



STREETLIGHT MASTER PLAN

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EXECUTIVE SUMMARY

Republic ITS was hired by the City of Richmond to prepare a Streetlight Master Plan (SLMP) and help the City modernize their streetlight system. The SLMP process lead by the Engineering Services Department involved collaborations from various City departments including Police, Public Works, Planning, Redevelopment, Information Technology, and the Green Team.

The SLMP summarizes the current streetlight infrastructure and its condition, recommend standards such as lighting levels and equipment types, provide cost estimates, and defines financing options. Highlights of the SLMP are:

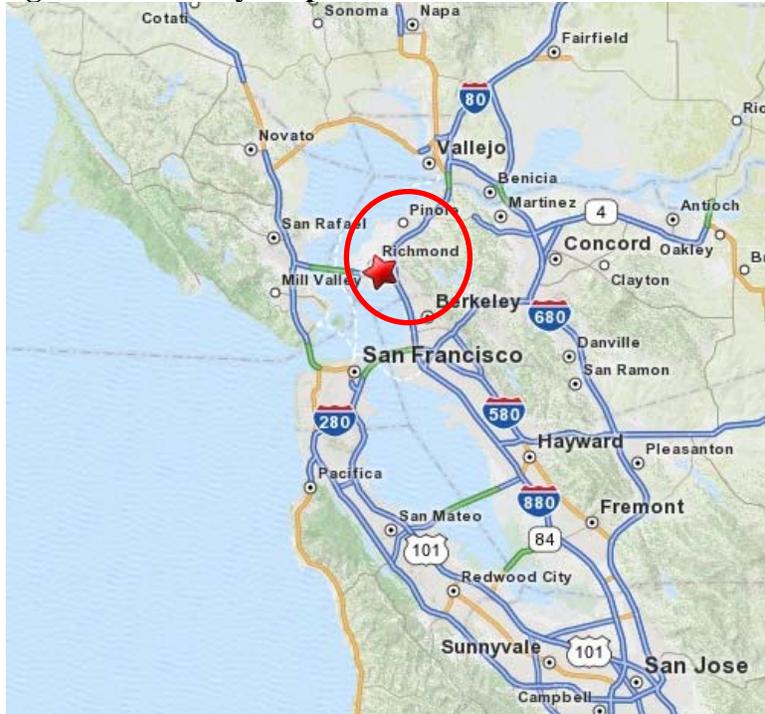
- ❖ The City of Richmond maintains a database of 8,639 streetlights
 - The City owns and maintains 3,741 streetlights on public streets.
 - There are 3,619 lights on City streets owned and maintained by PG&E.
 - There are another 1,279 owned and maintained by Contra Costa County in unincorporated pockets that are within the City's sphere of influence.
 - The City also owns and/or maintains streetlights in parks and private streets. These are not counted or directly evaluated, but are addressed in the proposed lighting standards
- ❖ Republic ITS visited each streetlight in February - April, 2010, and verified the location, wattage, and determined the condition of the poles.
- ❖ A fair proportion of the streetlights owned and maintained by the City were installed during a period of rapid growth in the 1940s, and these are due for replacement.
- ❖ Twenty eight poles were found with significant damage that are urgently due for replacement
- ❖ There are three older neighborhoods with a power source called Series Circuit that need modernizing. The most urgent need, the Park Plaza neighborhood, is currently being updated. The other two, Park View and May Valley, need similar treatment.
- ❖ Lighting standards:
 - The City currently has a lighting design standard that is incomplete and needs updating for new technology. Part of it is listed in the City Municipal Code and deals with lighting levels, but is rarely consulted. Part of it is shown in the City Standard Plans and deals with the type of equipment to be used, which is often referenced but needs to be expanded.
 - The part in the Municipal Code establishes average brightness levels, but is missing key factors that are typically part of a streetlighting standard. The adopted brightness levels are in conformance with the Illuminating Engineering Society standards for streetlighting, the most often cited source for lighting standards in the US.
 - The two existing Standard Plans have been very effective in standardizing the installation of overhead lights. Similar standards are needed for architectural poles, which are currently not addressed.
 - This SLMP includes recommendations to update City lighting standards to a complete standard with reference to new technology lighting.

- ❖ The single most urgent and ongoing issue facing the City related to providing streetlights is wire theft. The pervasive problem of wire theft has left about 10 percent of the City-owned streetlights without power. City maintenance staff are already aware of the most effective anti-theft strategies and are deploying them, but budget and staffing constraints prevent full scale deployment of these strategies.
- ❖ Richmond has several high crime neighborhoods, and streetlighting is a tool that can be used to deter or solve crimes. Most of the highest crime neighborhoods are west of 10th Street, and have PG&E owned lighting on wood utility poles. This SLMP recommends two types of upgrades:
 - On many streets, the wood utility pole spacing is not ideal for streetlight placement and supplemental poles are needed for uniform lighting
 - On all streets, new technology lighting such as LED is needed for higher quality lighting (color rendering) to make it easier for witnesses or the Police Department to accurately identify perpetrators, who can then be prosecuted.
- ❖ Richmond has activity centers that have high crime rates. In the neighborhood around Kaiser Hospital or on the west side of Metro Village, street trees have been planted and grown up around streetlight poles and the foliage blocks light from reaching the sidewalk area. Supplemental pedestrian level lighting is required.
- ❖ This SLMP outlines an improvement program to address the deficiencies identified with an estimated cost of \$15.7 million (2010 dollars). There are three methods to fund this program:
 - Incorporate it into the City's Capitol Improvement Program. With a current annual amount of \$500,000 typically programmed for streetlight improvements, the program outlined in the SLMP could be completed in approximately 30 years.
 - Obtain a loan for the improvements and pay it back in part from energy cost savings and in part from the City General Fund. This would allow acceleration of the program deployment to completion in about 10 years, and is the recommended option.
 - Work with a turn-key packager who will provide the up-front cost of the program and use the net reduction in energy costs for a set period of time to repay the costs. This option only appears to be available for the LED retrofit portion of the program, however, so is not ideal for every component. It may be the ideal option for retrofitting fixtures on PG&E owned poles.
 - A combination of obtaining a loan and committing a portion of the City's CIP budget appears to be the best option for the City. A sub-option would be to implement a City-wide streetlight assessment district with a levy of about \$25 per year for each single family household and equivalent levies for non-residential land uses. This district, with a 10-year life, would pay the debt service on the loan.

INTRODUCTION

Richmond, California, is a city with a population of approximately 104,500, located in the East Bay region of the San Francisco Bay Area. The City covers 34 square miles and its streetlight system includes approximately 8,639 lights. The City's GIS database indicates the City owns 3,741 of these streetlights and PG&E or Contra Costa County owns the balance. Figure 1 shows the general vicinity.

Figure 1 – Vicinity Map



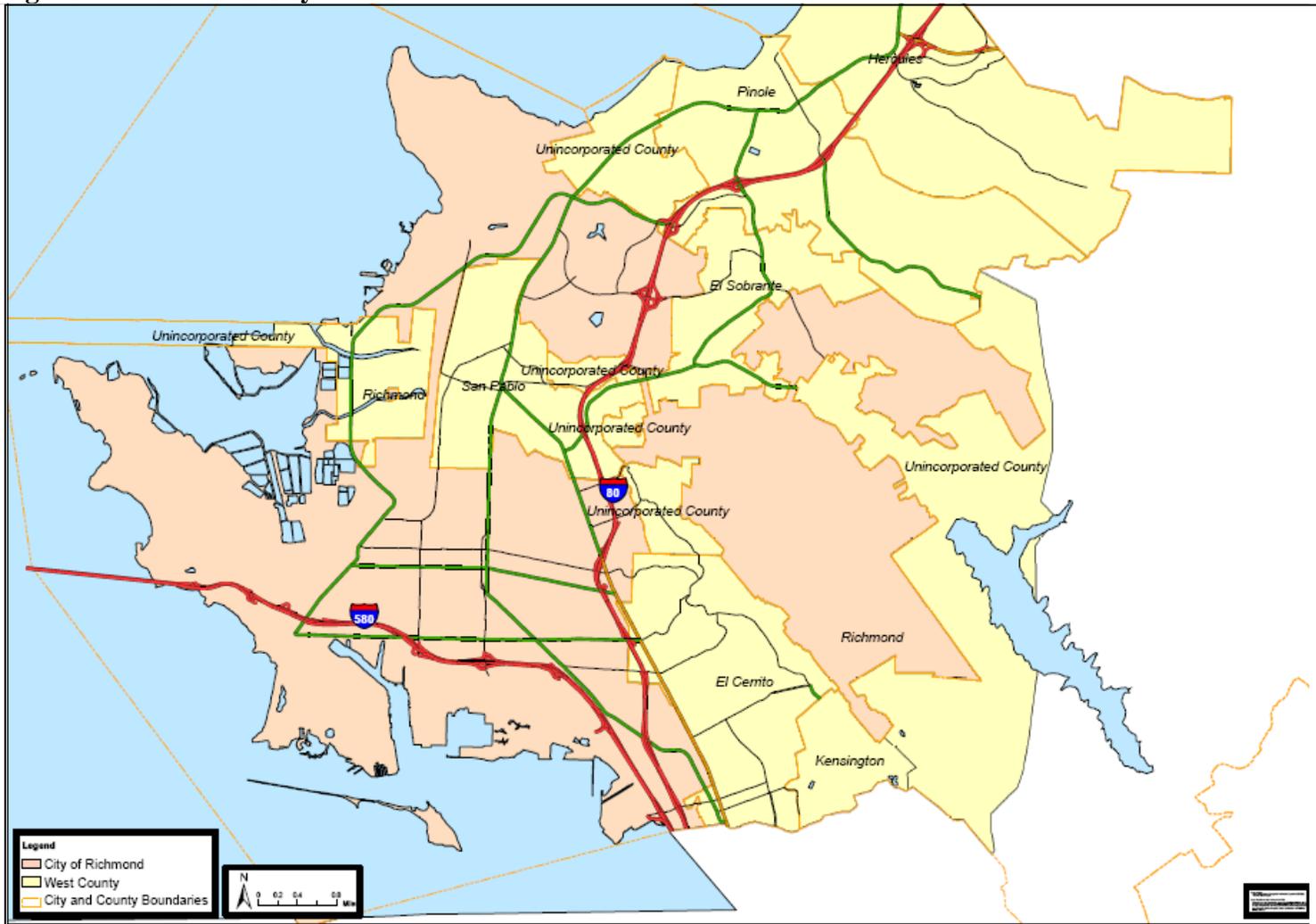
The City's population spiked dramatically in the 1940s, when many of the streetlight systems were built, indicating some of the streetlight infrastructure is over 60 years old and near due or overdue for replacement. Select streetlighting has also been upgraded by the Redevelopment Department in some portions of the City, particularly near the marinas. Figure 2 shows the incorporated limits of Richmond.

The City of Richmond hired Republic ITS to prepare a Streetlight Master Plan (SLMP). The scope of the project includes:

- ❖ A streetlight infrastructure inventory and assessment
- ❖ Updating GIS records
- ❖ Recommending upgrade projects
- ❖ Financing options
- ❖ Review and update of City streetlight standards
- ❖ Vandal-proofing of installations

This SLMP presents the findings of those topics.

Figure 2 – Richmond City Limits

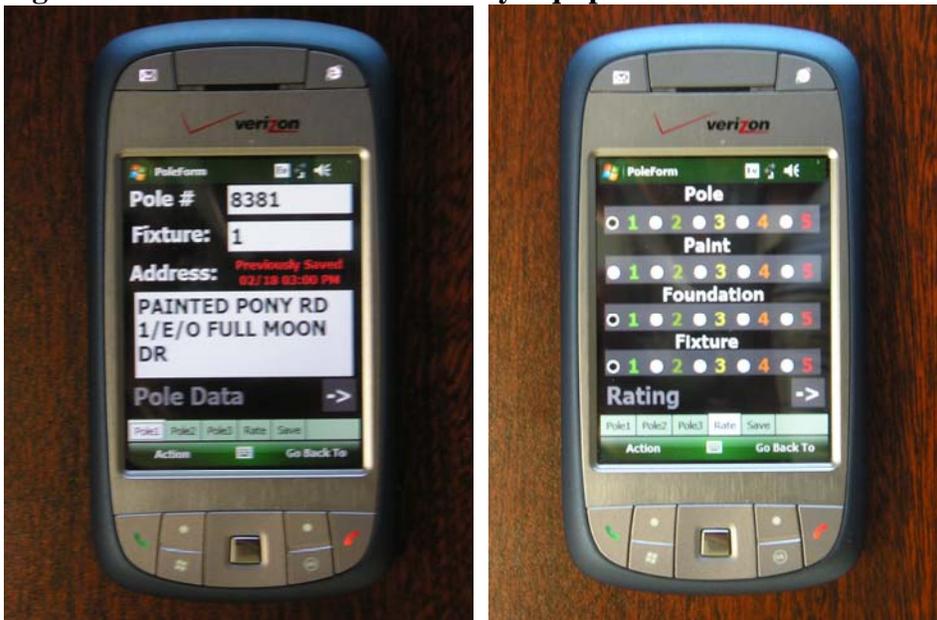


SYSTEM ASSESSMENT

Republic ITS conducted a review of the City's existing streetlights to assess the condition of the equipment and develop recommendations for improving maintenance and upgrading or replacing equipment.

The basis for the streetlight inventory was the City's previous database, which had been furnished to them by PG&E. That database indicated a total of 7,550 streetlights, with slightly more than half mounted on steel poles, just under half on wood poles (all but a few of these are owned by PG&E), and a relatively small number of concrete and aluminum poles. Republic ITS linked the database to our hand-held PDAs, and used it as the basis for our inventory (See Figure 3). As the lighting poles were individually visited, the database was updated.

Figure 3 – Hand Held PDA Inventory Equipment



Republic ITS field staff visited each pole location during February - April, 2010, and either confirmed correct entries or updated entries that did not match apparent field conditions. For each pole, the condition was also noted for various criteria (see the right half of Figure 3), including the pole, fixture, paint, and foundation. Note that the foundation rating turned out to be of limited value since foundations are only partially visible, or in most cases, not visible at all.

Methodology

The system assessment consisted of field inspections of all streetlights on public streets in Richmond, whether owned by the City, PG&E, or the County. Members of Republic ITS's field staff, who are highly knowledgeable about streetlight systems, conducted the

inspections. Field staff visually inspected various elements of City-owned equipment which were rated on a scale of 1 to 5, with a rating of 1 signifying very good condition and a rating of 5 signifying an imminent need for replacement or repair. A more detailed description of the various ratings is as follows:

Field Inspection Rating System

- 0 No Rating (item not present or not visible)
- 1 Very Good: No obvious flaws, very good surface condition.
- 2 Good: Equipment shows minimal wear
- 3 Average: Equipment may be worn or aesthetically poor in appearance but basically undamaged and still functional.
- 4 Poor: Equipment is deteriorated or damaged but still functional. This equipment should be replaced as first priority as time and budget allows.
- 5 Very Poor: Equipment is badly deteriorated or damaged and may have failed or be about to fail. This equipment should be replaced as soon as possible.

For various reasons, some locations did not receive ratings for every inspection element.

- No paint condition rating was given to concrete poles or galvanized steel poles that do not have paint coats. This is true for the vast majority of poles in Richmond.
- No foundation condition rating was given if the foundation could not be inspected because landscaping covered the foundation or foundation was covered by sidewalk paving or other improvements.

Pole Ratings

Republic ITS field staff visited every streetlight pole on public streets in the City of Richmond in February - April, 2010. The basis of the survey was the previous Geographic Information Systems (GIS) database furnished by the City.

Streetlights are defined as lighting on public streets. Park or parking lot lighting was not included in this survey, or directly addressed in this SLMP. PG&E provides power for all the streetlights in Richmond. About half the lights are owned and maintained by the City and the other half are owned and maintained by PG&E.

In addition, there is a large quantity of lights owned and maintained by Contra Costa County. These lights are in unincorporated pockets of land within Richmond, and are of interest to the City only since they are in the City's Sphere of Influence (possible future incorporation). The condition of these poles was not rated, only the quantities and individual locations.

