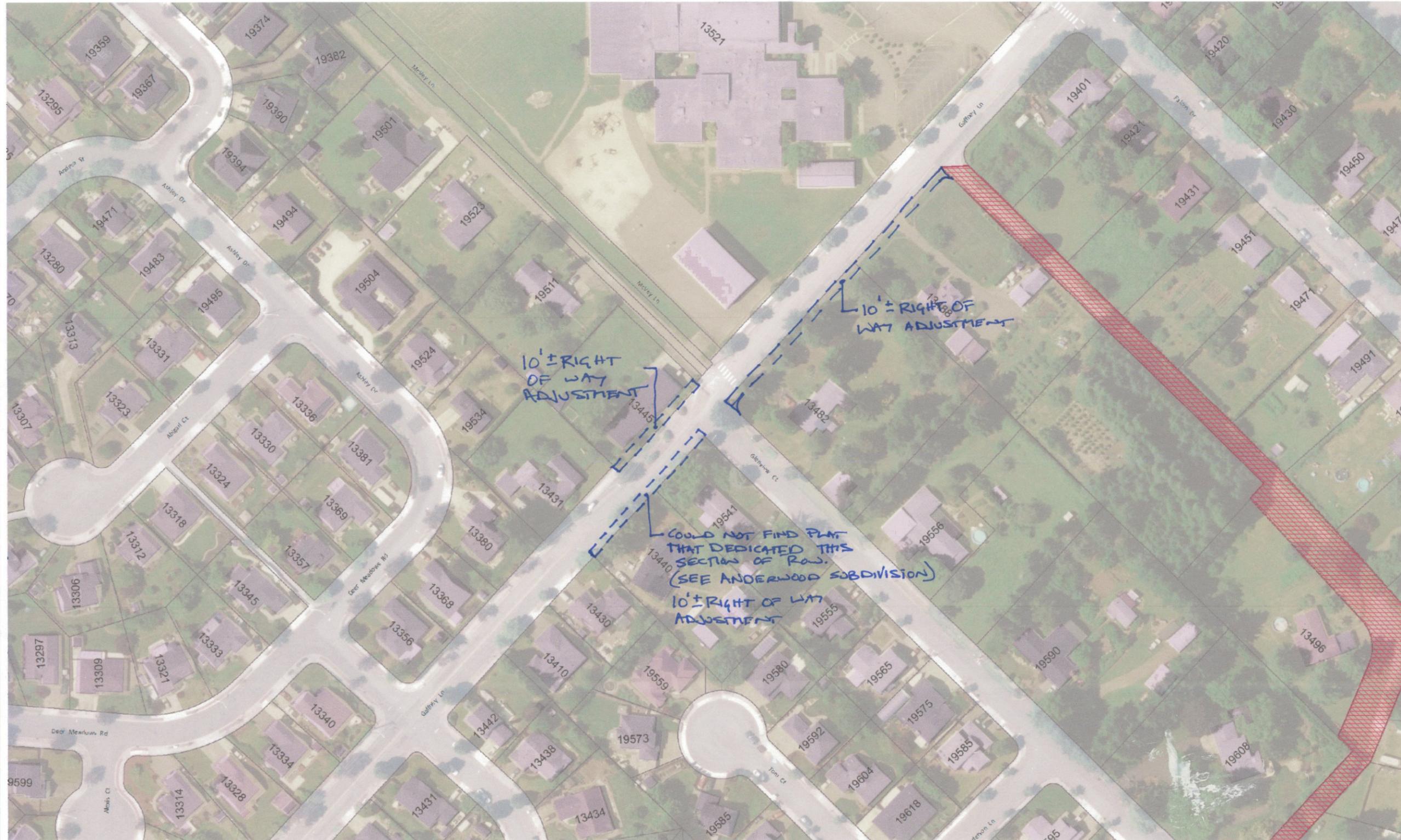
- SIGHT DISTANCE CHECK -

SOURCE: CITY AS-BUILT #10035  
ANDERWOOD SUBDIVISION

SCALE: 1" = 50' H  
1" = 5' V

ASSUMED DESIGN SPEED = 35 MPH  
SSD = 250 FT (AASHTO 2011)  
OBJECT HEIGHT = 2.0'  
EYE HEIGHT = 3.5'

