
Streetlight Inventory

Bradford, Vermont

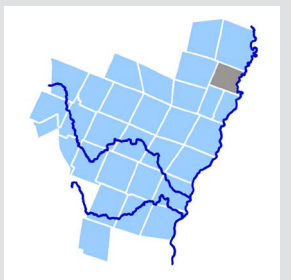


February-May, 2011

An analysis of Bradford's street
lighting system conducted by:

The Two Rivers-Ottawaquechee
Regional Commission

*Funded by Energy Efficiency and Conservation
Block Grant from the US Dept. of Energy*



This Streetlight Inventory was provided for your community at no charge with help from an Energy Efficiency and Conservation Block Grant through the US Department of Energy.

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Introduction & Overview

The Two Rivers-Ottawaquechee Regional Commission is pleased to offer the town of Bradford this streetlight inventory report. This report was commissioned for the town at no charge through TRORC's Energy Efficiency and Conservation Program, which was funded through a grant from the US Department of Energy.

TRORC staff wishes to thank the members of the Bradford Energy Committee who participated in the field study for this project: Sandra Price and Tom Gray.

Why conduct a streetlight inventory?

Municipalities generally install street and public area lights for reasons appropriate to the public good. These would include the health and safety of pedestrians and drivers, to support outdoor public activities or increase commerce and occasionally for aesthetics. But because the street lighting system has been developed and added on to over many years, it is important for a community to occasionally evaluate the value of the lights in the system. Many communities find that they have locations which are over-lighted. In the past when energy was relatively cheap, communities opted to err on the side of more lighting rather than less. Given the growing costs associated with energy use, a street light inventory which re-evaluates the need for certain lights can be valuable for your town.

Taking stock of what a community has in terms of lighting is valuable for several reasons. First, it provides an opportunity to determine if all the equipment are working properly and are serving the community's needs appropriately. Second, it allows the community to identify areas where lighting may no longer be needed to serve the public good. Simply reducing the number of lights can have a remarkable impact on municipal energy use (see sidebar on Hartford Streetlight). During a streetlight inventory, there may also be areas in which additional lights should be added to increase public safety.

Hartford Streetlight Inventory

In 2009 the town of Hartford, with assistance from the Two Rivers-Ottawaquechee Regional Commission, conducted a streetlight inventory for the entire community with the intention of upgrading existing lighting to more efficient LED (light emitting diode) technology. Out of the 562 lights which were paid for by the municipality, it was recommended that 207 of those fixtures be removed (they were deemed unnecessary), 7 more be added in areas where increased public safety was needed and the remaining 348 be kept in their existing locations.

The impact of turning off 207 lights in Hartford is estimated to net the community nearly \$30,000 in savings per year. Their next steps will be to reduce costs further by upgrading to more efficient LED technology.

Lighting for the Public Good

Streetlights primarily serve the purpose of making public places safe for all modes of transportation (pedestrian, automobile and bicycle). Areas which generally require good lighting include:

- **Public parking lots** - Lights in these locations provide needed safety and convenience at night for getting to and from locations adjacent to the lot.
- **Sidewalks or paths**- Areas which have regular pedestrian traffic and are served by a system of sidewalks or paths are often logical choices for lighting as they ensure pedestrian safety. Good lighting is particularly important in locations where pedestrian traffic and automobile traffic intersect (crosswalks).





- **Downtown street lighting** - Lighting a downtown is commonly done for aesthetic reasons, but also serves to promote an increased sense of security and safety, which can enhance commerce activity for businesses in this area.
- **Roadways** - Roadway lighting generally serves as an added safety measure for busy transportation corridors and a visual indication that travelers have arrived at key town centers or intersections. It is essential that street lighting be properly located so as to ensure full lighting coverage. Studies by the Transportation Research Board have indicated that in areas where lighting is inconsistent or intermittent traffic accidents can increase. It is considered safer in many instances to have no street lighting than inconsistent street lighting.

Measuring Light Levels in Street Lighting

The effectiveness of street lighting is generally measured in foot-candles (fc). The Foot-Candle is a measurement of illuminance or light intensity widely used in photography, film, television, conservation lighting, and the lighting industry.

The unit is defined as the amount of illumination the inside surface of a 1-foot radius sphere would be receiving if there were a uniform point source of one candela in the exact center of the sphere. Alternatively, it can be defined as the illuminance on a 1-square foot surface of which there is a uniformly distributed flux of one lumen. This can be thought of as the amount of light that actually falls on a given surface. The foot-candle is equal to one lumen per square foot.