The inventory data for all the City-, PG&E-, and County-owned poles on public streets was confirmed, updated, or newly input by Republic ITS staff using equipment shown in Figure 3. A brief summary is provided as follows and shown in Figure 4:

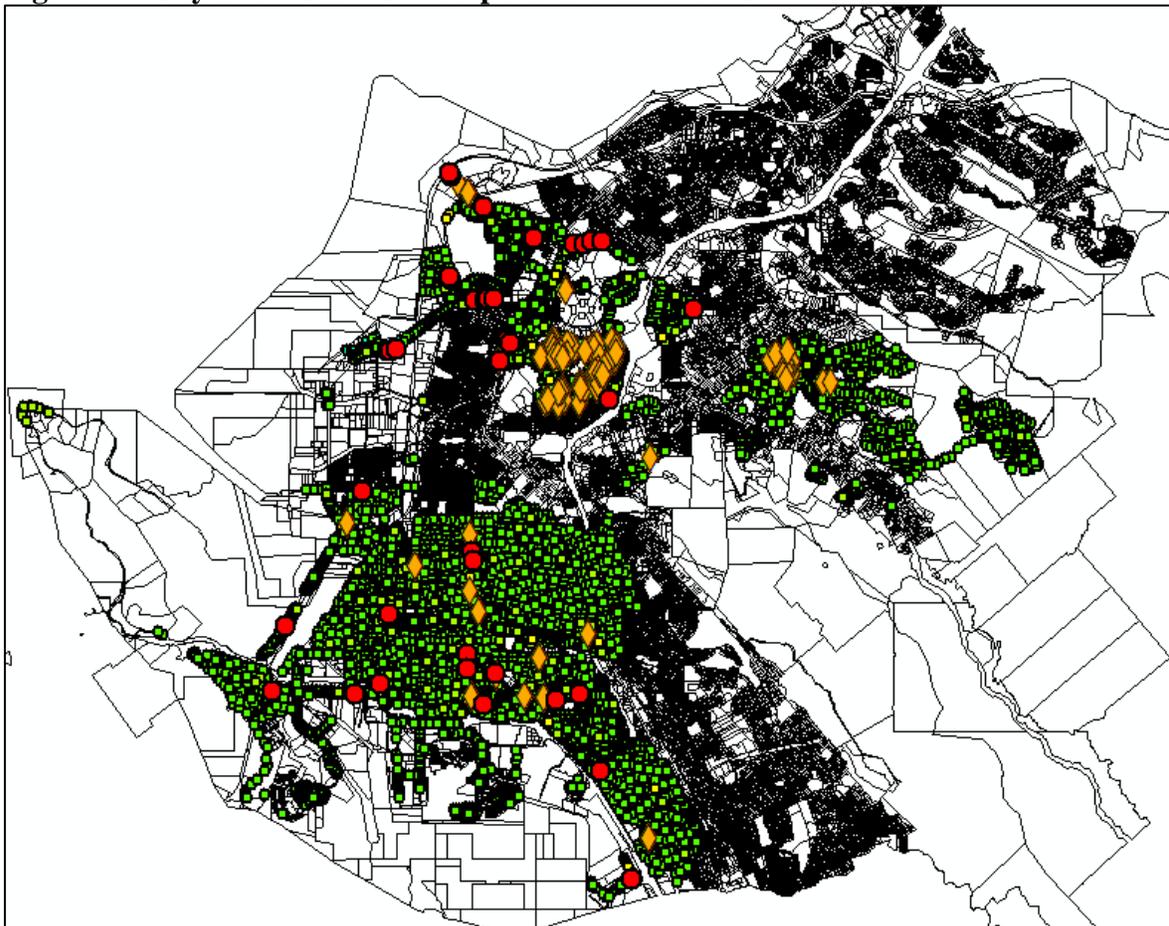
- ❖ There are 7,113 poles in the existing database whose locations were confirmed and conditions assessed

- ❖ There are 220 poles found that were not in the database, and were assessed and added
- ❖ There are 27 pole foundations found with no poles standing or poles knocked down.
- ❖ There are 107 poles in the database that were not found
- ❖ There are another 1,279 County-owned poles

A large format version of Figure 4 (and all subsequent figures generated from GIS mapping) was also delivered to City staff under separate cover.

It is possible that the 107 poles that were not found are included in the 182 that were added. This might be the case if the GPS coordinates were incorrect in the original database, or if a pole had been knocked down and replaced at a different location since the original database was built. In total, the locations and condition of 7,360 City- or PG&E-owned poles were either confirmed, updated, or entered new in the GIS database. A grand total of 8,639 poles are included in the database with the County-owned poles added in.

Figure 4 – City and PG&E Owned poles and conditions



Legend: Green dot = pole in good condition, Yellow diamond = pole is poor but serviceable condition, Red circle = pole in poor condition and needing replacement

The poles with a rating of 5/Very Poor are shown in Figure 4 with red circles. These poles are significantly dented, rusted, or missing. The locations of these poles are shown in the

appendix. City staff have indicated that several fiber glass poles in the Marina area have severely rusted steel bases. These bases are completely covered by the ornamental base cover and were not visible to Republic ITS field staff. The poor condition of these poles is not reflected in the survey results. Poles with 4/Poor ratings are also shown in Figure 4. These poles might have visible dents but are still vertical, or significant rust but still pass the ‘ping’ and penetration tests.

Examples of poles with poor (4 or 5) ratings are shown in Figure 5.

Figure 5 – Explanation of poor pole ratings



Rating 4 – Extensive rust with pitting

Rating 5 – Severely dented and no longer vertical

There are also several poles that have been knocked down and not yet replaced. These pole locations are shown in Table 1.

Table 1 – Locations of Knocked-down Poles

Location	Pole Type	Pole Height (ft)
Berk Ave Opp 527	Steel	25-29
S/S Wendell Ave 1 Pole E/O 23rd St	Steel	25-30
W/S Eight St 1 Pole S/O Nevin Ave	Unknown	30-34
S/S Rober H Miller Dr 200' E/O San Pablo Ave	Unknown	Other
S/S Rober H Miller Dr 340' E/O San Pablo Ave	Unknown	Other
Richmond PKWY EXT 3/P/W/O Lakeside Dr	Steel	25-29
Richmond PKWY 1/P/E/O Lakeside Dr	Unknown	Other
Richmond PKWY 1/P/E/O Lakeside Dr	Unknown	Other

Location	Pole Type	Pole Height (ft)
Richmond PKWY 3/P/E/O Lakeside Dr	Unknown	Other
Richmond PKWY 3/P/E/O Lakeside Dr	Unknown	Other
23rd St Center Island 1/P/N Ohio	Unknown	Other
23th St Center Island 1/P/N Ohio	Unknown	Other
S/S Richmond PKWY 3/P/E/O Gate 98	Steel	35-39
S/S Richmond PKWY 3/P/E/O Goodrick	Steel	30-34
S/S Richmond PKWY 4/P/E/O Goodrick	Unknown	Other
S/S Richmond PKWY 7/P/E/O Goodrick	Unknown	Other
S/S Richmond PKWY **	Steel	30-34
S/S Richmond PKWY 11/P/E/O Interchange	Unknown	Other
S/S Richmond PKWY 13/P/E/O Interchange	Unknown	Other
S/S Richmond PKWY 30/P/W/O Hill Top Dr	Steel	30-34
S. 26th 4/P/W/O S. 28th	-	-
WS S45th 10N/Cutting	Concrete	25-29
Center Island Carlson 1 N/O SO 28TH St	Steel	25-29
Center Island Carlson 1 N/O SO 28TH St	Steel	25-29
WS S23rd Opp Welcome Ave	Steel	25-29
Central 100 W/Rydin	Unknown	25-29
Central 100 W/Rydin	Unknown	Other
Bayview 25' W/O Hartnett	Concrete	25-29
Note: ** = Pole still at site, pole number 12993. Other pole numbers are unavailable. Pole data shown is repeated from previous City database, and the data was not verified in the field.		

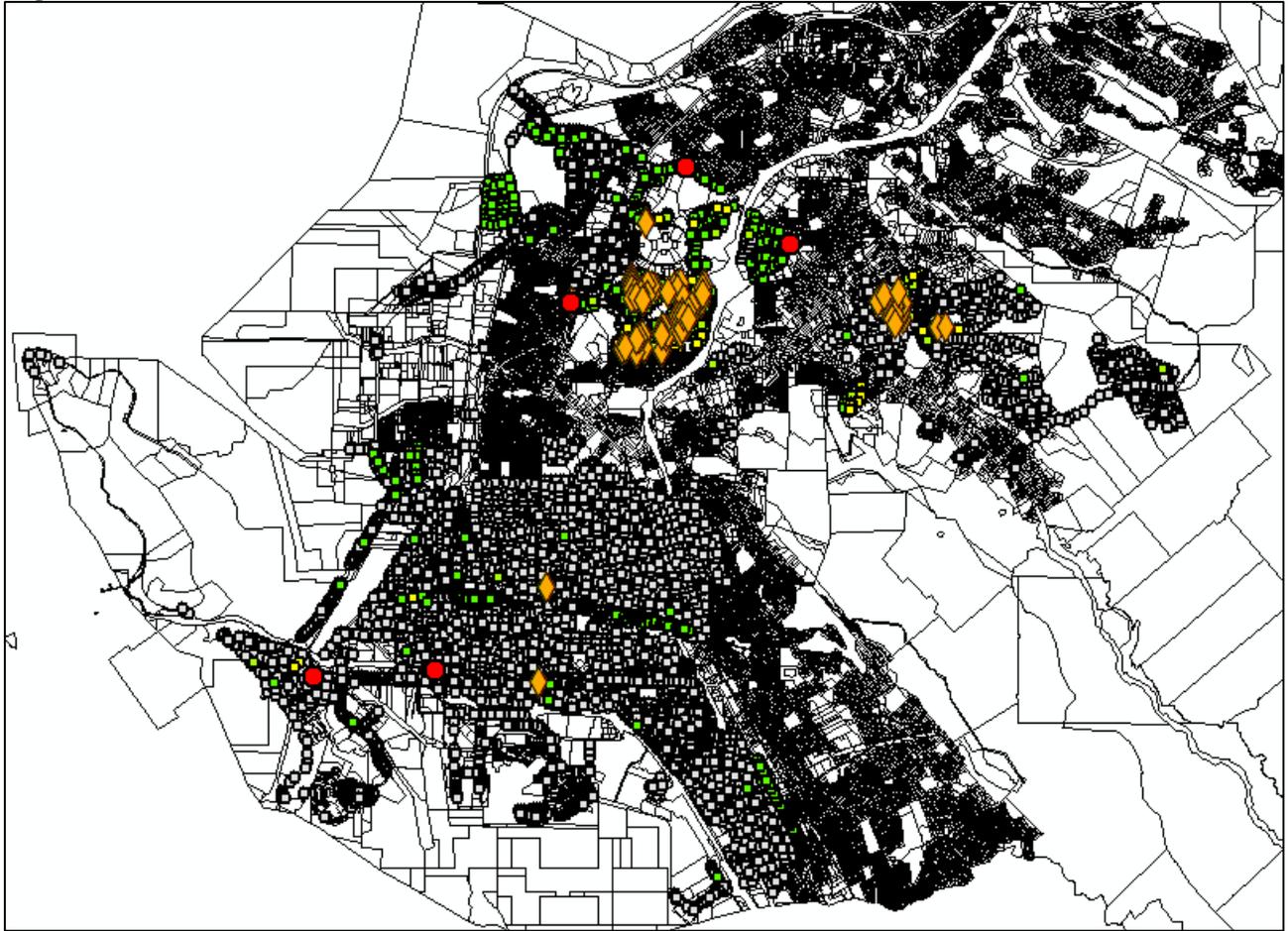
Paint Ratings

Only a small percentage of the streetlight poles in Richmond have been painted. Many that have are old steel poles, often with significant rust. They appear to have been painted to cover the rust and marginally extend the pole life. Almost all poles of this type have a Poor rating for paint, since the rust typically bleeds through the paint.

Another large group of painted poles are relatively newly installed poles, typically decorative styled with paint to match an aesthetic theme. These poles are typically in good condition.

Figure 6 shows the inventory of painted poles, with color coding to note paint condition. Note that several poles in the Fairmede/Hilltop neighborhood appear to have been repainted since the inventory was conducted, and have better appearance than the inventory suggests.

Figure 6 – Painted Poles and Conditions

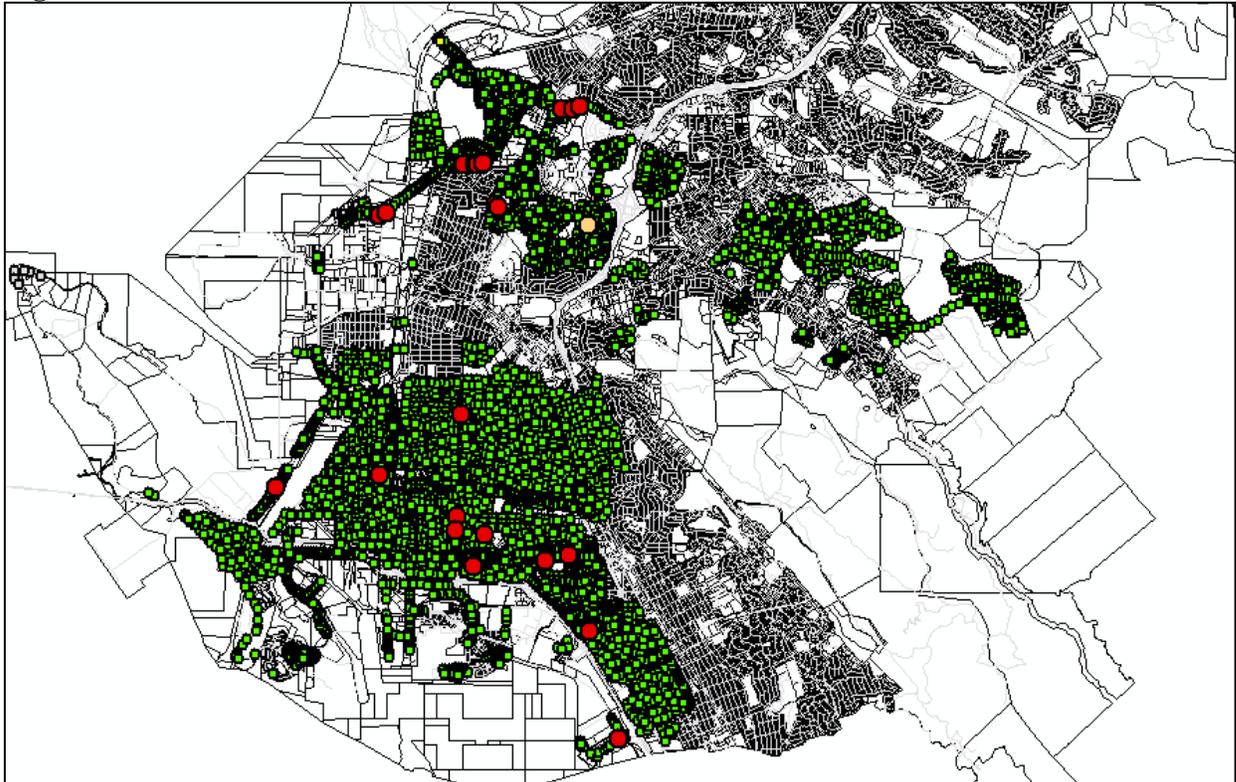


Legend: White dot = no paint or rating, Green dot = paint in good condition, Yellow diamond = paint in poor condition, Red circle = paint in very poor condition

Foundation Ratings

Poor rated foundations are identical to the locations shown in Table 2 for knocked down poles. It can be stated in general that when a pole is hit hard enough to knock down the pole, the foundation is damaged and must also be replaced. Most foundations were not visible because of a base cover plate or landscaping. These were not rated. See Figure 7.

