Huntington Lower Village
Bicycle and Pedestrian Scoping Study

FINAL Report

Prepared for:
The Town of Huntington

Prepared by:

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February, 2016

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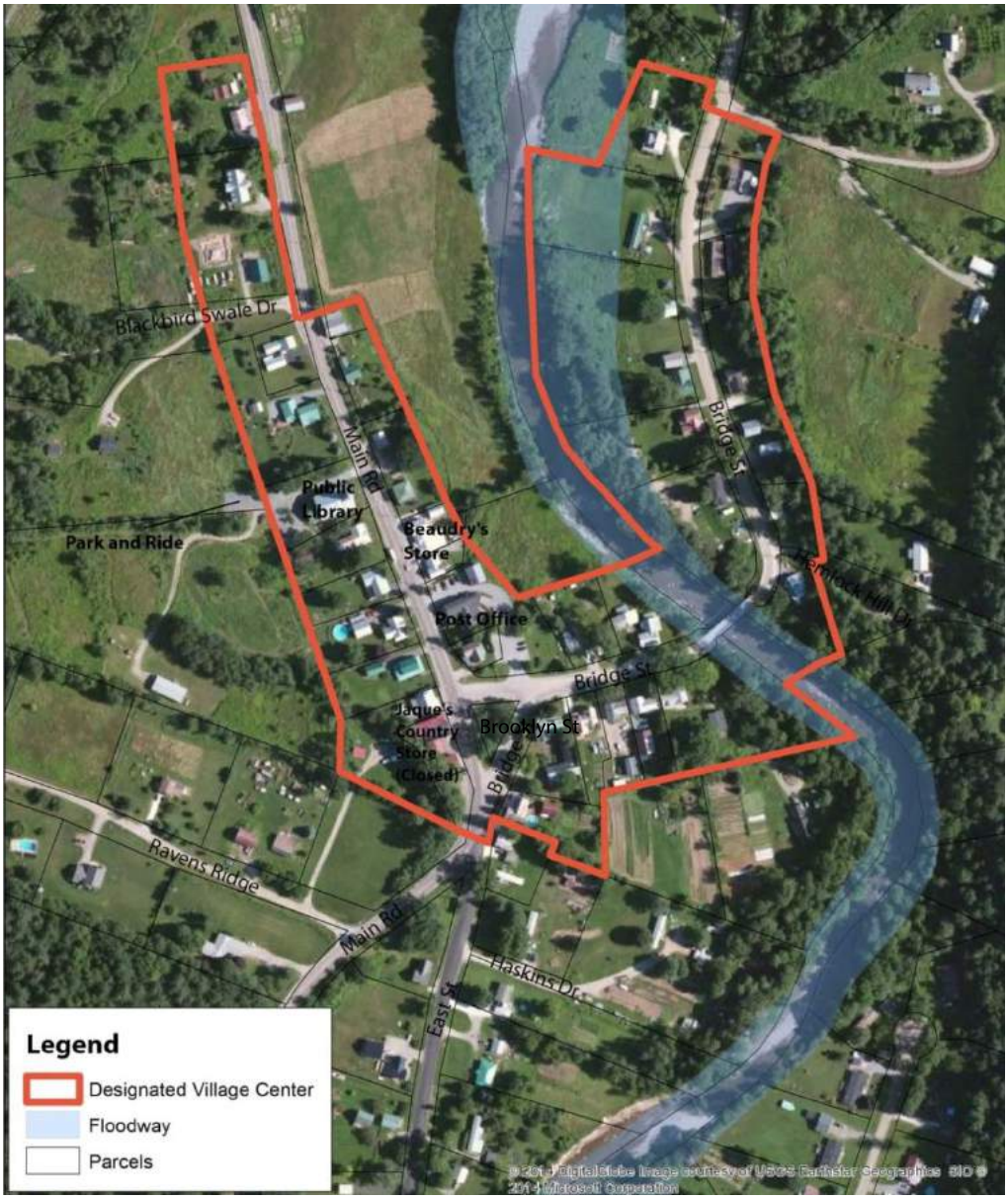
1 Introduction

The Town of Huntington has undertaken this study to address the needs of pedestrians in the town's Lower Village. The village lacks sidewalks, with pedestrian facilities limited to walkways to village buildings. There has also long standing concerns about the speed of vehicular traffic making the Lower Village less safe, which have been verified with speed data collection. When the high traffic speeds are combined with the lack of sidewalks, walking in this compact village center feels unsafe, and need to be addressed for Huntington to achieve its goals of greater accommodation of non-motorized transportation. Figure 1.1 shows the project area, which coincides with the state-designated village center.

Figure 1.1: Study Area Location



2 Existing Conditions

The following sections describe the project area in terms of relevant transportation, land use, and environmental features. This is followed by the project's purpose and need statement, which is informed by the existing conditions and public input.

2.1 Roadway Network and Traffic Circulation

Main Road is a Class 2 town highway, with the functional classification of a major collector. The other public streets in the study area, East Street, Bridge Street and Brooklyn Street, are class 3 town highways. The Brooklyn St approach to Main Road has stop control, as does East Street as it approaches Main Road and Bridge St. However, there is a stop sign missing where Bridge St approaches Main Road (see figure) Main Road has a downhill grade that gets as steep as 10% for northbound traffic entering lower village, which contributes to issues related to speeding and limited sight distance for East and Bridge Streets. With the closely spaced intersections, right turn signals can be confusing to oncoming traffic or traffic approaching from East Street as they aren't sure where the vehicle will be turning.

2.2 Safety

A review of crash data from VTrans indicates that there are no high crash locations in the study area, and that there were only 2 crashes in the study area since 2009. Public input received during the study process highlighted safety concerns related to speeding through the village, the steep downhill grade of Main Road for northbound vehicles entering the village, and the geometrically awkward intersection of East Street, Bridge Street and Main Road

2.3 Traffic Volumes

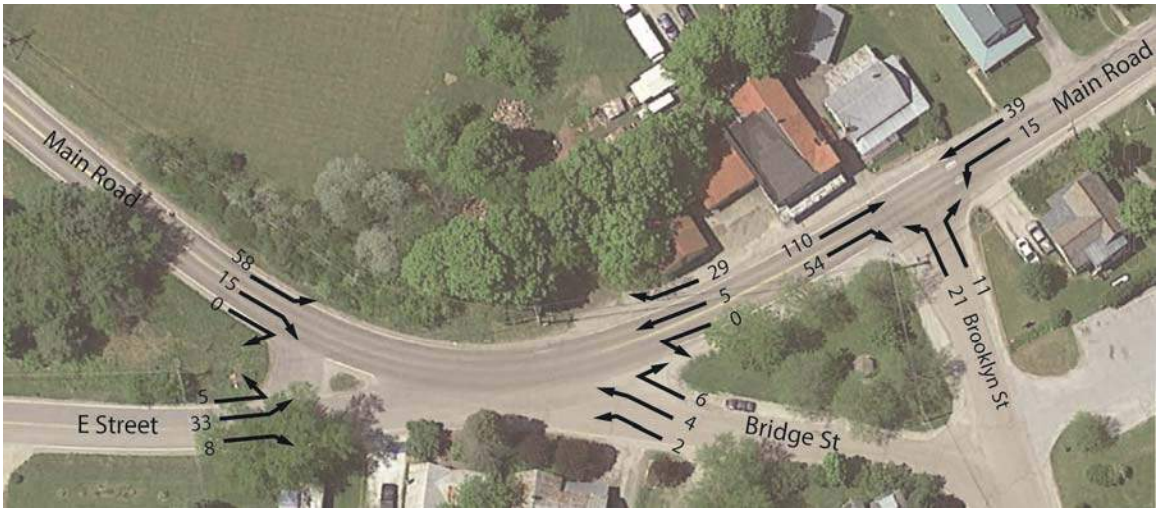
The streets have average annual daily traffic (AADT) as shown on the table below.

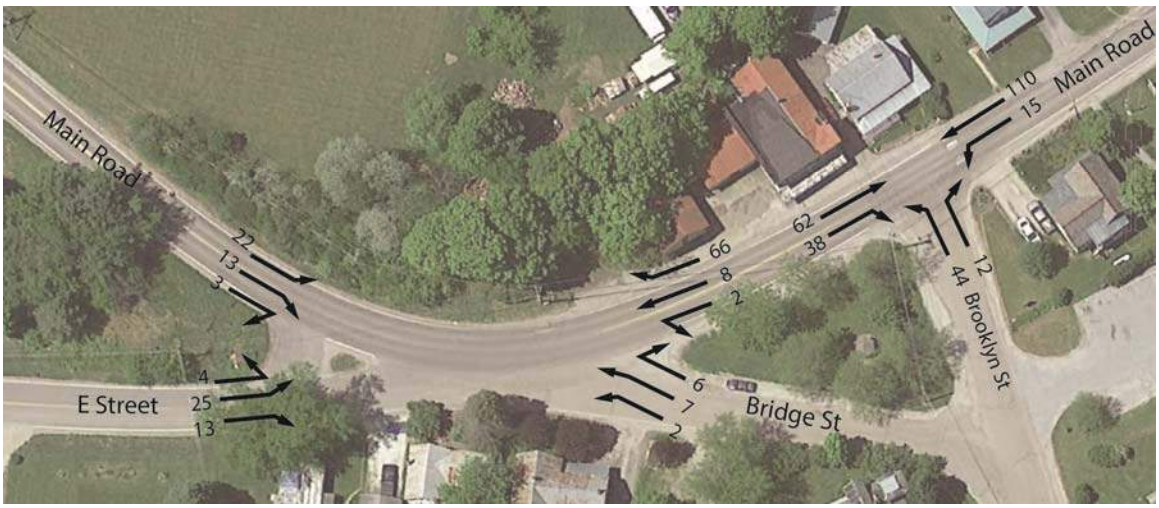
Table 2.1: Traffic Volumes (Source: VTrans ATR Data)

Location	AADT (vehicles per day)
Main Road – north of Lower Village	2,400
Main Road – south of Lower Village	1,700
Bridge Street – just east of Huntington River	390
East Street	860

Turning movement counts at the intersection of Main Road with Brooklyn Street and East/Bridge Street conducted on May 27, 2009, were also reviewed and summarized in the graphics below.

Figure 2.1: AM and PM Turning Movement Counts for Main Road Intersections (CCRPC/VTrans, 5/27/09)





The CCRPC counts for the study area intersections showed fewer than ten pedestrians during the four hour count periods. Based on site observations, most pedestrian activity occurs during the time when the school bus picks up and drops off students, and for short trips between destinations including village residences, Beaudry's Store, the Library and the Post Office. Main Road is also a popular and scenic recreational bicycling route. Although counts are not available, anecdotal information suggestions that on a weekend day with good weather, more than 100 cyclists likely ride through the village, many stopping at Beaudry's store.

2.4 Traffic Speeds

Speed data was collected by CCRPC at several locations in the village in August, 2015, summarized in the table below, and shown on the map Figure 2.2.

The 85th percentile speed is the speed that is exceeded by 15% of cars. Each count was conducted for one week, with the start date provided in the table.

Table 2.2: Speed Monitoring Summary (Source: CCRPC)

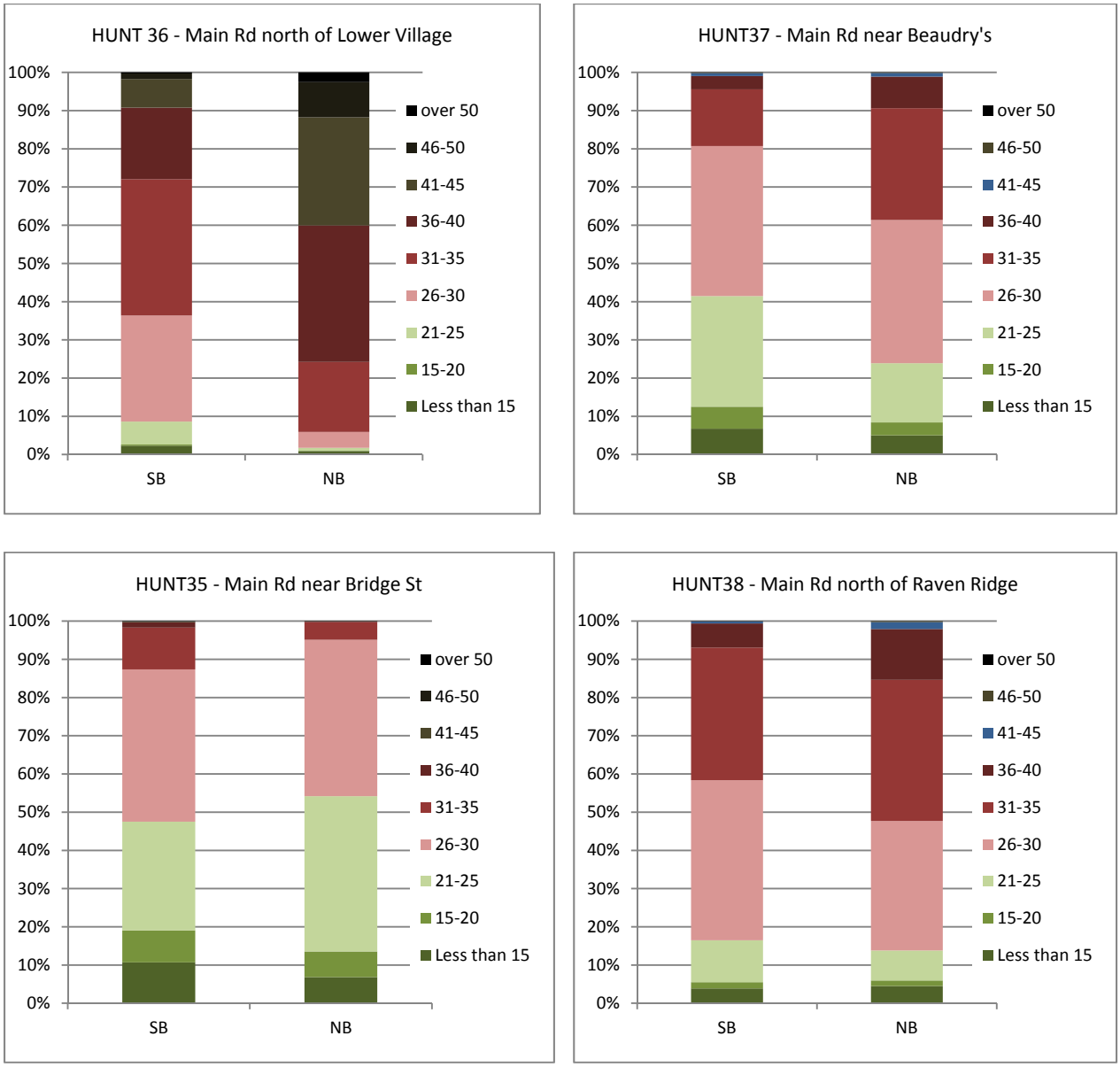
		Northbound		Southbound	
Station	Start Date	85th percentile	% Speeding	85th percentile	% Speeding
HUNT35	7/29/15	28 mph	46%	29 mph	53%
HUNT36	7/29/15	44 mph	99%	38 mph	91%
HUNT37	8/6/15	34 mph	76%	31 mph	50%
HUNT38	9/3/15	35 mph	89%	34 mph	85%

The lowest speeds were at HUNT37 and HUNT35, which are closest to the Brooklyn St intersection. The two stations at each edge of the village showed a very high percent of vehicles exceeding the speed limit. The speed data is tabulated on the following charts, showing the proportion of traffic exceeding the speed limit in red shades, and vehicles traveling within the speed limit in green.

Figure 2.2: Speed Monitoring Locations (Source: CCRPC)

Figure 2.3: Speed Distribution in Huntington Lower Village, CCRPC, August, 2015.

Charts are arranged for stations starting at the north of the village and proceeding south



The data above show the highest speeds overall are at HUNT 36, which is north of the village center, followed by the station south of the village, near Raven Ridge. The two stations in the village were at Beaudry's and just south of the Brooklyn St intersection. Of these two, the highest speeds were at Beaudry's in the northbound direction. It is apparent from this data that there is a pattern of northbound traffic accelerating in the vicinity of the store. With the high level of traffic maneuvers and pedestrian activity accessing the store, reducing speeds at this location is a particularly high priority, particularly for northbound vehicles that are increasing their speed prematurely as they head north out of the village.

2.5 Land Use Context

The project area was recently designated as a Village Center in the Vermont Agency of Commerce and Community Development designation program. The land uses that contribute to the area's function as a village includes a busy general store, Town library, Town park-and-ride lot, and Post Office. The alignments of Bridge St, Brooklyn St and Main Rd form a triangle shaped green space, which currently does not contain any public amenities such as benches or lights. There is also a school bus pick-up and drop-off and bus exchange zone adjacent to the green space.

The Town Plan contains many passages that emphasize the desire to improve safety by reducing speeds, and to promote walking and bicycling safely on local roads and streets.

> Maintaining and replacing bridges and culverts, creating safe traffic speeds, reducing single-driver trips, and providing safe non-motorized road use (walking and bicycle) are the major transportation issues for Huntington. (Huntington Town Plan, 2013, page 7)
>
> In addition to the increase of vehicular traffic, there has been an increase in recreational use of our roads. Our rural countryside attracts bicyclists of all ages, interests and abilities. There have been, however, inevitable safety concerns that flow from having both more cars and more bikes sharing the road as well as traffic speed concerns. (Huntington Town Plan, 2013, page 10)

2.6 Public Right-of-Way

Parcel boundary GIS data and local records indicate that the right-of-way is 66 feet (4 rods) along Main Road, and 49.5 feet (3 rods) along East, Brooklyn and Bridge Streets.

2.7 Utilities

There are overhead utilities along Main Road, which should be considered in the design of sidewalks, crossings, and other streetscape features. There are no other utilities servicing the Lower Village, as water and sewer is provided with on-site systems.

2.8 Natural and Cultural Resources

Huntington's Lower Village is a small settlement surrounded by largely undeveloped forested hills and mountains, and the area provides habitat for many species, including larger mammals. Road crossings and sightings of moose, deer, bear, coyotes and bobcats are not infrequent, as these animals move between higher ground and the Huntington River corridor.

The Huntington River traverses the Lower Village. As with any high water quality river, efforts should be made to reduce runoff and non-point source pollution to the river, and some of the techniques described in the following sections can mitigate the runoff from the village roadways.

The Vermont Agency of Natural Resources atlas for the project area was evaluated, as shown in
An Archeological Resource and Historical Preservation Assessment of the study area was conducted by Hartgen Archeological Associates which included a detailed analysis of the area's environmental and developmental history. The following are key conclusions of their report, which is attached.

- Project design should avoid effects to historic structures and streetscape features such as stone walls and, large trees.
- Most of the project area is considered sensitive for precontact and early historic archeological deposits. Undisturbed areas along the roads and around the standing structures should be considered to have archeological potential
- Future sidewalks will typically be located in the front yard areas of village homes, which are generally less archaeologically sensitive. Precontact archaeological resources are likely to have been disturbed with development activity. Historic archaeological resources are unlikely, as front yards were typically kept clean of potential artifacts.
- Any project such as a sidewalk or path that is not located in a front yard area will require a Phase 1B assessment.

Figure 2.4, and summarized on the following table. The atlas mentions a hazardous waste site at the former Jacques store, which had underground gas tanks. The store has closed, and the gas tanks have been removed.

Table 2.3: Project Area Summary of Natural Resources

Potential Resources	Presence/Absence in Study Area
1. Wetlands	Wetlands are present adjacent to Main Road north of the village.
2. Lakes/Ponds/Streams/Rivers	The Huntington River traverses the study area, and any project would need to include erosion control measures.
3. Floodplains	The 100 year floodplain of the Huntington River extends to Main Road in the northern portion of the study area
4. Endangered Species	None in study area
5. Flora/Fauna	Project area is primary developed land with low potential as habitat for local fauna or native flora.
6. Stormwater	There are several stormwater drainage features in the study area.
7. Hazardous Wastes	There are two sites with underground gas tanks (Beaudry's and Jacques stores)
8. Forest Land	Little forested land in study area; primarily developed.

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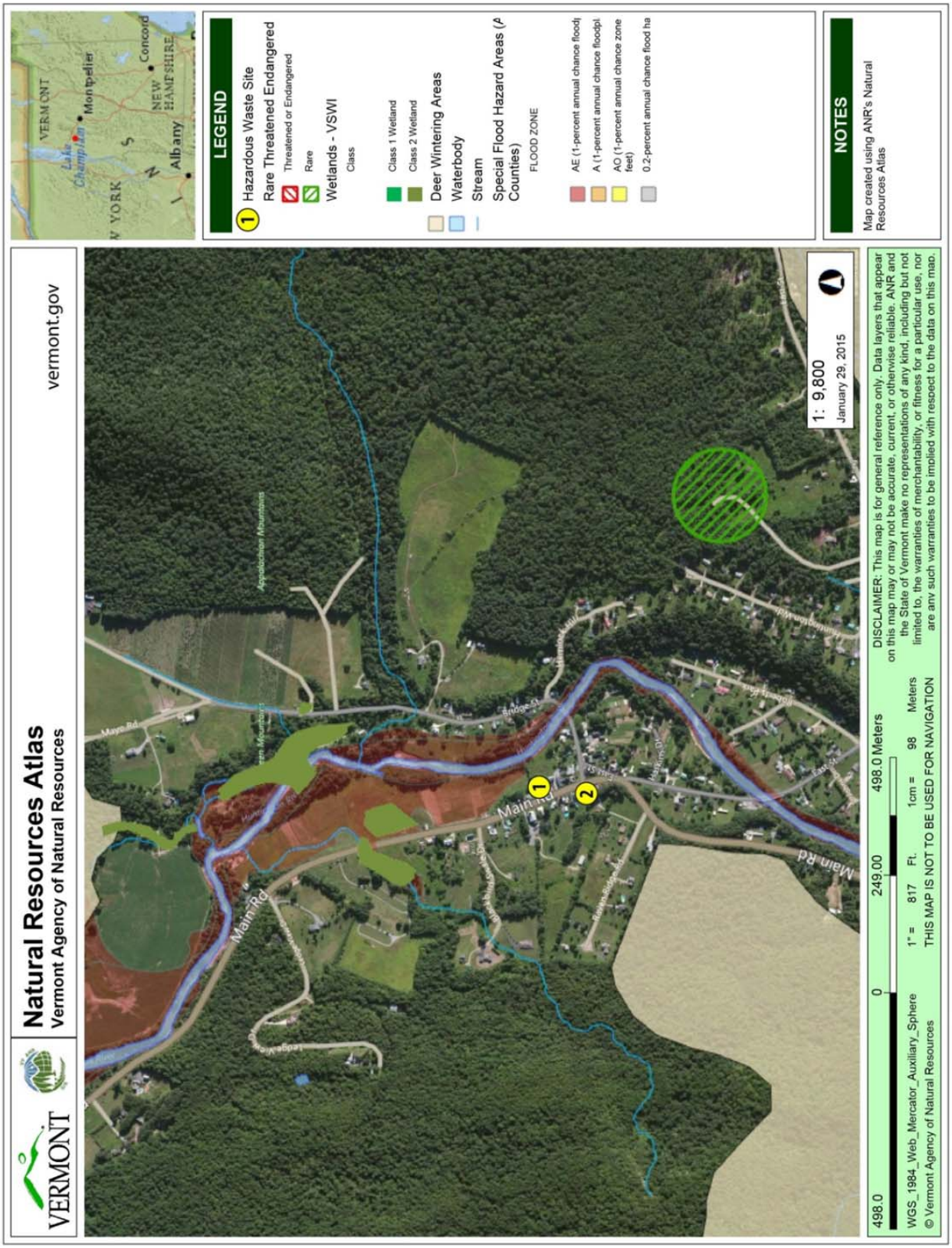
Figure 2.4: ANR Natural Resource Atlas



2.9 Purpose and Need Statement

After collecting and reviewing the above information on the project area, speaking with municipal and regional stakeholders, and gaining input at a Local Concerns Meeting (July 29, 2014), the following purpose and need statement has been developed:

> Prepare a scoping report to identify potential bicycle and pedestrian improvement and traffic calming strategies for Huntington's Lower Village. Selected strategies will help improve transportation options in this State-designated village center and will also have public safety benefits. The need exists due to the combination of high vehicle traffic speeds on Main Road, wide intersections with inadequate traffic control, and increased village activity means the potential for conflict is growing.