According to Efficiency Vermont’s publication “Improving Efficiency in Municipal Street and Public Space Lighting”, adequate lighting for street and sidewalk illumination will, on average, fall between the 0.25 and 1.0 foot candle(fc). The lower value (0.25 fc) is adequate for paths, walkways and lesser trafficked streets, while the higher value (1.0 fc) will be adequate for most busy streets and intersections.

Bradford’s Streetlight System

Bradford has 88 lights in its municipal lighting system, which consists of two different styles of light, each with its own specific purpose. They include:



Cobrahead Light

- **83 non-metered (leased) streetlights.** These consist exclusively of cobra-head style lights. (See below for definition of “non-metered.”) Bradford’s non-metered lighting system covers most of the village and several other locations outside of the village. This system of lighting is owned by Central Vermont Public Service and is leased by the town.
- **5 metered (owned) decorative pole lamps with acorn-style fixtures.** These lights are located along Barton St.



Decorative Light

Non-metered and Metered Lighting

Power companies have two separate classifications of lighting, Metered and non-metered.

Ownership of non-metered lighting lies exclusively with your power provider. Your community leases the lights from the power company, and all maintenance of these lights is generally provided by the power company as part of this lease agreement.

Metered lighting is most often owned by the community in which it is located. The community simply pays a monthly fee based on the meter which serves power to the lighting. The responsibility of maintenance and replacement is the towns and not the power company. Because this lighting is most often community owned, it is the easiest to upgrade with energy efficient equipment.





Streetlight Inventory Process Overview

The methodology used to conduct this streetlight inventory is based primarily on field study, visual assessment and selective use of a light meter. In addition to staff from TRORC, municipal officials from the Bradford Energy Committee were involved in the field work in order to ensure that the community was well represented and involved in the initial assessment used to create the final recommendations of this inventory.

Street Analysis

Utilizing data provided by Central Vermont Public Service (CVPS) who owns the majority of the streetlights in Bradford, TRORC staff and local officials conducted an “on the street” lighting analysis. During the on-street analysis, participants reviewed each light for public benefit. Priority benefits include:

- pedestrian and bicycle safety
- road intersections
- unique road features such as bridges or alignments

When trying to determine whether or not a streetlight can be removed or shut off, participants considered:

- Lighting escalation (more light than needed) and redundancies
- Private vs. Public benefits (is the light benefiting everyone or just a single home?)
- Unknown or unidentifiable uses
- Horizontal alignment
- Low volume, dead end streets

Data Analysis

Once the on-street analysis has been conducted (including data collection with the light meter), it will be up to the Selectboard and other appropriate officials (police, road crew) to consider the recommendations made in this report and determine which lights should be kept on, turned off, upgraded or added.

Public Process

When the Selectboard has made its initial decisions, it is essential that public input be taken with regard to which lights will be removed, added or altered prior to a test phase. Once an initial response from the public has been gauged, and any public input has been considered, the municipality should arrange with CVPS to conduct a "test phase" in which any lights proposed for removal are temporarily turned off. During this period, additional input from the public should be sought.

Final Determinations

Upon completion of the test phase, the Selectboard will ultimately decide which lights are to remain, which are removed, and which (if any) should be added.

“But I Like My Streetlight!”

It should be noted that while some residents may enjoy having a streetlight adjacent to their home (lighting their lot), the light must be analyzed for its benefit for the community as a whole.

For example, in the town of Hartford, one resident objected to having a light removed because he used the streetlight to “work on his truck at night.”

It is not generally considered the responsibility of the municipality to provide lighting for private property. The Selectboard must weigh the public’s sentiment about particular lights against the greater public benefit of the light when they finalize any removal of street lights.





Disclaimer

The following recommendations are the result of an “on the street” inventory process involving TRORC Staff and local Officials using observation, assessment and judgement based on local knowledge. They are provided for the municipality to consider as they re-evaluate the street light system for the purpose of enhancing safety and reducing energy costs. They are recommendations only. The Selectboard will have the ultimate responsibility of deciding which lights, if any, shall be removed or added.