Figure 7 – Locations of Failed Foundations



Legend: Green dot = foundation not visible (assumed to be in good condition), Yellow circle = foundation appears damaged and should be replaced, Red circle = foundation damaged and no longer useful for pole installation

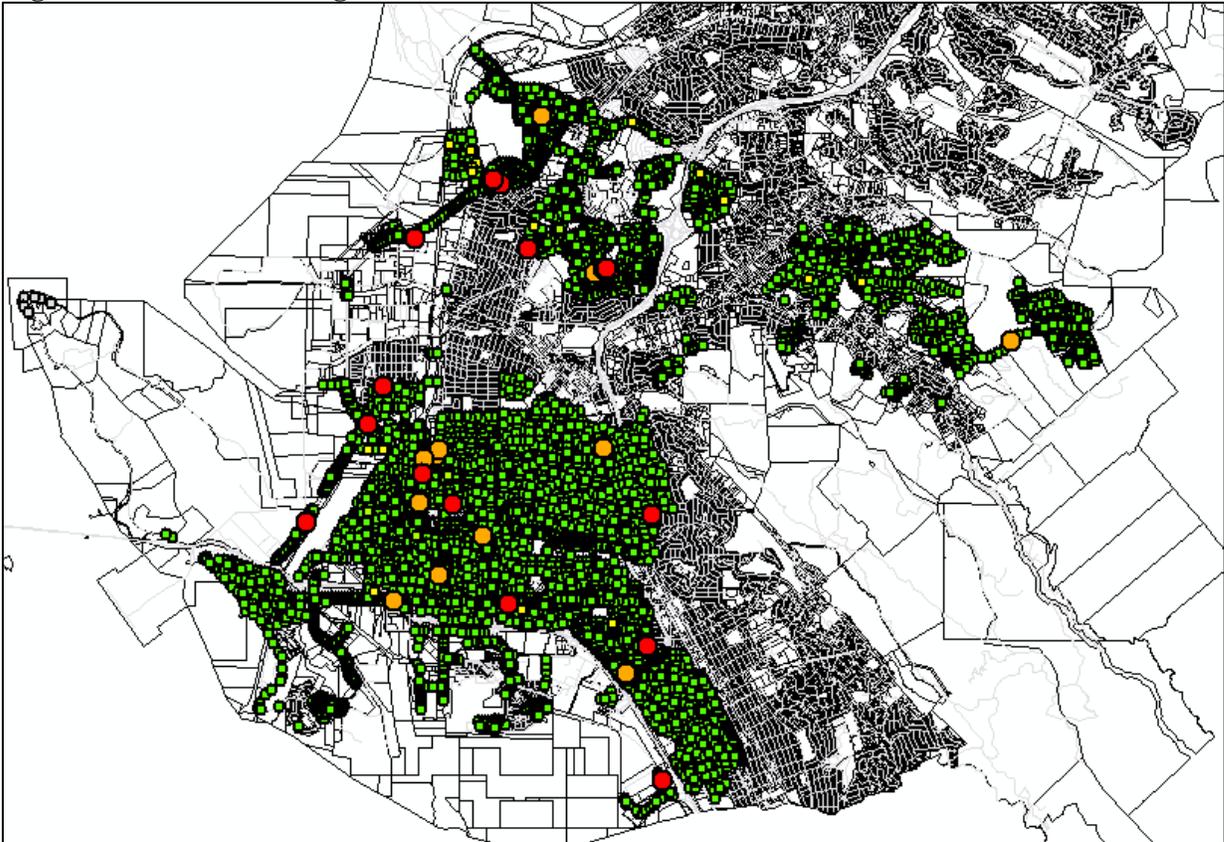
The locations of the failed foundations are also shown in Table 2.

Fixture Ratings

Fixture ratings are shown in Figure 8. Failed (rating of 5) ratings indicate broken lamp covers or lamps, shown as a large red dot in the figure. Fixtures that are due for replacement (rating of 4), shown as a large yellow dot in the figure, indicate aged and obscured glass covers or other damage.

Since the survey was conducted in daylight hours, the ratings do not show lamps that are burned out, or the large number that are not functioning because of wire theft (discussed later in this SLMP).

Figure 8 – Fixture Ratings

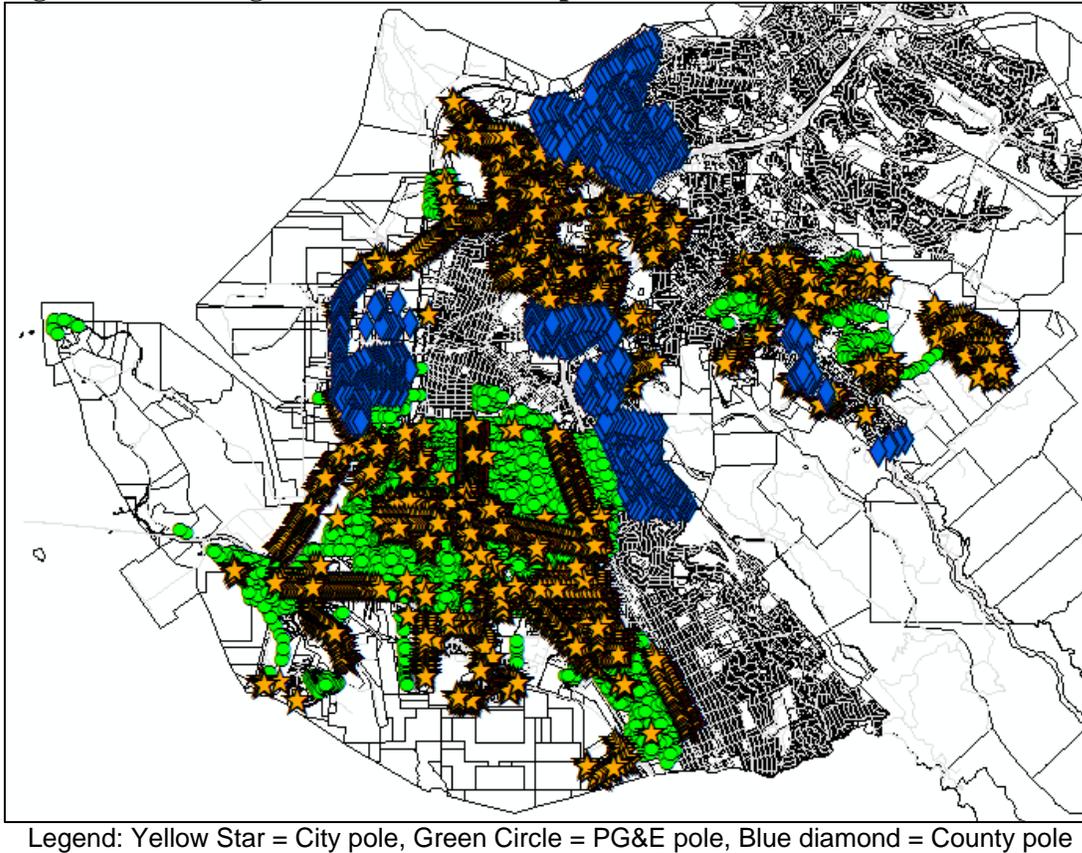


Legend: Green circle = fixture intact, Yellow circle = fixture damaged, Red circle = fixture extensively damaged and likely not functional

Pole Ownership

Streetlight poles within Richmond City limits are either owned by the City or PG&E. Most of the poles owned by PG&E are wood utility poles. Contra Costa County also owns poles in the unincorporated pockets within the City limits. Pole ownership is shown in Figure 9.

Figure 9 – Streetlight and Pole Ownership



The City-owned poles are generally along major street corridors, and in neighborhoods like May Valley, Hilltop Bayview, Fairmede/Hilltop, City Center, Park Plaza, and Marina Bay. PG&E-owned poles are in most other neighborhoods, and County-owned poles are within unincorporated areas.

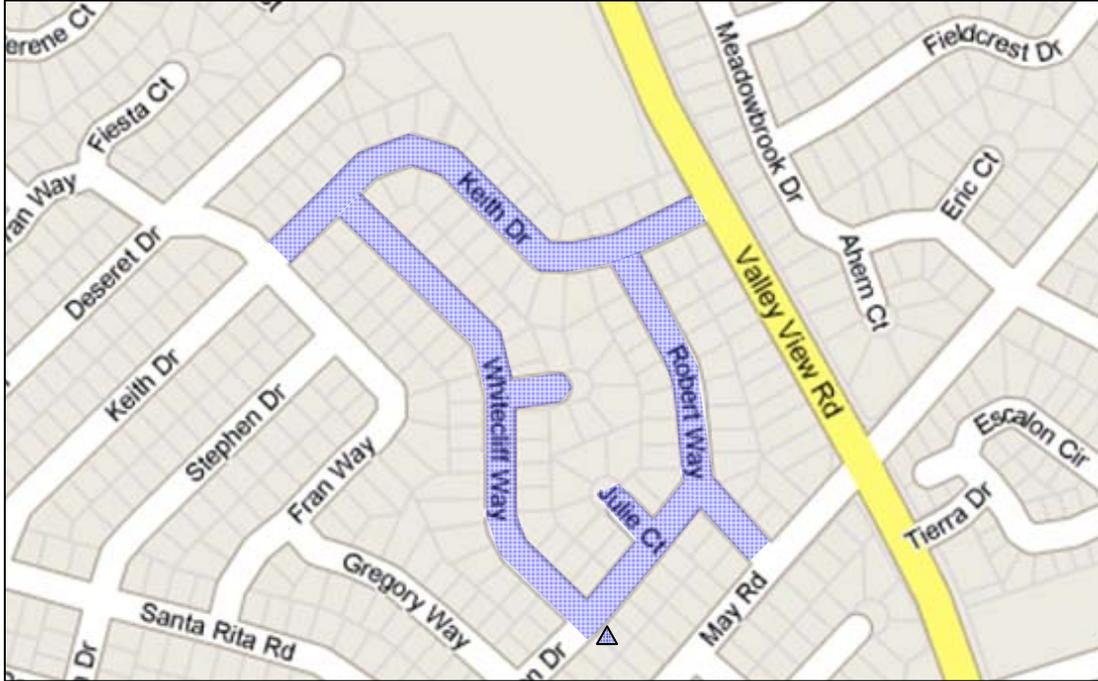
Series Circuit Lighting

Richmond has three lighting circuits that are configured as Series Circuits. This is a type of electrical power circuit that was commonly used in the early and mid-1900s. It has gradually been replaced by a power circuit called Multiple Circuit as lighting technology improved, particularly the part of a streetlight fixture called the ballast. Although Series Circuits are still used today by many agencies, it is considered more expensive to install and maintain than Multiple Circuit lighting. The cost of maintaining Series Circuit lighting is also increasing as replacement parts become less readily available and more expensive.

The neighborhoods are called Park Plaza, Park View, and May Valley, and are shown in Figures 10, 11, and 12, respectively.

The Park View neighborhood contains about 46 streetlights and pull boxes and 8,000 feet of conduit. Using information in the Park Plaza bids recently opened by the City, the expected cost to upgrade the Park View lighting is \$629,000. The result will be a state of the art LED lighting system.

Figure 12 – May Valley Neighborhood Series Circuit



The May Valley neighborhood contains about 28 streetlights and pull boxes and 4,500 feet of conduit. Using the same unit costs as above yields a cost of \$363,000 to upgrade these lights to a state of the art LED lighting system.

CURRENT LIGHTING DESIGN STANDARD

Like many cities in northern California, Richmond does not have a comprehensive standard for the design of streetlight spacing or lighting levels. The City has adopted two Standard Plans which focus on streetlight pole requirements and typical layouts, but do not address lighting level requirements. The City Municipal Code also contains the following text:

15.04.840.040 Lighting and Glare Standards. All lighting, reflective surfaces or any other sources of illumination shall be utilized in a manner which produces no glare on public streets or on any other parcel. Lights shall be shielded at lot lines so as not to be directly visible from an adjoining residential district.

15.08.610 Design standards--Street lighting.

1. LIGHTING REQUIRED. Adequate lighting shall be provided in all subdivisions along all streets, paths, private streets, and other pedestrian or vehicular ways.

2. MATERIALS. Street lighting standards shall be as shown on the city standard plans. Path lighting standards shall be as approved by the director of public works. Either a pull box or a street lighting standard with a handhole shall be placed at all sharp bends in the conduit, or every two hundred feet on straight runs of conduit.

3. ILLUMINATION INTENSITY. Spacing of street lighting standards shall be approved by the director of public works. Size of luminaires and length of mast arms shall be as shown on the city standard plans. The average illumination as determined by the director of public works shall be 1.0 foot-candle for major arterials, 0.6 foot-candle for collector streets, 0.4 foot-candle for minor streets, and 0.2 foot-candle for paths.

About half the streetlighting in Richmond is lights on PG&E poles. The pole layout was most likely determined based on electricity-distribution needs, and not on criteria such as average illumination. Lighting on other Richmond streets with City-owned poles may have been designed based on lighting levels, or with Contra Costa County standards, which in the past (at the time the lighting systems were installed) used a look-up table that provided light wattage and pole spacing based on street type and curb-to-curb width.

Lighting in more recent subdivisions in Richmond may have used a national standard such as the American National Standards Institute/Illuminating Engineering Society (ANSI/IES) Recommended Practice-8 (RP-8) (July 2000) guideline. If so, however, this would not necessarily have been because of City requirements but instead would have been good design practice by the subdivision designers.

A recommended standard for streetlighting in Richmond is discussed later in this SLMP.

PUBLIC WORKS INPUT

The City of Richmond maintains their own streetlights via the Public Works Operations and Maintenance Division. City input is summarized from an interview with Cornell Hughes, Electrical Supervisor, conducted on July 1, 2010. Staff available for streetlight maintenance currently consists of the Supervisor, who works about 20-25 percent of his time on streetlights, and one full time electrician. There is one unfilled electrician position, plus three more electrician positions requested. If all were filled, one new electrician would be dedicated full time to streetlight maintenance and a second would be half-time on streetlights and the other half on other electrical systems.

Important challenges facing the Division are summarized as follows:

- ❖ Wire theft: the City has a significant ongoing problem with wire theft. Streets such as Richmond Parkway, Castro Street, and areas within the Marina are frequently vandalized. These streets typically do not have adjacent land uses with direct views of the streetlights, which may allow vandals to believe in a low risk of being caught.
- ❖ Aging streetlight equipment: certain areas of the City have old streetlight installations that are near or past their design life (the amount of time the equipment is expected to last before complete replacement is required). These include the

Fairmede subdivision near Hilltop, portions of Auto Plaza, portions of the Civic Center Plaza area that have not already been upgraded by Redevelopment projects, and portions of the Marina.

- ❖ Lack of staffing: The Division currently has 1.0 full time equivalent (FTE) electricians and has requested 2.5 electricians to perform streetlight maintenance.
- ❖ Aging maintenance equipment: Two essential pieces of equipment for streetlight maintenance are the bucket truck and crane. The City very recently purchased a dual function truck which addresses this lack. However, the older equipment previously in use frequently broke down and hampered the City’s ability to complete maintenance. The high number of knocked down poles that had not been replaced can be attributed to equipment failures.

Individual items are discussed in the following sections.

Wire Theft

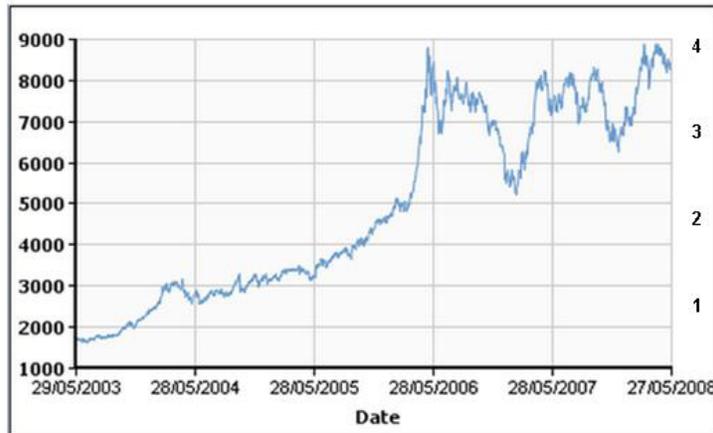
The primary motivation for wire theft may be the salvage value of copper. As the value of copper increases, wire theft can become more prevalent. Wire theft appears to be a random type of crime: random in the sense that is it not organized, and catching one thief does not necessarily stop the problem. Figure 13 shows the locations within Richmond that have been sites of wire theft over the last year.

Figure 13 – Wire Theft Locations in Richmond



Figure 14 shows a graph of increasing copper prices over the last several years. The graph makes clear how scrap copper value has increased in parallel with the frequency of wire theft in recent years. The graph ends in 2008, but values have hovered between \$3 and \$4 per pound since.

Figure 14 – Value of Scrap Copper



Note: 9000 = dollars per metric tonne, 4= dollars per pound

To more fully understand the attraction, #8 AWG wire (commonly used in streetlight circuits) weighs about 50 pounds per 1,000 feet of wire, and the majority of the weight is the copper. Thieves can strip 3#8 wires from about 600 feet of conduit (roughly the length between three streetlights) and sell it for \$200.

The Richmond Operations & Maintenance Division and the maintenance arm of Republic ITS (in other jurisdictions) have tried several approaches to deter wire theft with varying levels of success. They are summarized in Table 2, along with discussion of costs to implement.