Conducting the study is particularly timely, given the Town's plan to repave this section of the Main Road in the next year or two. The study recommendations should also support relevant goals as stated in the Huntington Town Plan, including the following:

- To provide residential opportunities and community services efficiently . . .
- Promote safe and efficient pedestrian and other transportation capability, and encourage the social and cultural aspects of neighborhood community life.
- Pedestrian and bicycle uses are prioritized without sacrificing automobile accessibility.

3 Public Involvement

There were numerous opportunities for public and stakeholder input in the process of completing this study.

3.1 Steering Committee

A project steering committee consisting of town officials and village residents and property owners met several times during the course of the study and provide review, guidance and input on the study's direction.

3.2 Public Meetings

In addition, the following well-attended public meetings were held:

- Local Concerns Meeting: July 29, 2014
- Alternatives Presentation: May 13, 2015
- Final Public Meeting: February, 2016

At each meeting the participants had a high level of interest and support for many of the alternatives under discussion. There were also concerns about the safety of parallel parking, and the potential to reduce the apparent size of village resident's front yards. Members of the public provided valuable input for project design and refinements.

3.3 Traffic Calming Ad Hoc Committee

The Lower Village Traffic Calming Ad Hoc Committee, co-chaired by Selectboard member Helen Keith and Lower Village resident Dean Grover, spent considerable time and effort from June to November mapping out, researching (including site visits to nearby towns), evaluating and discussing potential traffic calming devices and methods for addressing concerns in the Lower Village. As part of this effort, the Selectboard approved FY 15-16 deficit spending for an amount not to exceed $5,000 for traffic calming tests and/or devices. Action taken by the Committee to date has been to narrow the fog lines from 10' lanes to 9' lanes; to conduct tests on the impact of speed radar feedback signs on vehicle speed at the north and south entrances to the Lower Village; to research and propose the purchase of either a speed feedback radar sign or a moveable speed table for the current year; and to investigate potential traffic flow redesign for the Village Green area. The Committee has also recommended to the Selectboard that they allocate $12,000 for additional Lower Village traffic calming/redesign in the FY16-17 budget to be proposed at Town Meeting. The Selectboard's final determination on the amount to include in the FY16-17 budget they present to voters is expected in December.

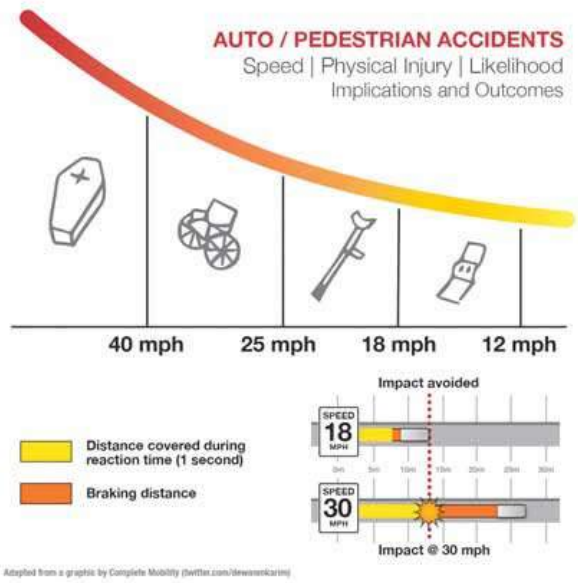
4 Alternatives

The following sections present a variety of options that can address the purpose and need of the project. In summary, these alternatives provide a variety of approaches to meet the project goals, which can be used separately or even more effectively in combination. These can be summarized as:

1) **Reduce speeds** – through the implementation of traffic calming techniques in the village, so that anyone walking, biking, parking, or crossing the street will be safer and more comfortable.
2) **Establish a village streetscape** – with sidewalks, curbing, on-street parking, lighting and landscaping, the village's identity can be reinforced to bolster traffic calming and provide a safe and inviting pedestrian network.
3) **Reconfigure overly wide and undefined intersections**– the intersection of Bridge and East Streets with Main Road has an excess of paved area, yet lacks clear definition for vehicles and pedestrians. Reconfiguring and managing access at this location will improve the village's appearance, expand village green space, further reinforce lower speeds, and provide greater pedestrian safety.

4.1 Traffic Calming

The speed data collected by CCRPC indicates that concerns about speeds in the village are well founded, and that efforts to reduce speed should be among the high priority actions. Pedestrians and bicyclists are both very vulnerable to speeding traffic. Any type of collision between a person walking or biking and a moving vehicle is much more likely to result in an injury or fatality at speeds over 25 mph. For a village to be safe and pleasant for walking and bicycling on a shared street, the 85th percentile speed should be less than 25 mph. Huntington's speeds are well above this level, ranging from 28 to 34 in the village center, so a concerted effort to reduce speeds using a variety of different traffic calming measures is warranted. These options are described in more detail in the following sections, generally in order of cost and complexity.



4.1.1 Pavement Markings

Many research projects across the US, including come in rural communities that are applicable to Lower Village, have found that some types of pavement markings can be effective in reducing speeds. These techniques have the advantage of low cost, and great flexibility. The following pavement marking techniques can be incorporated into the resurfacing project as described below and shown in Figure 5.1. The estimated costs assume that a pavement marking contractor has already been mobilized, and provide the additional estimated cost to add this to a pavement marking project.

ANOTHER ADVANTAGE OF TRAFFIC STRIPING AS A TRAFFIC CALMING OPTION IS FUTURE FLEXIBILITY. TRAFFIC STRIPING CAN EASILY BE CHANGED IN THE FUTURE BY SANDBLASTING THE PAINTED STRIPING, IF A PARTICULAR INSTALLATION IS UNSUCCESSFUL IN MEETING ITS GOALS OR NEEDS TO BE CHANGED

Traffic Calming-Pavement Marking Technique	Example
Speed limit pavement markings. Research has shown that marking the speed limit on the pavement is effective, and even more so if the markings are highlighted with a bold color, as shown to the right. An asphalt sealer such as Star Spectrum can be used to provide the colorized background, which has relatively low cost and durability. Estimated Cost: $1,500 for each location.	
Chevrons. Marking a series of closely spaced chevrons, as shown to the right, has also shown to reinforce a gateway and speed zone transition. The cost for these depends on the quality and durability of the pavement marking method used, and ranges from $500 to $1500 per location.	
Remove the pavement center line. Roadway centerlines are not required on roads with volumes of less than 6,000, and Huntington Main Road's volumes are well below this level. Research being conducted primarily in the UK shows that removing the centerline can result in lower speeds, as drivers feel less certainty as to where they should be driving and therefor exhibit greater caution and awareness of their surroundings. With new pavement, this has no additional cost.	
Narrower lanes. Reducing lane width has also been found to be an effective traffic calming technique, which can be reinforced with providing hatch marks in the shoulder area, as shown in the example to the right. With new pavement and markings, this has no additional cost.	

4.1.2 Radar Feedback Signs

An easily implemented option is to install permanent or portable radar feedback signs, which provide an indication to motorists of their travel speed in relation to the speed limit. The Town of Huntington recently installed a temporary radar feedback sign on Main Road near Raven Ridge Road, south of the Lower Village and conducted a survey to gauge public opinion. Most respondents believed that the sign resulted in reduced traffic speeds. Concerns about the signs were related to their temporary effect, and there was support for purchasing moveable signs that could be installed at different locations in the town.

Quotes from recent town survey:

"I believe that radar feedback signs are very effective. I know from my own experience that they affect my driving behavior whenever I encounter one."

"Those radar indicators may have slowed traffic at first, but people get used to them and realize there are no repercussions for going faster than the posted speed limit other than seeing that you are going faster on a sign."

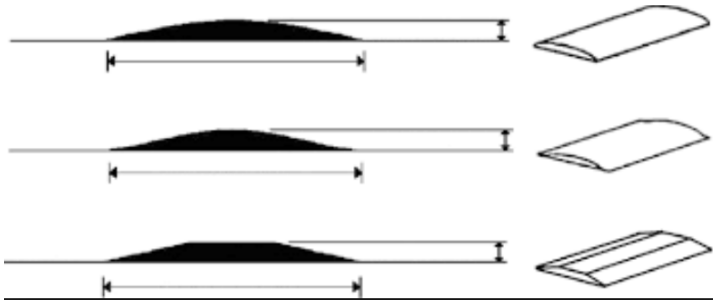
4.1.3 Speed Tables

Speed tables are generally considered a cost effective permanent traffic calming technique, and can be designed to target a speed range by adjusting the height and profile of the raised portion. Providing speed tables at the gateways into the lower village could be one of the most effective methods to reduce speeds.

The recommended profile is a 22 ft long, with 6 ft ramps and a 10 ft level table. The table should be 4 inches above the pavement surface, and the ramps should be in the sinusoidal form for easier winter maintenance.

An example shown above right on Skunk Hollow Road in Jericho is a recent installation on a rural collector roadway. The example to the right is a typical speed hump. The cost for speed tables is approximately $3,000 each, assuming a pavement contractor is mobilized

The diagram to the right shows different profiles for speed humps and tables. Typically, speed tables use the "trapezoidal" profile (bottom), with straight line ramps up and down. The most "snow plow friendly" design is the sinusoidal profile (center), which is typically used for a speed hump rather than a speed table.



4.1.4 Splitter Islands

Constructing a landscaped island in the center of the road is an effective way to reduce speeds by requiring deflection of vehicles, with added benefits of reinforcing a gateway transition from rural areas to the village. The example to the right is a recently constructed island on Skunk Hollow Road in Jericho that was part of a rural traffic calming plan. Islands could be placed at either gateway to the Lower Village, as shown on accompanying maps. The cost of a median island will vary on the size and location, and is estimated to be between $12,000 and $15,000.

4.2 Village Streetscape

The Lower Village is a very scenic and attractive place, but lacks sidewalks, formalized on-street parking and other features that could help reinforce the character of the village as a walkable village. The following sections discuss measures that could be undertaken to reinforce the lower speeds, provide a safe pedestrian realm, and enhance the character and appearance of the Lower Village.

4.2.1 Sidewalk Network

A sidewalk network can be built in 3 phases, as described below and shown on the following page:

- Phase 1: From Bridge to Library (purple). This will serve the Library, Store and Post Office, and connect to the sidewalk on the bridge over the Huntington River. The total length include 600 ft of curbed sidewalk (where parallel parking is proposed), and 400 ft of uncurbed sidewalk (where sidewalk is separated by a green buffer).
- Phase 2: Connections to East Street and Raven Ridge (dark blue). These connections will serve nearby residential neighborhoods.
- Phase 3: Connection to Community garden (light blue). This will connect residents north of the village, on Blackbird Swale Dr, and the community garden to the village center.

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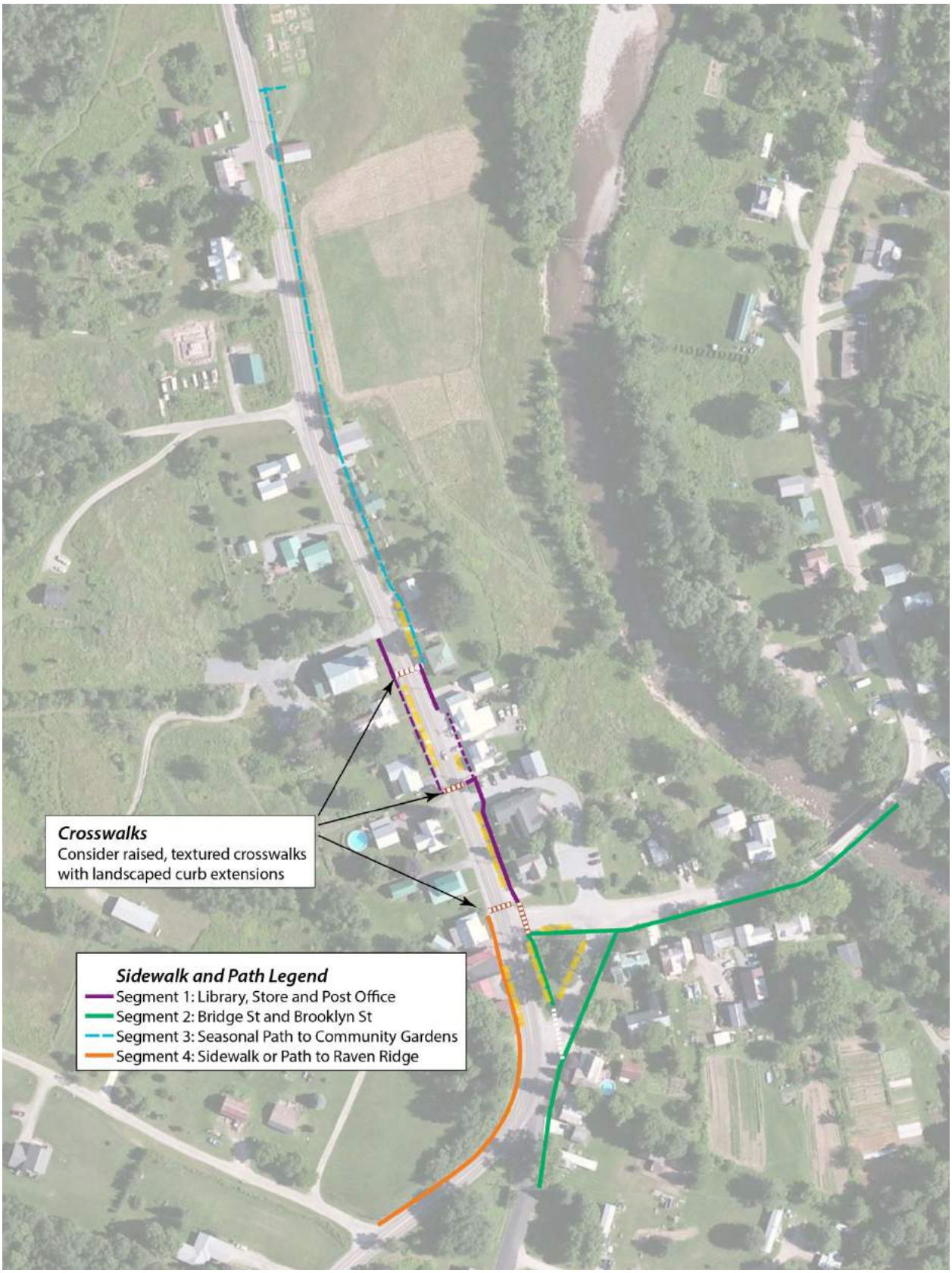
Figure 4.1: Pedestrian Network Recommendations



The table below summarizes the costs for these phases, which are broken down by curbed and uncurbed sections due to different unit costs

Table 4.1: Pedestrian Network Estimated Costs

	Sidewalk Segment	Location	Quantity	Units	Unit $	Total cost
1	Sidewalk (curbed)	Post Office to Library	600	ft	$240	$ 144,000
2	Sidewalk (uncurbed)	Post Office to Bridge	900	ft	$160	$ 144,000
3	Seasonal Path (gravel)	Store to Community Garden	900	ft	$80	$ 72,000
4	Sidewalk (curbed)	To Raven Ridge	600	ft	$240	$ 144,000
Total Construction Cost						$ 504,000
Mobilization						$ 70,560
Allowance for Enhancements (lights, streetscape)						$ 220,000
Contingency						$ 50,400
Design/Engineering						$ 211,240
TOTAL PROJECT COST						$1,056,200

The costs above do not include allowances for lighting, landscaping, design/engineering/permitting, cost to pave on-street parking, and contingency. These will be discussed in the later sections of the report on implementation and phasing.

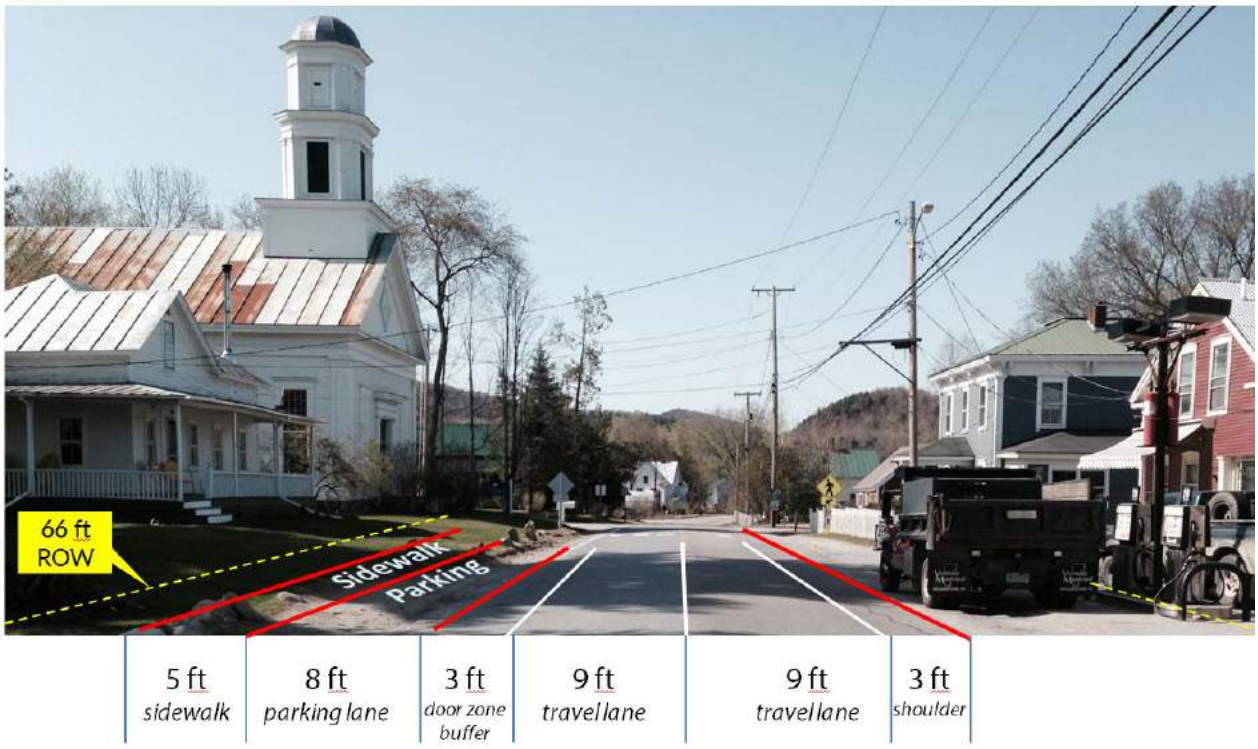
4.2.2 On-street parking

On-street parking can meet multiple objectives for the village, including the following:

- Narrow visual width of the road and reinforce low speed through village.
- Eliminate the safety hazards resulting from head-in parking in front of Beaudry's Store and adjacent buildings, improving safe access for drivers and walkers.
- Support local business development in the village, particularly those without sufficient on-site parking space.
- Reduce need for off-street parking and new pavement by providing public, shared parking.

The 66 feet right-of-way width on Main Road provides ample room to accommodate travel lanes, a door zone buffer area/shoulder, on-street parking, and sidewalks in appropriate locations, as shown on the following photo.

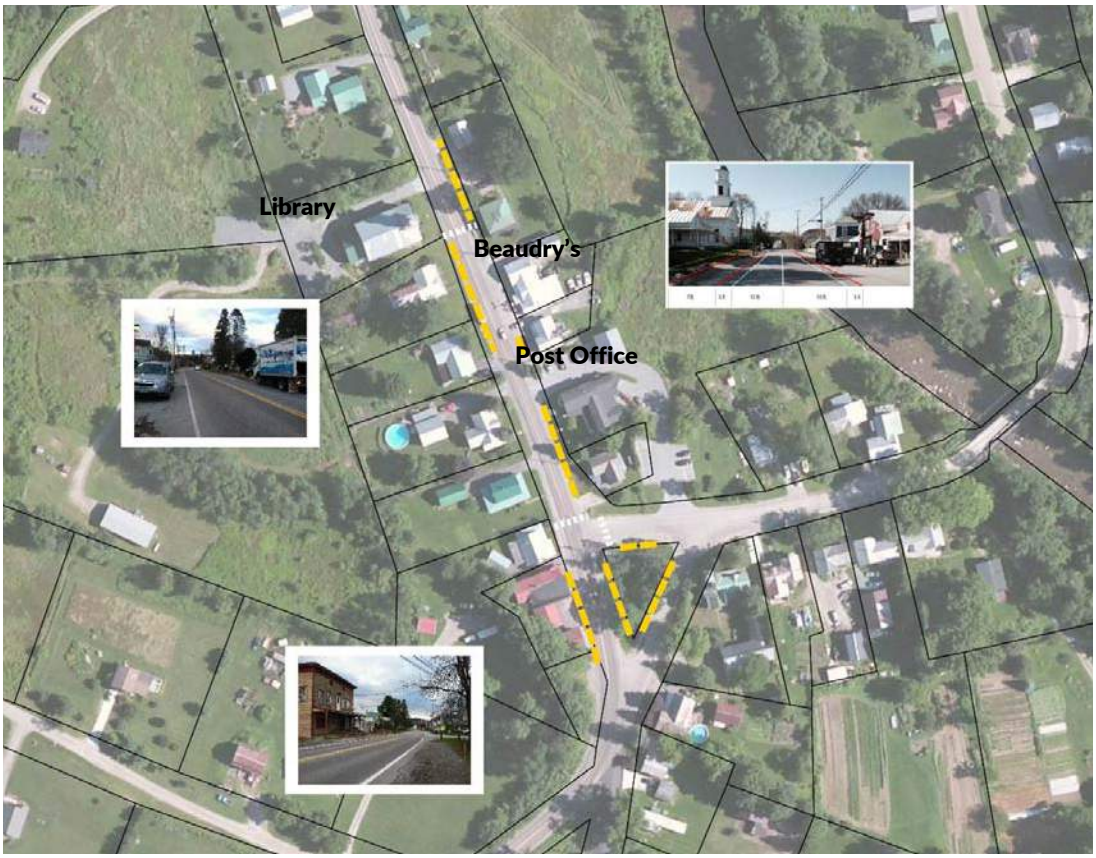
Figure 4.2: Street Cross Section at Beaudry's Store



The cost to provide on-street parking will include providing an adequate gravel base and pavement. For purposes of estimating costs, it is assumed that the additional base and pavement will cost approximately $80 per linear foot of parking spaces. The map that follows shows potential locations for on-street parking that can serve the important destinations in the Lower Village, allowing patrons to park once and walk to several different locations. In total, approximately 40 parking spaces could be provided, for an estimated cost of $80,000.

Future enhancements for on-street parking could include reconstructing them to provide stormwater treatment. This would entail excavation and placing of perforated pipes and porous material, and surfacing the parking lanes with concrete paving blocks or other similar durable and porous surface. This treatment also reinforces traffic calming by narrowing the appearance of the road surface. Cost for this treatment is obviously much higher, estimated at $22,000 per parking space, and will provide numerous benefits to the environment and village aesthetics.