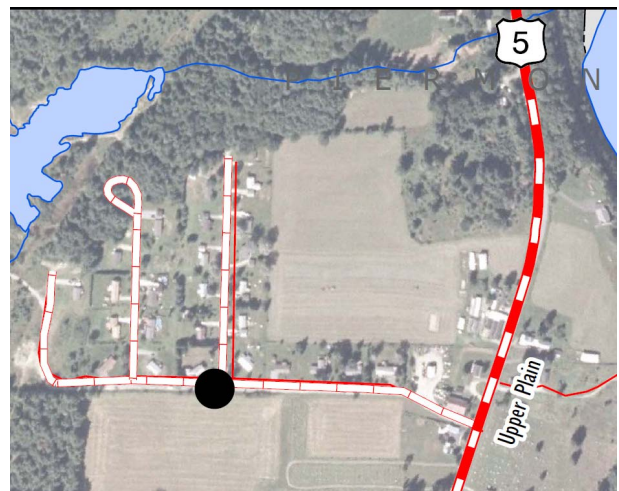
Recommendations

Bradford’s system of streetlights is very compact. Unlike many of the communities TRORC has worked with previously, there were very few instances in which we considered recommending the removal of lights. Staff identified very few areas in which streetlights had little apparent value in terms of protecting the safety of automobile, pedestrian and bicycle traffic (the primary focus of a streetlight system). However, there were a number of areas in which lighting was insufficient and not adequately meeting the needs of all modes of transportation.

Recommended for Removal

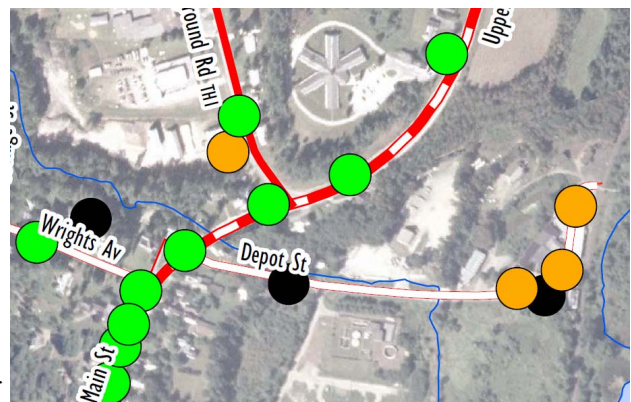
The following lights have been identified as lighting that could be removed with little impact on the safety of automobile, pedestrian or bicycle traffic:

Blue Spruce Dr. - Map data indicates that this road is privately owned. Given that there is only a single light on this road, and it is well outside the village, there appears to be little value in maintaining this light as part of the municipal streetlight system. There is no sidewalk in the vicinity of this light, and the area is outside of the range commonly defined as “walking distance” (1 mile or less).



Visual inspection of this light found that it is located adjacent to a fire hydrant, which may be the reason that this light is present. Selectboard should consult with the Bradford Fire Chief to confirm whether or not this light is essential for fire safety. If, as data indicates, this light is located on a private drive, the town should arrange with adjacent property owners to take over control of this light as it is the responsibility of the private citizen to light their own property.

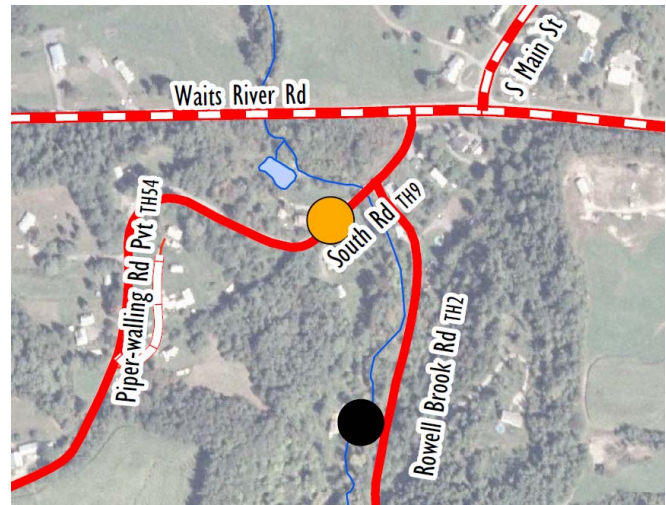
Depot St. - Depot st. has very few houses located on it and they are clustered close to the junction of Depot st. and North Main St. These homes receive adequate lighting from the street light located where the two streets meet. Out of the five lights located on Depot St. only two of them are part of the public street light system. This road serves almost exclusively as an access to the town Public Works facility and several industrial businesses. There is little night-time traffic on this road and there are no sidewalks. These lights do not appear to serve a public good and are recommended for removal.





Wright's Ave & Rowell Brook Rd. - Fieldwork revealed two lights which appeared to be lighting private property and had no apparent public good associated with them. The lights are located north of Wright's Ave (see photo on previous page) and approximately 1/4 mile South on Rowell Brook Rd.

These lights may have served some historical purpose at one point, but they are simply lighting driveways and are not actually on public roads. The responsibility for paying for these lights to remain active should be with the property owner.