Table 2 – Summary of Wire Theft Prevention Strategies

Approach	Unit Cost	Notes
1. No change from current installation standard, limit maintenance actions to only replacing wires, or Replace Only.	\$400 per 100 feet, for wires and installation to replace loss from theft.	Common approach for agencies to take when wire theft is infrequent
2. Caulk lid with adhesive caulk	\$25 per lid	Mild deterrent, can be effective in highly visible areas because it increases the time required to steal wires
3a. Install locking pull box lid	\$125 per kit (materials only)	All three must be completed together for maximum effectiveness. 3c is not required when pull boxes are already set within the sidewalk paving.
3b. Replace lid with reinforced lid	\$75 per lid (materials only)	
3c. Set PB in concrete	\$500 per box (concrete plus labor)	
3. Subtotal for Reinforced Pull	\$200 per pull box in	

Approach	Unit Cost	Notes
Boxes	sidewalk, \$700 per pull box in dirt	
4. Replace pull box with traffic rated box, spot weld lid shut, or Welded Pull Boxes	\$500 (materials), \$200 (labor), plus \$500 to reset pull box in concrete	Required box to be set in concrete if not currently within sidewalk. Most effective deterrent, also causes the least difficulty for regular maintenance activity.
5. Seal off wires and conduit ends, fill box with concrete slurry	\$100 per box.	Mild deterrent, can be effective in highly visible areas because it increases the time required to steal wires. Makes maintenance tasks very difficult to accomplish afterwards.
6. Cover pull box with concrete or asphalt	\$120 per box	Mild deterrent, requires extra time and noise for thieves to break through concrete. Makes maintenance tasks very difficult to accomplish afterwards.
7. Install alarm that will send text message to PD when circuit is cut	NA	Effectiveness depends on availability of officer. Can be very effective for apprehending thieves. Extensive use may overload PD resources.
8. Fix conductors to conduit in pull boxes with expandable foam or other sealant.	\$50 per box	Unknown effectiveness, not yet field tested. Makes wire replacement very difficult to accomplish afterwards.
9. Retrofit with solar-LED fixtures	~\$5,000 per fixture	Richmond is trying out this equipment in City Parks. However, battery technology does not currently allow this option for replacing lights with more than 100W. Most SLs on Richmond arterials are 200W or larger.

For discussion purposes, the comparison shown in Table 2 can be applied to a hypothetical 1,000 foot street segment with a single conduit and a total of six poles and pull boxes. The comparison is provided for the most common and effective strategies: 1, 3, 4, and 9.

- ❖ Replace Only – spend \$4,000 each time the wires must be replaced
- ❖ Locking pull boxes - \$8,200 for upgrade and replacement after wires are stolen (includes \$4,000 for wire replacement)
- ❖ Welded pull box - \$11,200 for upgrade and replacement after wires are stolen (includes \$4,000 for wire replacement)
- ❖ Solar powered streetlights - \$30,000 (for 6 fixtures, not an option in all areas)

If wires in all the affected areas were being stolen and replaced only twice a year, the Locking pull box option would pay for itself within a year and would clearly be a more desirable choice than the Replace Only option. Similarly, the Welded pull box option would pay for itself in two years. Clearly, Replace Only is not a good option.

More specific to Richmond, the portion of Richmond Parkway that is particularly prone to wire theft is about 5.5 miles long or 30,000 feet. The other areas of the City that are also prone to wire theft (see Figure 12) add about another 50,000 feet, for a total of 80,000 linear feet of streetlight circuit that is prone to wire theft. In general, these are located on streets with no adjacent land use “looking” directly at the lights.

The City could be currently spending about \$320,000 replacing wires each time they are stolen. The Reinforced Pull Boxes option would cost \$336,000 more than Replace Only. The Welded Pull Box option would cost \$576,000 more than Replace Only.

City staff estimate that if wires were quickly replaced each time they are stolen and no upgrades were made to existing pull boxes, wire theft could be occurring at least 5-10 times per year. However, limitations in staff resources, both in terms of staff time and funding to pay for replacement wire, currently mean that when wires are stolen the lights in the affected circuits remain dark for extended periods of time.

Assuming the wire theft currently occurs 5 times per year, it would reduce to 2 times per year with Locking Pull Boxes, to once per year with welded pull boxes, and would be eliminated with solar powered lights: annual costs would be as shown in Table 3.

Table 3 – Cost of Wire Theft Prevention Strategies

Option	Annualized Cost
Replace Only	\$1.6M
Locking Pull Boxes	\$0.98M
Welded Pull Boxes	\$0.90M
Solar Powered SL ¹	\$0.5M ²
Notes:	
1. Not an option in all areas	
2. Assumes a 5-year life for equipment	

Copper theft is a pervasive issue, faced by many agencies. There is no known set of solutions that will completely eliminate the problem. For example, Republic ITS has a maintenance contract with Caltrans. One of the frequent maintenance areas includes a pump station in a rural area where large wires (AWG 2 and bigger = more copper per foot of wire than AWG 8) are in use and a pervasive wire theft issue has developed. After deploying pull box upgrades similar to those described in Table 3, the wire theft still continued. One night the thieves were evidently interrupted and left the scene quickly. Among the equipment left behind was a Bobcat tractor, capable of lifting large chunks of concrete or buried conduit out of the ground.

It is exceptionally important to note that this discussion and cost estimates are focused on areas that are currently prone to wire theft. If the City does decide to improve the infrastructure in these areas, it is likely that other areas will be targeted by wire thieves. This clearly is not a decision to make lightly.

A more radical option in some specific areas is removal of the streetlights. Streetlights are beneficial in two general roadway areas:

1. Conflict points, such as intersections, or sharp curves
2. Areas with pedestrian or bicycle activity

In portions of the roadway with a straight alignment and no intersections, driveways or pedestrian activity, lighting is optional. A well known example of this type of facility is a freeway, where lighting is generally only provided at ramps. Two other Bay Area examples are Stanley Boulevard in Alameda County, and Central Expressway in Santa Clara County. Stanley Boulevard extends from Livermore to Pleasanton, roughly parallel with I-580. Travel speeds are often above 50 mph. It has lighting at intersections but no continuous lighting between intersections (see Figure 15).

Central Expressway extends from San Jose to Mountain View, roughly parallel to Route 101. The portion in Sunnyvale has on-ramps but no signalized intersections and no driveways. It is used by bicyclists. It has no continuous lighting between interchanges (see Figure 15). Stanley Boulevard and Central Expressway are similar in design, travel speeds, and function to Richmond Parkway.

Figure 15 – Expressway Examples



Stanley Boulevard



Central Expressway

Source: Google Streetview

The key question to address before recommending lighting removal is safety, so this SLMP includes a review of accident records on Richmond Parkway. Figure 16 shows the results of that review.

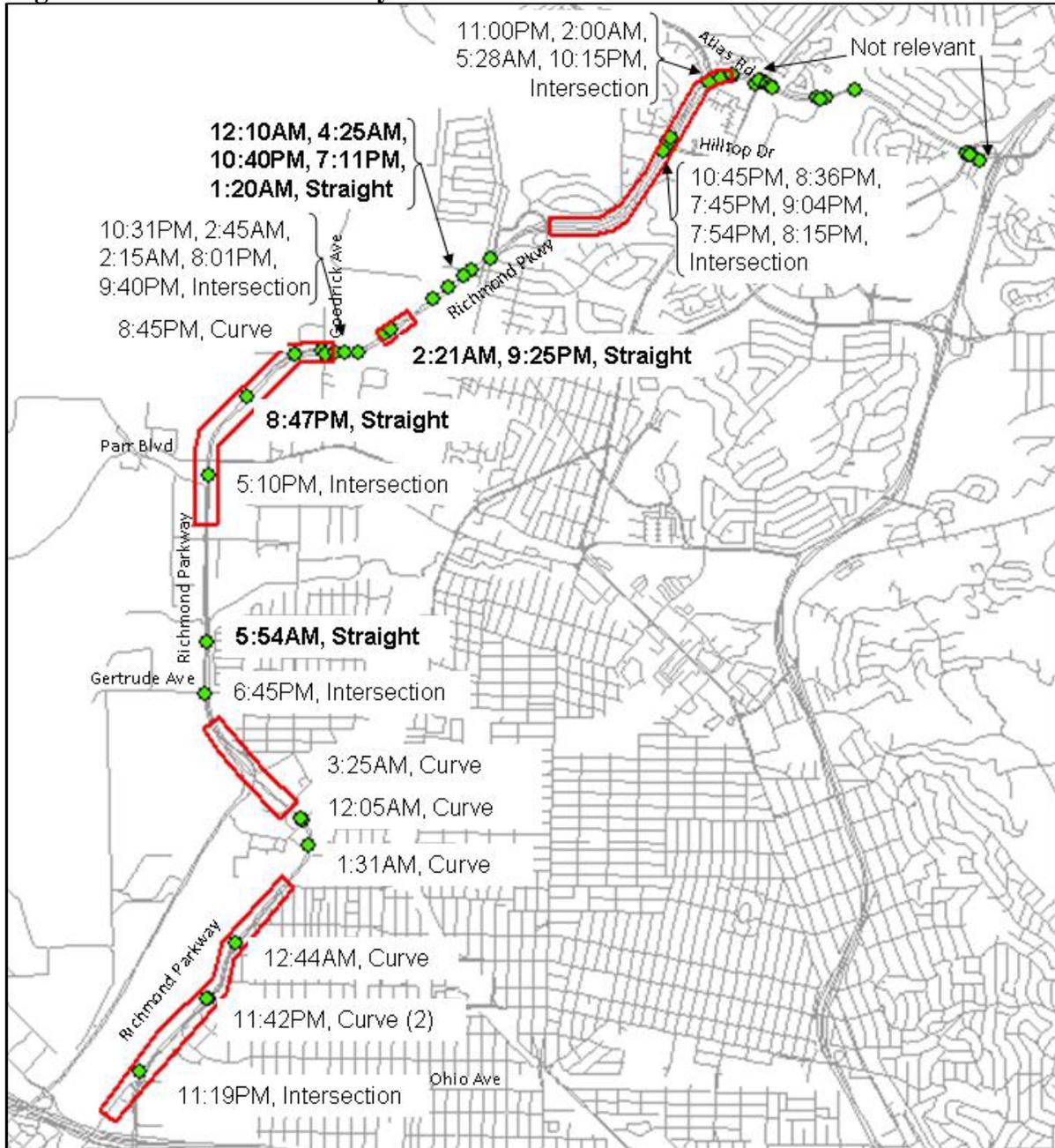
The figure shows accidents along Richmond Parkway for the most recent 12-month period available, corresponding to the months when wire theft has put streetlights out of commission. The red rectangles show the locations where lights are not functional because of wire theft. The green dots show individual (or sometimes overlapping) accident locations. Each green dot is labeled with the time of day the accident occurred and whether it is located in a straight section of road, a curve, or an intersection.

Several things are clear from a review of the figure:

- ❖ Most of the crashes occurred at intersections or curves, where streetlights should remain in place.

- ❖ The majority of the crashes occurred at night. The next largest group occurred in the evening peak hour when lighting would not be an issue.
- ❖ Four clusters of accidents are labeled in bold font, and they occurred on straight sections of the Parkway. There are 9 accidents total in this category, 6 of them occurred on segments where the streetlights are working and 3 where they are not.

Figure 16 – Richmond Parkway Crash Records



Legend: = Wires stolen, no lighting

There is a tilt in the data suggesting that lighting on straight segments is not mandatory. However, three accidents in the darkened straight sections make it ill-advised to remove all the lighting. At best, the data suggests that repairing circuits near intersections and curves can take priority over circuits in straight sections.

It is clear that the rate of wire theft in Richmond is exceptionally high and impacts a large number of streetlights. Changes in design standards are required to change this trend, and are discussed later in this SLMP.

Equipment Age

Most municipal infrastructure has a “design life”, which means the number of years the equipment is expected to be functional after it is installed.

The vast majority of streetlight poles in Richmond are galvanized steel. The galvanizing process, described in the Caltrans Standard Specifications, consists of dipping a new pole in a very large vat of liquid galvanizing material so the pole is coated on every surface inside and outside the pole. The dip process results in a higher unit price for the pole, but also in minimized rust and very long pole life.

Different sources cite greatly varying life expectancies for galvanized steel poles. Some say as low as 30 years while others say over 80 years. Several factors can reduce pole life, such as proximity to salt water (the portions of Richmond west of I-80 are considered close to the Bay), continually damp conditions at the pole base, minor vandalism, or dents (usually from errant cars).

The oldest poles in Richmond were installed in the 1940s and 1950s (Fairmede/Hilltop neighborhoods and poles within series circuits), meaning they are between 60 and 70 years old. The results of the streetlight assessment suggest these poles are well past the end of their design life, and ready to be replaced. The condition assessment data suggests the average life of a galvanized pole in Richmond is in the range of 50-60 years.

Size of Maintenance Staff

Republic ITS contacted other agencies in the San Francisco Bay Area to determine typical staffing levels for streetlight maintenance, and the results are summarized as follows:

- ❖ Oakland maintains 36,000 streetlights with 4 full time electricians and one helper, plus one supervisor
- ❖ Contra Costa County maintains streetlight poles and 100 traffic signals with about 5.5 FTE electricians. However, this same group of technicians also provides traffic signal maintenance for several cities within the County on a contract basis
- ❖ Fairfield has one electrician maintaining about 8,300 streetlights, and two electricians who maintain about 90 traffic signals. The electrician maintaining streetlights gets help from the other two for work that requires two staff.
- ❖ Vacaville has two electrical technicians maintaining 4,800 streetlights. They are currently supplementing in-house resources with electrical contractors to deal with wire theft replacement projects

- ❖ Private maintenance contractors typically budget one FTE electrician per about 10,000-12,000 streetlights for routine maintenance only, and add to that for non-routine items such as knockdowns, power issues, and wire theft

Staff responsibilities are varied and there is no clear single solution. Richmond's current staffing level, one electrician maintaining 3,735 streetlights, appears to be within a reasonable staffing range for basic maintenance only. However, Richmond also appears to have a more significant problem with wire theft and pole damage than any other agency consulted, and additional resources are necessary to deal with that issue.

POLICE DEPARTMENT INPUT

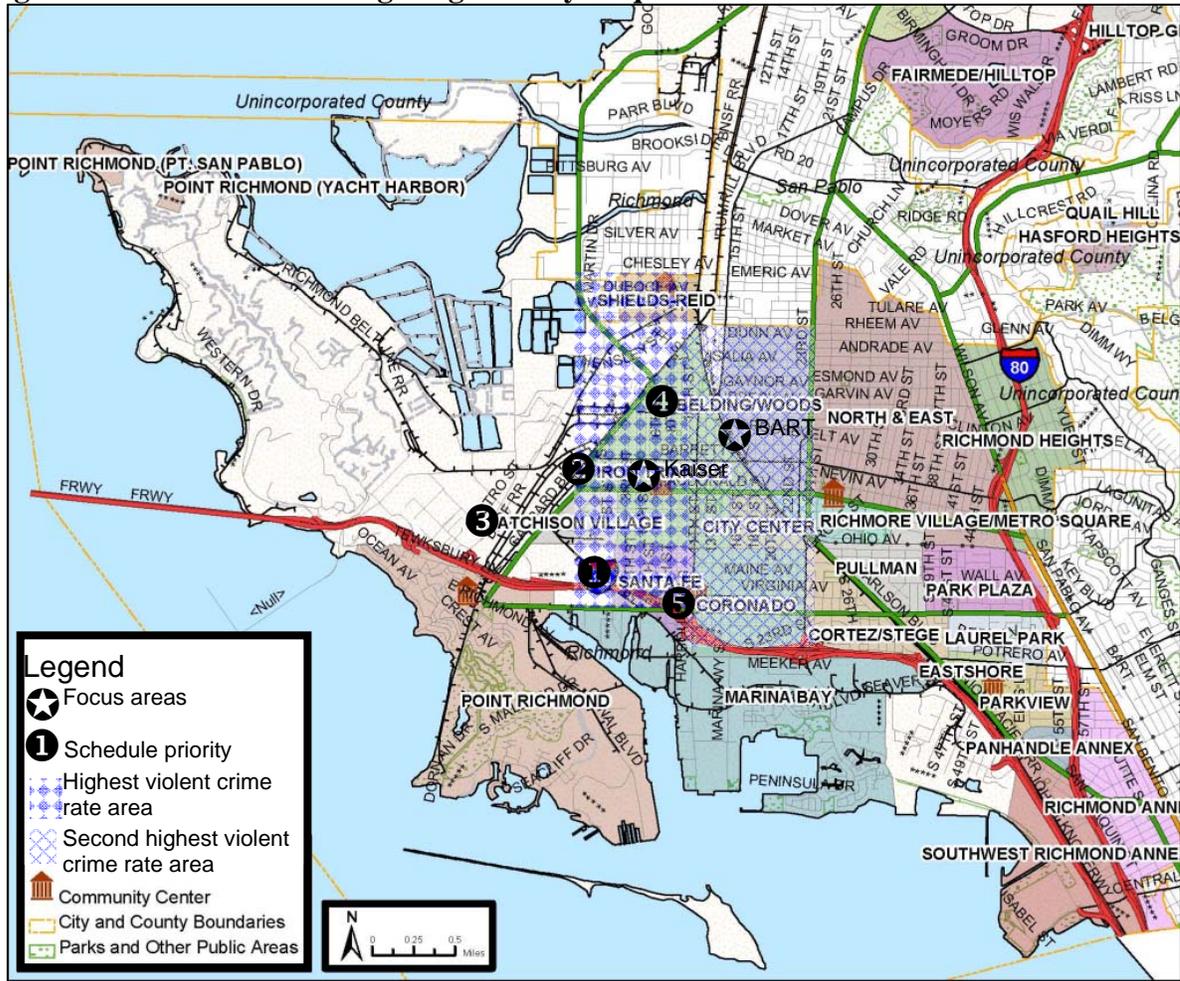
Police Department (PD) input can be central to development of a streetlight master plan as it relates to crime prevention and vandalism. The PD input is summarized from an interview with Deputy Chief Ed Medina, conducted July 8, 2010.