Figure 4.3: Potential Areas for On-Street Parking

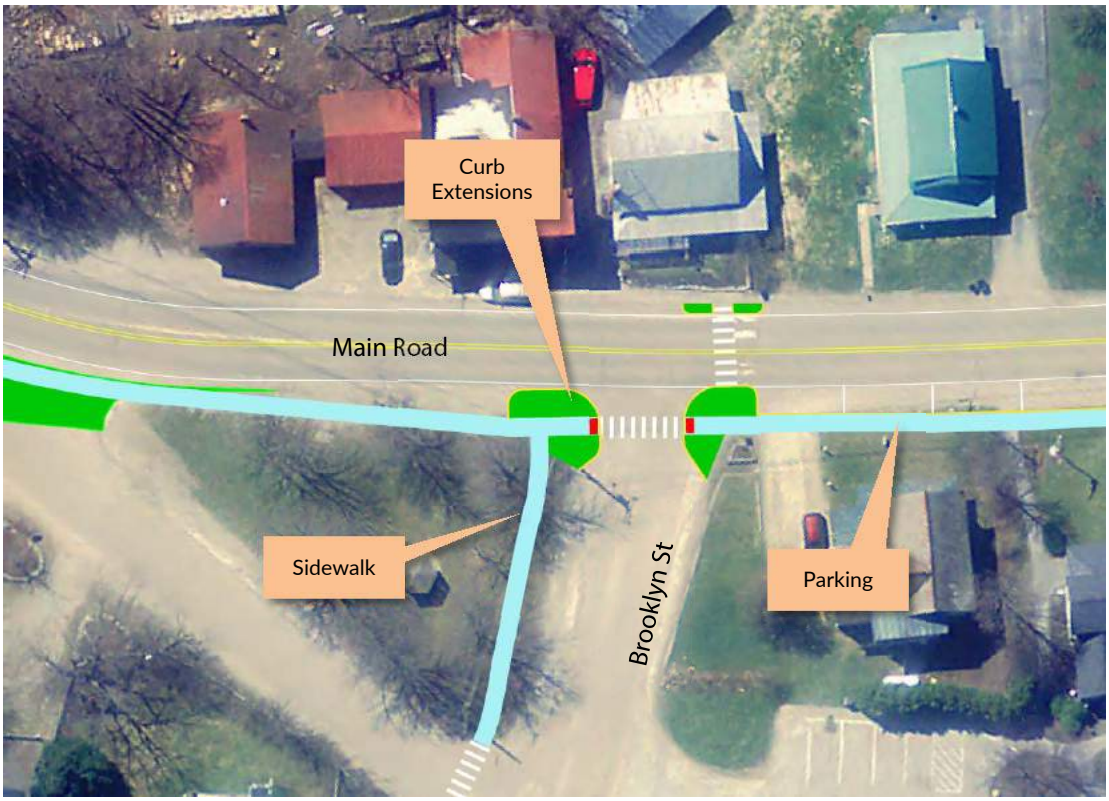


4.2.3 Streetscape Amenities

To further enhance the village's appearance, character and walkability, the following enhancements can be incorporated into the streetscape design.

- **Pedestrian scale light fixtures** can be placed at strategic locations, such as crosswalks. Cost per light fixture including wiring, conduit, base and installation ranges from $5,000 to $7,500 each depending on the style.
- **Tree planting** can be used to reinforce traffic calming by visually narrowing the road, and also be an important an effective way to improve the village's appearance and character. The cost to plant a tree ranges from $500 to $1,500, depending on the size.
- **Green stormwater or rain gardens** can be incorporated into the streetscape and help reduce the flow of runoff from paved areas. In the example below, the curb extensions can be designed to absorb and treat roadway runoff. Costs for bioretention areas varies widely depending on the surrounding drainage, but are typically in the range of $10 to $20 per square foot.
- **Curb Extensions** can further reinforce traffic calming by visually narrowing the road and tightening the corners, and also shorten the distance that pedestrians need to cross. They can be located at corners, particularly where parallel parking is considered. Costs vary with size and materials used, and typically range from $5,000 to $8,000.

Figure 4.4: Curb Extensions on Main Road at Brooklyn Street



The curb extension design can be refined after a pilot test, which should include some field trials of larger vehicles making the right turn onto Brooklyn St from northbound on Main Rd. The curb extensions can be landscaped, or have a textured and mountable such as cobblestones, which can be traversed by larger vehicles. Several examples of design options are shown below, and will all require maintenance.

4.3 Intersection Reconfiguration and Access Management

Over the years, many options to reconfigure the intersection of East St, Bridge St and Main Road have been discussed. In a public workshop held for this project, additional options including one-way circulation around the village green space was also proposed. D&K conducted a topographic survey of the intersection area in order to be able to more accurately analyze and assess options for their feasibility. The following summarizes the input and conclusions for the alternatives under consideration.

4.3.1 Divert East Street traffic to Bridge Street

All East Street traffic is diverted to Bridge Street, with no direct access to Main Road. This option requires realigning of Main Road to the west. This alternative was rejected due to excessive paved area and awkward circulation.

4.3.2 One-way East Street

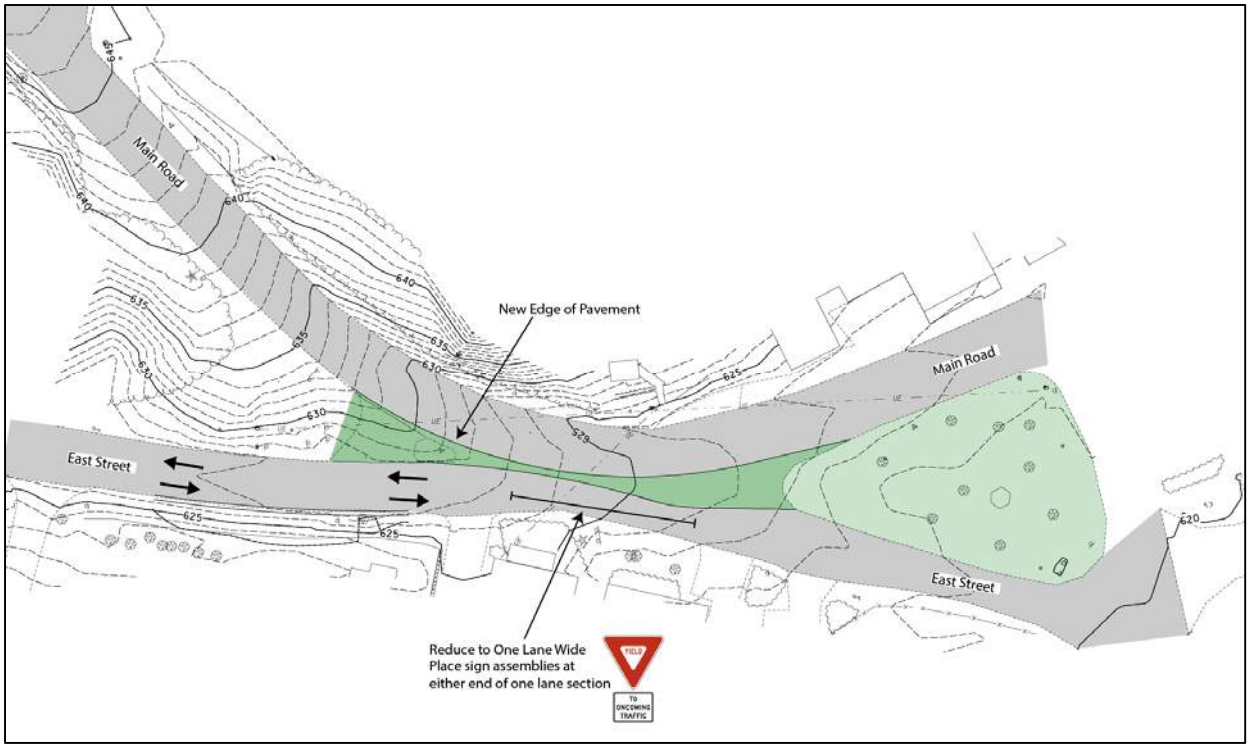
This option has garnered the most interest and support at public meetings. East Street would have one-way circulation along the village green space, and the intersection with Main Road would be realigned to provide a less steep grade.

4.3.3 Create T-intersection with East Street and Main Road; close end of Bridge Street

This option was not favored due to the difficult series of grades accessing East Street from Main Road. In particular, the grade of East Street where it meets Main Road gets as high as 12%.

4.3.4 One lane/Two way East Street Hybrid

This variation on the option shown in section 4.3.1 is shown below. In this option, which is largely within the existing footprint of the road, East Street has a one lane wide section where approaching traffic has to yield to oncoming traffic, using the signs shown below.



Some type of vehicle barrier should be provided to separate Main Road from East Street. This could be conventional guardrail, or a more attractive style such as a steel-backed timber or masonry system (shown to the right).

4.3.5 All Way Stop at Brooklyn Street and Main Road

The traffic conditions at the Brooklyn St and Main Rd intersection were analyzed to determine if they met the requirements for all-way stop control set forth in the Manual for Uniform Traffic Control Devices (MUTCD). Conversion to an all-way stop is not warranted due to the low traffic volumes, ample sight distance and lack of crash history. Even if the traffic circulation changes as shown in the above sections were implemented, traffic volumes are well below the MUTCD warrants for an all way stop. There is anecdotal history of many "near misses", so this location should be re-evaluated \ to determine if an all-way stop has merit in the future, if there is a stronger history of crashes.

4.3.6 Mini-Roundabout at Brooklyn/Main Road

Mini-roundabouts can reinforce traffic calming in an attractive and effective manner, and are among the safest type of intersection control. A mini-roundabout could be designed to fit within the existing paved area at this intersection, and also provide pedestrian crossings. The central and "splitter" islands in a mini-roundabout are constructed of a durable, slightly raised, surface that is traversable by trucks or other large vehicles, so it should not hamper circulation at all.

The photo to the right shows a typical design of the mountable islands, allowing trucks to traverse the intersections easily. Research conducted by the Federal Highway Administration shows that mini-roundabouts have nearly all the safety benefits of full sized modern roundabouts, which are the safest type of intersection.

4.3.7 Analysis of Intersection Alternatives

The following table provides a summary of the characteristics, potential impacts, design issues and costs of the above intersection options.

Alternative	Benefits and Design Issues	Cost Estimate*
4.3.1 - East St diverted to Bridge St (2-lane section)	Will result in significant increase of paved surface in Lower Village. Requires re-aligning Main Road, cutting into bank and relocating utilities.	$300,000
4.3.2 - One way circulation for East St	Results in steep grade on approach to East St from Main Rd (approximately 12%).	$220,000
4.3.3 - T-intersection for East St; close Bridge St	Steep grade on East St as it approaches Main Rd (approximately 12%).	$200,000
4.3.4 - East St diverted to Bridge St (1-lane section)	Maintains existing footprint, avoids property and utility impacts, reducing cost.	$150,000
4.3.5 - All-way stop	Not warranted by traffic volumes, not recommended for traffic calming, can lead to driver frustration.	$5,000
4.3.6 - Mini-Roundabout	Safest form of intersection control; can be created with attractive textured and mountable surfaces.	$100,000

* Cost estimate is based on highly conceptual design and offered for programming and planning level decisions.

Due to consideration of costs, impacts, and effectiveness of these options, it is recommended that Alternative described in section 4.3.4 be tested for the East St intersection, which can be accomplished at relatively low cost (see section 5.3). For the intersection of Brooklyn St/Main Rd, a mini-roundabout is recommended at such time that intersection control is necessary, unless traffic increases sufficiently to warrant an all-way stop.

4.3.8 Shared Space Street Design

Widely used in small rural villages in the United Kingdom, shared space design relies on use of a variety of colors and textures to separate traveled ways from pedestrian and parking areas, rather than paint and curbs. This has been shown to have a traffic calming effect, as drivers tend to feel slightly less certain about their right-of-way, and are more cautious. These treatments can also greatly enhance a village's aesthetics, although costs are considerably higher than conventional pavement markings and materials. Below are a number of before (left) and after (right) examples of shared space treatments.

Figure 4.5: Shared Space Design in Dorset, UK

Credit: *Traffic in Towns*, by Ben Hamilton-Baillie

There are several opportunities to implement this type of treatment by using varied materials for the on-street parking and curb extensions to accentuate the road edge. The cost of this type of treatment can be relatively high compared with using more common curbing or gravel to delineate these areas.

5 Recommendations: From Planning to Action

The concepts presented here in sparked a great deal of interest and discussion in the community. There were a range of opinions on many matters, with few areas of consensus, but a lot of enthusiasm and interest in exploring further options. In response to the community sentiment, a phased plan is recommended that moves ahead with the activities for which consensus is the greatest, and provides an opportunity to test other ideas with temporary demonstration to allow the community to learn and improve upon designs to address many long standing village and safety concerns. Once the community experiences some of these projects on a temporary basis, it may be easier to reach consensus on a long term plan.

Strategy: From Planning to Action

1) **Pilot test** the reconfiguration of the East St/Main Road/Bridge St intersection. These ideas have been discussed for years, and it will be difficult to reach consensus on these potentially significant changes. Allowing the community to experience these changes with a pilot reconfiguration (see section 4.3.4) would help reach consensus. The plan shown below in Figure 5.2 requires only signs and temporary barriers.
2) **Phase 1 of Traffic Calming-Pavement Markings.** The resurfacing project can be include speed tables, narrower lanes, elimination of the center line, and accented marking of the speed limits on the road surface as discussed above with very little additional cost. Recommendations are illustrated in Figure 5.1.
3) **Phase 2 of Traffic Calming-Street design changes**. Additional components of traffic calming can include formalizing on-street parking (ideally with an unpaved or textured surface to reinforce traffic calming, permanent intersection reconfiguration, and curb extensions or mini-roundabout at Brooklyn Street/Main Road. In addition, some areas can be adapted with landscaped stormwater buffers.
4) **Sidewalk network.** Apply for funding of sidewalk construction, which can happen in phases or as one project as desired.

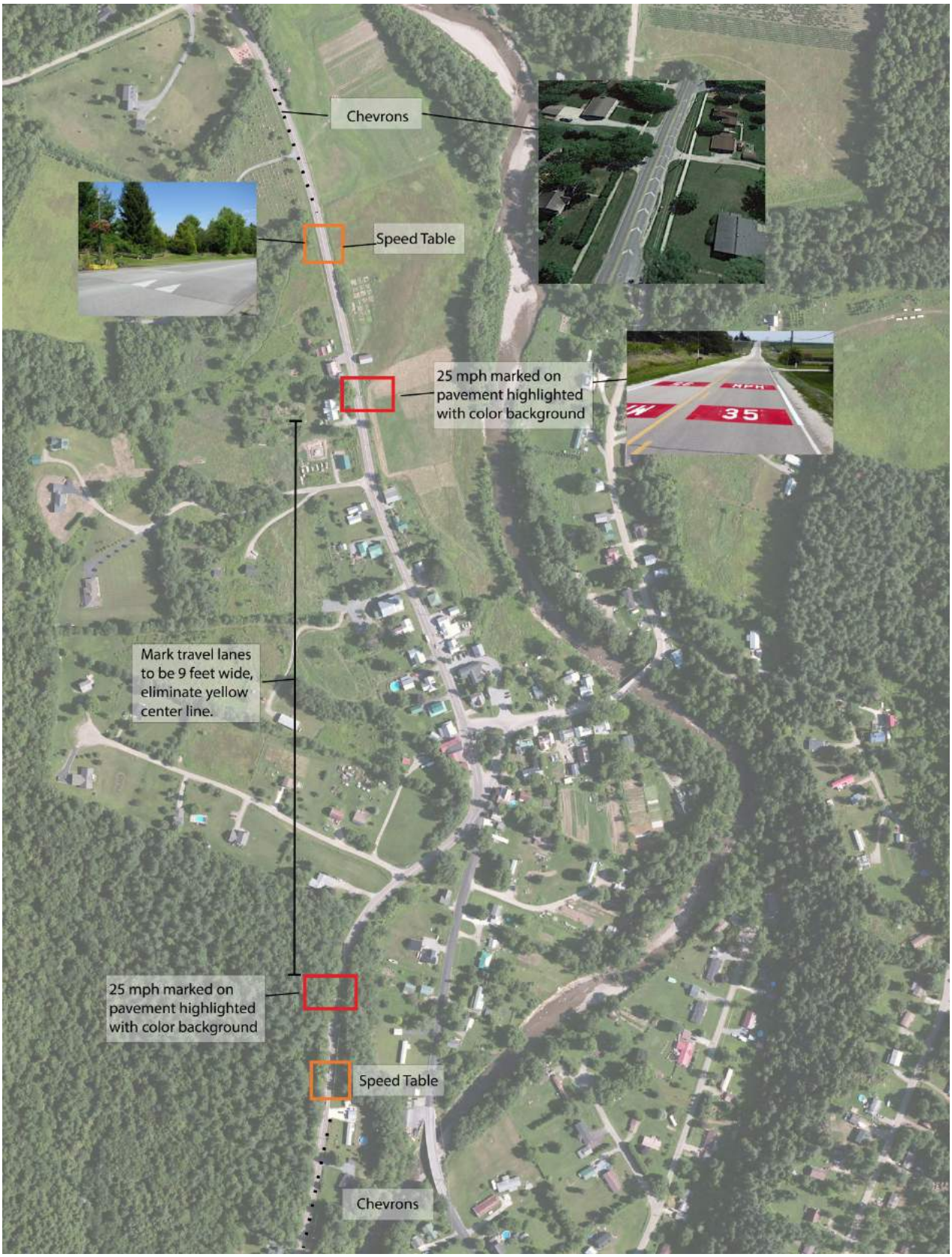
These steps are discussed in more detail in the following sections.

5.1 Phase 1: Traffic Calming

The traffic calming pavement marking plan illustrated in Figure 5.1 could be implemented as the Town of Huntington proceeds with resurfacing of Main Road through the Lower Village, planned for the 2016 season. Many of these recommendations have been evaluated in federal research projects in Iowa and other rural states, and have been found to be effective[1,2].

[1] *Roadway Striping as a Traffic Calming Option*, ITE Journal, Kahn, Robert E and Allison Kahn Goedecke. Sept, 2011.
[2] FHWA TechBrief, *Traffic Calming on Main Roads through Rural Communities*, FHWA-HRT-08-067, February 2009

Figure 5.1: Phase 1 Traffic Calming Plan – Pavement Marking



The Town of Huntington may also purchase temporary speed tables and mobile radar feedback signs within the next year before permanent placement of speed tables. These will provide an opportunity for testing the location and effectiveness for traffic calming, given the baseline of speed data that the town currently has available from CCRPC. A mobile radar feedback sign was recently tested on the northbound approach into Lower Village, and found to decrease the 85th percentile speeds about 3 mph.

5.2 Phase 2 Traffic Calming

Traffic calming and the village streetscape can be further enhanced in the future by implementation of permanent changes, including the following:

- reconfiguration of the intersection (supported by pilot testing and temporary changes),
- curb extensions, all-way stop (if traffic warrants), or mini-roundabout at Brooklyn/Main
- creation of permanent on-street parking, potentially with textured and permeable surface to enhance the appearance and traffic calming effect, and reduce stormwater impacts.

The design will need to be refined after the pilot tests of intersection changes are complete.

5.3 Pilot Testing of East Street/Bridge Street Intersection Changes

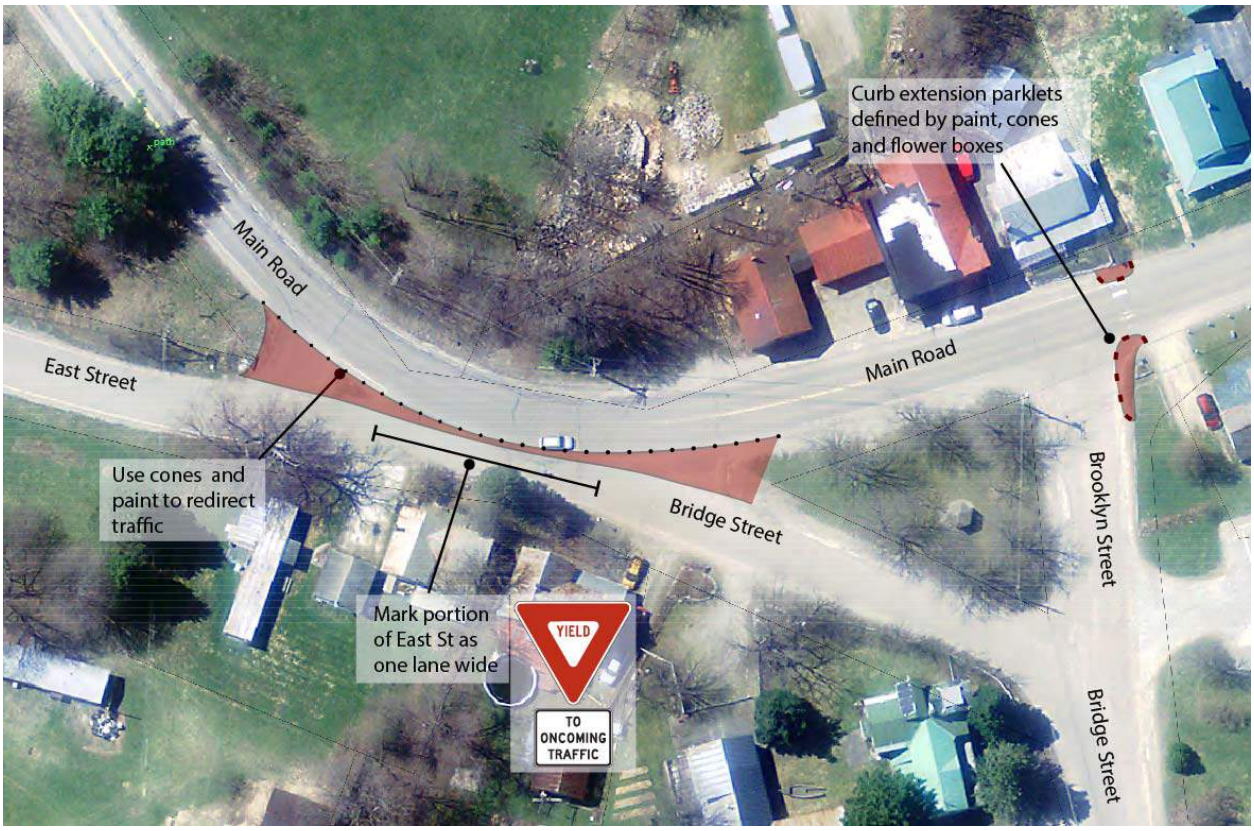
Using the funding made available by the Town of Huntington, and with regional support from Local Motion, the Town of Huntington can undertake a pilot project in the spring and summer of 2016 to test several options for traffic calming. Pilot projects provide a valuable opportunity for testing a low cost, temporary design in order to learn and evaluate, so that the design can be refined before permanent implementation, or abandoned. The following are among the options for pilot projects:

Using flexible plastic bollards, washable paint, and flower boxes or potted plants, a pilot could be conducted to test reconfiguration options for the intersection of Main Road, East Street and Bridge Street. This type of reconfiguration could make the Lower Village both safer and more attractive, with opportunities for landscaping and public spaces. The photos to the right show a recent demonstration project in Burlington, VT, which used readily available materials such as traffic cones, haybales and flower boxes to allow the community to see the benefits of a curb extension. Similar materials could be used in Huntington, which are available from Local Motion, a regional advocacy organization. The map shown on the following page outlines a potential demonstration project that could implemented with assistance from Local Motion in the summer of 2016.

Parklet - Before

Parklet - After

Figure 5.2: Potential demonstration project for intersection reconfiguration and traffic calming



This plan is intended to reduce speeds for traffic turning onto East St or Bridge St by consolidating all turns at the Main Rd/Brooklyn St intersection. When turning traffic reduces speed, following traffic must also slow down, resulting in an overall traffic calming effect.

5.4 Sidewalk Construction-Implementation and Timeline

The chart below shows a possible timeline for the implementation of the proposed sidewalk network. This schedule assumes that the Town of Huntington receives state or federal funding for sidewalk construction in 2017 from VTrans, which requires a lengthy process of design, permitting and review.

Figure 5.3: Project Timeline for Sidewalk construction through VTrans Bike-Ped or Transportation Alternatives Programs

	2017				2018				2019			
Seek sidewalk funding*		■	■									
Project initiation				■								
Project Design and permitting					■	■	■	■	■	■		
Bidding and construction											■	■

* from VTrans and/or CCRPC

5.5 Permanent Traffic Calming and Intersection Reconfiguration Timeline

Based on results of the pilot/demonstrations, the Town can proceed to implement permanent projects in the form of radar feedback signs, gateway islands, curb extensions, and intersection reconfiguration. The pilot projects described earlier should provide clarity on the most desirable traffic calming elements that can be implemented. Funding sources for traffic calming projects are limited to the Transportation Alternatives program. However, it may be possible to combine other sources if the project includes elements such as pavement reduction and green stormwater infrastructure. Using local funds provides the greatest level of flexibility and can accelerate the potential timeline.