Additional Lighting Recommended

Street lighting and Roadway Safety

Since the 1960's studies have shown that well designed street lighting in urban and suburban areas can reduce accidents as much as 30%. A successful lighting design employs layers of light. Lighting should provide uniform lighting on the street and strong vertical light at crosswalks and intersections for pedestrian detection. In areas along the corridor emphasizing pedestrian activity, the street lighting can be supplemented with additional pedestrian lighting assemblies.

Poorly designed street lighting, however, can be more of a hazard than a benefit. Areas of roadway which have "patchy" lighting due to poor pole placement, equipment failure or poorly focused fixtures have a negative impact on visibility. This is primarily because night driving relies greatly on contrasts.

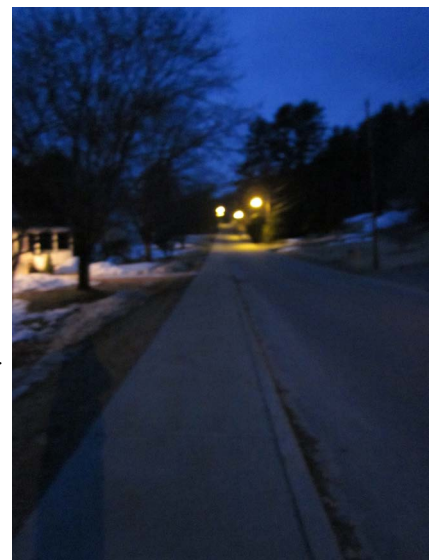
In 1990 the National Traffic Highway Safety Commission discovered that the nighttime auto accident rate was 3.7 times higher than the daytime rate. Some contributing factors are:

- Difficulty seeing contrast in poor light.
- Decreased peripheral vision when contrast sensitivity is diminished.
- Rapid recognition ability deteriorates under poor contrast.
- Visual attentions falls off at night.
- Many younger myopic drivers (20-40 years old) experience decreased night-time vision.

During the field study of Bradford's streetlight system, TRORC staff and volunteers identified several areas of weakness in terms of the uniformity of lighting. In these areas poles are either spaced to far apart to provide adequate illumination between them, or the fixtures are of a nature that focuses light downward in such a fashion that there is little overlap between lights. The result is a consistent pattern of light and dark contrasted areas. For the driver, this makes it difficult to see because her eyes continuously have to adjust to the change in contrasts. For the pedestrian, this pattern creates areas on the sidewalk which are poorly lit, potentially leading to accident or criminal activity.

According to Efficiency Vermont's publication "Improving Efficiency in Municipal Street and Public Space Lighting", adequate lighting for street and sidewalk illumination will, on average, fall between the 0.25 and 1.0 foot candle(fc). The lower value (0.25 fc) is adequate for paths, walkways and lesser trafficked streets, while the higher value (1.0 fc) will be adequate for most busy streets and intersections.

During field study, TRORC staff utilized an ETECH light meter to analyze the apparent gaps in lighting in reference to the levels suggested above.



Gaps in lighting on N. Pleasant St.





N. Pleasant St. - This is an area identified (see map at right) as in need of additional lighting coverage. Because N Pleasant is not a high traffic area, the primary issue in this instance is one of pedestrian safety.