Improved streetlighting can help the Richmond PD solve or prevent crime in the ways summarized below:

- ❖ In high pedestrian volume areas, such as near Richmond BART station or Kaiser Richmond, improved lighting can serve as a violent crime (mugging) deterrent by helping pedestrians see and stay clear of suspicious people. New technology lighting such as LED can also help solve crime by providing better color rendering which helps more accurately identify perpetrators.
- ❖ Some criminal activity in Richmond is geographic based, such as illegal narcotics sales. Richmond PD has been installing closed circuit television to monitor crime hot spots. New technology lighting such as LED can help detect and solve crime through better color rendering, which provides better descriptions of suspects and vehicles.

Figure 17 shows a summary of high crime areas where the PD requested lighting upgrades to help prevent and prosecute crime.

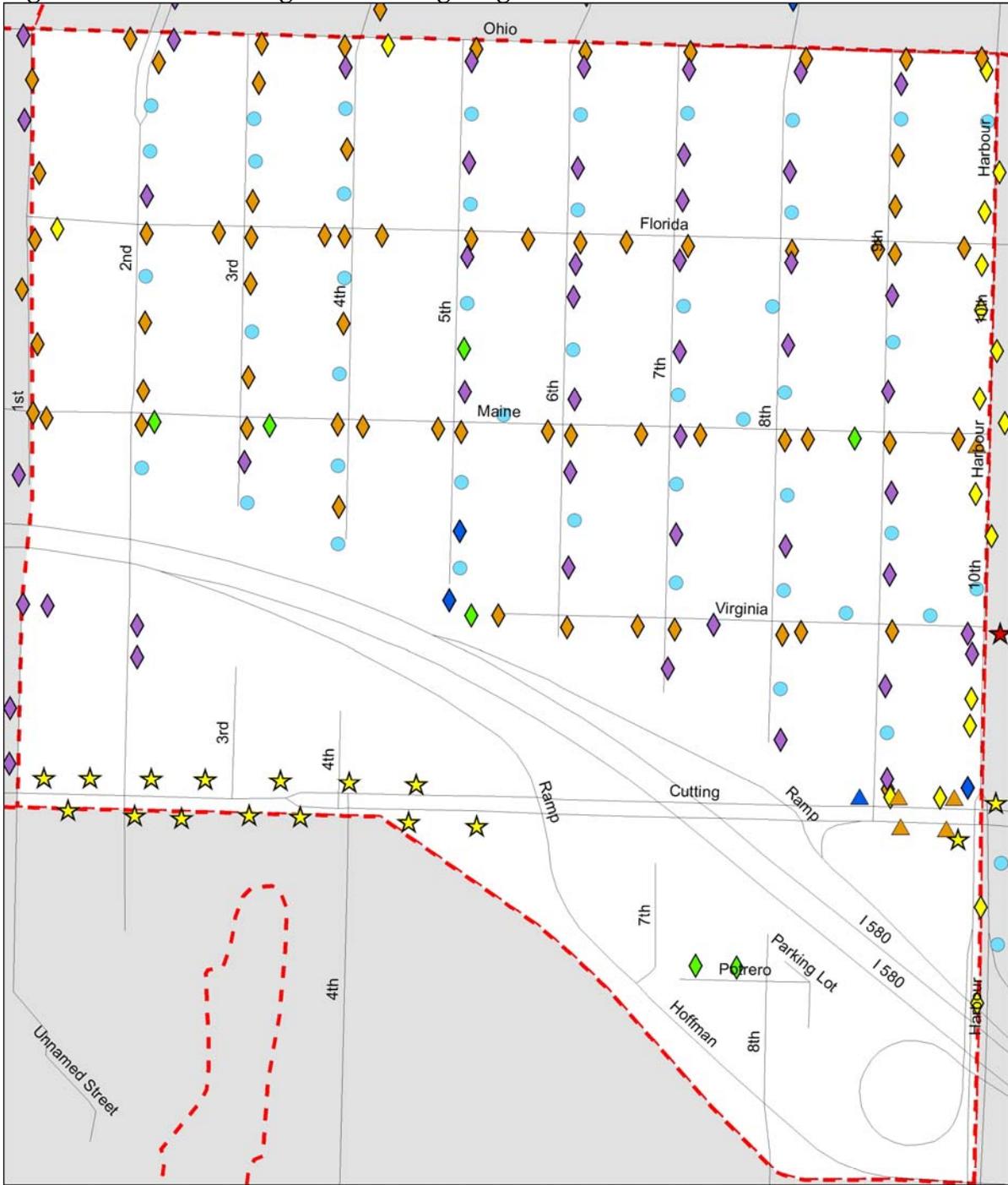
Figure 17 – Richmond PD Lighting Priority Requests



Santa Fe Neighborhood

The Santa Fe neighborhood was identified by Richmond PD as the highest priority location where streetlight upgrades may help reduce criminal activity. The lighting in this neighborhood is primarily PG&E-owned on wood utility poles, and fixtures are a variety of wattages, with more 70W than any other size. The lighting in this neighborhood is shown in Figure 18, which shows pole locations, ownership, and wattages.

Figure 18 – Santa Fe Neighborhood Lighting



PG&E Owned: ◆ = 70W ◆ = 100W ◆ = 150W ◆ = 200W ◆ = 250W ◆ = 400W ◆ = Unknown W
 City Owned: ☆ = 70W ☆ = 100W ☆ = 150W ☆ = 200W ☆ = 250W ☆ = 400W ☆ = Unknown W
 Unknown Owner: ▲ = 70W ▲ = 100W ▲ = 150W ▲ = 200W ▲ = 250W ▲ = 400W ▲ = Unknown W
 Proposed Light: ●

Note that the Santa Fe neighborhood is the portion of Figure 18 with a white background. The portions with a gray background are in adjacent neighborhoods. Lights shown on the gray background are not included in this discussion.

Nearly all the lighting in the neighborhood is PG&E-owned, on and mounted on wood utility poles. The position of the lights is most likely based on the pole location, which was selected based on distributing power to the properties in the neighborhood. A comparative review of the lighting layout shows a fairly consistent layout with a number of exceptions where gaps are evident.

The neighborhood currently contains 145 streetlights. Analysis of the gaps between poles indicates a need for another 45 streetlights. There are three likely ways to install new streetlights:

1. Ask PG&E to set an additional wood pole and streetlight. Provide power to the new light with overhead wires.
2. Install a new metal pole. Provide power to the new light by trenching a conduit from the nearest PG&E pole.
3. Install a new metal pole with a solar panel and battery. The option is viable with up to a 100W fixture.

Each option would be roughly the same cost, about \$5,000 per light. Option 3 is recommended because there would be no ongoing monthly power bill.

Upgrading the lighting to LED fixtures would be a cooperative venture with PG&E. The cost per fixture is about \$1,000 per fixture. The approximate cost for upgrading the entire neighborhood, including 50% for administration, design, and miscellaneous items, is \$555,000. ($145 \times \$1,000 + 45 \times \$5,000$ plus 50% of both = \$555,000)

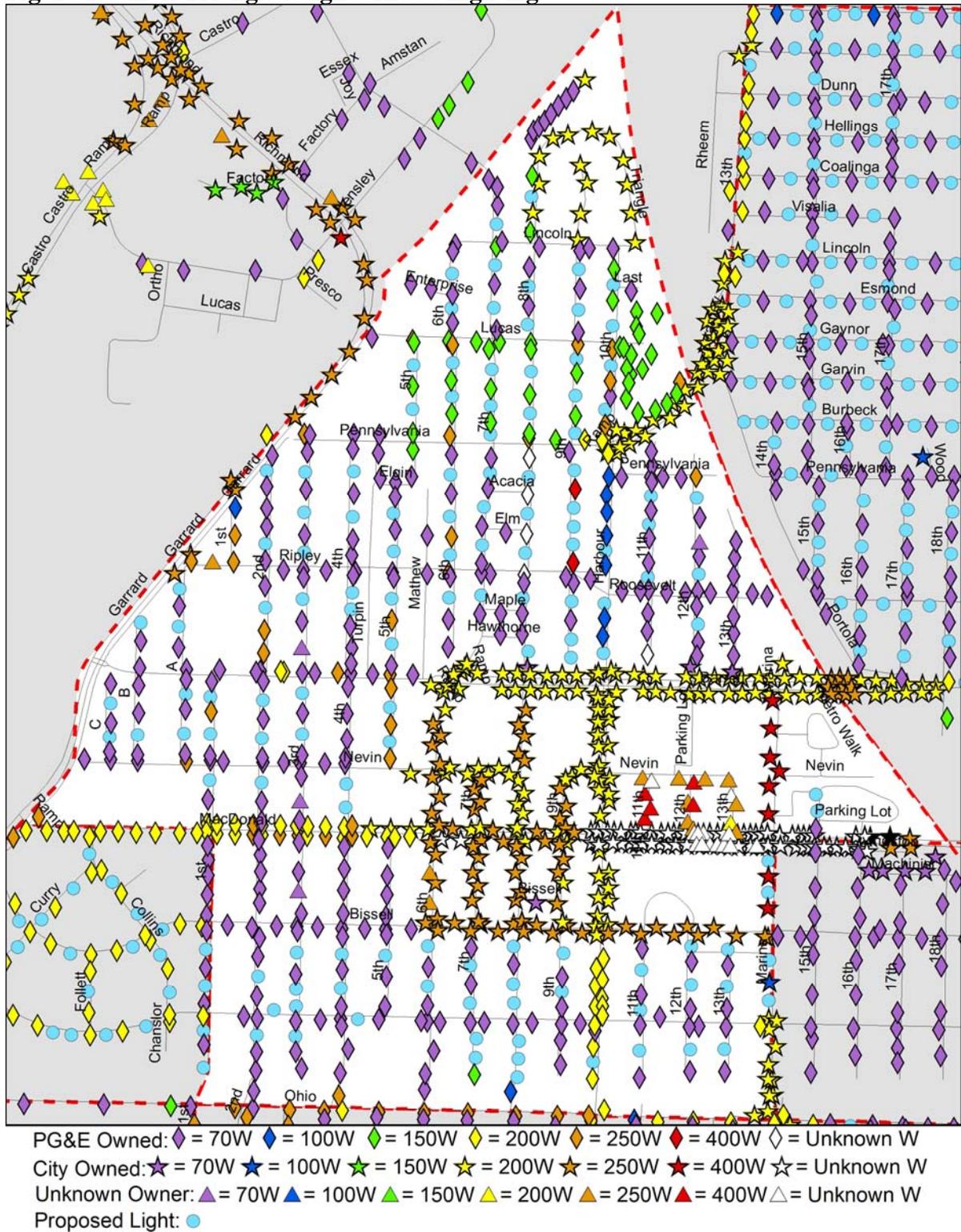
Iron Triangle Neighborhood

The Iron Triangle neighborhood was identified by Richmond PD as the second highest priority for lighting upgrades. It is shown in Figure 19.

In parallel with the discussion for the Santa Fe neighborhood, the Iron Triangle neighborhood has 796 existing streetlights, and a cursory analysis indicates the need for 131 additional. The approximate cost for upgrading the entire neighborhood is \$2,176,500. ($796 \times \$1,000 + 131 \times \$5,000$ plus 50% of both = \$2,176,500)

Note that the Iron Triangle neighborhood is the portion of Figure 19 with a white background. The portions with a gray background are in adjacent neighborhoods. Lights shown on the gray background are not included in this discussion.

Figure 19 – Iron Triangle Neighborhood Lighting

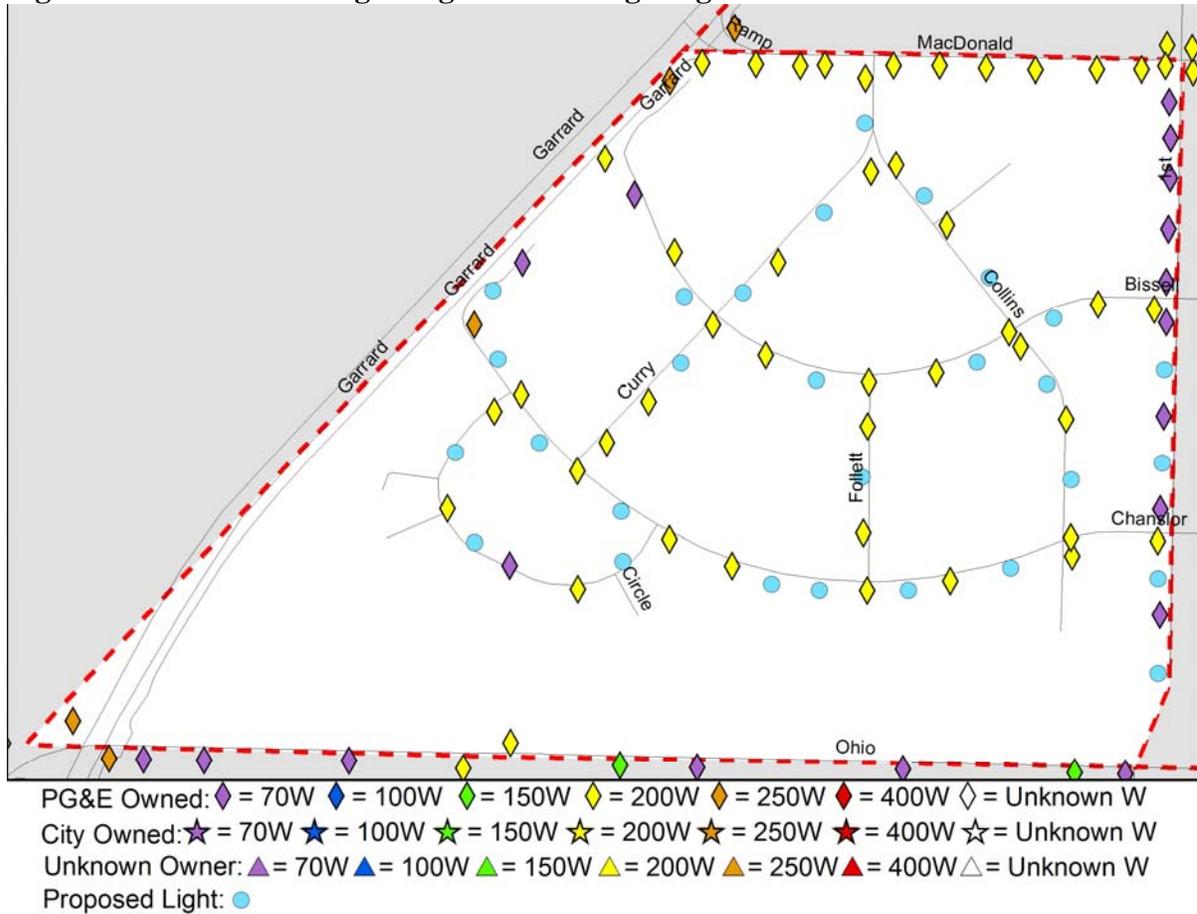


Atchison Village Neighborhood

The Atchison Village neighborhood was identified by Richmond PD as the third highest priority for lighting upgrades. It is shown in Figure 20.

Note that the Atchison Village neighborhood is the portion of Figure 20 with a white background. The portions with a gray background are in adjacent neighborhoods. Lights shown on the gray background are not included in this discussion.