Figure 5.4: Project Timeline for Pilot Projects

	2016				2017			
Plan for Demonstration/Pilot								
Conduct Pilot/Demonstration of Intersection								
Implement Traffic Calming with pavement marking								
Conduct speed surveys for “after” traffic calming								
Plan for permanent traffic calming and sidewalk								

6 Attachments

1) Meeting Minutes
2) Hartgen Report
3) Traffic Calming resources

Attachment 1

Meeting Notes

Town of Huntington — Lower Village Local Concerns Meeting
Lower Village Bicycle/Pedestrian Scoping Study

Monday, July 29, 2014—7:00 pm

Union Meeting House / Library – Lower Village

** UNAPPROVED ** MINUTES

Agenda	• Purpose: Solicit local concerns related to bicycle, pedestrian and vehicular transportation as part of the VTrans Lower Village Scoping Study grant • Review background and goals • Review process and timelines • Review & discuss: Existing conditions; Goals and concerns; Past & ongoing projects; Concepts from other communities
Attendees:	Jeanine Carr, Jim Christiansen (Chair, Selectboard), Barbara Elliott (Town Adminstrator), Jeff Fergerson, Paul Finnerty, Lucy Gibson (Presenter; Dubois & King), Peter Keating (CCRPC), Dean Grover, Nancy Grover, Paula Kelley, Bruce Moody, Heidi Racht, Mike Ramsey, Lorrie Richland, Randy Richland, Bill Rogers, Julie Rogers, Daryl Storrs, Debbie Worthley
Call to order; Introductions	Christiansen called the meeting to order at 7:10 pm and introduced Lucy Gibson (consultant from Dubois & King). Gibson facilitated the meeting.
Study Milestones & Timeframes	• August 2014 - Public Meeting: Local Concerns • September/October 2014 – Develop Alternatives (Dubois & King) • November 2014 – Public Workshop to review alternatives • December 2014 – Refine Alternatives (Dubois & King) • January/February 2015 – Cost & Feasibility Analysis • March 2015 – Final Meeting & Report
Average Daily Traffic	**<u>Average Daily Traffic</u>** 2,400 – On Main Road, heading south into Lower Village 1,700 – On Main, just past the Village Green in the Lower Village 820 – On East Street 390 – On Bridge Street

Public Comment	• General Transportation Concerns/Feedback for Lower Village
	  ○ Highest vehicle volumes are from 6:00 to 8:30AM
	  ○ Noise, from braking and acceleration, are also concerns
	  ○ Mid-day the Village is quiet
	  ○ VT State Police Speed enforcement is only 6.5 hours/week
	  ○ Main Road pavement height is getting too high causing water runoff issues (although not mentioned, this has been a problem in the past on Bridge Street as well).
	  ○ Need to have the roadway narrowed
	• Main Road Vehicle Speed Concerns:
	  ○ Speeding is the major problem in the Lower Village
	  ○ Cars passing each other in the Village area is a problem
	  ○ No Passing sign should be installed by the Community Gardens
	  ○ The 45 to 35 mph transition zone should be moved further out from Village; Vehicle acceleration occurs too soon moving out of Village

unapproved

	○ The Town plow trucks drive too fast • Bridge Street Concerns: ○ Speed is also a concern on Bridge Street north of the bridge but it's compounded by dust and visibility issues near bridge ○ Some support for paving Bridge Street (including the UK model of shared-space lanes) ○ The sidewalk on the Bridge Street bridge is not plowed • East Street Intersection / Village Green Area: ○ East Street intersection is a problem ○ Vehicle parking encroaching on the Village Green is a problem ○ Don't ignore the school bus transfer activity at the Green • Pedestrian / Bicycle Concerns: ○ Need improved safety conditions for pedestrians ○ Pedestrian traffic is light but bicycle traffic is increasing ○ Seems to be a general lack of awareness by drivers that there are pedestrians in the Lower Village ○ The crosswalk and shoulder striping are fairly new – not sure there's been any impact from these ○ Need to have damaged pedestrian cross walk signs replaced ○ Every day problem noted by a daily pedestrian ○ Runners note early morning speed problem ○ There was a pedestrian hit by a car in the Village about 10 years ago • Feedback on Alternative Solutions/Concepts: ○ The 2000 Village concepts did not generate overwhelming approval ○ Traffic calming techniques, especially splitter islands, seemed to have broad support from those in attendance ○ General support for speed bumps/tables on Main Road and Bridge Street (Good example in S. Burlington on Hadley and Meadow Roads) ○ Support for intermittent road narrowing, as traffic calming tool ○ The Danville project was widely admired ○ The UK traffic calming removing the center stripe was supported ○ Speed radar feedback signs might be a positive solution – enforcement can only go so far, so other passive mechanisms are needed ○ Install a stop sign on Main Rd near East St intersection (make cars stop at bottom of or on the hill heading north into the Lower Village center) ○ Suggestion that enforcement cameras could be a good tool ○ Stormwater can be addressed with curbing – although concern was expressed about the safety for bicyclists with curbing ○ Try doing something dramatic with the road surface
Adjournment	Meeting wrapped up at 9:05pm
	07/29/14 – Meeting date 07/31/14 – Draft/unapproved minutes sent to Town Clerk for website posting Xx/xx/14 – Final/approved minutes approved xx/xx/14 – Approved minutes sent to Town Clerk for recording & website posting

unapproved

Attachment 2

Hartgen Report

HARTGEN
archeological associates inc

ARCHEOLOGICAL RESOURCE AND HISTORIC PRESERVATION ASSESSMENT

Huntington Lower Village Bicycle/Pedestrian Path Scoping Study

Town of Huntington
Chittenden County, Vermont

HAA # 4831-11

Submitted to:
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June 2015

MANAGEMENT SUMMARY

Involved State and Federal Agencies: Vermont Agency of Transportation
Phase of Survey: Archeological Resource and Historic Preservation Assessment

LOCATION INFORMATION

Location: Town of Huntington
County: Chittenden County, Vermont

SURVEY AREA

Length: Approximately 1,450 feet (394 m) along Main Road
Approximately 1,588 feet (431 m) along Bridge Street
Approximately 218 feet (59 m) along East Street
Width: Approximately 10 feet (3 m)
Number of Acres Surveyed: Approximately 1.5 acres (0.61 ha)
7.5 Minute Quadrangle Map: Huntington, Vermont

RESULTS OF RESEARCH

Sites within one mile: 3
Surveys in vicinity: 2
NR/NRE sites in or adjacent: 12
VDHP inventoried structures in or adjacent: 12
Precontact Sensitivity: High
Historic Sensitivity: High

RECOMMENDATIONS

Project design should avoid effects to historic structures and streetscape features such as stone walls and, large trees. Fences in the area are not historic, but should be avoided if possible. Most of the project area is considered sensitive for precontact and early historic archeological deposits. Undisturbed areas along the roads and around the standing structures should be considered to have archeological potential.

Report Authors: Thomas R. Jamison and Walter R. Wheeler
Date of Report: June 2015

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Photo 26. Structure 19, 2236 Main Road, facing southwest. A one-and-one-half story five-bay wide wood-frame classic cottage with Greek revival and Italianate details, constructed in the mid-19th century, with 20th century additions. 23

Photo 27. Structure 20, 2246 Main Road, facing southwest. A two-story mixed-use wood-frame vernacular building with Italianate bracketed cornice, dating to c. 1900. Former District #3 school, built c. 1860, forms part of the complex, and is seen at left. Both structures are listed on the Vermont State Register (0408-9 and 0408-10). 23

Photo 28. Structure 21, 1 East Street, facing northeast. A one-and-one-half story wood frame vernacular upright-and-wing house constructed in the second half of the 19th century, with 20th century two-bay garage. 24

Photo 29. Structure 22, 16 Bridge Street, facing east. A one-and-one-half story wood-frame upright-and-wing house with Italianate and Greek revival details, constructed c. 1870. It is listed on the Vermont State Register (0408-8). 24

Photo 30. Structure 23, 52 Bridge Street, facing east. Wood-frame carriage barn built c.1870, formerly associated with Structure 22. It is listed on the Vermont State Register (0408-8, 3). 25

Photo 31. Structure 24, 54 Bridge Street, facing south. A one-and-a-half story vernacular wood-frame house constructed in the third quarter of the 19th century, with extensive additions built in the late 19th century including bay windows, dormers, and a tower. 25

Photo 32. Structure 25, Bridge Street, facing south. A two story wood-frame house of T-shape plan, with Greek revival details, built in the third quarter of the 19th century, with later Queen Anne style additions including two-story bay window and ornamental shingle siding. 26

Photo 33. Structure 27, 86 Bridge Street, facing southeast. A two-story wood-frame vernacular house constructed in the fourth quarter of the 19th century. 26

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Photo 36. Structure 30, 106 Bridge Street, facing south. A two-bay wood-frame carriage barn, built in the second half of the 19th century and associated with Structure 30. 28

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Photo 40. Structure 36, 195 Bridge Street, facing southwest. A one story wood-frame ranch type house constructed c. 1960, with later alterations. 30

Photo 41. Structure 37, 210 Bridge Street, constructed c. 1875, facing southeast. A one-and-a-half story wood-frame gable-entry dwelling with Italianate brackets and porch. This house is listed on the Vermont State Register (0408-4). 30

Photo 42. Structure 38, 219 Bridge Street, facing southwest. A mid-19th century one-and-a-half story upright-and-wing vernacular wood-frame house, with Greek revival details; Queen Anne bay window added c. 1890, and a 20th century porch. 31

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ARCHEOLOGICAL RESOURCE AND HISTORIC PRESERVATION ASSESSMENT

1 Introduction

Hartgen Archeological Associates, Inc. (Hartgen) was retained by DuBois & Kinc, Inc. to conduct an Archeological Resource and Historic Preservation Assessment for the proposed Huntington Lower Village Bicycle and Pedestrian Path Scoping Study (Project) located in the Town of Huntington, Chittenden County, Vermont (Map 1). The project requires approval by the Vermont Agency of Transportation (VTrans). This investigation was conducted to comply with *The Vermont State Historic Preservation Office's Guidelines for Conducting Archeology in Vermont* (VDHP 2002).

The Project requires approvals by Vermont Agency of Transportation (VTrans). This investigation was conducted to comply with Section 106 of the National Historic Preservation Act of 1966, as amended and will be reviewed by the VTrans Archeology Officer. This investigation adheres to the Vermont State Historic Preservation Office's (SHPO) *Guidelines for Conducting Archeology in Vermont* (2002).

2 Project Information

A site visit was conducted by Thomas R. Jamison on April 21, 2015 to observe and photograph existing conditions within the project area. The information gathered during the site visit is included in the relevant sections of the report.

2.1 Project Location

The project is located in the center of the Huntington Lower Village along Main Road, Bridge Street and East Street (Map 1).

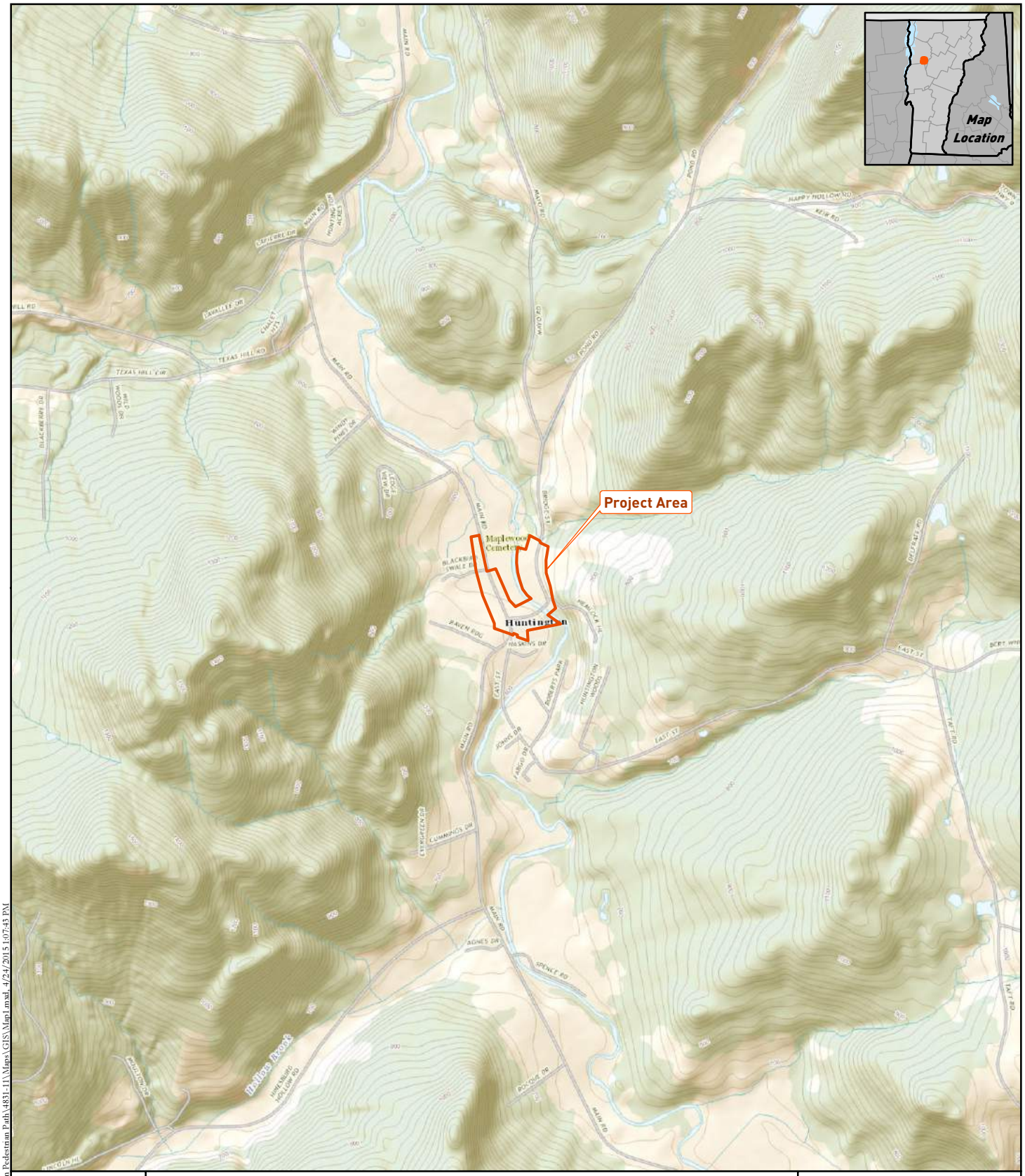
2.2 Description of the Project

The proposed project has not been determined, however, the town's application to the VTrans Bicycle and Pedestrian Program describes the project as "potential bicycle and pedestrian improvement strategies in Huntington's Lower Village. Selected strategies will not only improve transportation options in this, the primary settlement area of Town, but lead to public safety benefits as well. The combination of increased vehicle traffic with local pedestrian and bicycle activity means the potential for dangerous conflicts is growing. Implementation of this scoping report's recommendations should alleviate these conditions."

2.3 Description of the Area of Potential Effects (APE)

The area of potential effects (APE) includes all portions of the property that will be directly or indirectly altered by the proposed undertaking. A specific project is not being considered in this review. However, the APE corresponds to the limits of Main Road, East Street and Bridge Street within the Designated Village Center (Map 2). The road alignments are approximately 1,450 feet (441 m) along Main Road, ,1588 feet (484 m) along Bridge Street and 218 feet (66 m) along East Street. Assuming a width of 50 feet (15 m), the APE encompasses approximately 3.7 acres (1.5 ha).

For the purpose of this study, the Project Area and APE are considered to be synonymous and the terms are used interchangeably.



N

1,000 0 1,000 2,000 Feet

300 0 300 600 Meters

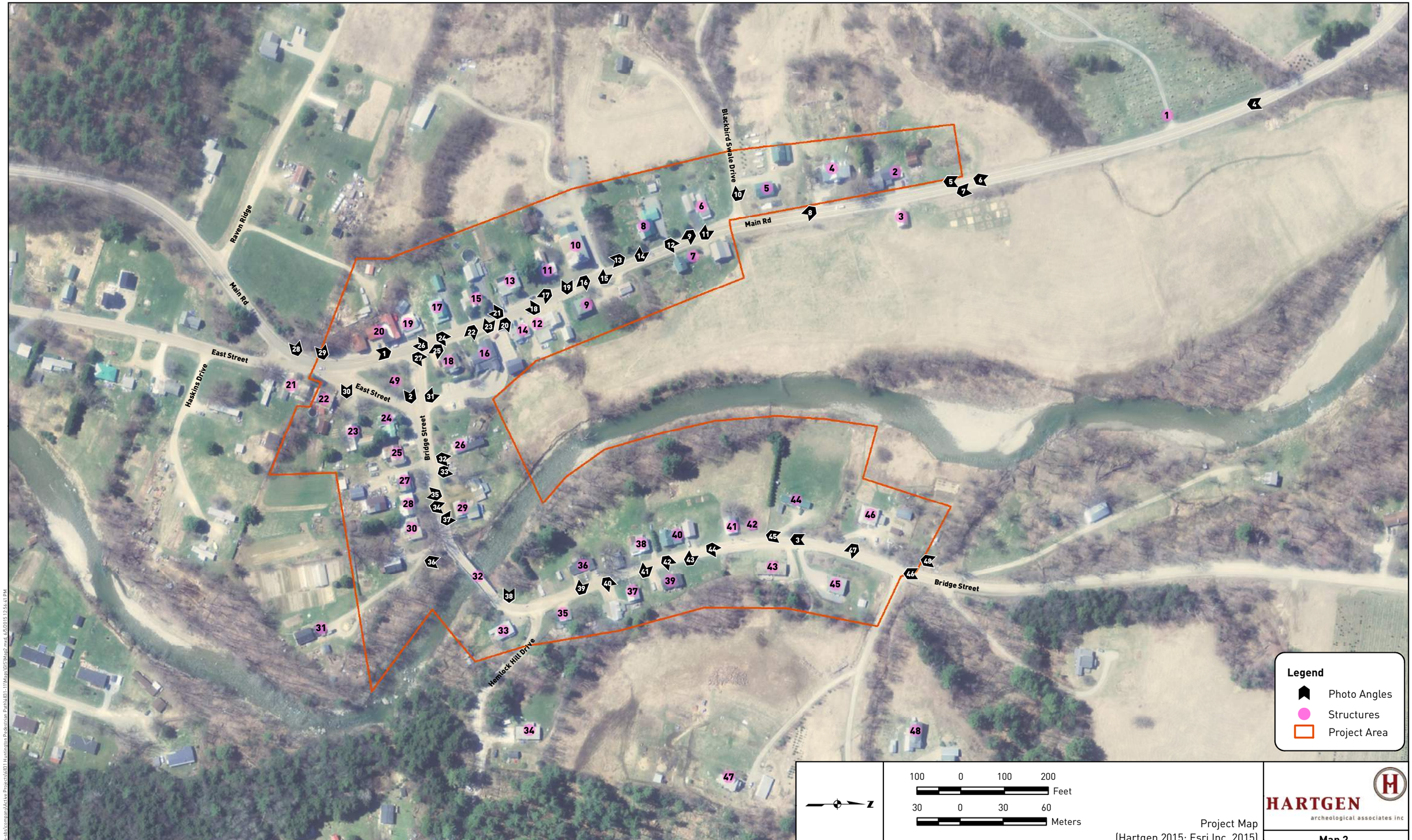
Note: Contour interval is 20 feet.

Project Location (USGS 2015)

HARTGEN archeological associates inc

Map 1

R:\Active Projects\4831 Huntington Pedestrian Path\4831-11\Maps\GIS\Map1.mxd, 4/24/2015 1:07:43 PM



Project Map
(Hartgen 2015; Esri Inc. 2015)

3 Environmental Background

The environment of an area is significant for determining the sensitivity of the Project Area for archeological resources. Precontact and historic groups often favored level, well-drained areas near wetlands and waterways. Therefore, topography, proximity to wetlands, and soils are examined to determine if there are landforms in the Project Area that are more likely to contain archeological resources. In addition, bedrock formations may contain chert or other resources that may have been quarried by precontact groups. Soil conditions can provide a clue to past climatic conditions, as well as changes in local hydrology.

3.1 Present Land Use and Current Conditions

The project area is located in Huntington Lower Village, characterized by a fairly dense cluster of residential, business and civic structures and activities. Most of the roadsides in the APE are approximately level with the adjacent road, with the exception of a few ditches and banks (Photos 1 to 3)

Photo 1. Main Road. Note close proximity of structures to the roadside. View to the north.

Photo 2. Bridge Street from Main Road. Note slope from right to left in the background and bridge (Str. 32) over the Huntington River. View to the east.

Photo 3. Bridge Street east of the river. Note slope from left to right. View to the south.

3.2 Soils

Soil surveys provide a general characterization of the types and depths of soils that are found in an area. This information is an important factor in determining the appropriate methodology if and when a field study is recommended. The soil type also informs the degree of artifact visibility and likely recovery rates. For example, artifacts are more visible and more easily recovered in sand than in stiff glacial clay, which will not pass through a screen easily.

The soils of the project area consist of glacio-fluvial and alluvial soils deposited along the Huntington River (USDA 2015). The glaciofluvial soils consist of Agawam fine sandy loam and Colton gravelly loamy sand, both along the west side of the river, including along Main Road, East Street and Bridge Street. The alluvial soils in the project area are Winooski very fine sandy loam east of the river along Bridge Street and at the northern end of the Main Road alignment. The Winooski soils have potential for deeply buried archeological deposits, while the Agawam and Colton soils are unlikely to contain deeply buried archeological deposits.

Table 1. Soils in Project Area

Symbol	Name	Textures	Slope	Drainage	Landform
AgA	Agawam	Fine sandy loam	0-5%	Well drained	Glaciofluvial terraces
CoB	Colton	Gravelly loamy sand	5-12%	Excessively drained	Glaciofluvial terraces
Wo	Winooski	Very fine sandy loam	Level	Moderately well drained	Alluvium

3.3 Bedrock Geology

The bedrock of the project area consists of the Underhill formation characterized as quartz-muscovite-chlorite schist and phyllite (Ratcliffe 2011). This formation is unlikely to have been utilized by Native American groups for stone tool manufacture, although expedient tools may have been made from this material.

3.4 Physiography and Hydrology

The project area is fairly level with the Huntington River passing through it from south to north (Map 1). The west side of Main Road and the east side of Bridge Street gradually slope up away from the river, usually behind the structures along the road. Two unnamed tributaries enter the river just beyond the extreme northern end of the APE along Main Road (from the west) and Bridge Street (from the east).

4 Documentary Research

Hartgen conducted research at the Vermont Division for Historic Preservation (VDHP) to identify previously reported archeological sites, State and National Register (NR) properties, properties determined eligible for the NR (NRE), and previous cultural resource surveys.

4.1 Archeological Sites

The archeological site files at VDHP contained three sites within one mile (1.6 km) of the Project Area (

Table 2). Previously reported archeological sites provide an overview of both the types of sites that may be present in the APE and the relationship of sites throughout the surrounding region. The presence of few reported sites, however, may result from a lack of previous systematic survey and does not necessarily indicate a decreased archeological sensitivity within the APE.

An examination of the archeological site files at the Vermont Division for Historic Preservation (VDHP) identified three reported archeological sites within a one mile (1.6 km) radius of the project area. The Sheldon Subdivision (VT-CH-839) precontact site is located west of Main Road on a slightly raised terrace overlooking the river and a small tributary to the north. Two historic sites have been identified in the vicinity. The Melville Site (VT-CH-638) may be the site of a former saw mill and grist mill that was more recently a creamery. The

second site, VT-CH-844, consists of 19th- to 20th-century sheet scatter of artifacts associated with businesses and residences in the area of the current post office.