# Oregon City GIS Map



### Legend

- Taxlots
- Unimproved ROW
- City Limits
- UGB
- Aerial Photos - 2012

### Notes

EXHIBIT E -  
RIGHT OF  
WAY

### Overview Map

The City of Oregon City makes no representations, express or implied, as to the accuracy, completeness and timeliness of the information displayed. This map is not suitable for legal, engineering, surveying or navigation purposes. Notification of any errors is appreciated.



0 243 485 Feet



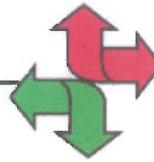
1: 1,456

Map created 4/17/2013

City of Oregon City  
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[www.orcity.org](http://www.orcity.org)



# Manual on Uniform Traffic Control Devices (MUTCD)

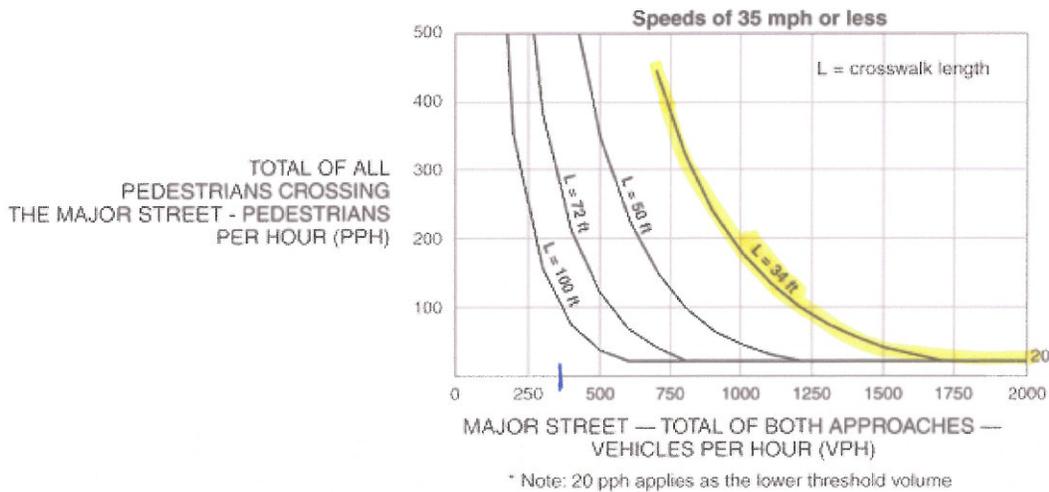


Knowledge

[Back to Chapter 4F](#)

## 2009 Edition Part 4 Figure 4F-1. Guidelines for the Installation of Pedestrian Hybrid Beacons on Low-Speed Roadways

Figure 4F-1. Guidelines for the Installation of Pedestrian Hybrid Beacons on Low-Speed Roadways



\*PEAK VPH = 317 vph  
@ MOLDWA

\*PEAK VPH = 204 vph  
@ MARRAS

\*PER 2011 COUNT DATA

Figure 4F-1. Guidelines for the Installation of Pedestrian Hybrid Beacons on Low-Speed Roadways

This figure shows a graph depicting numerical values for guidelines for the installation of pedestrian hybrid beacons on low-speed roadways at speeds of 35 mph or less. The figure displays four curves for different crosswalk lengths: 34 ft, 50 ft, 72 ft, and 100 ft.

The table below shows the approximate vehicles per hour (VPH) on the major street and corresponding pedestrians per hour (PPH) for the total of all pedestrians crossing the major street.