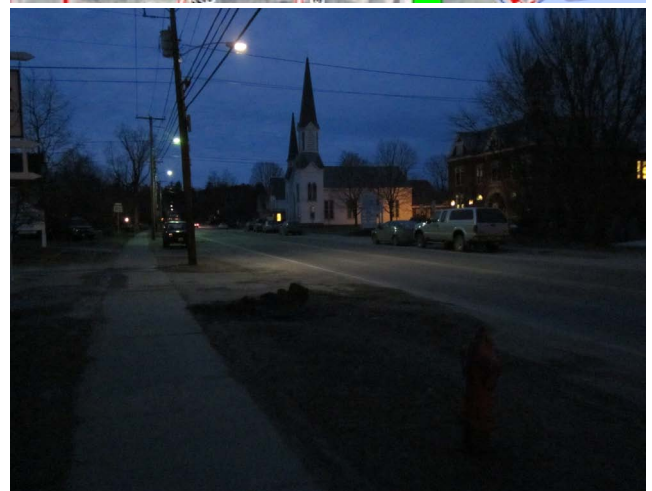
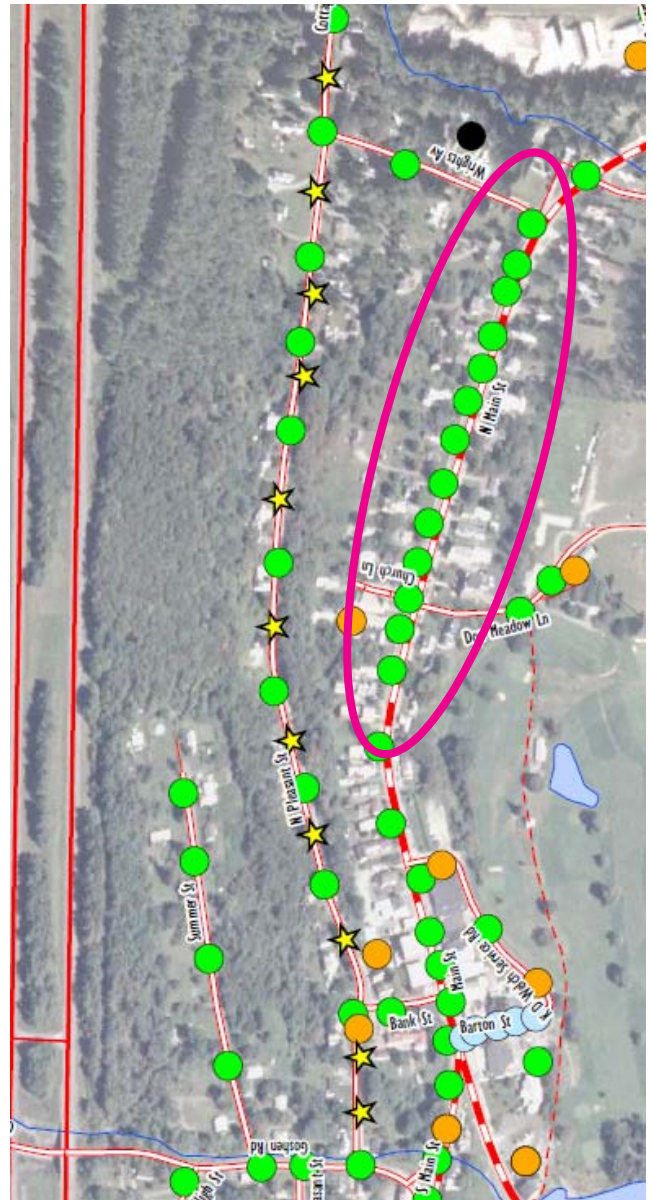
The photo on the previous page clearly shows that there are areas of gaps in the street lighting in this area. Because the poles are located on the west side of the street and the sidewalk is on the east, street lighting must be focused so as to cover both the street and the sidewalk. The foot candle levels measured on N. Pleasant st., were sufficient when located directly under the street light. However, when passing between lights on the road, the level of light dropped below the recommended level of .25fc to the point that light did not register on the light meter (effectively below .001 fc). The lack of consistent lighting was worse on the sidewalk.

In this case, pedestrians who choose to walk along N. Pleasant at night will be travelling through areas of bright light and areas of limited light. Given the topography, it would not be unreasonable to think that those areas of limited light present an opportunity for criminal activity.

The downside to additional lights in this area is that it would potentially impact the aesthetic appearance of what is a very quiet and peaceful residential street. Landowners in this area may not appreciate the addition of more lighting because it may bleed into their residences. To avoid this problem and still increase lighting on the sidewalk, Bradford could consider adding fixtures along the sidewalk that are substantially shorter and focused only on the sidewalk itself.

N. Main St. - On the adjacent map, the placement of streetlights is substantially more dense than that of N. Pleasant St. One would assume that this would indicate that coverage would be more uniform and that there would be less areas of contrast. However, in the area circled in pink on the map, this is not the case.

The lighting on N. Main st. is very poorly focused. This is due in part to the choice of fixture. The fixtures used along N. Main st. appear to be heavily shielded. This shielding, which is often utilized to reduce glare and light pollution has the effect of focusing the light downward creating distinct pools of light. The image to the right illustrates the “pooling”