Table 2. Vermont Archeological Inventory Sites within One Mile (1.6 km) of the Project Area

VAI Site No.	Site Identifier	Description	Proximity to Project Area
VT-CH-638	Melville Site	19th-century stone foundation, pos. saw mill, grist mill, creamery	1,014 ft to S
VT-CH-839	Sheldon Subdivision Site	Middle to Late Woodland, 1 quartzite core, quartzite flakes, ceramic fragment	822 ft to W
VT-CH-844		19th- to 20th-century sheet scatter	Adjacent to Bridge Street

4.2 Historic Properties

A search of the files at VDHP identified twelve properties listed on the State Register of Historic Places (SR) located adjacent to the APE. One of those properties is also listed on the National Register (NR). No other National Register listed properties are located in the area. All properties listed on the State Register of Historic Places are considered eligible for listing on the National Register (Boone 2009). The locations and a brief description of the properties adjacent to the APE are provided below in Table 3 and on Map 2.

Table 3. NR/NRE Properties and Inventoried Buildings within or Adjacent (<200ft) to the Project Area

VHSSS Number	Property Name	Status	Description	Location and Proximity to Project Area
0408-4	Beane House	SRL 12/15/1989	c. 1880 Italianate house	Adjacent to APE on E side of Bridge Street
0408-6	Rood-Frey House	SRL 12/15/1989	c. 1850 Greek Revival house	Adjacent to APE on S side of Bridge Street
0408-7	Former Huntington Post Office	SRL 12/15/1989	c. 1890 Queen Anne house	Adjacent to APE in NE quadrant of intersection of Main Road and Bridge Street
0408-8	Tefft-French House	SRL 12/15/1989	c. 1870 Italianate house	Adjacent to APE on E side of Main Road
0408-9	District #3 School	SRL 12/15/1989	c. 1860 vernacular school	Adjacent to APE on W side of Main Road
0408-10	Jacques Store	SRL 12/15/1989	c. 1900 Italianate commercial	Adjacent to APE on W side of Main Road
0408-11	United Baptist Church	SRL 12/15/1989, NRL 8/23/1984	1870 Greek Revival	Adjacent to APE on W side of Main Road
0408-12	Beaudry's Store	SRL 12/15/1989	c. 1845 Greek Revival house/shop	Adjacent to APE on E side of Main Road
0408-13	Dr. A. H. Chessmore House	SRL 12/15/1989	c. 1870 Italianate house	Adjacent to APE on E side of Main Road
0408-14	Schofield-Smith House	SRL 12/15/1989	c. 1855/c. 1840 Federal/Greek Revival house	Adjacent to APE on E side of Main Road
0408-15	Ross School	SRL 12/15/1989	1915 Queen Anne school	Adjacent to APE on W side of Main Road
0408-16	Johnson-Hanson House	SRL 12/15/1989	c. 1830/c. 1810 wing Classic Cottage	Adjacent to APE on W side of Main Road

4.3 Previous Surveys

On file at VDHP are two previous surveys within the immediate vicinity of the Project (Table 4).

Few archeological surveys have been conducted in the project vicinity. One Phase IB survey was conducted adjacent to the project APE for the current post office (Hartgen 1999). This survey around the c. 1890 Huntington Post Office building identified a 19th- and 20th-century sheet scatter of artifacts.

The only other surveys relevant to the immediate project area are those conducted by the USDA-NRCS for farm improvement projects in the area. These surveys generally consist of small scale surface inspections or shovel testing for farm drainage, stream bank stabilization, logging roads, grading or other activities. The reports for Huntington date from 1986 to 2013 and none encountered archeological deposits (VDHP files).

Table 4. Relevant previous surveys within or adjacent to the Project

Year	Investigator	Methodology	Results	Notes
1986-2013	David Skinas (USDA-NRCS)	Surface survey, shovel testing	Negative	Series of farm or other improvement projects
1999	Hartgen Archeological Associates, Inc.	Shovel testing	19th-century sheet midden	

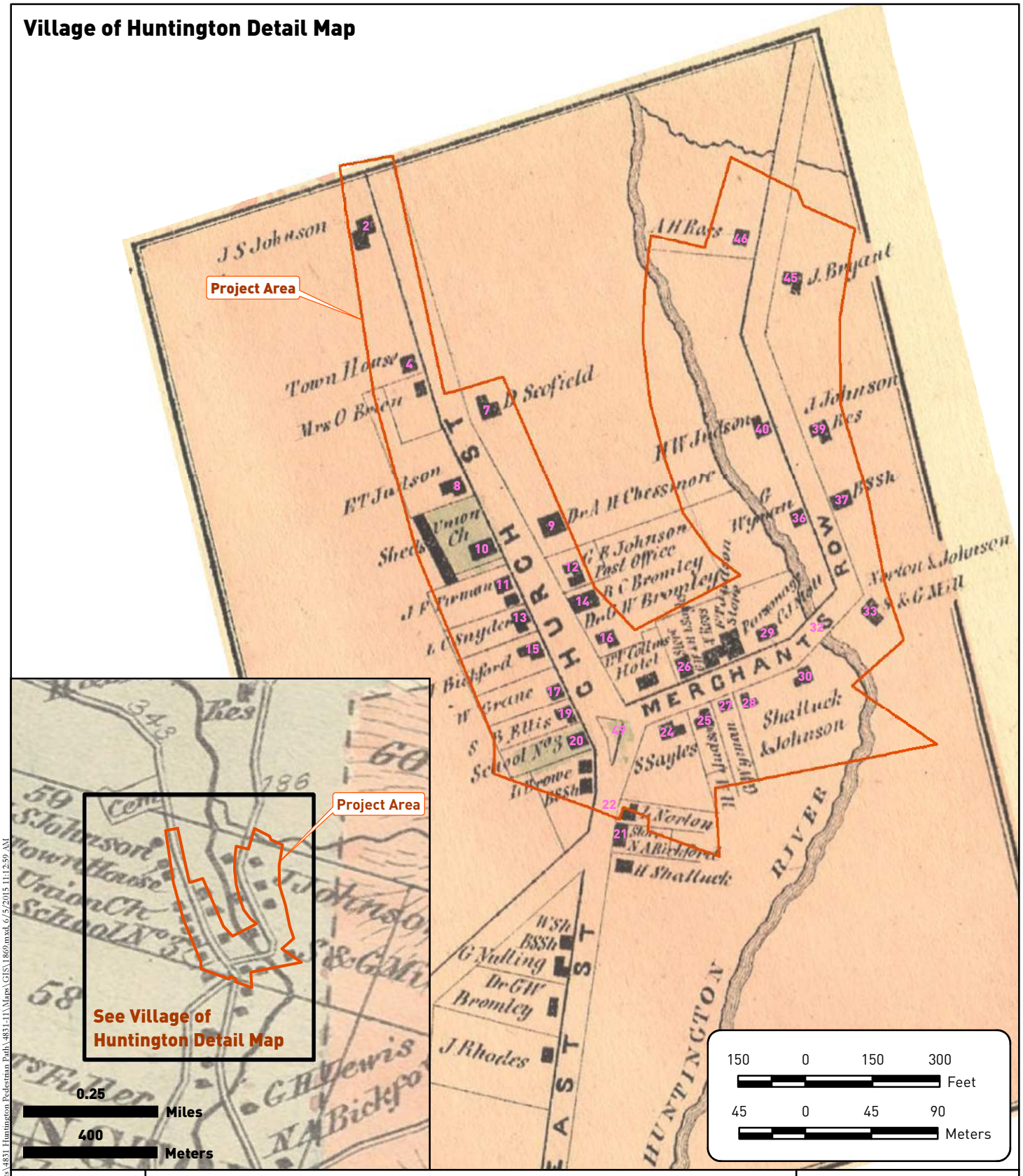
The lack of reported sites in the area is certainly reflective of the limited archeological review that has been conducted. Survey in similar settings around the state has identified precontact and early historic archeological sites.

5 Historical Map Review

The two 19th-century maps available for the project area are the 1857 Walling and the 1869 Beers maps (Beers 1869; Walling 1857). The 1857 map depicts a village with a saw mill, grist mill, two black smiths, a school, a church, a doctor's office and approximately 23 residences. By 1869 the village included a saw mill, grist mill, three blacksmiths, one wagon shop, a school, a church, a parsonage, two doctor's offices, two stores, a hotel, post office and about 25 residences (Map 3). Those eight years saw substantial growth.

Many of the structures on these maps are still standing and are listed on the State Register described above. The road alignments are substantially the same, although Bridge Street was named Merchant's Row in 1869 and Main Road was named Church Street.

Village of Huntington Detail Map



6 Architectural Discussion

6.1 Historic Context

Structures within and adjacent to the project APE provide a cross-section of the history of the village, and range in date of construction from c.1830 to the present. Dwellings are chiefly vernacular in form, with popular typologies such as the classic cottage and upright-and-wing house predominating, and were chiefly constructed between 1830 and 1900. Several dwellings feature detailing derived from the Greek revival, Italianate or Queen Anne styles. Commercial structures, built between c.1845 and c.1900, similarly reflect styles popular at the time of their construction. Village institutions, including two former schools and a church, were all constructed in the period 1860-1915, and also reflect popular stylistic trends.

6.2 Survey

There are 49 individual and associated structures within or adjacent to the APE (Map 2). Twelve structures have previously been surveyed, and are listed on the Vermont State Register. One of these has, in addition, been listed on the National Register (Table 3). Thirty-seven structures have not previously been surveyed (Table 5). Thirty-nine of the 49 surveyed structures are in excess of 50 years in age. Captioned photographs of all structures located within or adjacent to the APE, and more than 50 years in age, are included in this report (Photos 4 through 46).

Three structures (6, 8 and 19; Photos 9, 12 and 26) have low fieldstone walls located along their street frontage, and several houses have mature plantings in their front yards. Project impacts to these features should be minimized or mitigated.

While not historic, fences associated with several structures perform important functions in defining yard spaces for several properties. Examples include structures 7, 9, and 24 (Photos 11, 15, and 31). Maplewood Cemetery's fence performs a similar function (Photo 4).

Table 5. Standing structures within or adjacent to the APE (Map 2)

Structure number	Photo number	Name/Address	VHSSS Number
1	4	Main Road, Maplewood Cemetery	
2	5 - 6	2030 Main Road	0408-16
3	7	Main Road	
4	8	2044 Main Road	0408-15
5	-----	Blackbird Swale Drive	
6	9	2100 Main Road	
7	–10-11	2115 Main Road	0408-14
8	–12-13	2126 Main Road	
9	–14-15	2165 Main Road	0408-13
10	16	Main Road, United Baptist Church	0408-11
11	17	2180 Main Road	
12	–18-19	2175 Main Road, Beaudry's Store	0408-12
13	20	2190 Main Road	
14	21	Main Road	
15	22	2190 Main Road, rocks along road	
16	23	2209 Main Road, garden	
17	24	2224 Main Road	
18	25	2235 Main Road	0408-7
19	26	2236 Main Road	
20	27	2246 Main Road	0408-9 and 0408-10
21	28	1 East Street	

Structure number	Photo number	Name/Address	VHSSS Number
22	29	16 Bridge Street	0408-8
23	30	52 Bridge Street	
24	31	54 Bridge Street	
25	32	Bridge Street	
26	-----	75 Bridge Street	
27	33	86 Bridge Street	
28	34	96 Bridge Street	
29	35	105 Bridge Street	
30	–36-37	106 Bridge Street	0408-6
31	-----	120 Bridge Street	
32	-----	Bridge Street bridge	
33	38	160 Bridge Street	
34	-----	Hemlock Hill Drive	
35	39	Bridge Street	
36	40	195 Bridge Street	
37	41	210 Bridge Street	0408-4
38	42	219 Bridge Street	
39	43	222 Bridge Street	
40	44	235 Bridge Street	
42	45	Bridge Street	
43	-----	280 Bridge Street	
44	-----	285 Bridge Street	
45	46	300 Bridge Street	
46	47	315 Bridge Street	
47	-----	318 Bridge Street	
48	-----	320 Bridge Street	
49	--	Gazebo in park	

Photo 4. Structure 1, Main Road, facing southwest. Maplewood Cemetery, established in the 19th century.

Photo 5. Structure 2, 2030 Main Road, facing southwest. A vernacular one-and-a-half story wood-frame classic cottage with attached back house and carriage shed, dating to the second quarter of the 19th century. This house is listed on the Vermont State Register (0408-16).

Photo 6. Structure 2, 2030 Main Road, facing south. View showing relationship of house and three small barns.

Photo 7. Structure 3, Main Road, facing southeast. A gable-entry wood-frame barn, dating to the second half of the 19th century, and possibly associated with Structure 2, which sits directly across the street.

Photo 8. Structure 4, 2044 Main Road, facing northwest. A one-and-a-half story wood-frame vernacular former school house, built as the Ross School in 1915. This structure is listed on the Vermont State Register (0408-15).

Photo 9. Structure 6, 2100 Main Road, facing west. A one-and-a-half story c. 1860 wood-frame vernacular side-passage house with associated 20th century garage.

Photo 10. A 19th century carriage barn, associated with Structure 7, facing southeast.

Photo 11. Structure 7, 2115 Main Road, facing east. A one-and-a-half story wood-frame vernacular gable-entry house built in mid-19th century, with later one-story addition. This house is listed on the Vermont State Register (0408-14).

Photo 12 Structure 8, 2126 Main Road, facing southwest. A one-and-one-half story wood-frame vernacular gable-entry house, built in the third quarter of the 19th century, with later additions.

Photo 13. Stone wall associated with Structure 8, facing northwest.

Photo 14. 2165 Main Road, facing east. A one story wood-frame late-19th century vernacular outbuilding, associated with Structure 9.

Photo 15. Structure 9, 2165 Main Road, facing east. A two-story wood-frame foursquare Italianate house built in the third quarter of the 19th century. This dwelling is listed on the Vermont State Register (0408-13).

Photo 16. Structure 10, Main Road, facing west. The Union Meeting House, built in 1870, a wood-frame structure with Greek revival details. This structure is listed on the National Register of Historic Places, as well as on the Vermont State Register (0408-11).

Photo 17. Structure 11, 2180 Main Road, facing west. A one-and-one-half story wood-frame vernacular dwelling constructed in the third quarter of the 19th century.

Photo 18. Structure 12, 2175 Main Road, facing north. A wood-frame vernacular mixed-use structure with Greek revival details, constructed beginning c. 1845 as a residence, store and post office. This structure is listed on the Vermont State Register (0408-12).

Photo 19. Structure 12, 2175 Main Road, facing east. Wood-frame late 19th century carriage barn associated with Structure 12.

Photo 20. Structure 13, 2190 Main Road, facing west. A mid-19th century upright-and-wing wood-frame vernacular house with Greek revival detail, and numerous 20th century alterations.

Photo 21. Structure 14, Main Road, facing northeast. A one-and-a-half story wood-frame vernacular upright-and wing house, constructed in the third quarter of the 19th century.

Photo 22. Structure 15, 2206 Main Road, facing west. A one-and-a-half story wood-frame center passage vernacular house built in the second half of the 19th century, with later porch and dormer additions.

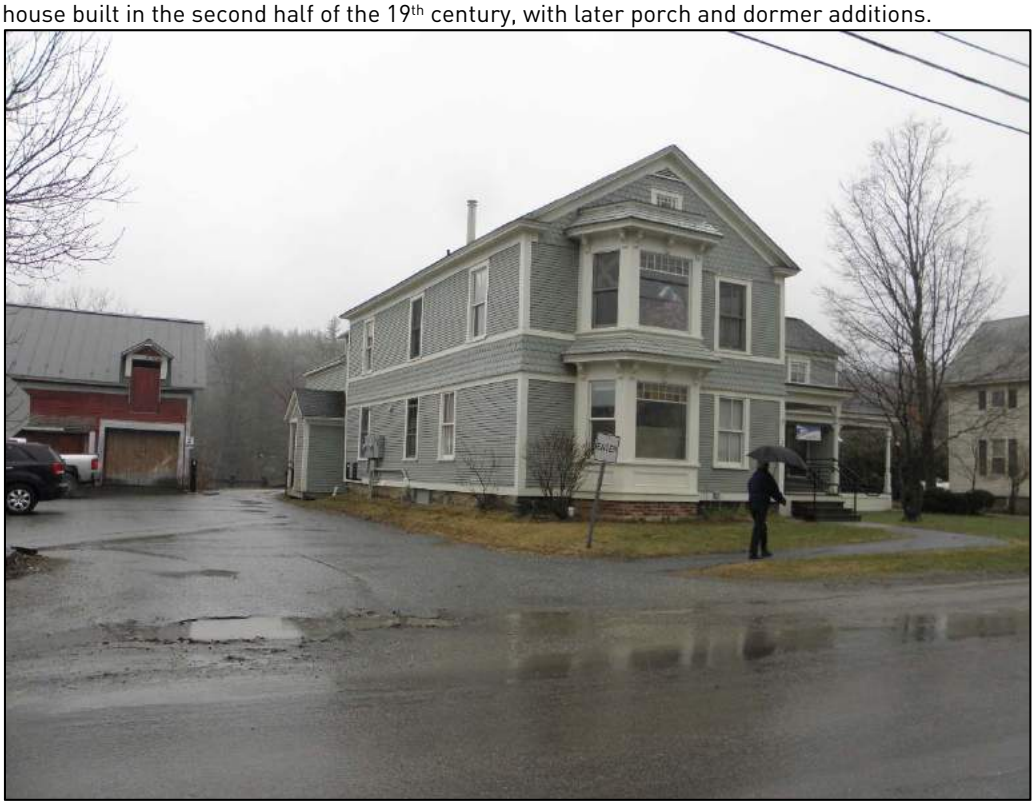


Photo 23. Structure 16, 2209 Main Road, facing east. A two story wood-frame upright-and-wing house with Queen Anne details, built c. 1885.

Photo 24. Structure 17, 2224 Main Road, facing west. A one-and-one-half story gable-entry vernacular house dating to the third quarter of the 19th century, with 20th century additions of dormers and wrap-around porch.

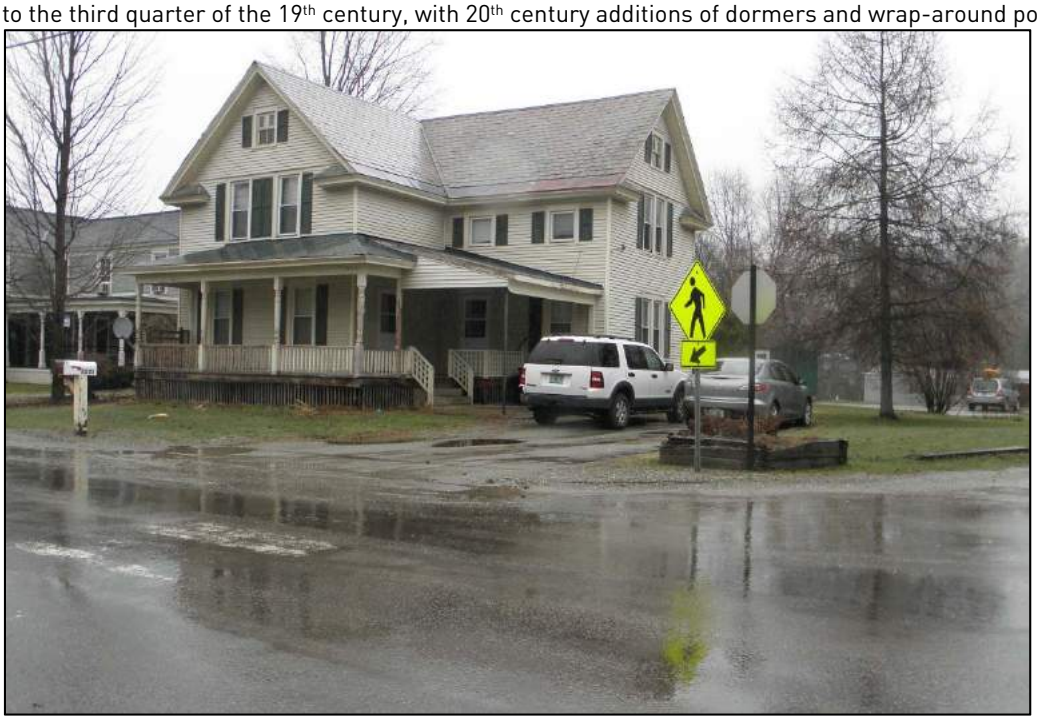


Photo 25. Structure 18, 2235 Main Road, facing northeast. A c. 1890 one-and-one-half story wood-frame vernacular house of T-shape plan, which formerly served as the post office. This house is listed on the Vermont State Register (0408-7).

Photo 26. Structure 19, 2236 Main Road, facing southwest. A one-and-one-half story five-bay wide wood-frame classic cottage with Greek revival and Italianate details, constructed in the mid-19th century, with 20th century additions.

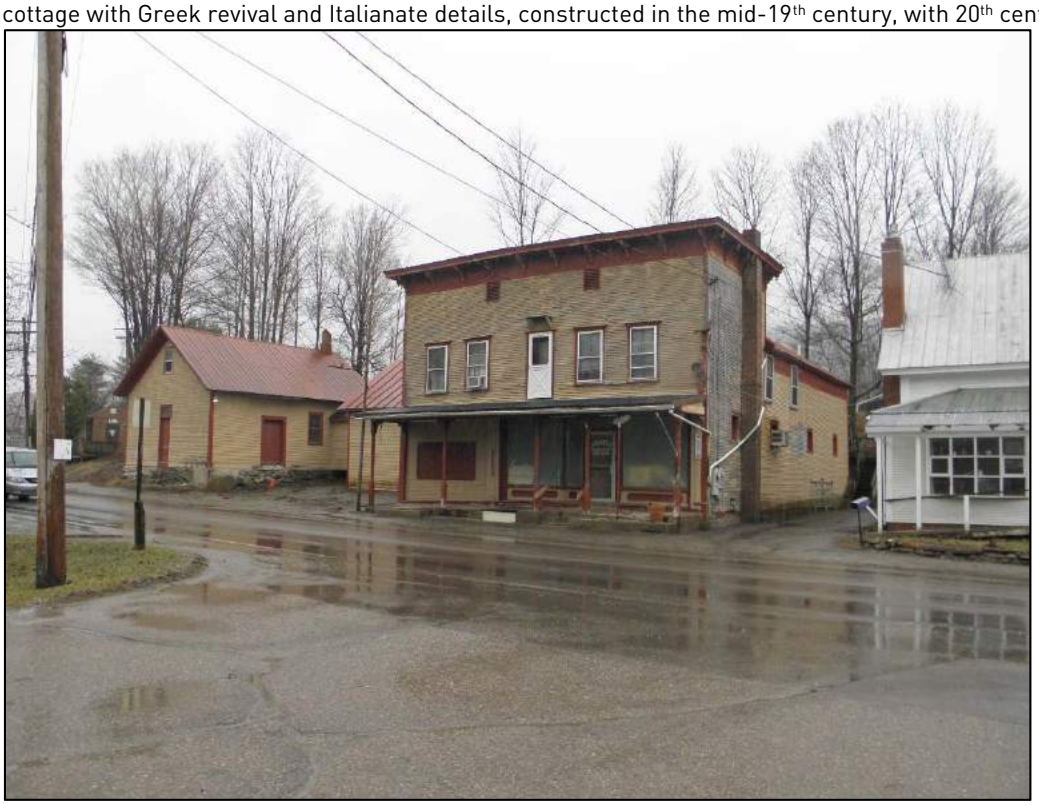


Photo 27. Structure 20, 2246 Main Road, facing southwest. A two-story mixed-use wood-frame vernacular building with Italianate bracketed cornice, dating to c. 1900. Former District #3 school, built c. 1860, forms part of the complex, and is seen at left. Both structures are listed on the Vermont State Register (0408-9 and 0408-10).