Table for Figure 4F-1

Crosswalk length = 34 ft		Crosswalk length = 50 ft		Crosswalk length = 72 ft		Crosswalk length = 100 ft	
VPH on the major street (Total of both approaches)	PPH for total of all pedestrians crossing the major street	VPH on the major street (Total of both approaches)	PPH for total of all pedestrians crossing the major street	VPH on the major street (Total of both approaches)	PPH for total of all pedestrians crossing the major street	VPH on the major street (Total of both approaches)	PPH for total of all pedestrians crossing the major street
2000	20*	2000	20*	2000	20*	2000	20*
1750	20*	1750	20*	1750	20*	1750	20*
1500	40	1500	20*	1500	20*	1500	20*
1250	90	1250	20*	1250	20*	1250	20*
1000	190	1000	50	1000	20*	1000	20*
750	40	750	125	750	25	750	20*
500	—	500	350	500	120	500	30
250	—	250	—	250	500	250	250
225	—	225	—	225	—	225	500



## Rectangular Rapid Flash Beacon (RRFB)

### Purpose

According to the National Highway Traffic Safety Administration, there were a total of 14,340 pedestrian fatalities and 193,000 pedestrian injuries resulting from pedestrian-vehicle crashes nationwide during the 2004-2006 period. Rectangular Rapid Flash Beacons (RRFB) can enhance safety by reducing crashes between vehicles and pedestrians at unsignalized intersections and mid-block pedestrian crossings by increasing driver awareness of potential pedestrian conflicts.

### Alternative Names

Light Emitting Diode (LED) Rapid-Flash System, Stutter Flash or LED Beacons.

### Operation

- RRFBs are user-actuated amber LEDs that supplement warning signs at unsignalized intersections or mid-block crosswalks. They can be activated by pedestrians manually by a push button or passively by a pedestrian detection system.
- RRFBs use an irregular flash pattern that is similar to emergency flashers on police vehicles.
- RRFBs may be installed on either two-lane or multi-lane roadways.

### Potential Benefits

- RRFBs are a lower cost alternative to traffic signals and hybrid signals that are shown to increase driver yielding behavior at crosswalks significantly when supplementing standard pedestrian crossing warning signs and markings.
- An official FHWA-sponsored experimental implementation and evaluation conducted in St. Petersburg, Florida found that RRFBs at pedestrian crosswalks are dramatically more effective at increasing driver yielding rates to pedestrians than traditional overhead beacons.
- The novelty and unique nature of the stutter flash may elicit a greater response from drivers than traditional methods.
- The addition of RRFB may also increase the safety effectiveness of other treatments, such as the use of advance yield markings with YIELD (or STOP) HERE FOR PEDESTRIANS signs. These signs and markings are used to reduce the incidence of multiple-threat crashes at crosswalks on multi-lane roads (i.e., crashes where a vehicle in one lane stops to allow a pedestrian to cross the street while a vehicle in an adjacent lane, traveling in the same direction, strikes the pedestrian), but alone they only have a small effect on overall driver yielding rates.



This summary is one in a series describing Innovative Intersection Safety Treatments. The summaries identify new technologies and techniques to improve intersection safety developed since NCHRP Report 500, Volumes 5 and 12, were published in 2003 and 2004, respectively. These treatments show promise for improving safety but comprehensive effectiveness evaluations are not yet available.

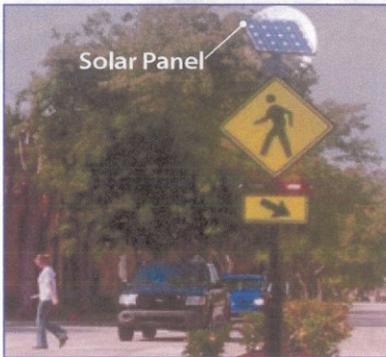


Figure 1: Activated, solar-powered RRFB on a center island at an unsignalized intersection—beacons flash using an irregular flash pattern that is similar to emergency flashers on police vehicles



Figure 2: Activated, solar-powered, roadside RRFB at a mid-block crosswalk



Figure 3: Combined roadside and median system of solar-powered RRFB

## Agency Experience

“An Analysis of the Effects of Stutter Flash LED Beacons to Increase Yielding to Pedestrians Using Multilane Crosswalks,” along with “The Use of Stutter Flash LED Beacons to Increase Yielding to Pedestrians at Crosswalks,” presented at the Transportation Research Board Annual Meeting in 2008, summarized the results of two studies on the effects of RRFBs when used to supplement standard pedestrian crossing warning signs at crosswalks<sup>1</sup>.