Figure 20 –Atchison Village Neighborhood Lighting



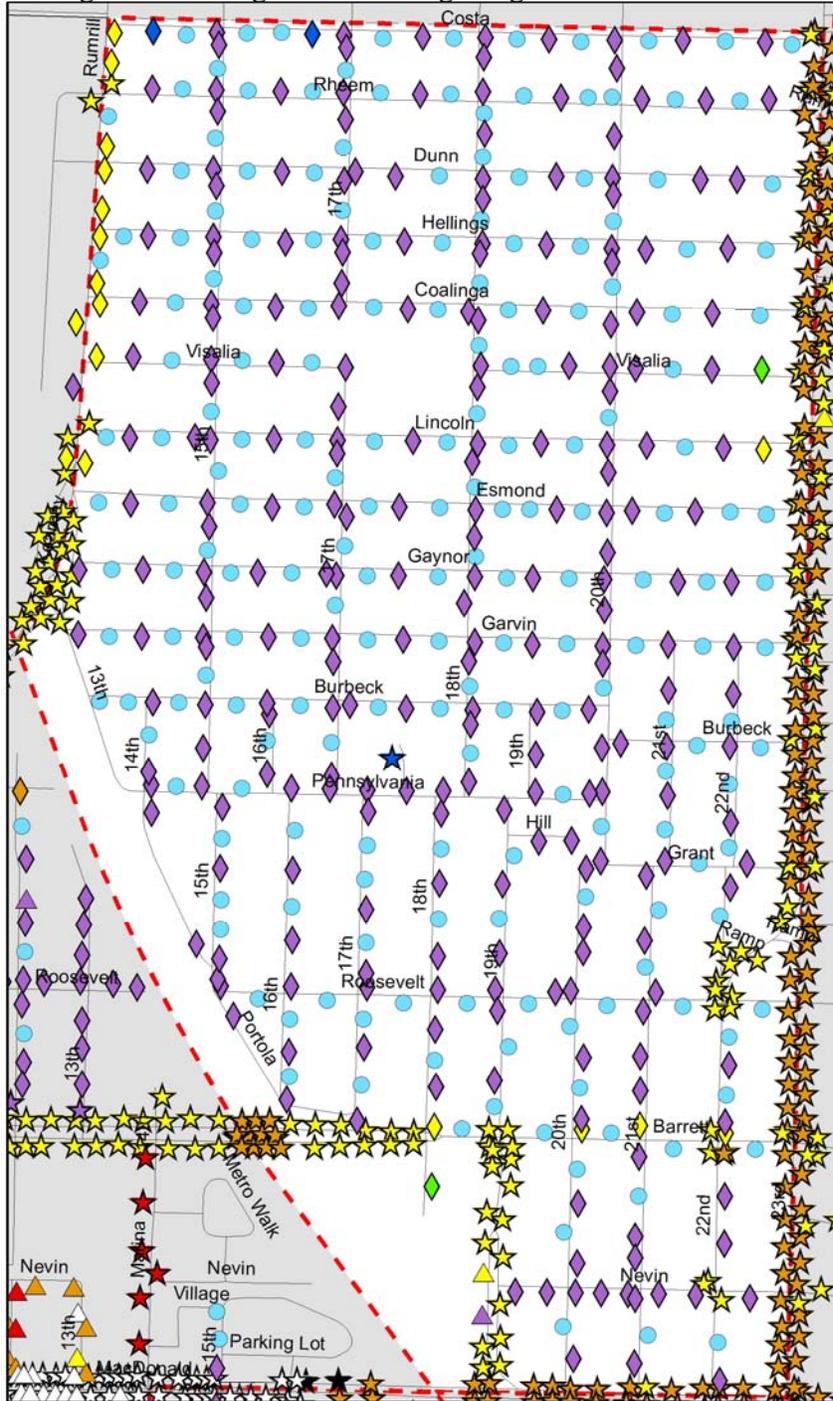
The neighborhood has 59 existing streetlights, and a cursory analysis indicates the need for 28 additional pole and fixtures. The estimated cost for upgrading the entire neighborhood is \$411,000.

Belding/Woods Neighborhood

The Belding/woods neighborhood was identified by Richmond PD as the fourth highest priority for lighting upgrades. It is shown in Figure 21.

Note that the Belding/Woods neighborhood is the portion of Figure 21 with a white background. The portions with a gray background are in adjacent neighborhoods. Lights shown on the gray background are not included in this discussion.

Figure 21 –Belding/Woods Neighborhood Lighting



PG&E Owned: ◆ = 70W ◆ = 100W ◆ = 150W ◆ = 200W ◆ = 250W ◆ = 400W ◇ = Unknown W
 City Owned: ☆ = 70W ☆ = 100W ☆ = 150W ☆ = 200W ☆ = 250W ☆ = 400W ☆ = Unknown W
 Unknown Owner: ▲ = 70W ▲ = 100W ▲ = 150W ▲ = 200W ▲ = 250W ▲ = 400W ▲ = Unknown W
 Proposed Light: ●

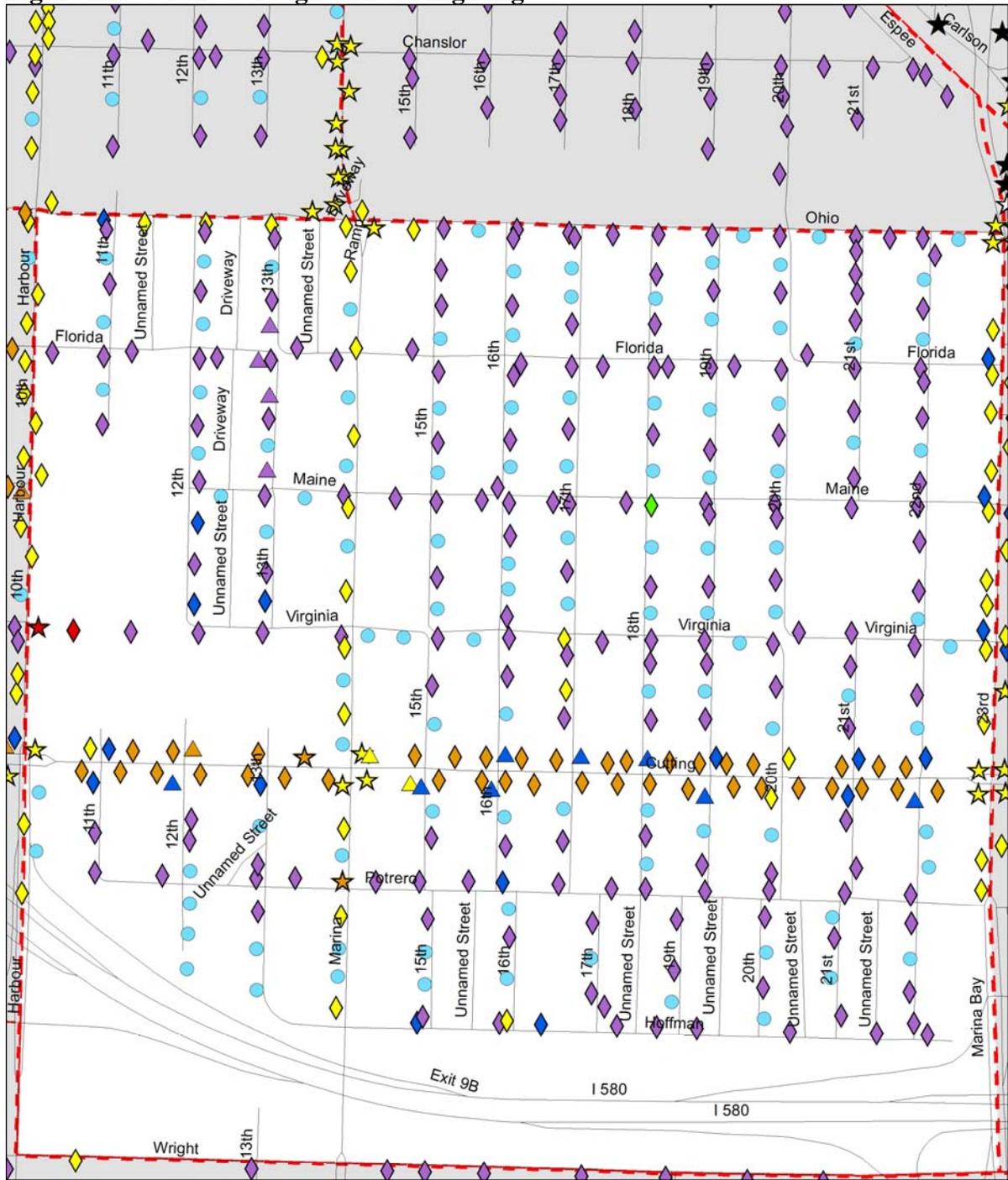
This neighborhood has 414 existing streetlights, and a cursory analysis indicates the need for 197 additional. The estimated cost for upgrading the entire neighborhood is \$2,098,500.

Coronado Neighborhood

The Coronado neighborhood was identified by Richmond PD as the fifth highest priority for lighting upgrades. It is shown in Figure 22.

Note that the Coronado neighborhood is the portion of Figure 22 with a white background. The portions with a gray background are in adjacent neighborhoods. Lights shown on the gray background are not included in this discussion.

Figure 22 – Coronado Neighborhood Lighting



PG&E Owned: ◆ = 70W ◆ = 100W ◆ = 150W ◆ = 200W ◆ = 250W ◆ = 400W ◆ = Unknown W
 City Owned: ☆ = 70W ☆ = 100W ☆ = 150W ☆ = 200W ☆ = 250W ☆ = 400W ☆ = Unknown W
 Unknown Owner: ▲ = 70W ▲ = 100W ▲ = 150W ▲ = 200W ▲ = 250W ▲ = 400W ▲ = Unknown W
 Proposed Light: ●

This neighborhood has 291 existing streetlights, and a cursory analysis indicates the need for 105 additional. The estimated cost for upgrading the entire neighborhood is \$1,224,000.

BART/Metro Village Vicinity

The Richmond BART station is located just east of the Iron Triangle neighborhood between Barrett Avenue and Macdonald Avenue. The BART station has entrances on the east and west side of the tracks. Most of the parking is to the east, and the transit hub and Metro Village are to the west. Richmond PD has noted a concern about muggings of BART patrons walking to and from the Metro Village development. Metro Village is within the Iron Triangle neighborhood.

Lighting within Metro Village is privately-owned, as are the streets. It is therefore outside the scope of this study. Figure 23 shows Nevin Plaza, the main corridor leading to the Village from the BART station. The corridor is very well lit, and the pedestrian-scale lights shown in Figure 20 are supplemented by lighting on the front of each house.

Figure 23 – Existing Metro Village Lighting (looking west)



Lighting along Marina Way, the west edge of the development, is a different issue. There does not appear to be any lighting provided by the development except small lights on the front of each house. The City-owned lighting consists of 70W or 400W ‘cobra-head’ lighting on poles that are located along the east side of the street.

Figure 24 shows Marina Way. In theory, the 400W lighting should be more than adequate. However, the cobra-head lighting (visible on the left side of the photo) is all surrounded by foliage of the large adjacent Sycamore trees. The SLMP recommends installation of pedestrian level lighting on these poles. There are five streetlight poles along the west side of Marina Way. At a cost of about \$3,000 and 50% markup, the total project cost is \$22,500.

Also, there is another line of street trees between these lights and the sidewalk on the east side of the street, so the sidewalk is not well illuminated at night. However, since the sidewalk is on private property, this SLMP does not include recommendations for

enhancements. Instead, we recommend the City contact the homeowners association and defer action to them.

Figure 24 – Marina Way (looking north from Nevin Plaza)



Kaiser-Richmond Vicinity

Kaiser Hospital is included within the Iron Triangle neighborhood. Richmond PD has noted a concern about violent crime (muggings) involving hospital staff and patients, walking to and from parking areas. The hospital is located in the northeast corner of Harbour Way and Nevin Avenue. The main entry is located one block west at 9th Street, as shown in Figure 25.

Figure 25 - Kaiser Hospital Front Entry (looking north along 9th St)



The parking structure, shown in the left portion of the fixture, is connected to the hospital via a covered walkway. There are City-owned ‘acorn’ lighting fixtures along the walkway, and also pedestrian scale lighting within the walkway cover. It appears lighting on this primary pathway is more than adequate.

There is also on-street parking at a few locations nearby, notably along the north side of Macdonald Avenue near 9th Street and on both sides of 9th Street for about half a block on either side of Macdonald Avenue. Figure 26 shows Macdonald Avenue west of 9th Street, which appears to have adequate ‘shoe-box’ lighting, visible on the left edge of the photo. However, the foliage of the street trees is between the streetlight fixture and the sidewalk, meaning the sidewalk is not well illuminated at night. This is an area where pedestrian level lighting is needed to supplement the existing streetlights.

Figure 26 - Macdonald Ave near Kaiser Hospital (looking west)



The length of sidewalk involved is about 1,600 feet. With lamps spaced at 60' intervals, this equates to about 24 lights. With a unit price of about \$3,000 and 50% markup, the approximate cost would be \$108,000. The costs of upgrading the shoe-box fixtures is already included in the Iron Triangle Neighborhood discussion.

PLANNING DIVISION AND REDEVELOPMENT AGENCY INPUT

Input from the Planning Division and Redevelopment Agency was obtained in a senior staff meeting on July 7 and department head meeting on August 31, 2010. The Planning Division has a role in streetlight installation through the approval process for new development, or from preparation of documents such as the draft Pedestrian Master Plan (City of Richmond, November 2010) draft and the Redevelopment Agency through direct implementation of projects. The key staff participating in both meetings were Hector Rojas of the Planning Division and Chadrick Smalley from the Redevelopment Agency. Two subsequent meetings were held in December 2010 with the Planning Director, Richard Mitchell.

The primary streetlighting interest of both agencies is decorative lighting. Examples of existing decorative lighting in Richmond follow. Both agencies are interested in the development of new standard plans for decorative lighting as it relates to existing decorative lighting, and how to transition from the existing or planned lighting to the requirements in

new Standard Plans the City may adopt. Also, how the new Standard Plans can encourage the use of decorative lighting in residential areas.

Existing Decorative Lighting

All decorative lighting on Richmond public streets appears to have been installed by private development such as the Horizon Drive photo below, or public redevelopment projects such as the MacDonald Avenue photo below (see Figure 27).

Figure 27 – Decorative Lighting at various locations in Richmond



Key issues to consider when developing new streetlight standards for decorative lighting in Richmond include the following:

- ❖ Upgrades to lighting that is already in place
- ❖ Requirements to change the design of lighting projects that are waiting to go out to bid
- ❖ How to match existing lighting on new projects that expand existing installations

Pending Projects

The Redevelopment Agency has furnished a listing of projects that are ready to go out to bid (design is complete, projects will be advertised for bids from contractors once funding is available and committed). The following projects were identified:

- ❖ Nevin west of BART (extends along Nevin Avenue from Harbour Way to 450' east of 13th St)
- ❖ Nevin east of BART (extends along Nevin Avenue from 19th Street to 27th Street)
- ❖ West Macdonald (extends along West Macdonald Avenue from Garrard Boulevard to Harbour Way)
- ❖ Marina Bay Parkway at the underpass (extends along Marina Bay Parkway from Regatta Boulevard to Meeker Avenue)

All of the lighting designs appear to conform to current City standards and current standards of the industry. None conform fully to recommended updates in this SLMP.

If Richmond adopts the new Standard Plans recommended later in this SLMP, the design drawings for these projects should be modified to incorporate the new Standard Plans. The modifications for foundation designs should be minimal, including adding a reference to the new Standard Plans, and crossing out foundation details within the plan sheets that are superseded by the Standard Plans.

Changing the design drawings to show LED lighting instead of HPS would be a larger change, and would require the designers to find equivalent LED lighting products and redo the lighting layout calculations. However, this change is also recommended given the level of commitment to LED lighting the City has already shown.

The third general recommended change, use of Welded Pull Boxes to reduce wire theft, would also require an easy modification to the plans but would increase construction cost estimates. This change is recommended for the Marina Bay Parkway project, only.

Decorative Lighting Design Standards

In general, the key technical issues to address are replacement of poles that are knocked down and meeting minimum lighting levels. These issues govern the selection of poles and equipment to have a long life cycle and easy maintenance. Other issues such as pole appearance or vendor are not covered in the recommended standards, as they are not in the current City standard plans for overhead lighting poles.