Photo 28. Structure 21, 1 East Street, facing northeast. A one-and-one-half story wood frame vernacular upright-and-wing house constructed in the second half of the 19th century, with 20th century two-bay garage.

Photo 29. Structure 22, 16 Bridge Street, facing east. A one-and-one-half story wood-frame upright-and-wing house with Italianate and Greek revival details, constructed c. 1870. It is listed on the Vermont State Register (0408-8).

Photo 30. Structure 23, 52 Bridge Street, facing east. Wood-frame carriage barn built c.1870, formerly associated with Structure 22. It is listed on the Vermont State Register (0408-8, 3).

Photo 31. Structure 24, 54 Bridge Street, facing south. A one-and-a-half story vernacular wood-frame house constructed in the third quarter of the 19th century, with extensive additions built in the late 19th century including bay windows, dormers, and a tower.

Photo 32. Structure 25, Bridge Street, facing south. A two story wood-frame house of T-shape plan, with Greek revival details, built in the third quarter of the 19th century, with later Queen Anne style additions including two-story bay window and ornamental shingle siding.

Photo 33. Structure 27, 86 Bridge Street, facing southeast. A two-story wood-frame vernacular house constructed in the fourth quarter of the 19th century.

Photo 34. Structure 28, 96 Bridge Street, facing south. A one-and-one-half story wood-frame vernacular house constructed in the third quarter of the 19th century, with Greek revival details, and a later Italianate porch.

Photo 35. Structure 29, 105 Bridge Street, facing northeast. A 19th century five-bay wide vernacular wood-frame house with later one-story porch addition, and associated carriage barn.

Photo 36. Structure 30, 106 Bridge Street, facing south. A two-bay wood-frame carriage barn, built in the second half of the 19th century and associated with Structure 30.

Photo 37. Structure 30, 106 Bridge Street, facing south. A c. 1850 one-and-one-half story wood frame upright-and-wing house with Greek revival details and later Italianate porch. This house is listed on the Vermont State Register (0408-6).

Photo 38. Structure 33, 160 Bridge Street, facing east. A 19th-century vernacular wood-frame house with extensive late-20th century alterations.

Photo 39. Structure 35, Bridge Street, facing southeast. A two-bay wood-frame vernacular garage, probably dating to the second quarter of the 20th century.

Photo 40. Structure 36, 195 Bridge Street, facing southwest. A one story wood-frame ranch type house constructed c. 1960, with later alterations.

Photo 41. Structure 37, 210 Bridge Street, constructed c. 1875, facing southeast. A one-and-a-half story wood-frame gable-entry dwelling with Italianate brackets and porch. This house is listed on the Vermont State Register (0408-4).

Photo 42. Structure 38, 219 Bridge Street, facing southwest. A mid-19th century one-and-a-half story upright-and-wing vernacular wood-frame house, with Greek revival details; Queen Anne bay window added c. 1890, and a 20th century porch.

Photo 43. Structure 39, 222 Bridge Street, facing southeast. A one-and-a-half story upright-and-wing vernacular wood-frame house constructed in the mid-19th century, with 20th century porch.

Photo 44. Structure 40, 235 Bridge Street, facing southwest. An upright-and-wing wood-frame vernacular house of one-and-one half stories constructed in the mid-19th century, with later Italianate porch. Associated carriage barn seen at right.

Photo 45. Structure 42, Bridge Street, facing southwest. Additional 19th century vernacular wood-frame outbuildings probably associated with Structure 40.

Photo 46. Structure 45, 300 Bridge Street, facing northeast. A late 19th or early 20th-centruy one-story wood-frame vernacular house with later enclosed porch addition.

Photo 47. Structure 46, 315 Bridge Street, facing northwest. A 19th century one-and-a-half story wood-frame vernacular house with later wrap-around porch addition.

7 Archeological Discussion

7.1 Precontact Archeological Sensitivity Assessment

Completion of the VDHP Environmental Predictive Model provides a measure of the precontact archeological sensitivity of the project area (Appendix 1). The Project Area is sensitive for proximity to the Huntington River and tributaries, the confluence of the river and a tributary, an alluvial terrace, a glacial outwash terrace and the natural travel corridor of the river. There is limited disturbance in the APE that would reduce the score. The Project Area has a score of 64. A score of 32 and above is considered to indicate precontact sensitivity.

7.2 Historic Archeological Sensitivity Assessment

The historic sensitivity of an area is based primarily on proximity to previously documented historic archeological sites, map-documented structures, or other documented historical activities (e.g. battlefields).

The project area is sensitive for 19th-century historic archeological deposits associated with the many standing historic structures adjacent to the APE. However, most of that sensitivity is located in the side and back yards of the structures. Although there is some archeological potential in front yards, front yards are known to have often been kept clear of features or debris that would have accumulated as archeological deposits (Borstel 2005). An exception in the project area is what appears to be a barn foundation directly adjacent to Bridge Street on the property of Structure 46 (Photo 48).

Photo 48. Remains of barn foundation adjacent to Bridge Street at Structure 46. Note stone and concrete wall in brush. View to the south.

7.3 Archeological Potential

Archeological potential is the likelihood of locating intact archeological remains within an area. The consideration of archeological potential takes into account subsequent uses of an area and the impact those uses would likely have on archeological remains.

With no project proposed, it is difficult to define areas of archeological sensitivity in detail. However, it is clear that undisturbed areas along Main Road, Bridge Street and East Street are sensitive for precontact as well as early historic archeological deposits. Disturbance from paving, underground utilities and road construction are fairly limited throughout the project area. Therefore, the project area should be considered to have a high archeological potential.

7.4 Archeological Recommendations

In designing development in this area, care should be taken to limit disturbance to the front lawns of the structures along the project route. Proposed disturbance to previously undisturbed areas should be expected to require Phase IB archeological reconnaissance survey.

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Appendix 1: VDHP Environmental Predictive Model

Vermont Division for Historic Preservation
Archeological Resources Assessment Form

DHP# _____
Organization & Recorder: Hartgen Archeological Associates, Inc./T. Jamison
Date: June 3, 2015

Envronmental Predictive Model				ArcheoMapTool GIS Model	Field Inspection Comments
Variable	Proximity	Value	Assigned Score	Variable	
A. Rivers and Streams (Existing or relict)					
1) Proximity to Rivers and Permanent Streams*	0–90 m	12	12	Layer 1: Proximity to Rivers and Permanent Streams (0-180 m)	
	90-180 m	6			
2) Proximity to Intermittent Streams	0–90 m	12	12	-	
	90-180 m	6			
3) Proximity to Permanent River/Stream Confluences	0–90 m	8	8	Layer 6: Proximity to River/Stream Confluences (0-180 m)	
	90-180 m	4			
4) Proximity to Intermittent Stream Confluences	0–90 m	12		-	
	90-180 m	6			
5) Proximity to Waterfalls	0–90 m	8		Layer 7: Proximity to Waterfalls (0-180 m)	
	90-180 m	4			
6) Proximity to Heads of Drainages	0–90 m	8		Layer 5: Proximity to Heads of Permanent Drainages (0-300 m)	
	90-180 m	4			
7) Major Floodplain - Alluvial Terrace	0–90 m	8	8	Layer 10: Floodplain Soils Presence	
	90-180 m	4			
8) Knoll or Swamp Island		32		Layer 1: Proximity to Rivers and Permanent Streams (0-180 m)	
9) Stable Riverine Island		32		Layer 2: Proximity to Waterbodies (0-180 m)	
B. Lakes and Ponds					
10) Proximity to Pond or Lake	0–90 m	12		Layer 2: Proximity to Waterbodies (0-180 m)	
	90-180 m	6			
11) Proximity to Stream-Waterbody Confluences	0–90 m	12		Layer 4: Proximity to Stream-Waterbody Confluences (0-180 m)	
	90-180 m	6			
12) Lake Coves, Peninsulas, and Bayheads	0–90 m	12		Layer 2: Proximity to Waterbodies (0-180 m)	
	90-180 m	6			
C. Wetlands					
13) Proximity to Wetlands*	0–90 m	12		Layer 3: Proximity to Wetlands (0-180 m)	
	90-180 m	6			

Envronmental Predictive Model				ArcheoMapTool GIS Model	Field Inspection Comments
Variable	Proximity	Value	Assigned Score	Variable	
14) Knoll or Swamp Island		32		Layer 3: Proximity to Wetlands (0-180 m)	
D) Valley edge and Glacial Landforms					
15) High Elevated Landform (e.g. Knoll Top, Ridge Crest, Promontory)		12		See Landmarks (Info Layers) and Catchment layers (Water-related Layers)	
16) Valley Edge Features (e.g. Kame Outwash Terrace)		12	12	Layer 9 Glacial Outwash and Kame Terrace Soils	
17) Marine/Lake Delta Complexes		12		Layer 9 Glacial Outwash and Kame Terrace Soils Presence	
18) Champlain Sea or Glacial Lake Shore Line**		12		Layer 8: Paleo Lake Soils Proximity (0-180 m)	
E. Other Environmental Factors					
19) Caves and Rockshelters		32		-	
20) Natural Travel Corridors (e.g. Drainage Divides)		12	12	See Landmarks (Info Layers) and catchment layers (Water-related Layers)	
21) Existing or Relict Springs	0–90 m	8		-	
	90–180 m	4			
22) Potential or Apparent Prehistoric Quarry for Lithic Material Procurement	0–90 m	8		See Soils with "M" parent material (Under Construction)	
	90–180 m	4			
23) Special Environmental or Natural Area~	0–180 m	32		-	
F. Other High Sensitivity Layers					
24) High Likelihood of Burials		32		See VAI layer (Under Construction)	
25) High Recorded Archeological Site Density		32		See VAI layer (Under Construction)	
26) High likelihood of containing significant site based on recorded or archival data or oral tradition		32		See VAI layer (Under Construction)	

Envronmental Predictive Model				ArcheoMapTool GIS Model	Field Inspection Comments
Variable	Proximity	Value	Assigned Score	Variable	
G. Negative Factors					
27) Excessive (>15%) or Steep Erosional (>20%) Slopes		-32		See Slope Layer (Info Layers folder)	
28) Previously Disturbed Land***		-32		See Land Use ND Building Footprint Layers (Info Layers folder)	
Total Score:			64		

*measured from top of bank
** remains incompletely mapped; digital layer includes paleo lakes and wetlands based on soils data
*** as evaluated by a qualified archeological professional or engineer based on coring, earlier as-built plans, or obvious surface evidence (such as a gravel pit)
~such as Milton acquifer, mountain top, etc. (historic or prehistoric sacred or traditional site locations, other prehistoric site types)
*Environmental predictive model limits wetlands to those > one acre in size; ArchSensMap

Attachment 3

Traffic Calming Resources

DuBois & King inc.

Roadway Striping as a Traffic Calming Option

IN LIEU OF TRADITIONAL TRAFFIC CALMING, ROADWAY STRIPING AS A TRAFFIC CALMING OPTION IS A VIABLE, LOW-COST ALTERNATIVE TO TRADITIONAL VERTICAL/HORIZONTAL ROADWAY DESIGN FEATURES. THE ROADWAY STRIPING ALTERNATIVES HAVE LESS DETRIMENTAL IMPACT TO EMERGENCY SERVICES, ARE LESS COSTLY TO CONSTRUCT, AND CAN SUCCESSFULLY REDUCE SPEEDS FROM TWO TO MORE THAN SEVEN MILES PER HOUR.

BY ROBERT KAHN, P.E. AND ALLISON KAHN GOEDECKE, MBA

INTRODUCTION

Traditional traffic calming techniques include vertical and horizontal displacement of the roadway surface, which can be effective in reducing speeds and cut-through traffic on roadways. These roadway design features can include speed humps, cushions, chokers, chicanes, medians, mini traffic circles, diverters, and full/partial roadway closures. While these features can have significant benefits to a community, they are sometimes difficult to implement as a result of potential negative impacts to local residents, emergency service departments, and persons with disabilities and may not be consistent with public agency policies.

In lieu of many of the traditional traffic calming devices, roadway striping can be implemented as a traffic calming option that is a viable, low-cost alternative to vertical/horizontal displacement traffic calming features. The roadway striping alternatives

- Have less detrimental impacts upon emergency services;
- Are less costly to construct;
- Provide greater flexibility to meet future changes;
- Have no adverse impact to highway drainage;
- Are recognized by local residents as standard traffic control devices;
- Can provide bike/parking lanes;
- Can successfully reduce speeds from one to more than seven miles per hour. Even greater speed reductions have been documented in some case studies; and
- Can be implemented quickly.

A number of roadway striping calming alternatives have been successfully installed in Southern California with positive results. In many cases, these have been implemented on private streets and have resulted in reduced speeds in these communities. These private streets have been designed to public street standards. Traffic calming striping has also been used on public streets in Southern California. The calming alternatives that have been implemented follow standard *California Manual on Uniform Traffic Control Devices* (CMUTCD) requirements. These traffic calming options have been implemented in a timely and cost-effective manner and are easily understood by the local residents and driving public. They have resulted in some speed reductions, which were desired by the local residents. While more traditional traffic calming devices (e.g., speed humps) may be required in certain instances to obtain greater speed or volume reductions, roadway striping is a viable traffic calming option in many cases.

TRAFFIC STRIPING AS AN ALTERNATIVE TO STANDARD TRAFFIC CALMING TECHNIQUES

Striping as a traffic calming technique has less disruption to emergency service vehicles, since no vertical or horizontal displacement occurs within the roadway surface. Emergency service requirements are a major barrier to the installation of many traffic calming projects. Roadway striping that is used for traffic calming is universally recognized by the traveling public and emergency agencies. Traffic calming striping gives the visual impression that roadway width has been reduced, which has been shown to slow vehicles down while traveling along a roadway. This type of striping will not slow down emergency service vehicles utilizing the roadway or adversely affect traffic operations. Other types of traffic calming devices are new to some drivers, particularly out-of-the-area drivers who are not familiar with a particular area that has the traffic calming devices.

In addition, there is considerably less cost to striping than other traffic calming techniques. As opposed to $2,500-$3,500 USD per installation for speed humps

or speed cushions, the same segment of roadway can be striped for only $500 to $1,000 USD. Another advantage of traffic striping as a traffic calming option is future flexibility. Traffic striping can easily be changed in the future by sandblasting the painted striping, if a particular installation is unsuccessful in meeting its goals or needs to be changed. Furthermore, traffic striping can be implemented quickly through conventional construction techniques by existing in-house public works staff or contract services.

Another significant benefit of traffic striping is that it does not adversely affect drainage. Many traffic calming devices such as speed humps, roadway chokers/curb extensions, medians, and chicanes can adversely affect roadway drainage. These devices can constrict normal drainage patterns within the roadway surface, which could affect drainage for the roadways. This can require additional roadway maintenance for local public works departments.

Traffic striping as a traffic calming device can effectively reduce speeds on a roadway. This is particularly effective on long, straight roadways where there are wide travel lanes for long distances. Before-and-after speed surveys by RK Engineering Group, Inc., with which the author is affiliated, have shown that speed reductions in the range of one to more than seven miles per hour are easily accomplished through roadway striping, especially for wide local streets with a curb-to-curb width of 36 to 40 feet. Another advantage of roadway striping is that it can provide for bike lanes or parking areas adjacent to the travel lanes as part of the "complete streets" system. These bike or parking lanes are used to define the various functions of the roadway: not only vehicular travel but also vehicle access to the neighborhood, parking, and accommodations for other modes of transportation, such as bicycles.

STRIPING ALTERNATIVES

There are numerous striping alternatives that can be used for traffic calming. The basic concept of traffic calming striping is to reduce the driver's perceived width of the roadway. By doing this, the drivers tend to reduce speed and may also be diverted from a particular route as a result of the reduced speed. The striping alternatives can consist of adding the following:

- Centerline stripe;
- Edge lines;
- Centerline plus edge line;
- Striped median;
- Striped choker or chicane;
- Striped speed hump without the raised speed hump; and
- Psycho-perceptive striping.

Figure 1. Typical traffic calming striping.

Centerline striping consists of adding a typical double-yellow centerline stripe or single-dash yellow line in the roadway. This separates the direction of traffic and reduces the roadway width of the travel lane to the driver. White 4-inch **edge lines** can be added to the right and left side of the roadway where there is sufficient width for the 8-foot parking lane. The parking lane can be provided and separated by the 4-inch white edge line. A combination of both centerline and edge line striping is the most effective method of reducing the overall travel way width of the roadways. This can be provided on typical local streets and will provide for 10-12 foot travel lanes and 7-8 foot parking lanes. A sample of this design is shown in Figure 1.

Another method of reducing the roadway width is by providing a **striped median**. The median can be provided by double-yellow centerline stripes or can be a two-way left-turn lane, which provides left turns from the roadway to the adjacent properties or across the roadway itself. Another option for reducing roadway width is **striping chokers or chicanes**. These can be striped with a white 8-inch channel to provide the delineation of the choker or chicane. Although not as prominent as the raised curbing of a typical choker or chicane, it does provide some of the same operational features as the raised curbing for chokers or chicanes by requiring the driver to slow while traveling the traffic calming area.

Another traffic calming option is to provide **"striped" speed humps** across the roadway. These can be effective where normal speed humps cannot be implemented, such as a hilly area or where grades exceed 8 percent. While limited operational data is available on this type of striping, it can give the impression of a speed hump in the roadway area, therefore slowing vehicles. **"Psycho-perceptive"** striping has also been used in conjunction to implementation of speed humps. This type of striping is shown in CMUTCD (Figure 3B - 31). Smaller stripes are provided, initially going to larger stripes when approaching the traffic calming device. A photo of this type of striping is included in Figure 2. The evaluation of the effectiveness of optical speed bars was presented in the November 2001 (Eric Meyers) and March 2009

Figure 2. UCI example of psycho-perspective striping.

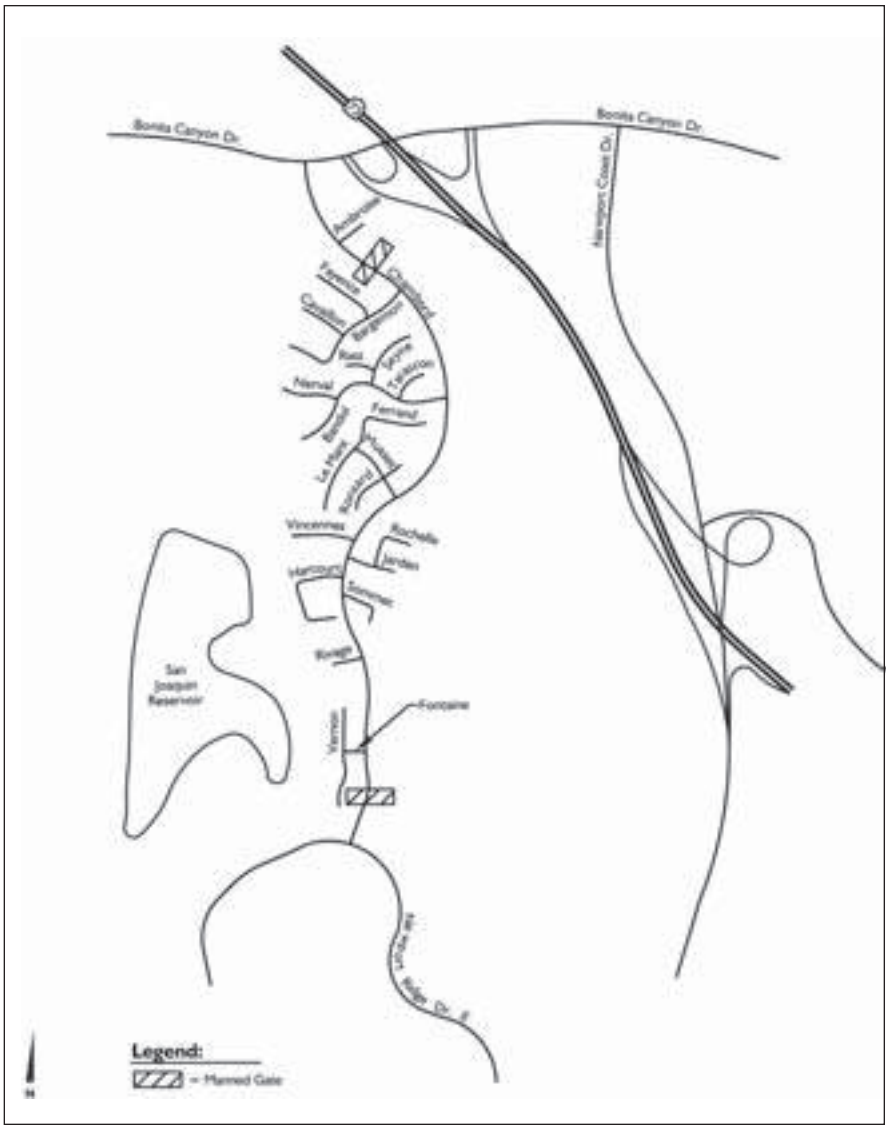

Figure 3. Newport Ridge North, Newport Beach.

(Steven P. Latoski) issues of *ITE Journal*. These studies did show promising results in speed reduction with these types of pavement markings.

TRAFFIC CALMING STRIPING CASE STUDIES

RK Engineering Group, Inc. has been involved in several case studies involving traffic calming striping as an alternative traffic calming device. These studies have been primarily completed for private communities; however, the private roadways and streets were constructed to city standards. In nearly all cases, the roadways were 36- to 40-foot curb-to-curb width and in many cases were long, straight streets, which encouraged speeding. The implementation of traffic calming striping effectively reduced speed on these roadways and had a positive reception by the community and local agencies, including emergency service departments.

Case Study No. 1 (June 2005–June 2006)

The Newport Ridge North Community is a manned-gated community in the city of Newport Beach, California, USA. The community consists of high-end, single-family detached homes, which are served by a primary collector road (Chambord Road). Chambord Road is a 40-foot curb-to-curb roadway with sidewalks on both sides of the street. The roadway is oriented in a north-south direction (as shown in Figure 3) and has a length of approximately 1.31 miles.

The steep grades along Chambord did not allow for typical traffic calming techniques, such as speed humps or speed cushions. In addition, the community was concerned with the construction of these types of traffic calming devices and their effects on traffic operations and vehicle damage. There was also pedestrian activity near the community recreation center and pool located at the center portion of Chambord Road and a community tennis court facility located on the north end of the street.

Photos of Chambord before the traffic calming striping was implemented are shown in Figure 4. This wide 40-foot curb-to-curb street with an undefined travel way encouraged speeding throughout the roadway. Before the implementation of

traffic calming striping, the 85th percentile speed along Chambord ranged from 45 to 47 miles per hour, and the average speeds ranged from 40 to 41 miles per hour.

Traffic calming striping was implemented along the entire length of Chambord. This included a double-yellow centerline and 4-inch edge line stripes 8 feet from the curb face. After the traffic calming striping was implemented, the 85th percentile speed was reduced to 37 to 39 miles per hour and the average speed decreased to 35 to 36 miles per hour throughout the length of Chambord as shown in Table 1.

Case Study No. 2
(August 2005–December 2007)

Traffic calming striping was implemented in south Orange County within the city of San Clemente, California, USA at the Reserve Community Association. This project consists of a large number of single-detached family dwelling units with a recreation center located in the southern portion of the community. The project has four electronic gates, which provide access to an adjacent arterial highway (Camino Vera Cruz). This community had four roadways serving a series of cul-de-sacs throughout the community, both north and south of Camino Vera Cruz.

The main roadways serving the community south of Camino Vera Cruz were 40-foot curb-to-curb width streets and those roadways serving the northerly section of the community had a curb-to-curb width of 36 to 38 feet. Existing traffic volume and speeds were collected throughout the community before traffic calming was implemented. The 85th percentile speeds ranged from 23 to 34 miles per hour prior to the implementation of traffic calming striping. Before-and-after 85th percentile speeds are summarized in Table 1.