The former found that going from a no-beacon arrangement to a two-beacon system, mounted on the supplementary warning sign on the right side of the crossing, increased yielding from 18 percent to 81 percent. There was a further increase in yielding behavior, with a four-beacon system (with two beacons on both the right and left side of the crossing) to 88 percent. “An Analysis of the Effects of Stutter Flash LED Beacons to Increase Yielding to Pedestrians Using Multilane Crosswalks” also evaluated the sites over a 1-year period, and found that there was little to no decrease in yielding behavior over time.

## Implementation Considerations

- Including RRFBs on the roadside increases driver yielding behavior significantly. Including RRFBs on a center island or median as well can further increase driver yielding behavior, although with a lower marginal benefit than roadside beacons.
- RRFBs can use manual push-buttons or automated passive (e.g., video or infrared) pedestrian detection, and should be unlit when not activated.
- RRFBs typically receive power by standalone solar panel units, but may also be wired to a traditional power source.

## Manual on Uniform Traffic Control Devices (MUTCD) Specifications

- The MUTCD gave interim approval to RRFBs for optional use in limited circumstances in July 2008. The interim approval allows for usage as a warning beacon to supplement standard pedestrian crossing warning signs and markings at either a pedestrian or school crossing; where the crosswalk approach is not controlled by a yield sign, stop sign, or traffic-control signal; or at a crosswalk at a roundabout.
- The MUTCD interim approval memo also contains other provisions for the implementation of the device and should be reviewed ([http://mutcd.fhwa.dot.gov/resources/interim\\_approval/ia11/fhwamemo.htm](http://mutcd.fhwa.dot.gov/resources/interim_approval/ia11/fhwamemo.htm)).

## Costs

Cost is approximately \$10,000 to \$15,000 for purchase and installation of two units (one on either side of a street). This includes solar panels for powering the units, pad lighting, indication units (for both sides of street) with RRFBs in the back and front of each unit, signage on both approaches, all posts, and either passive infrared detection or push buttons with audio instructions.

- Costs would be proportionately higher for additional units placed on a median island, etc.

## Learn More

**Michael Frederick**, St. Petersburg Neighborhood Transportation Manager

727.893.7843

michael.frederick@stpete.org

**Ed Rice**, Intersection Safety Team Leader  
FHWA Office of Safety

202.366.9064

ed.rice@dot.gov

## See Also:

[http://mutcd.fhwa.dot.gov/resources/interim\\_approval/ia11/stpetersburgrpt/intro.htm](http://mutcd.fhwa.dot.gov/resources/interim_approval/ia11/stpetersburgrpt/intro.htm)

[http://www.stpete.org/pdf/ite\\_paper\\_07.pdf](http://www.stpete.org/pdf/ite_paper_07.pdf)

<sup>1</sup>The two known studies of stutter flash were both conducted in Florida—one in Miami Beach and one in St. Petersburg. They are:

Sherbutt, J., R. Van Houten, and S. Turner. “An Analysis of the Effects of Stutter Flash LED Beacons to Increase Yielding to Pedestrians Using Multilane Crosswalks.” Presented at the Transportation Research Board Annual Meeting, Washington, DC, 2008.

Van Houten, R., R. Ellis, and E. Marmolejo. “The Use of Stutter Flash LED Beacons to Increase Yielding to Pedestrians at Crosswalks.” Presented at the Transportation Research Board Annual Meeting, Washington, DC, 2008.