Most streetlight manufacturers produce product after an order is placed, and do not keep a large stock of poles in storage. Many manufacturers also tend to update product designs every few years, in the same way for example, that car manufacturers update appearance of popular models. Therefore, once a specific pole is selected for an individual project, there is no guarantee that specific product will be available whenever it is needed for future replacement.

However, the City adopted Standard Plans for overhead light poles many years ago that have served the City very well. These plans establish general dimensions for the poles, a very specific design for the foundation, and reference to a Caltrans Standard Plan for details not shown on the City Standard Plan. Within this framework, the City has been able to modify pole color and finish, or decorative enhancements such as base plates, to suit the needs of individual neighborhoods.

This SLMP recommends a similar approach for decorative streetlight poles, to include the following:

1. Reference Caltrans standard plans for foundations and general pole fabrication requirements.
2. Expand the streetlight brightness standards from what is currently shown in the Municipal Code.

3. Allow flexibility to choose any product from any vendor to suit the aesthetic needs of an individual neighborhood or redevelopment area.

More detailed recommendations are provided in the Standard Plans and Specifications section of this SLMP.

PROJECT DEVELOPMENT

The Richmond streetlight system has considerable need for upgrades, including:

- ❖ Improved lighting in high crime areas
- ❖ Replacing failing equipment
- ❖ Dealing with wire theft
- ❖ Upgrading to new technology for energy savings and better color rendering
- ❖ Replacing antiquated series circuit technology

This section discusses each of these issues in detail.

Improved Lighting in High Crime Areas

There are different ways to use streetlighting as a deterrent to crime.

1. Add lights to eliminate dark spots
2. Replace existing lights with brighter lighting to raise average illuminance levels
3. In companion with closed circuit television (CCTV) replace existing lighting with new technology for better color rendering and more effective identification of perpetrators.

Also, when street trees have grown up around streetlights, pedestrian scale lighting can be added as supplement to ensure lighting reaches the pavement level. Table 4 shows a summary of costs discussed in the Police Department Input section.

Table 4 – Summary of Projects in High Crime Areas

Neighborhood	# Existing SL¹	# New SL	Cost Estimate
Santa Fe	145	45	\$555,000
Iron Triangle	796	131	\$2,176,500
Atchison Village	59	28	\$298,500
Belding/Woods	414	197	\$2,098,500
Coronado	291	105	\$1,224,000
BART Vicinity	5	5 ³ , NA ²	\$22,500
Kaiser Vicinity	NA	24 ³	\$108,000
Subtotal	1,710	535	\$6,483,000
Notes: ¹ SL = Streetlight ² Lighting enhancement is needed on one private walkway in Metro Village ³ New lights are pedestrian-scale lighting			

Streetlight Replacement Projects

The streetlight inventory indicates there are a total of 41 badly damaged poles, 28 knocked down poles with damaged foundations, and 90 poles in Poor condition. Table 5 shows estimated replacement costs for these 159 poles and 28 foundations. 50% for design, administration, and miscellaneous items is included in the unit prices.

Table 5 - Cost Estimates for Replacement of Streetlight Poles

	Qty	Unit Price	Extension
Replace Steel Poles	159	\$ 7,500.00	\$ 1,192,500.00
Replace Foundations	28	\$ 3,900.00	\$ 109,200.00

Costs shown are 2010 dollars.

Wire Theft Replacement

Per the previous discussion in the Public Works Input section, the City has a pervasive problem with wire theft. In many areas of the City, generally on streets with no fronting land use, streetlight wires have been stolen multiple times and staff are seeking additional budget to upgrade infrastructure to make it more theft-resistant. Meanwhile, lights remain dark at night. Table 6 summarizes the costs.

Table 6 – Wire Theft Prevention Costs

Item	Cost
Restore and upgrade ¹ wire theft circuits	\$896,000
Ongoing annual cost for replacing wires	\$320,000
Annual budget for new areas of wire theft ²	\$600,000
Notes: ¹ Welded Pull box option ² This SLMP assumes that if all the current areas of wire theft are upgraded, other areas will be targeted.	

Upgrading to New Technology

Richmond owns and maintains a total of 3,735 streetlight fixtures. Costs for replacing 1,371 of these fixtures has already been provided in the discussion of high crime neighborhoods. The estimated cost to replace for the remaining 2,364 is \$2,364,000.

The City also has 3,619 lights within the City limits that are owned and maintained by PG&E. Current practice for agencies such as Richmond with large numbers of PG&E-owned poles is to contract directly with PG&E to replace these fixtures with LED. In a recent project with a Bay Area agency, PG&E charged a turn-key price of \$875 per fixture to furnish and install the new LED fixtures and modify their records with the reduced monthly prices.

The cost used in a previous section of \$1,000 per fixture includes the cost to furnish and install the actual fixture plus 50% for design, administration, and inspection. The markup for PG&E fixtures would be lower because there would be no design fee, and the level of effort for inspection would be less. The appropriate markup is 25% and the equivalent unit cost is \$1,100. The cost for the PG&E-owned lights is \$3,958,000.

Pacific Gas and Electric’s Emerging Technology Program published Application Assessment Report #0727 in December of 2008. This report contained the results of LED street lighting tests conducted in San Francisco. The report found that some LED streetlights are able to provide equivalent or better performance than comparable HPS lamps based on the test project metrics.

The report found the energy savings from the tested LED products to range from 50% to 70%. The report found that under retrofit conditions, it is possible to see payback for installation of LED streetlights in approximately 10 years. The report assessed the average retrofit cost per LED light at \$500.00. Recent projects have shown a cost of \$1,000 per fixture, so the payback period is more likely to be in the range of 20 years. Also, recent field tests conducted by Republic ITS have shown the 70% reduction may be overly optimistic.

The US Department of Energy has been testing new streetlight technologies under the Commercially Available LED Product Evaluation and Reporting (CALiPER) Program (see <http://www1.eere.energy.gov/buildings/ssl/caliper.html>) since 2006. Eight rounds of testing have been completed with the most recent results published in July 2009.

LED lamp vendors are projecting a minimum 10-year life for their streetlights, which implies labor cost savings compared to current re-lamping schedules for HPS lamps, which typically require replacement every 5 years. The wattage of LED lamps is just over half that of equivalent HPS, which also suggests a significant reduction in energy use.

Inductive lighting, also referred to as CFL, is another emerging technology that is an alternative to HPS. It has many of the potential energy savings issues in common with LED, although with a lower level of savings.

Replace Series Circuit Systems

Richmond currently has three neighborhoods whose streetlight circuits are configured as Series Circuits. One neighborhood, Park Plaza, is currently being upgraded to state-of-the-art LED lighting. It includes streetlight poles that were noted in the inventory as Poor condition, and was the appropriate choice to be upgraded first.

The other two, Park View and May Valley, have poles that are still in serviceable condition but should be upgraded as budget allows. Costs to upgrade each neighborhood are summarized in Table 7.

Table 7 – Costs to Upgrade Series Circuits

Neighborhood	# SL	Cost
Park Plaza	83	\$726,000 ¹
Park View	46	\$466,000
May Valley	28	\$275,000
Notes: ¹ Bid price for installation, design costs, plus administration.		

Table 8 shows a summary of all the recommended Capital projects and costs.

Table 8 – Summary of CIP Projects and Costs

No.	Project Title	Estimated Cost
1	Park View - Series Circuit Installation	\$466,000
2	May Valley - Series Circuit Installation	\$275,000
3	Santa Fe Neighborhood - Upgrading Street Lighting to LED Fixtures	\$555,000
4	Iron Triangle Neighborhood - Upgrading Street Lighting to LED Fixtures	\$2,176,500
5	Atchison Village Neighborhood - Upgrading Street Lighting to LED Fixtures	\$298,500
6	Belding/Woods Neighborhood - Upgrading Street Lighting to LED Fixtures	\$2,098,500
7	Coronado Neighborhood - Upgrading Street Lighting to LED Fixtures	\$1,224,000
8	BART Vicinity	\$22,500
9	Macdonald Ave/9th Street Near Kaiser Hospital - Upgrading Pedestrian Lighting	\$108,000
10	City Wide Damaged Streetlight Poles Replacement Projects	\$1,301,700
11	City Wide Wire Theft Replacement Projects	\$896,000
12	City Wide City-owned Streetlight upgrade to LED Fixtures	\$2,364,000
13	City-wide PG&E-owned Streetlight upgrade to LED Fixtures	\$3,958,000
Total Cost		\$15,743,700

FINANCIAL ANALYSIS

This section of the SLMP focuses on methods to get the lighting recommendations accomplished without use of the City’s general fund. It assumes tight financial constraints

and the need to use other funding mechanisms than typical Capital or Operations and Maintenance funding.

Funding Options

This SLMP looks at funding options for financing streetlight improvements, as follows:

1. City General Funds
2. Streetlight Assessment District
3. Simple Interest loans
4. Turn-key private financing

City General Funds

For agencies in good economic conditions with healthy budgets, special needs can often be accommodated by scheduling extra costs through the normal budgeting cycle. One item of work discussed in this SLMP, replacing stolen wires and upgrading pull boxes to reduce the likelihood of the wires being stolen again, has an estimated cost of \$900,000. When asked how quickly the City's budget could accommodate this funding need from the maintenance budget, the Public Works Operations & Maintenance Director replied, "The best answer with the current budget unpredictability is many years".

The City Engineer has programmed an annual amount of \$500,000 for the last several years for streetlight capitol projects. Recent use of this line item has gone toward the conversion of the series circuit in the May Valley neighborhood. Use of this level of funding for upgrades recommended in this SLMP is discussed in the Program section.

Streetlight Assessment District

Streetlight assessment districts are used by many agencies in California. If adopted by a City, funds are typically collected through property tax assessments in the form of an additional charge per parcel. There are often multiple charges depending on the type and size of each parcel, such as a charge for a single family home, another for multi-family, and more for commercial property. Richmond currently has assessment districts set up in two neighborhoods.

Many agencies approach a new assessment distract as a new tax before implementing one. Steps taken before implementing a District may be described as follows:

1. Establish the need for an assessment and/or District
2. Conduct a public opinion survey or focus group process to determine the level of public support
3. If support exists, conduct a focused financial study to develop detailed cost needs and assessment methods.
4. Seek a 2/3 vote of support from the City Council or all residents

With a population of 104,000 and an estimated number of households of 41,000, the City could potentially generate between \$1M and \$2M per year with an annual assessment of \$25 per household and comparable assessments for non-residential properties.

The entire process can take up to two years, sometimes more, depending on the schedule of the vote. If the vote were held by the City Council only, the schedule may be less than two years. Steps 2 and 4 have no certainty of success, especially in a down economy with high unemployment and property foreclosure rates.

Given the long lead time on developing the income stream and the uncertain prospect for a successful vote, a District is also not considered the best course of action in the short term, although it may be a good mechanism in combination with other options.

Simple Interest Loans

Lenders can be sources of funds to City's with special funding needs. These loans are typically granted when the capital goes toward a project that will generate income, or offset current expenses. In the case of streetlighting, upgrading to new lighting technology can substantially reduce the cost of energy used by the City, and in turn reduce the monthly utility bill.

For example, PG&E charges the City a set amount of money each month for each streetlight. For the sake of discussion, the monthly charge for a 200 Watt High Pressure Sodium (200W HPS) fixture is \$9.74 per month. Assuming all 3,741 city-owned fixtures were 200W HPS, the city's current monthly bill for streetlights would be \$36,440.

Cities can replace HPS fixtures with LED to reduce costs. The equivalent LED fixture is about 95W, and has a monthly energy cost of \$3.85. The net difference is \$22,035 per month. Private financing can be a good option when the loan payment is comparable to the net difference.

Table 8 shows the cost of the recommended upgrades for Richmond, with a total cost of \$8M. Republic ITS recently worked with an east coast client to find commercial funding at a rate of 2.8% over 20 years. The 2.8 % rate was made available to a City with excellent financial ratings. According to Standard & Poors, Richmond currently has an A+ bond rating (Source: <http://www.ci.richmond.ca.us/DocumentView.aspx?DID=5912>) so Richmond may be able to find similar financing.

For a loan repayment amount that does not exceed the net cost reduction, the City could seek financing of up to \$6.5M. This is not enough to cover the entire program, but is enough to cover LED lighting upgrades and wire theft repairs.

Additional work could be financed if the City has the ability to commit General Fund monies to loan repayment.

Private financing is considered a good option to pursue.

Turn-Key Private Financing

Turn-key private financing is available to cities from service providers who can process the necessary paperwork with PG&E to modify the monthly charges, and furnish and install the

new LED fixtures. Turn-key financing is similar to simple interest loans in that it uses the net reduction in the monthly electricity bill as repayment of the up-front costs.

The City would contract with a turn-key provider and pay the equivalent of the current monthly electricity bill to the provider for a pre-agreed amount of time. Once that time expires, the agreement would end and the City would start normal (although reduced) monthly payment directly to PG&E again.

A recent example indicates that the financing is available to Richmond for LED conversion, and monthly payments equivalent to the net reduction could be used to finance the LED conversion cost over a 13 year period.

This has an advantage over simple financing in that Richmond would enjoy the benefit of the reduced monthly cost after 13 years instead of 20. It has the disadvantage of only funding the LED conversion.

Although turn-key financing is a good option in some situations, it does not appear to be the best choice for Richmond because it only funds about half of the needed upgrade projects.

General Trends

The portion of the streetlighting industry bringing LED streetlights to the market is typical of many new technology industries:

- ❖ The industry has reached a point where many high quality products are now available
- ❖ Companies in the industry are starting to sell more product
- ❖ Many agencies within an urbanized area have already started implementing LED lighting, and the “bleeding edge” label is changing to “leading edge”. Eg, agencies are feeling more comfortable proceeding with LED investments
- ❖ As product sales increase, unit prices are going down

Within the next year or two, costs are expected to decrease enough that all four options examined herein may be more appealing. At the moment, private financing combined with use of General Fund monies for loan repayment appear to be the best option for Richmond, with pursuit of a city-wide assessment district to relieve the burden on the General Fund.

PROGRAM

This section of the SLMP presents a programmatic approach to completing the recommended upgraded identified herein. The Program establishes priorities for implementing the various recommendations, and a schedule for systematic project completion.

Project Priorities

Priorities are based on a comparison of overall public safety if a project is completed or not. Table 9 shows the five basic categories of recommended improvements, the priority rankings, and comments on the rankings.

Table 9 – Project Priorities

Work Description	Priority	Comments
Funded projects	1	Projects with committed funding must be completed on agreed schedules
Replacing failing streetlight poles	2	Poles with ratings of 5 are in imminent danger of falling over. A pole that falls over may cause property damage, or if it falls into the street may cause an accident.
Repairing circuits damaged by wire theft	3	The analysis of reported collisions on Richmond Parkway shows a correlation between adequate lighting and collisions. Restoring circuits can reduce accident rates.
Improved lighting in high crime areas	4	Doing nothing in high crime areas does not make the current situation worse, but improvements have the potential to make it better
Replacing antiquated series circuit technology	5	Doing nothing increases the potential for circuit failure and leaving entire neighborhoods dark.
Upgrading to new technology for energy savings and better color rendering	6	Upgrades reduce monthly energy costs by about \$22,000.

Annual Budget

The City Engineer has indicated an annual budget amount for streetlight upgrades of \$500,000, and asked for a Program option using this amount. This amount may not be ideal since it would result in program life of over 31 years ($\$15.7\text{M} \div \$0.5\text{M per year} = 31 \text{ years}$). Note that obtaining grants and special loans shortens the length.

A large percentage of the program consists of upgrading existing HPS lighting to LED. LED lighting is expected to last up to 15 years. This implies that the overall program length must be less than 15 years, or the LED lighting installed as part of this program would need to be replaced before the program is complete. Since the cost of the replacement could supersede the entire program budget for a year, the program may never be complete. However, since there is an established precedence for this annual budget amount, a 30-Year Program is discussed as an option for this SLMP.

Alternatively, the program term should be 15 years or less, so the full list of recommended projects can be completed before any replacement costs come due. This implies an annual spending of close to \$1M per year. However, this SLMP recommends an approach with annual spending of \$1.5M because of the logistical details of delivering the recommended improvements, summarized as follows:

1. The estimated cost to implement each improvement includes an added 50% for administration, design, and minor items. This amount is broken down as follows:
 - a. 10% for administration
 - b. 10-15% for design,
 - c. 10% for inspection
 - d. 15-20% for minor items
2. Assuming the City would hire or contract for one full time position to administer the upgrade program, this full time staff person could process \$1.5M per year (\$1.5M of capitol costs x 6.67% = assumed annual salary of \$80K+ benefits)
3. Similarly, the City would hire a full time field staff person to inspect the upgrades at the same percent of total program cost.