Traffic calming striping consisted of adding double-yellow centerlines and white 4-inch edge lines on the wider roadways and the striping of edge lines only for the narrower roadways. The 85th percentile was reduced to some degree after the implementation of traffic calming striping. The 85th percentile speeds were reduced to 22-33 miles per hour, with some minor reductions after the implementation of the striping. The rec-

Figure 4. Chambord Road before restriping.

Table 1. Before-and-after speed surveys.

Location	Roadway	85th% Speed	
		Before Traffic Calming Striping (mph)	After Traffic Calming Striping (mph)
Case Study #1 Newport Ridge North (Newport Beach)	• Chambord N/O Rivay	46	37
	• Chambord S/O Musset	47	39
	• Chambord S/O Baryemon	45	39
Case Study #2 The Reserve (San Clemente)	• Montana del Sol N/O Camino Vera Cruz	23	22
	• Colina Rodante S/O Camino Vera Cruz	32	30
	• Calle de Los Arboles N/O Camino Vera Cruz	27	26
	• Calle de Los Arboles S/O Camino Vera Cruz	34	33
Case Study #3 Oak Creek (Irvine)	• Eagle Creek W/O Indigo	37	31
	• Eagle Creek W/O Palm Wood	38	27
Case Study #4 Summit at Turtle Ridge (Irvine)	• Garden Terrace E/O Hedgewood	31	30
	• Crest Terrace N/O Blue Summit	29	29
	• Canyon Terrace N/O Cezanne Valley	33	31
	• Valley Terrace S/O Climbing Vine	30	28
Summit at Turtle Ridge (Irvine)	• Garden Terrace N/O Summit Park	31	30
	• Crest Terrace W/O Summit Park	29	29
	• Canyon Terrace N/O Summit Park	33	31
	• Valley Terrace N/O Summit Park	30	28
	• Summit Park Drive at Valley Terrace	46	44
	• Summit Park Drive W/O View Terrace	44	44
	• Summit Park Drive E/O Garden Terrace	43	42
	• Summit Park Drive at Garden Terrace	39	39

ommended speed limits ranged from 25 to 35 miles per hour depending on the location and the 85th percentile speed. Although not as significant of a reduction in comparison to the Newport Ridge North Community, speeds were reduced 1 to 2 miles per hour with the traffic calming striping. The smaller reduction in speed was probably caused by the fact that the true existing speeds before the traffic calming measures were implemented were lower than the existing speeds in the Newport Ridge North Community.

Case No. 3 (June 2002–December 2009)

The Oakcreek Village Community located in the city of Irvine, California, USA also implemented traffic calming striping. This is a private community with two sets of electronic gates located at the east and west ends of the project. The roadway layout for the Oakcreek Development is a linear alignment with very little curvature. The Oakcreek Development is served by a single roadway (Eagle Creek) which has direct access to driveways and homes along its entire length of 0.50 miles. The Oakcreek Village Community is served by two electronic gates located on the northwest and southeast end of Eagle Creek.

Eagle Creek is a two-lane, undivided street with a curb-to-curb width of 36 feet with sidewalks on both sides of the street. The 85th percentile speed on Eagle Creek before traffic calming striping was 37 to 38 miles per hour. The community felt that this was excessive, since the prima facie speed limit is 25 miles per hour for this type of roadway. Also, there was a concern that the crosswalk across Eagle Creek served an adjoining elementary school where there was a significant amount of pedestrian crossing.

The traffic calming striping consisted of a double-yellow centerline stripe along with white 4-inch edge lines on both sides of the street. Initially this was constructed with a 7-foot parking lane on each side of the roadway and 11-foot travel lanes in each direction. Since the original implementation of traffic calming striping, the travelway has been reduced further to 10 feet and parking lanes were increased in width to 8 feet. The 85th percentile speed after the traffic calming ranged from 31 to 27 miles per hour (see Table 1). The traffic calming measures implemented by the community of Oak Creek Village have been successful in reducing speeds as much as 6 to 11 miles per hour. After careful review, the original recommended striping was modified to create 10-foot-wide travel lanes and an 8-foot-wide parking lane. This should further reduce traffic speeds in the area.

ANOTHER ADVANTAGE OF TRAFFIC STRIPING AS A TRAFFIC CALMING OPTION IS FUTURE FLEXIBILITY. TRAFFIC STRIPING CAN EASILY BE CHANGED IN THE FUTURE BY SANDBLASTING THE PAINTED STRIPING, IF A PARTICULAR INSTALLATION IS UNSUCCESSFUL IN MEETING ITS GOALS OR NEEDS TO BE CHANGED.

Case Study No. 4 (April 2008–April 2010)

The community of the Summit at Turtle Ridge in the city of Irvine requested traffic calming to reduce the vehicle speeds on some of its local streets. The Summit at Turtle Ridge is a private manned-gated community with a primary collector road (Summit Park Drive). This hillside community included numerous cul-de-sac streets where speeds were generally low and consistent with what would be expected in the local street system. However, the local community association felt that these speeds were too high and traffic calming options should be investigated.

For this study, RK surveyed four local streets in the community. This included Garden Terrace, where the 85th percentile speed was 31 miles per hour before the implementation of traffic calming striping and was reduced to 30 miles per hour after implementation. On Crest Terrace the 85th percentile speed was only 29 miles per hour before traffic calming striping and remained at 29 miles per hour after the implementation of the striping. Canyon Terrace was the location with the highest speeds in the community on the local streets, where the 85th percentile speed was 33 miles per hour. This speed was reduced to 31 miles per hour after the implementation of traffic calming striping. The final location where traffic calming was implemented was Valley Terrace Street. This cul-de-sac had a speed of 30 miles per hour before implementation of the striping and 28 miles per hour after traffic striping was implemented.

In the community of the Summit at Turtle Ridge, the speeds were already low and generally consistent with what would be expected for local residential streets. However, the community was concerned with the speeds; therefore, rather than placing more aggressive traffic calming devices (e.g., speed humps, chokers, and so forth), traffic calming striping was utilized as the preferred option within the community. The recommended traffic calming striping included centerline and edge line striping with parking on one or both sides of the street depending on whether the streets were 32- or 36-feet wide. Although the speed reductions were not substantial within the community, the community was satisfied with the reduction of speeds as a result of the implementation of traffic calming striping. The relationship of speed reduction with traffic calming striping can be seen in Figure 5.

One conclusion that can be reached from the various case studies is that if local streets are operating at speeds typical for

these types of roadways (i.e. 25-32 mph), then only minor speed reductions can be obtained by traffic calming striping. Where speeds are significantly higher (i.e., more than 35 mph), then much greater speed reductions can be achieved from traffic calming striping.

COMPARISON TO OTHER TRAFFIC CALMING TECHNIQUES

The use of traffic calming striping compares favorably to other traffic calming techniques. Although speed reduction can vary from site to site, positive speed reductions can be anticipated with the traffic calming, depending on the specific roadway configurations and the width of travel way. There are significant pros and cons to all types of traffic calming devices, as summarized in Table 2.

As can be seen from Table 2, traffic calming striping can typically result in speed reductions of approximately one to seven miles per hour depending on the situation. Speed hump and speed cushions have considerable speed reduction capabilities of approximately 8 miles per hour. Chokers and chicanes can reduce speeds 3 to 6 miles per hour, and medians and pavement texture can result in 2 to 3 miles per hour reduction. When there are situations that require speed reductions on local roadways, traffic calming striping can be considered the first step in the traffic calming process. More aggressive traffic calming devices such as speed humps/speed cushions, chokers, chicanes, medians, and pavement textures can cost considerably more but can be utilized in the event that the traffic calming striping is not successful in reaching the speed-reduction goals set by the community.

COST COMPARISON

One of the major advantages of traffic calming striping is its cost. Not only can traffic calming striping be implemented less expensively than many other options, but it also can be modified or removed without major cost implications. An approximate cost comparison of various traffic calming devices is included in Table 2.

SAFETY CONSIDERATIONS

There are numerous safety considerations for implementing traffic calming devices. Anytime that the vertical or horizontal displacement of the roadway surface occurs, there is a potential for vehicles going out of control, hitting objects, or other actions which could be detrimental to the safety of the driver and passengers of the vehicle. Furthermore, impacts to emergency service vehicles can indirectly affect safety when responding to emergency events.

Generally, traffic calming striping minimizes safety considerations, since they follow standard traffic engineering practices pursuant to the CMUTCD. Drivers are familiar with these types of traffic control features and respond accordingly. This is true not only for local residents who are familiar with the traffic calming implemented in an area but also for drivers from outside the area that are unfamiliar with the traffic calming installations.

Speed humps do reduce vehicle speed if properly designed and when adequate signage/pavement markings are provided. Speed humps can have an adverse affect on safety—but only if drivers ignore them and if reduced speeds do not occur. Speed humps can also reduce travel times for emergency service vehicles, which have an indirect impact on safety.

Speed cushions have a similar effect on safety as speed humps, However, they can be traversed better by larger vehicles, including emergency service vehicles, which can travel through the speed cushions at a normal speed as opposed to a typical speed hump. This is a major advantage of speed cushions over speed humps.

Chokers can affect safety if they are hit by vehicles. Proper signage and pavement markers are necessary to ensure that this does not occur. Chokers can improve safety for pedestrians by providing a shorter walking distance for crosswalks. Chicanes, similar to chokers, can have a safety impact if a vehicle strikes them while traversing through the traffic calming device area. Implementation of sharp curb-width transitions can result in vehicle collision with the curb, causing vehicle damage and possible out-of-control vehicle operations.

Medians have been shown to improve safety by separating the direction of travel of vehicles, However, when implemented in only selective areas, vehicles can hit the ends of medians, causing damage to the

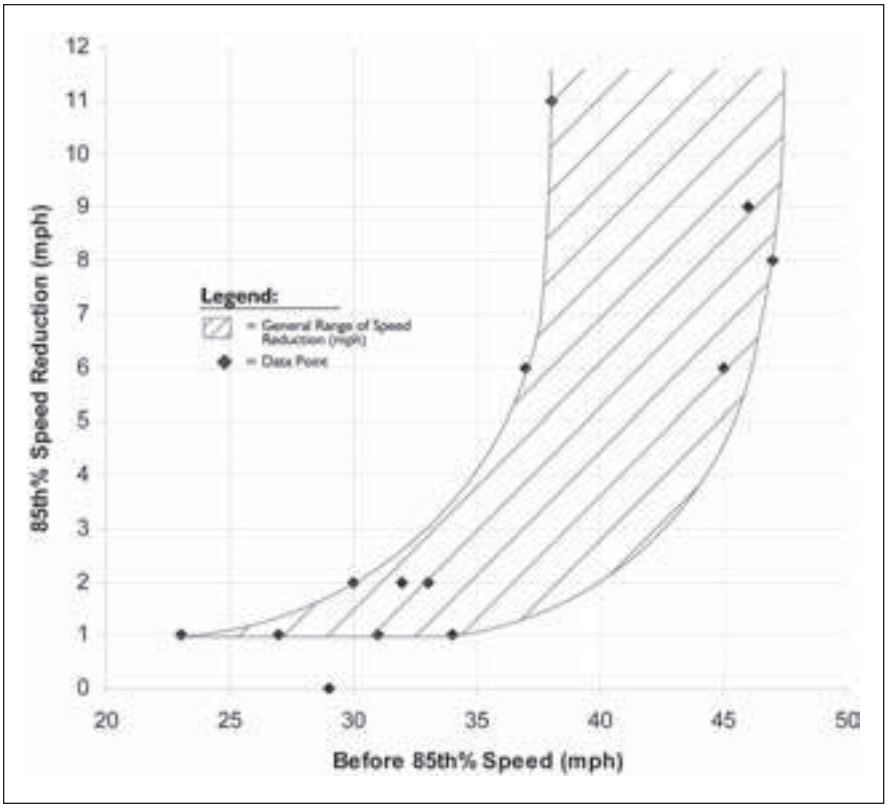

Figure 5. Speed reduction with traffic calming striping.

Table 2. Comparison of traffic calming devices.				
Traffic Calming Technique	**Pros**	**Cons**	**Speed Reduction (mph)**	**Cost2**
Speed Hump	• Effectively reduces speed by approximately 8 mph. • Can cause some diversion of excess traffic volumes.	• Not accepted by many local jurisdictions and emergency service agencies. • Improper driving can cause vehicle damage and can cause vehicles to go out of control. • Moderate cost considerations. • Can impact bicycles/motorcycles. • Difficult to remove.	8	$1,500 to $3,000
Speed Cushion	• Effective in reducing speeds up to 5 miles per hour. • More acceptable to public agencies / emergency service agencies, because can slow normal size vehicles but allows larger emergency vehicles to pass without speed reductions.	• Some agencies and emergency service agencies do not support these devices. • Cost for construction is moderate. • Difficult to remove. • May impact bicycles/motorcycles.	5	$2,500 to $3,500
Chokers and Chicanes	• Effectively reduces traffic speeds approximately 3 miles per hour. • Can reduce roadway width to reduce walking distance for pedestrian (which is a safety benefit). • Can be enhanced with landscaping to improve aesthetics.	• Expensive to implement. • Can cause drainage issues. • Difficult to remove in the future if not effective. • Some loss of parking. • Can impact bicycles.	3–5 Up to 6	$7,000–$15,000 per pair $10,000–$15,000
Medians	• Can reduce speeds to some degree. • Can provide aesthetic benefits to the community.	• Costly to implement. • Difficult to remove if not successful. • Can cause additional maintenance costs. • Water overall on pavement. • May lose parking.	2–3	$5,000–$15,000
Pavement Texture	• Can cause minor reduction in speed. • Can be aesthetically pleasing. • Can be tied into crosswalks or intersections to define channelized areas for pedestrians.	• Costly to implement. • Difficult to remove. • Can effect some types of pedestrians crossing the street. • Can cause noise impacts.	Limited data	$5–$16 per sq. ft.
Mini Traffic Circles	• Minor reduction in speed. • Improves aesthetics. • Slows traffic through the intersection.	• Costly to implement. • Can confuse drivers regarding which way to travel through an intersection. • May affect bicycles and pedestrians. • Can impact left turns for large vehicles. • Can slow emergency service vehicles.	4–6	$10,000–$60,000
Traffic Calming Striping	• Effective in reducing speeds from 1 to 7+ miles per hour. • Accepted by many public agencies and emergency service agencies because they are standard traffic control. • Easy to change if required in the future. • Less costly option to install • Installation can be implemented quickly. • Can be removed more easily than other options (sand blast).	• Some limitations in speed reduction. • Less effective when speeds are already low.	1–7 +	$500–$1,000 per 500-feet

vehicles, driver/passenger, and can also cause vehicles to go out of control. If medians are not properly designed, they can cause water to flow into the pavement. This can cause pavement deterioration and loss of control of vehicles.

Pavement texture has limited impact on safety, although vehicles can possibly lose traction, depending on the type of texture during wet conditions. Pedestrians crossing on pavement texture can trip or slip depending on the pavement type and condition. In addition, pedestrians (especially children) may not see the textured pavement as a part of the "street," which make them less aware of traffic.

Mini traffic circles can cause vehicles to hit the curbs or cause other accidents. Also, if such traffic circles are not properly designed, trucks can have a difficult time navigating the intersection and could hit objects in the roadway.

Traffic calming striping generally has a positive impact from a traffic safety standpoint. Traffic calming striping should be implemented pursuant to the CMUTCD requirements with respect to location, type, and placement of the striping. Where used as transitions, striping should be properly designed based upon the operating speed of the vehicles on that segment roadway.

COMMUNITY ACCEPTANCE

The community acceptance of any traffic calming measure is critical in long-term implementation and effectiveness. The vast majority of the professional literature indicates that at least two-thirds of the community must support the traffic calming techniques in order for them to be implemented within the community.

In many cases, vertical and horizontal displacement of traffic calming devices are heavily resisted by the local community and driving public. This is one of the major advantages of traffic calming striping, since it is readily acceptable to the local community because it is already implemented on most roadways throughout communities. Traffic calming striping is understood by the driving public throughout local communities. It causes little damage to vehicles and drivers/pedestrians of the community. It does not adversely effect the operation of vehicles for emergency service agencies. Traffic calming striping is not permanent and can easily be changed if required in the future. As a result of this, traffic calming striping can be less controversial than more restrictive devices.

CONCLUSIONS

RK Engineering Group, Inc. has completed a review of traffic calming striping as an alternative to vertical or horizontal displacement traffic calming devices such as speed humps, speed cushions, chokers, medians, pavement textures, and other roadway design features. Traffic calming striping has been shown to reduce speeds effectively as a first step of a traffic calming process. Striping is a low-cost traffic calming solution that can have major benefits to the community compared to other vertical/horizontal displacement traffic calming devices, yet still provides substantial benefits in terms of reducing traffic speeds on the roadways.

In conclusion, traffic calming striping is an effective measure in a traffic/transportation engineer's toolbox of traffic calming devices. These roadway striping techniques follow standard design practice, which reduces future tort liability. Traffic striping is a cost-effective and efficient traffic calming method that can be implemented quickly to reduce speeds on roadways. ■

Resources for further information

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TECHBRIEF

Traffic Calming on Main Roads Through Rural Communities

FHWA Publication No.: FHWA-HRT-08-067

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Introduction

Speed management is a significant challenge for most communities in the United States. This is particularly true for small, rural communities where the main roadway through the town serves a dual role. Outside the town, the roadway provides high-speed travel over long distances; within the built-up area, however, the same roadway accommodates local access, pedestrians of all ages, on-street parking, bicycles, and the many other features unique to the character of a community. This convergence of roadway purposes presents both an enforcement challenge for the community and a potential safety problem for the public.

Addressing the issue through law enforcement alone often leads to temporary compliance at a significant cost. A more permanent way to reinforce the need to reduce speed is to change the look and feel of the road by installing traffic calming treatments that communicate to drivers that the function of the roadway is changing. Traffic calming has been evaluated and used extensively within low-speed urban areas in the United States but less so in rural areas where driver expectations and traffic characteristics are different.

Traffic calming is more common in rural communities in Europe where multiple measures such as colored pavement, physical lane narrowing, signing, and landscaping are often combined.[1,2] A gateway treatment intended to evoke lower speed on the approach and entrance to the community is usually followed by a series of other measures repeated throughout the community to encourage drivers to maintain appropriate speeds. Speed reductions up to 15 mi/h from rural traffic calming have been

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reported in France, Denmark, and the UK, although speed reductions of 5 mi/h were more typical.[1,3] Total accidents were reduced by 50 percent and injury accidents by 25 percent or more.[3,4]

This TechBrief summarizes an evaluation of the effects on speed of low-cost, traffic-calming treatments on main rural highways passing through small, rural communities in Iowa. The full report, *Appropriate Traffic Calming Techniques for Small Iowa Communities* (TR-523), is available on Iowa State University's Web site at: http://www.ctre.iastate.edu/research/detail.cfm?projectID=-226410767.[5]

Study Methodology

Site Selection

Thirty rural communities (with populations less than 5,000) were identified as potential pilot-study locations through solicitation in a rural community newsletter. Site visits were conducted for each community; 18 met the initial selection criteria, which included the following:

- Through, paved, major county or state highway.
- No traffic calming currently in place or planned.
- No construction, reconstruction, or significant maintenance activities planned along the route during the study period.
- No access control.
- No adverse geometry such as sharp horizontal curves or steep vertical curves where treatments would be placed.

Initial speed studies were conducted in the 18 communities, and 5 were selected as pilot-study locations. These five locations were found to have the most significant speeding problems, as determined by the difference between the posted speed and prevailing travel speed.

Treatment Selection

An extensive list of both traditional traffic-calming treatments used in the urban areas of the United States and treatments used specifically for major roads in small communities (identified from European and other literature) was compiled. The appropriateness of each treatment for use in built-up areas along main rural roads was determined based on the following criteria:

- Low cost.
- Ability to accommodate farm vehicles and large trucks.
- Compatibility with the rural setting and driver expectations.

Treatments were selected for each study location in cooperation with local agencies.

A request for experimentation was submitted and approved by the Federal Highway Administration (FHWA) for three of the treatments that did not meet current provisions of the *Manual on Uniform Traffic Control Devices*.[6]

Seven different low-cost, traffic-calming treatments were implemented and evaluated in the five communities as shown in table 1. In some communities, a single traffic calming measure was installed, and in others, a combination of measures was implemented and evaluated. Speed limits ranged from 55 mi/h to 60 mi/h outside the community and from 25 mi/h to 35 mi/h inside the community where the treatments were applied.

Unless otherwise noted, treatments were placed from July through August 2006. Any treatment that included pavement markings was repainted in May 2007, just before the 12-month "after" data-collection period.

Data Collection

Speed and volume data were collected by a roadside traffic recorder using pneumatic road tubes placed across the road. Data were collected immediately downstream of each treatment or in the case of road narrowing near the midpoint of the section. For Roland and Union where combinations of treatments were applied, data were also collected 0.5 mi upstream of the first

Table 1. Summary of treatments by Iowa community.

City (population)	Treatment	Roadway	AADT (veh/day)	Cross section (all are two-lane)
Union (427)	Transverse pavement markings[1] with speed feedback sign	D-65 (west edge of City)	830	Asphalt (22.4 ft), unpaved shoulders
	Transverse pavement markings[1] with speed feedback sign	S-62/SH 215 (from intersection with D-65 to north city limit)	1,680	Concrete (40.0 ft), curb and gutter
	Lane narrowing using painted center island and edge line markings			
	Transverse pavement markings[1]	SH 215 (near south city limit)	1,000	Asphalt (22.4 ft), unpaved shoulders
Roland (1,324)	Converging chevrons[1] with "25 MPH" pavement legend	E-18 (near east and west city limits)	2,300	Asphalt (22.6 ft), unpaved shoulders
	Lane narrowing using shoulder widening and "25 MPH" pavement legend	E-18 (from intersection with R-77 to east city limit)	2,300	Concrete (36.0 ft), curb and gutter
	"25 MPH" pavement legend	E-18 (from intersection with R-77 to west city limit)	2,300	Asphalt (22.6 ft), unpaved shoulders
Gilbert (987)	Speed table	E-23 (center of community)	1,480	Asphalt (22.0 ft), shoulders
Slater (1,306)	Lane narrowing with center island using tubular markers channelizing markers	R-38 (from intersection with SH 210 to south city limit)	2,060	Concrete (25.8 ft), curb and gutter
	Speed feedback sign	R-38 (near north city limit)	2,870	Asphalt (22.6 ft), unpaved shoulders
	"SLOW" pavement legend	SH 210 (west from intersection with R-38 to west city limit)	2,940	Asphalt (22.5 ft), unpaved shoulders
Dexter (689)	"35 MPH" pavement legend with red background[1]	F-65 (near east and west city limits as well as at curve before west city limit)	1,000	Asphalt (25.4 ft), unpaved shoulders

[1] A request for experimentation was submitted to and approved by FHWA for this treatment.

treatment in order to determine whether speed changes observed were due to the treatments or to normal variation in speeds.

Results in this TechBrief are presented only for vehicles in the direction of travel that actually passed through the treatment. An in-depth discussion on data collected at other locations is presented in the full report.

After final locations were selected, a formal "before" speed study was conducted to establish baseline speeds and volumes. Speeds of all vehicles were collected continuously for at least 48 hours during each deployment. Data collection was planned at 1-, 3-, 6-, 9- and 12-month intervals after installation of the traffic-calming treatments. In several cases, data were not collected for a particular "after" period, mainly due to adverse winter conditions.

Most of the communities do not have any police officers and have no regular traffic enforcement, instead relying mostly on county sheriffs who drive through the community occasionally. Each community was asked to not change or request additional enforcement during the study period and to report any unusual speed enforcement or any other unusual activities. When additional enforcement or any unusual situation coincided with data collection, the data were discarded and recollected the following week. For instance, one community decorated the area around the roadway for Flag Day, and in one community roadway maintenance occurred during a data-collection period. In both cases, data were discarded and recollected. Data were only collected during nonholiday weekdays.