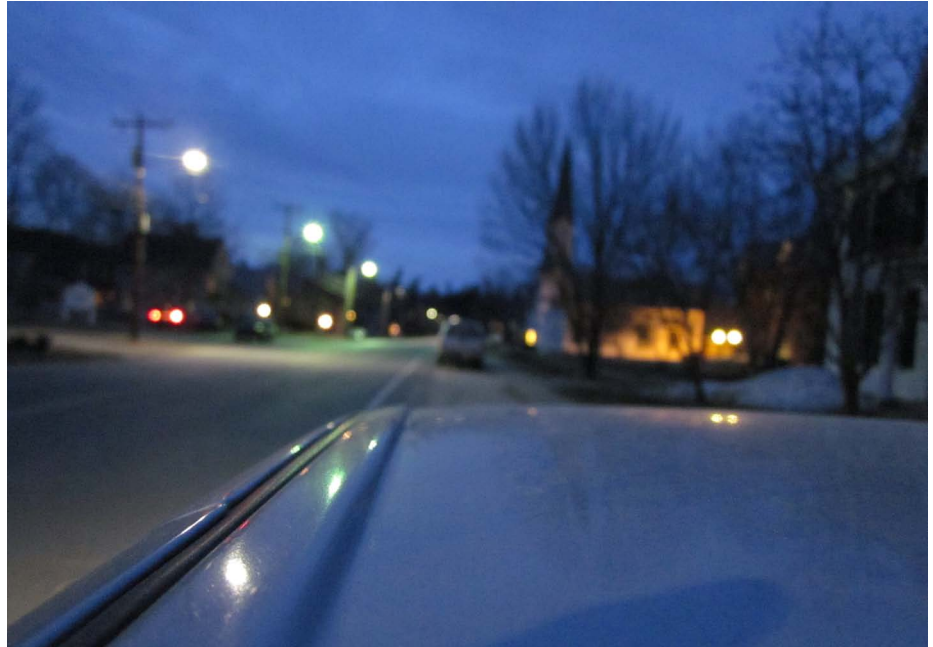
Hotspots from lighting on N. Main St.





which occurs on N. Main st. As outlined previously, areas of inconsistent lighting force the eyes of a driver to constantly readjust to the contrast in lighting. This in turn, limits visibility and increases the likelihood of accident, particularly in areas where pedestrians and vehicles interact (crosswalks).

When measured in the street, the light levels were erratic. Directly under the lights registered at 1.5fc (brighter than needed). In between the lights, the light level again dipped below .001fc (well below the 1.0fc recommended for a busy street).



North Main St. looking north. Note the clearly defined “pooling” of the street lights.

Because of light placement (along the western side of N. Main), the sidewalk on the eastern side of the street is virtually unlit. Like N. Pleasant, this lack of lighting has the potential to attract criminal activities at night. Bradford may want to consider installing sidewalk level lighting in this area. Although the image above is somewhat out of focus (due to the limited light available), it shows the consistent pattern of light and dark that exists on N. Mains st. The placement of these lights also creates further shadows on the eastern sidewalk when cars are parked along that side of the road.

Bradford should work with the Central Vermont Public Service to determine what the best options are in terms of lighting fixtures and wattages. With increased wattage, the lighting might become more uniform, but light pollution would increase. Most likely, the solution to the patchy lighting on N. Main St. will be a mixture of upgrades to existing lighting and added sidewalk lighting. It should also be noted that light levels were measured selectively in specific areas in town. Based on staff observations, it is highly likely this issue of insufficient lighting is prevalent throughout the community.

Implementation

As was previously stated, this report is intended to be a guide for the Selectboard to make its own decisions regarding the status of streetlights in Bradford. Like most decisions made by a legislative body, it is in the best interest of the community to ensure that the public is given the opportunity to voice its opinions.

Initial Review & Public Process

The Selectboard should thoroughly review this report, seeking any clarification from TRORC needed to fully understand the recommendations. With input from the Police Chief and the Energy Committee, the Selectboard will determine which of the recommendations have merit and need to be considered for removal, upgrade or new placement.

Regardless of whether lights are being proposed for removal or addition is essential for the Selectboard to present their findings to the public in some fashion, either through a public meeting or through the local newspaper, and to give the public an opportunity to comment on the proposal.





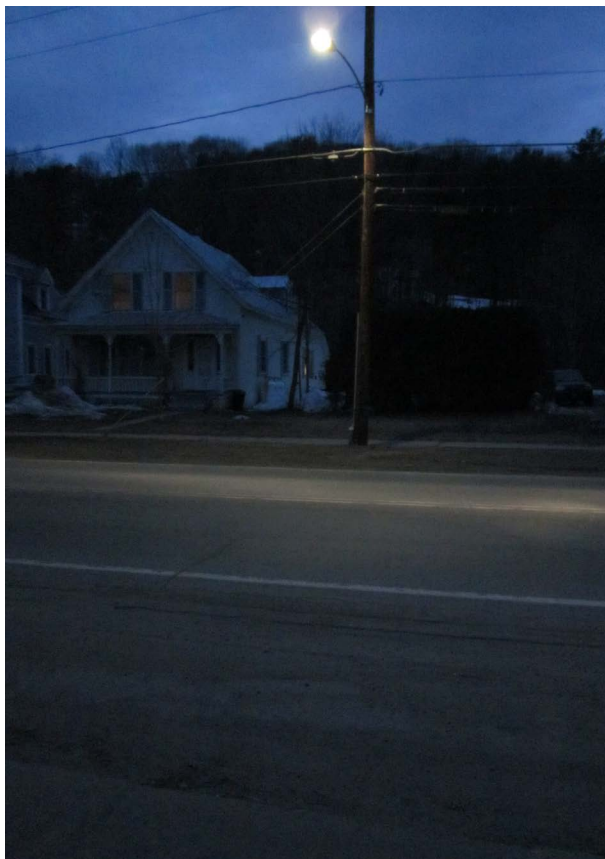
Streetlight Removal - Trial Outages and Public Process

Once the Selectboard has determined that there are lights that should be removed from the street light system, it is recommended that the town conduct a trial outage in order to gauge the impact on health and safety and to allow an opportunity for additional public input throughout the process.