This approach would result in a program duration of approximately 10 years.

30-year Program

The recommended projects and priorities have been stated in previous sections (see Tables 8 and 9). This section breaks the projects into annual portions, and shows how the projects would be distributed among the various Richmond neighborhoods. Table 10 shows an annual distribution of the overall program.

Actual implementation is more than 30 years, so the program title should be considered as nominal. Also, unit prices for fixture replacement is held the same for each year of the program. Unit prices for LED fixtures are currently dropping, and are expected to continue to do so as industry-wide purchase of LED lighting increases. With the drop in unit prices, the total implementation schedule will decrease.

A few important notes that make this program less than ideal:

1. The current PG&E rebate is a two-year program (2010 and 2011). It is likely it will extend, but not certain.
2. The LED lighting installed on the major arterials and in the May Valley and Parkview neighborhoods will be due for replacement in approximately 2026. The cost of the replacement will be more than the annual program budget, and will delay projects scheduled for 2026 and later by approximately 4 years. A similar statement can be made for the lighting installed in 2017, which will be due for replacement in 2032. Projects shown in Table 10 for implementation in 2026 or later will be further delayed.
3. Some neighborhoods will not see benefit from the SLMP program for 25 years or more.

10-year Program

As before, the recommended projects and priorities have been stated in previous sections (see Tables 8 and 9). This section breaks the projects into larger annual portions spread out in fewer years, and shows how the projects would be distributed among the various Richmond neighborhoods. It also makes more aggressive use of loans and turn-key financing. Table 11 shows an annual distribution of the overall program.

The 10-year program assumes the City will hire one full time engineering staff person, with a start date in early 2011. The SLMP assumes this position will be at the Associate Engineer or Senior Technician level, and the ideal candidate will be experienced with administering a CIP program, with streetlight design and preparing contract documents, and overseeing design consultants.

Similarly, the program assumes the City will hire one full time electrical inspector, with a start date in late 2011 or early 2012. The ideal candidate will be experienced at inspection of streetlight installations and modifications, and tracking progress payments. Both positions will be dedicated nearly full time to the SLMP administration.

STANDARD PLANS AND SPECIFICATIONS

The City currently has lighting level standards included within the Municipal Code. The lighting levels established are quite close to the standards identified in the national standard that is used by many agencies, the *American National Standard Practice for Roadway Lighting* (American National Standards Institute/Illuminating Engineering Society RP-8-00, June 2000).

This SLMP recommends updating the Municipal Code as follows (see page 16 of this SLMP):

3. ILLUMINATION INTENSITY. Spacing of street lighting standards shall be approved by the director of public works. Size of luminaires and length of mast arms shall be as shown on the city standard plans. The average illumination ~~as determined by the director of public works shall be 1.0 foot candle for major arterials, 0.6 foot candle for collector streets, 0.4 foot candle for minor streets, and 0.2 foot candle for paths~~ shall be as shown on the city standard plans.

The City currently has two Standard Plans that deal with streetlight installations. Std Plan No. 21 deals with the standard pole for overhead lighting. Std Plan No. 22 deals with typical layouts and spacing.

Three new recommended standard plans are included in the Appendix. They address pedestrian level lighting, anti-theft pull boxes, and lighting levels.

The recommended Standard Plan on lighting levels establishes *Roadway Lighting* (American National Standard Institute Recommended Practice 8-00, Illuminating Engineering Society of North America, June, 2000) as the basis for the standards. Further, where the standard shows lighting levels for High, Medium, and Low pedestrian activity levels, the High level should be used for any neighborhood identified in the SLMP as a high crime neighborhood.

Lighting Level Analysis

Sample lighting level calculations were completed for one street (selected to represent typical conditions) in each of the five high crime neighborhoods. Table 12 shows a summary of how the new lighting level standard would result in improved lighting for these neighborhoods.

Table 12 – Brightness Comparison

Neighborhood	Location		Brightness (footcandles)		
			Average	Min	Notes
Santa Fe	6th St between Virginia and Maine	Existing	0.29	0.00	
		Proposed	0.42	0.14	Requires new mid-block pole
Belding/Woods	Gaynor between 18 th and 20th	Existing	0.16	0.00	Requires two new mid block poles
		Proposed	0.74	0.14	

Neighborhood	Location		Brightness (footcandles)		
			Average	Min	Notes
Coronado	17 th St between Maine and Florida	Existing	0.04	0.01	
		Proposed	0.72	0.18	Requires two new mid block poles
Iron Triangle	3 rd St between Barrett and Ripley	Existing	0.24	0.00	
		Proposed	0.47	0.24	Required one new mid block pole
Atchison Village	Curry between Bissel and Chanslor	Existing	0.88	0.01	
		Proposed	0.48	0.15	Required one new mid block pole
Notes:					
1. Per RP-8, Average brightness for a Local street should be 0.9 fc, minimum should be 0.15. The recommended standard for Richmond would only apply the minimum value.					
2. The brightness values shown above are shown for illustrative purposes only. Final design values may vary.					

Existing minimum lighting values are zero or close to zero on each street segment tested. Existing HPS lighting shines a bright spot directly under the lamp, implying a big range between the brightest and dimmest spots along a typical street.

Proposed LED lighting does not shine a bright spot under the lamp, and minimums are substantially higher. Combined, these show a benefit of the recommended standard.

Note that the Proposed Average lighting value is lower in many cases than the Existing Average value. This is because the very bright spot directly under the existing lamp does not occur with the proposed LED lighting. The calculated average is lower even though the brightness of the lighting on 80% of the street remains as bright or brighter.

Appendix A – Recommended Standard Plans

Required Roadway Lighting Levels – Illuminance Method

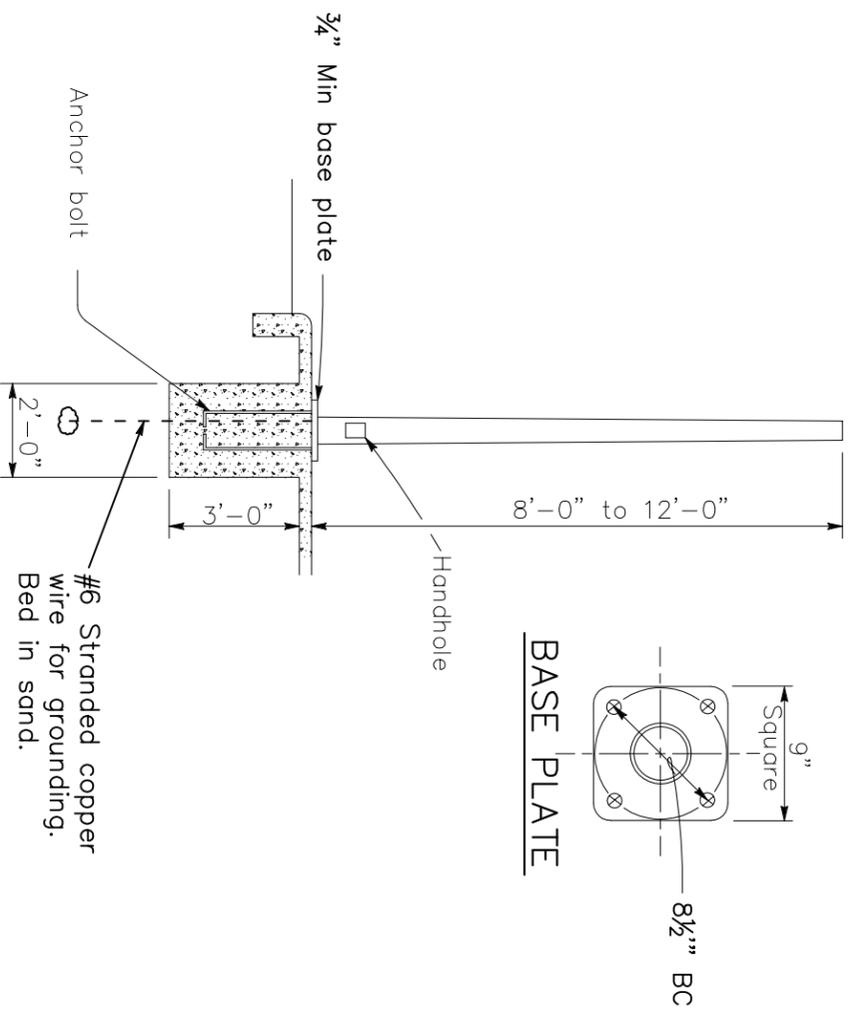
Road and Pedestrian Conflict Area		Minimum Maintained Average Illuminance* (footcandles)	Minimum Maintained Illuminance (footcandles)	Uniformity Ratio E_{avg}/E_{min}	Veiling Luminance Ratio L_{max}/L_{avg}	
Road	Pedestrian Conflict Area	High	1.4	0.47	3.0	0.3
		Medium	1.2	0.40	3.0	0.3
		Low	0.9	0.30	3.0	0.3
Expressway		High	1.7	0.57	3.0	0.3
		Medium	1.3	0.43	3.0	0.3
		Low	0.9	0.30	3.0	0.3
Major		High	1.2	0.30	4.0	0.4
		Medium	0.9	0.23	4.0	0.4
		Low	0.6	0.15	4.0	0.4
Collector		High	0.9	0.15	6.0	0.4
		Medium	0.7	0.12	6.0	0.4
		Low	0.4	0.07	6.0	0.4
Local		High				
		Medium				
		Low				

*Values are for asphalt concrete pavement.

NOTES:

- Lighting levels for HPS lighting systems shall conform to the requirement of the American National Standard Practice for Roadway Lighting, AES/IESNA RP-8-00, (June 2000 shown), most current edition.
- Lighting levels for LED lighting systems shall meet the Minimum Maintained Illuminance requirement of AES/IESNA RP-8-00 (current revision). Minimum Maintained Average Illuminance, Uniformity Ratio, and Veiling Luminance Ratio shall be less than the values shown above for HPS lighting, but not less than 50% of those values.
- Lighting levels in residential neighborhoods west of 23rd Street (excluding Point Richmond, Marina Bay and Parchester Village neighborhoods) shall use High Pedestrian Conflict Areal Lighting levels.
- Lighting fixtures shall use cutoff optics that do not permit light distribution above a horizontal plane, and shall conform to the International Dark Sky Association guidelines (www.darksky.org) for Outdoor Roadway lighting.
- The lighting fixture mounting height in residential neighborhoods with 1 or 2 story structures shall not exceed 14'. The mounting height in multi-story residential neighborhoods shall not exceed 25'.

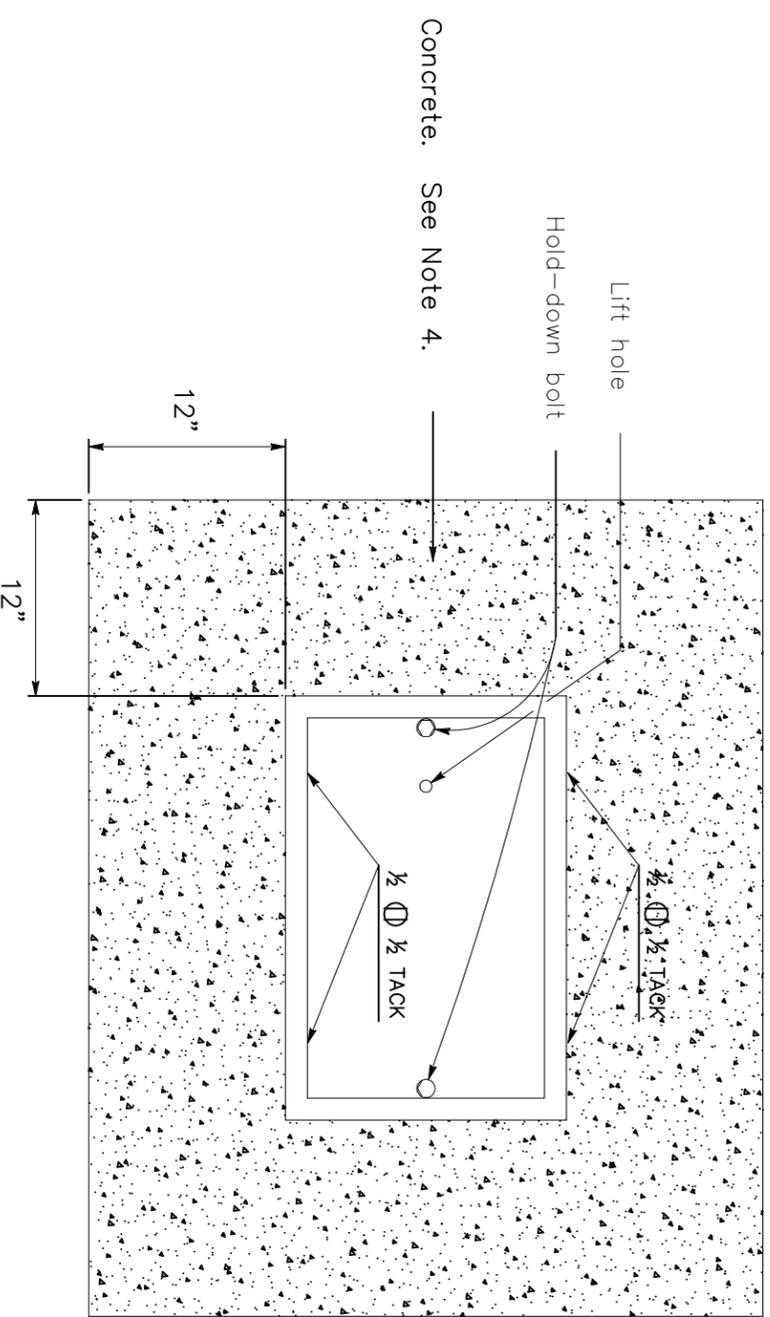
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PROJECT NO.																							
	 <p>CITY OF RICHMOND ENGINEERING SERVICES DEPARTMENT</p> <p>450 CIVIC CENTER PLAZA, RICHMOND, CA 94804 BUS: (510) 307-8091 FAX: (510) 307-8116</p>																						
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TYPE 3 – DECORATIVE LIGHT STANDARD 8’ TO 12’

Notes:

1. Anchor Bolt = 3/4" ϕ x 1'-6" x 4"
2. Hand holes shall be located on the downstream side of the pole unless otherwise noted on the plans.
3. Hand hole covers shall be tamper resistant.
4. See Caltrans 2006 Standard Plan ES-11 for additional foundation details.
5. Foundation and base plate design is mandatory. Pole design is optional.



STREETLIGHT PULL BOX

Notes:

1. All streetlight pull boxes shall be Caltrans traffic rated type unless otherwise noted on the plans. See Caltrans standard plan number ES-8.
2. All streetlight pull boxes shall be No. 5(T) size unless otherwise noted on the plans. See Caltrans standard plan number ES-8.
3. After all connections are completed within the pull box, the pull box cover shall be welded to the pull box Z-bar frame with four (4) 1/2" tack welds.
4. If the pull box is located in landscaping material (such as soil, sand, rocks) and not in a paved area (such as concrete sidewalk, asphalt roadway), the pull box shall be set in 5-sack concrete 12" all around the pull box and 12" deep.

DRAWING NO.				
SHEET OF	<h2 style="margin: 0;">STANDARD ELECTROPLIER DETAILS</h2>			
PROJECT NO.				
	<h3 style="margin: 0;">CITY OF RICHMOND</h3> <h4 style="margin: 0;">ENGINEERING SERVICES DEPARTMENT</h4>	BUS: (510) 307-8091 FAX: (510) 307-8116		
DATE:	REV #	BY	DATE	DESCRIPTION
SCALE:	DESIGNED:	DRAWN:	CHECKED:	APPROVED BY:
				DATE APPROVED:

Appendix B – Approved Product List

City of Richmond Streetlighting Standards

Qualified Products List – updated 1/20/11

Type 3 Lighting Standard – Pole Height 8' – 12'



Whatley
Municipal
XF45



Holophane
Cast
Aluminum



Phillips-
Hadco
P120



Sternberg
Lighting –
Lexington
Series

City of Richmond Streetlighting Standards

Qualified Products List – updated 1/20/11

Type 2 Lighting Standard – Pole Height 14' – 25'



Ameron
Steel
Poles



Holophane
RTS Steel
Poles



Phillips-
Hadco
P170



Valmont
Decorative
Steel Poles

City of Richmond Streetlighting Standards

Qualified Products List – updated 1/20/11

Type 1 Lighting Standard – Pole Height 30'



Union Metal
Steel Poles



Valmont
Traditional
Steel Poles



Ameron
Steel
Poles