Measure of Effectiveness

Vehicular speed was the primary measure used to evaluate the effectiveness of each treatment. This report presents changes observed in the 85th percentile speed of all vehicles. The 85th percentile speed is the speed at or below which 85 percent of the vehicles are traveling. Each data set had at least 630 vehicle speed samples. In almost all cases, differences were statistically significant at the 95-percent confidence level.

The effects on mean speed and the percent of vehicles exceeding the speed limit by various amounts, along with statistical significance, are presented in the full report but not within this TechBrief. In most cases, only minor reductions in mean speed resulted. The changes in the percentage of vehicles exceeding the speed limit by various amount correlated with the changes in 85th percentile speeds. Overall, the treatments appeared to have a greater effect on drivers traveling at higher speeds.

Results

The effectiveness of each traffic-calming treatment is discussed in the following sections. A brief description and photograph of each treatment is provided, along with a summary of the effects on speed.

Transverse Markings With and Without Speed Feedback Signs

Description

The transverse markings consisted of a series of parallel bars on the inside edges of the travel lane. The spacing between bars decreased approaching the community. The series of markings are intended to create the perception that the vehicle's speed is increasing to trigger driver awareness of the need to slow down. The transverse markings were 12 inches wide (parallel to roadway edge) by 18 inches long (figure 1). The markings were installed at the north, south, and west entrances to the city of Union. Markings were placed in advance of and terminated at the speed limit sign which established the speed within the community. The length of each series and distance between bars varied based upon each speed transition and location within the series.

Speed feedback signs (figure 2) were also installed within Union. These signs consisted of a static "Your Speed" sign and an electronic display of the approaching vehicle speed measured by radar. These signs were installed for inbound motorists at the north and west city entrances and were placed immediately downstream of the transverse markings as shown in figure 3. Due to purchasing and installation problems,

Figure 1. Experimental transverse markings at entrance to Union.

Figure 2. Speed feedback sign in Union.

the signs did not become operational until just before the 9-month data collection period.

Results

Table 2 shows the change in 85th percentile speed by location and observation period. For the south entrance (U5) where transverse markings were the only treatment installed, there was little change in prevailing speed. Similar results were found for southbound traffic entering the north side of town (U2) and eastbound traffic entering from the west (U1) prior to the installation of speed feedback signs.

After the feedback signs were installed, speeds dropped an additional 3 mi/h to 6 mi/h at the north and west entrances during the 9- and 12-month analysis periods. Since the signs were only in place for a short period of time, it is not known if the observed speed reductions persisted over the longer term.

Lane Narrowing Using Painted Center Island and Edgeline Markings

Description

Median and shoulder pavement markings shown in figure 4 were used to reduce lane

Figure 3. Treatment and data collection locations in Union.

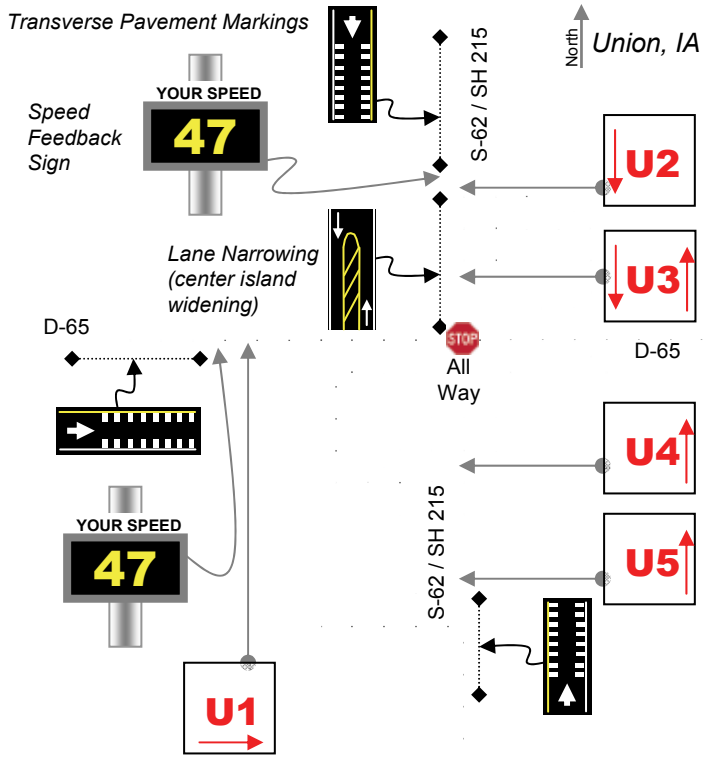

Table 2. Speeds before and after transverse pavement markings with and without speed feedback sign (SFS) at the entrances to Union.

Location and analysis period	Sample size (veh)	Posted speed (mi/h)	85th percentile (mi/h)	Change in 85th percentile speed from "before" period (mi/h)
U2 SB Before	1,870	30	41	
1-month	1,785	30	41	0
3-month	1,794	30	40	-1
9-month (+SFS)	1,737	30	35	-6
12-month (+SFS)	1,693	30	34	-7
U5 NB Before	886	25	46	
1-month	783	25	45	-1
3-month	943	25	45	-1
9-month	908	25	44	-2
12-month	871	25	45	-1
U1 EB Before	893	25	53	
1-month	659	25	51	-2
3-month	684	25	52	-1
9-month (+SFS)	749	25	49	-4
12-month (+SFS)	666	25	50	-3

widths for a section of S-62/SH 215 within Union. The existing two-lane roadway was 40 ft wide from curb to curb with parallel parking allowed on one side. A 10-ft-wide painted center island was used to reduce the existing lane widths from roughly 16 to 11 ft in each direction. A solid 6-inch channelizing line was painted to separate the travel lane from an 8 ft parking lane. Drivers were expected to slow down due to feeling constrained by narrower lanes.

Results

Table 3 summarizes speed data collected midway through the narrowed section (U3), as shown in figure 3. Results are presented for both

Figure 4. Painted center island and edgeline used to narrow lane.

directions of traffic, as both were exposed to the lane narrowing. No other traffic-calming measures were in place at this location.

No consistent changes in 85th percentile speed were observed for either direction. In some cases, vehicle speeds decreased; in other cases, vehicle speeds increased. The variability in speeds suggests that the treatment was not effective and that other factors may have influenced speeds. Speed data collected at a point upstream of the north section where vehicles were not influenced by any of the traffic-calming treatments exhibited an overall upward speed trend. This suggests the observed increases in speed were due in part to general time trends.

Even though the roadway was reduced from 16 ft to 11 ft lanes in each direction, the lanes may have still been too wide to affect driver behavior. A more drastic reduction in lane width (e.g., 9 ft lanes) or a physical barrier (e.g., raised curb) may be necessary to produce the desired effect since there are no consequences for driving over the pavement markings.

Converging Chevrons with "25 MPH" Pavement Marking Legend

Description

A series of converging chevron markings shown in figure 5 were installed on County Road E-18 on both entrances to Roland. The markings began 221 ft in advance of and terminated at the speed limit sign which established the speed within the community. The distance between chevrons gradually decreased from 25 ft to 18 ft, and the width of the markings decreased from 36 inches to 6 inches in the direction of travel, giving the perception of increasing speed. The pavement marking legend "25 MPH" was installed at the end of each chevron series to reinforce the posted speed.

Results

As shown in table 4, the 85th percentile speed decreased up to 4 mi/h, while 1 mi/h was more typical for the various analysis periods. Although the chevron markings were somewhat effective in reducing vehicle speeds, prevailing speeds were still 7 mi/h to 9 mi/h above the posted speed limit 12 months after implementation.

Figure 5. Experimental converging chevron markings followed by "25 MPH" pavement legend.

Table 3. Speeds before and after narrowing lane using painted center island and edge line markings.

Location and analysis period	Sample size (veh)	Posted speed (mi/h)	85th percentile (mi/h)	Change in 85th percentile speed from "before" period (mi/h)
U3 NB Before	2,055	30	35	
1-month	1,808	30	36	+1
3-month	1,840	30	32	-3
9-month	1,807	30	36	+1
12-month	2,064	30	35	0
U3 SB Before	2,058	30	33	
1-month	1,930	30	33	0
3-month	1,911	30	37	+4
9-month	1,881	30	32	-1
12-month	1,771	30	34	+1

Table 4. Speeds before and after installing converging chevron markings and "25 MPH" pavement legend.

Location	Analysis period	Sample size (veh)	Posted speed (mi/h)	85th percentile (mi/h)	Change in 85th percentile speed from "before" period (mi/h)
West entrance	Before	4,216	25	35	
	1-month	4,135	25	34	-1
	3-month	3,812	25	32	-3
	9-month	3,958	25	35	0
	12-month	3,945	25	34	-1
East entrance	Before	2,397	25	36	
	1-month	2,426	25	35	-1
	3-month	3,413	25	35	-1
	9-month	2,196	25	34	-2
	12-month	1,778	25	32	-4

Lane Narrowing Using Shoulder Widening with "25 MPH" Legend

Description

A wide edgeline and cross-hatch markings, as illustrated in figure 6, were used to create a shoulder on both sides of the roadway and reduce lane widths for a section of E-18 within Roland. The existing two-lane roadway was 36 ft wide from curb to curb. The painted shoulders reduced the lane width to 10.5 ft in both directions. The narrow lane was intended to make drivers travel slower due to feeling constrained. White pavement marking legends indicating "25 MPH" were placed at regularly spaced intervals within the narrowed section to remind drivers of the speed limit.

Results

Data were collected at the midpoint of the narrowed section. As shown in table 5, the lane narrowing and speed limit markings were not effective in reducing vehicle speeds. There were no consistent changes in the 85th

Figure 6. Shoulder markings used to narrow travel lanes in Roland.

percentile speed by analysis period or direction of travel with both increases and decreases recorded. In most analysis periods, there was no change in traffic speed compared to speeds measured before the lane narrowing. No data were collected 6 months after the change due to adverse winter weather.

Even though the eastern section of E-18 was reduced from a 36 ft cross-section to 10 ft lanes, the lanes may have still been too wide to affect driver behavior. A more drastic reduction in lane width (e.g., 9 ft lanes) or a physical barrier (e.g., raised curb) may be necessary to produce the desired effect since there are no consequences for driving on pavement markings.

Speed Table

Description

A speed table (figures 7 and 8) was installed on County Road E-23 within the center of Gilbert. The two-lane asphalt roadway has grass shoulders, no curb, and a 25 mi/h posted speed limit. The speed table was 3 inches high and 22 ft in the direction of travel, including 6 ft ramps at both ends. The asphalt speed table was designed to be traversed at 30 mi/h to accommodate heavy trucks and farm vehicles.

Results

The speed table was very effective in reducing speeds. As shown in table 6, 85th percentile speeds were reduced at the hump location by 4 mi/h to 5 mi/h over all "after" periods to within a few miles per hour of the 25 mi/h posted speed limit. Approximately 200 ft downstream of the speed table, speeds were still 4 mi/h

Figure 7. Aerial view of speed table in Gilbert.

Figure 8. Driver view of speed table in Gilbert.

Table 5. Speeds before and after lane narrowing using shoulder markings combined with "25 MPH" pavement legend.

Direction of traffic	Analysis period	Sample size (veh)	Posted speed (mi/h)	85th percentile (mi/h)	Change in 85th percentile speed from "before" period (mi/h)
Outbound	Before	2,884	25	34	
	1-month	2,708	25	34	0
	3-month	2,324	25	34	0
	9-month	2,489	25	33	-1
	12-month	2,727	25	34	0
Inbound	Before	2,864	25	31	
	1-month	2,681	25	29	-2
	3-month	2,361	25	31	0
	9-month	2,562	25	31	0
	12-month	2,835	25	32	+1

Table 6. Speeds before and after installing speed table.

Location	Analysis period	Sample size (veh)	Posted speed (mi/h)	85th percentile (mi/h)	Change in 85th percentile speed from "before" period (mi/h)	
200 ft downstream	Before	2,257	25	34		
	1-month	2,199	25	30	-4	
	3-month	2,763	25	30	-4	
	9-month	3,885	25	30	-4	
	12-month	3,886	25	30	-4	
15 ft downstream	Before	3,685	25	32		
	1-month	3,355	25	27	-5	
	3-month	3,413	25	28	-4	
	9-month	3,982	25	27	-5	
	12-month	3,279	25	27	-5	

lower than baseline speeds and within 5 mi/h of the posted speed.

Lane Narrowing with Center Island Using Tubular Markers

Description

Tubular markers shown in figure 9 were used to create two center islands along the southern section of R-39 in Slater. At this location, the roadway is 26 ft wide from curb to curb. Center islands were formed by placing two rows of 36-inch-tall yellow tubular channelizing markers to reduce lane widths to 11 ft in each direction. The tubular markers were spaced 4 ft apart in the taper and 8 ft elsewhere. A 25 mi/h speed limit sign was placed on a mountable sign support at both ends of each island. The first island was located at the southern entrance to Slater, just after the first posted 25 mi/h speed limit sign. The second island was located approximately one block north of the first island.

Although the treatment was designed to accommodate agricultural equipment and maintenance vehicles such as snowplows, the markers were damaged during winter operations and were removed for 6 weeks. The markers were reinstalled as soon as no more snow events were expected.

Results

Table 7 shows the speed data collected midway between the two center islands. The data indicate the islands using tubular channelizing markers reduced vehicle speeds; 85th percentile speeds decreased by up to 3 mi/h when the tubular markers were in place and increased up to 4 mi/h when the tubular markers were removed. Similar speed changes were also observed for inbound traffic just downstream of the second island. Even with the speed drop, 85th percentile speeds were still 10 mi/h to 15 mi/h above the posted speed limit.

Speed Feedback Signs

Description

A speed feedback sign pictured in figure 10 was

Figure 9. Tubular channelizing markers used for center island to narrow lanes.

Table 7. Speeds before and after lane narrowing using center islands with tubular markers for traffic entering (NB) and leaving (SB) Slater.

Dir	Analysis period	Sample size (veh)	Posted speed (mi/h)	85th percentile (mi/h)	Change in 85th percentile speed from "before" period (mi/h)
NB	Before	2,669	25	40	
	1-month	2,453	25	38	-2
	6-month	2,234	25	39	-1
	9-month/markers removed	1,808	25	44	+4
	9-month/markers replaced	1,549	25	37	-3
	12-month	2,207	25	40	0
SB	Before	2,806	25	45	
	1-month	2,657	25	42	-3
	6-month	2,387	25	42	-3
	9-month/markers removed	1,665	25	45	0
	9-month/markers replaced	1,402	25	42	-3
	12-month	2,172	25	43	-2

installed on County Road R-38 for inbound traffic at the north entrance to Slater. This section of R-38 is adjacent to an elementary school, has a 25 mi/h posted speed limit, and has a rural cross-section with steep shoulders and open ditch drainage.

The sign display varied based upon vehicle speeds measured via radar. The sign remained blank (black) when no traffic was present or when the approaching vehicle speed was less than or equal to 25 mi/h (or greater than 75 mi/h). Between 26 mi/h and 29 mi/h, the sign displayed the text "Your Speed" along with the measure vehicle speed, as shown in figure 10. For vehicles approaching between 30 mi/h and 75 mi/h, the message "Slow Down 25" was displayed. No other traffic-calming treatments were in place at this location.

Due to sign purchasing and installation problems, the speed feedback sign was not installed at the same time as the other traffic-calming treatments in the study. Once the sign was in place, it experienced numerous electrical failures, and the analysis was limited to only one "after" period.

Results

The speed feedback sign, when operational, was very effective. Speeds measured just downstream of the sign decreased from 37 mi/h to 30 mi/h 3 months after the sign was operational. It is not known if the 7 mi/h speed reduction can be sustained over time.

"SLOW" Pavement Legend

Description

Pavement marking legends indicating "SLOW" (as shown in figure 11) were used at two locations along the western section of SH 210 in Slater. The first pavement legend was placed just inside the

Figure 10. Speed feedback sign in Slater.

Figure 11. "SLOW" pavement legend in Slater.

western community entrance. At this location, there was a park and a crosswalk that children used to cross to and from school and the park. The second was placed about 1,500 ft downstream of the first location.

Results

The "SLOW" markings were not effective in reducing speeds. As shown in table 8, the 85th percentile speed actually increased for traffic entering Slater just downstream of the first pavement legend. There was little or no reduction in vehicle speed just downstream of the second "SLOW" marking. Data were not collected for the 12-month data collection interval because the road was resurfaced after the 9-month data collection period.

Entrance Treatment Using "35 MPH" Legend with Red Background

Description

Speed limit markings (figure 12) modeled after European entrance treatments using colored pavement were used at the east and west community entrances to Dexter. The treatment was also placed west of the community on a curve just before a steel fabrication plant, as requested by the community. Community members were concerned about the combination of large trucks backing out of the plant and high-speed vehicles approaching the plant after negotiating a horizontal curve. A large red rectangle (9.5 ft by 12 ft) was used to frame the on-pavement "35 MPH" speed limit markings. An 8 inch edgeline was also painted along the treatments to enhance visibility.

Results

As shown in table 9, the treatment was very effective in reducing the speed of traffic entering the community. Speeds downstream of the curve on the western edge of Dexter and at the western entrance decreased from 4 mi/h to 9 mi/h during most analysis periods. The speed reductions at the eastern entrance to Dexter were not as dramatic. This may be due in part to the prevailing speed in the baseline period at the east entrance, which was already lower than the west entrance to the community.

Table 8. Speeds before and after installing "SLOW" pavement legend.

Location	Analysis period	Sample size (veh)	Posted speed (mi/h)	85th percentile (mi/h)	Change in 85th percentile speed from "before" period (mi/h)
First legend	Before	2,812	25	41	
	1-month	2,888	25	44	+3
	6-month	2,901	25	42	+1
	9-month	2,570	25	42	+1
Second legend	Before	3,503	25	34	
	1-month	3,294	25	34	0
	6-month	2,886	25	32	-2
	9-month	3,084	25	33	-1

Summary of Effectiveness

Table 10 summarizes speed impact, cost, and maintenance requirements for the various traffic-calming treatments evaluated in this study. The effectiveness of the treatments in reducing speeds varied widely.

The most effective treatments were the speed feedback signs, speed table, median island using tubular markers, and speed limit markings with red background. The converging chevrons and transverse pavement markings were somewhat effective with speed reductions generally less than 3 mi/h. Lane narrowing using pavement markings to create a center island, lane narrowing using shoulder markings in combination with on-pavement speed limit markings, and on-pavement "SLOW" markings were either not effective or were only marginally effective.

Lessons Learned

The following lessons were learned during the course of the study and may be helpful to small communities considering traffic calming on main rural roads:

- Design vehicles should be considered when determining the type of traffic-calming treatment to implement. For example, farm vehicles and heavy truck traffic are common in many rural communities and must be accommodated.

- Maintenance can be an issue with many traffic-calming treatments. For example, the tubular channelizing markers used in this study to create a center island were effective in reducing speeds, but the tubular markers were frequently struck by vehicles and required frequent maintenance. The speed feedback signs provide a different example in that, to be effective, agencies must establish the capability to troubleshoot and maintain these signs within a reasonable response time.

- Cost effectiveness is always a factor in selecting traffic-calming treatments. While speed feedback signs were effective in all situations, their higher cost make them most appropriate for areas where it is critical that drivers slow down, such as near schools, playgrounds, or community pools.

- Durable pavement marking materials (such as thermoplastic, tape, epoxy, or other paint alternatives) should be considered when the markings extend within wheel paths.

Figure 12. Speed limit markings with experimental red background in Dexter.

Table 9. Speeds before and after "35 MPH" pavement legend with red background markings.

Location	Analysis period	Sample size (veh)	Posted speed (mi/h)	85th percentile (mi/h)	Change in 85th percentile speed from "before" period (mi/h)
Before curve	Before	2,190	35	52	
	1-month	2,150	35	47	-5
	3-month	2,022	35	47	-5
	9-month	4,033	35	43	-9
	12-month	2,031	35	51	-1
West entrance	Before	2,369	35	45	
	1-month	2,256	35	40	-5
	3-month	2,119	35	41	-4
	9-month	4,027	35	37	-8
	12-month	3,168	35	41	-4
East entrance	Before	4,254	35	40	
	1-month	3,998	35	38	-2
	3-month	2,900	35	39	-1
	9-month	4,087	35	40	0
	12-month	4,031	35	39	-1

Standard paint products wear quickly and without frequent reapplication can reduce the effectiveness of the message.

- Community buy-in is important. In several cases, although community leadership was on-board, the community was opposed to the treatment, even when it was proven to be effective.

- Lane narrowing using just pavement markings to create a center island or shoulder was not effective. The lane narrowing treatment that used tubular markers to create a center island was more effective, suggesting that lane narrowing is most likely to be effective when drivers are presented with a physical object that causes deflection.

- Small communities may not be familiar with traffic calming and may need additional education.

Other Considerations

In visiting a large number of small communities to select pilot study locations, the research team observed a number of practices that could affect the successful outcome of main road traffic calming. These and other implementation issues are noted as follows:

- Small communities often do not have a traffic engineer and appear to be addressing perceived speeding problems by lowering the speed limit, believing wrongly that this will change driver behavior. While lower travel speeds may be desirable, reducing the speed limit is not likely to have much effect.

- Speed limits which are not consistent with the area characteristics and roadway function lead to disregard for posted speeds and create animosity toward law enforcement. The recently released USLIMITS Web-based speed zone advisor could be a useful tool in setting appropriate speed limits in rural communities.[7]

- Speed limits in the transition zone between the rural and built-up area in small communities were often improperly set, extending well passed the edge of the community into rural agricultural areas where there was no reason for reduced speeds. In other cases, the speed reductions were abrupt without appropriate speed reduction warning signs.

- The maximum speed reduction observed

Table 10. Summary of impacts and costs of rural traffic calming treatments.

Treatment	Change in 85th percentile speed (mi/h)	Cost	Maintenance	Application
Transverse pavement markings[1]	-2 to 0	$	Regular painting	community entrance
Transverse pavement markings[1] with speed feedback signs	-7 to -3	$$$	Regular painting	community entrance
Lane narrowing using painted center island and edge marking	-3 to +4	$	Regular painting	entrance or within community
Converging chevrons[1] and "25 MPH" pavement markings	-4 to 0	$	Regular painting	community entrance
Lane narrowing using shoulder markings and "25 MPH" pavement legend	-2 to 4	$	Regular painting	entrance or within community
Speed table	-5 to -4	$$	Regular painting	within community
Lane narrowing with center island using tubular markers	-3 to 0	$$$	Tubes often struck needing replacement	within community
Speed feedback sign (3-months after only)	-7	$$$	Troubleshooting electronics	entrance or within community
"SLOW" pavement legend	-2 to 3	$	Regular painting	entrance or within community
"35 MPH" pavement legend with red background[1]	-9 to 0	$	Background faded quickly; accelerated repainting cycle	entrance or within community

$ = under $2,500
$$ = $2,500 to $5,000
$$$ = $5,000 to $12,000
[1] Experimental approval required per Section 1A.10 of MUTCD.

in this study was 9 mi/h. Physical measures such as roundabouts and curbed center islands may be needed to achieve the speed environment that rural communities often desire.

- Large areas of pavement markings, such as the speed limit markings with colored background, may become slippery when wet. Communities planning to use such treatments should ensure adequate skid resistance is provided. High friction surface material should be considered.

- Speed tables are only appropriate when the posted speed limit is 30 mi/h or less and approach speeds are less than 40 mi/h. Speed tables are not recommended for use on routes with significant (more than 5 percent) truck and bus traffic. Because emergency response times may increase, emergency service providers should be consulted before installing speed tables.

- STOP signs should not be used for traffic calming.

- The chevron markings, transverse markings, and red background for pavement legend evaluated in this study are not standard devices and require experimental approval in accordance with section 1A.10 of the MUTCD.

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Key Words—Traffic calming, speed management, transverse markings, chevron markings, speed feedback signs, lane narrowing, tubular channelizing markers, pavement legend, rural roads.

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FEBRUARY 2009

FHWA-HRT-08-067
HRDS-05/2-09(5M)E