The town will need to arrange a trial outage with CVPS. TRORC recommends that this trial period last at least three weeks. The public should be encouraged to comment during this period.

Streetlight Removal - Final Decisions

Once the trial outage is complete and the Selectboard has thoroughly considered all public input, they will identify which lights (if any) should be permanently removed from the street light system and make arrangements to do so with CVPS. Any upgrades should also be discussed at this time. In some communities, the Selectboard has taken a graduated approach to removing street lights, spreading the process of removing lights out over several months. This can allow the community time to adjust to the new makeup of the streetlight system before removing additional lights.



This light on North Main St. has a very bright hotspot.

Adding Streetlights

Bradford's streetlight system is extremely deficient in terms of available light levels. As noted previously, the key areas tested for light levels all had areas between lights which failed to register on our equipment. It is likely that there are deficiencies of this nature throughout the town that were not identified.

For Bradford's non-metered roadway lighting, the community will need to meet with CVPS to discuss ways in which the lighting can be refocused to provide more effective lighting coverage from existing streetlights. As with any municipal upgrade, there will be an expense to adding lighting. Any lights that are added to the existing streetlight system will increase the yearly cost of lighting in Bradford, but should not have a cost associated with the installation.

As an alternative, Bradford can install additional lighting similar in nature to the pole-style lights on Barton st. These lights would be effective at lighting areas of the sidewalk on N. Main st. or N. Pleasant st. that are currently too dark for pedestrian use in the evening.





Planning for Energy Efficiency Improvements - Capital Budgeting

The ability to improve Bradford's lighting system (through upgrades or brand new lighting) will depend primarily on funding. It is unlikely that the community will be able to immediately invest in lighting improvements, but the community can plan and budget for these expenses now in order to implement them in the future.

The Vermont Planning and Development Act (24 V.S.A., Chapter 117) specifically authorizes municipalities that have duly adopted municipal plans—with utility and facility elements as required under the act—to adopt capital budgets and programs (§§4403, 4443). Chapter 117 also spells out the required content of a capital budget and program (§4430). The capital budget and program is a six-year document: year one is the capital budget for the upcoming fiscal year, and years two through six are the capital program, or schedule of investments, for the following five years. The planning commission, town manager, or other appointed group may take the lead in developing a capital improvement program for consideration by the legislative body. Recommended projects, however, must conform to the municipal plan. Therefore, it is essential that any project that will be considered in the future, be discussed within the Town Plan. The planning commission should review and submit annual project recommendations for inclusion in the Capital Budget and Program.

Layout and Placement

The placement of equipment on any road should provide the lighting necessary for safe vehicular navigation and pedestrian circulation. In addition, the lighting equipment must provide information and visual cues as to the nature of the road and upcoming hazards. A lighting system can do this in several ways. For example:

- *Emphasize the intersection by increasing the quantity of luminaires and/or different pole placement near the intersection. An example of this may be to use median mounted poles along the road between intersections, and to use corner mounted poles at the intersections.*
- *Utilize medians for equipment placement, thus providing uncluttered views from the road to the businesses and storefronts.*
- *Avoid staggered spacing of fixtures in order to improve visibility. Respond to parking and turn lanes where appropriate to maintain visual cues.*
- *Provide a visually organized, hierarchical and easily understandable lighting system.*
- *Integrate the lighting equipment with the landscape.*
- *Reduce clutter by combining functions such as lighting poles used for signage and banners.*



LED Cobrahead Light Fixture

In the Town Plan Bradford planners should include elements of the data collected in this Streetlight Inventory Report, and any additional analysis that is conducted. The Plan should address where the priorities of need are in the Bradford streetlight system (N. Main St. and N. Pleasant) as well as what the apparent costs of upgrading or adding additional lighting will be. Additionally, a discussion of how such improvements might be financed is also important.

Any lighting upgrades that occur within the next few years, should include an investigation into energy efficient LED street lighting. The town of Hartford has invested in these lights, creating an opportunity for Bradford officials to see them in action.





Energy Efficient Street Lighting

The next step in the reduction of energy costs in street lighting is to consider upgrading the lights which remain active to more efficient LED (Light Emitting Diode) technology. In the past five years, there have been a number of exceptional advances in this technology, making it a very viable and cost-effective improvement in community lighting.

LED Street lighting

LED's have a number of advantages over conventional incandescent lighting which make them more efficient.

- **Inherently Directional** - unlike incandescent lighting which spreads light all around the bulb and requires shielding to reflect light downward, LED's direct light in a specific direction based on placement.
- **Don't Burn Out** - LED's do not burn out, but they get dimmer over time, which allows for replacements to be done on a schedule as opposed to when the light is already out.
- **More Controllable** - can be placed on dimmers and timers more easily than incandescent lighting.
- **Tolerant of Cold Temperatures** - LED's actually thrive in colder temperatures.
- **Mercury-Free** - LED's are substantially less toxic than traditional streetlights, thus making disposal easier.
- **Instant On** - LED's do not take any time to warm up.
- **Better Control of Light** - Unlike conventional street lights, LED's do not have large "hot spots" that cause over lighting. The light produced by an LED is more uniform and because of their directionality, they do not tend to bleed into unwanted areas if properly focused.
- **Better Lumens per Watt** - LED's create more light for less wattage when compared to traditional street lighting.



Upgrading Leased Lighting

When considering upgrades to existing lighting, it is important to recognize that the ownership of the lighting and the pole will play a key role in this decision. The streetlight system which Bradford leases from CVPS remains the property of the power company, therefore any changes to that system will have to be authorized by CVPS. At the time of writing this report, CVPS did not offer a rate for LED lighting, although it is likely that they will have one in the future.

When working with the power company to upgrade lighting, the community should recognize that they will be required to purchase any new lights, and will most likely be charged for the depreciated value of the lighting which will be replaced. In addition, Bradford will need to carefully analyze the tariff rate charged by the power company to determine whether or not the upgrade is cost-effective.





Upgrading Owned Lighting

The easiest lighting to upgrade to energy efficient technology are those owned by the town. In Bradford's case this includes only a few lights (pole lights on Barton St.). Because these lights are owned by the community and not the property of the power company, they may be upgraded at any time at the discretion of the legislative body.

Another advantage to targeting community owned lighting is that cost savings will be immediately reflected based on energy use and not utilizing the complicated tariff rate imposed by the power company. Additionally, upgrades can be done in small batches (such as a single parking lot), giving the community the opportunity to analyze the benefits before making more improvements.

Cost of Upgrades

The cost of upgrading street lighting to LED technology will vary by lighting manufacturer, pole type and mount and wattage. Generally, LED lights will cost between \$275-\$600 per fixture depending on wattage and style of light. Some of that expense can be offset by rebates offered by Efficiency Vermont. In 2010, Efficiency Vermont was offering a rebate of \$300 for pole/arm mounted and decorative street lights. In order to receive a rebate from Efficiency Vermont, lighting must be pre-approved and must meet the requirements set forth in the terms of their rebates.

Resources

There are a number of resources available to communities considering street lighting upgrades, and it is important to utilize them whenever possible as they will save your community time and money.

- **Efficiency Vermont** - Efficiency Vermont can assist communities in the streetlight upgrade process and can provide educational information about LEDs. In October of 2010 Efficiency Vermont rolled out a program of rebates for LED lighting including street and parking lot lighting.
- **Sustainable Energy Resource Group (SERG)** - Staff at SERG can be contracted to assist your community with education, outreach and implementation of streetlight upgrade projects.
- **Other Communities** - Other communities in the TRORC region have been working on LED upgrade projects. Contact the towns of Hartford, Thetford and Strafford for additional information.

Local Experience

The towns of Thetford and Strafford both received grants to upgrade their street lights in 2010.

Prior to applying for these grants, each town conducted a streetlight inventory and approached CVPS about upgrading the lighting. In their discussions with the power company, these communities realized that it was more cost-effective for them to take complete ownership of the streetlight system than to work under their existing rate tariff.

Hartford Upgrades

The town of Hartford has chosen to upgrade 334 streetlights to LED technology. With prices ranging from \$272 (27 Watt LED) to \$585 (94 Watt LED) per fixture, the town will be spending a substantial amount of money on these upgrades.

The total cost of installation is nearly \$190,000, but after a \$50,000 rebate incentive from Efficiency Vermont, it is anticipated that this expense will be recouped after less than four years. The projected annual cost savings with the new LED lighting will be more than \$40,000 per year. This does not include costs saved by eliminating lights.



