Van Ness Avenue Bus Rapid Transit (BRT) Overhead Contact System (OCS) Support Poles / Streetlights

Conceptual Engineering Report

October 2, 2009

Prepared for:

San Francisco County Transportation Authority

Prepared by:

Department of Public Works
Bureau of Engineering

ES Executive Summary

ES.1 Project Background

Van Ness Avenue is one of San Francisco's key north-south arterials, designated as US 101; it is a bustling six-lane roadway that carries a mix of automobiles, transit, pedestrians, and bicycles. Each day, Van Ness Avenue and South Van Ness Avenue, from Mission to North Point Streets, serves 20,000 transit trips. Along this corridor, transit is unreliable and travel times are nearly double auto travel times. The purpose of the Bus Rapid Transit (BRT) Project is to improve transit performance and safety along Van Ness Avenue and South Van Ness Avenue, between Mission and North Point Streets.

The Van Ness BRT OCS Support Poles/Streetlights Project is a specialized sub-project of the BRT Project. The sub-project's focus is on the poles which support the trolley overhead contact system (OCS), and corridor lighting. The project area is along Van Ness Avenue and South Van Ness Avenue, from Mission to North Point Streets. There are a total of 277 existing concrete poles, all of which would be replaced with new structural steel poles with new reinforced concrete foundations, and new roadway and pedestrian lighting systems.

ES.2 Conceptual Engineering Summary

The project has performed an observational structural evaluation of the existing poles and lighting elements, and created design criteria for replacement poles and lighting, all of which comprise the Conceptual Engineering Report (CER) for the OCS support poles/streetlights. The CER provides a conceptual engineering basis for the project design phase. The report includes descriptions of the recommended improvements for implementation, preliminary design criteria, guidelines for selection of the design criteria, and sections of related requirements, including: construction sequencing, cost estimates, and required local permits and approvals.

During the conceptual engineering phase, it has been determined that the findings of this CER will apply to all BRT constructed Alternatives: Alternative 2, Alternative 3, and Alternative 4. Therefore, the body of the report applies to all three constructed alternatives, except where noted. A recent visual inspection of existing poles within three sample areas revealed that about 50 percent of those poles have a significant degree of structural damage. Over the years, since so many poles were found to be structurally failing, they were and continue to be replaced on as-needed basis. Accordingly, this CER also serves in the event the BRT project is not constructed, and the City replaces the OCS support poles/streetlights for the entirety of the Van Ness Avenue Corridor.

The new poles will be used to support pedestrian lights, roadway illumination lighting, and overhead contact cables for MUNI while maintaining the aesthetics of the Van Ness Avenue corridor. Utilizing a hybrid design, the poles will be constructed from MUNI's set of standardized 30 feet steel poles and adorned with historically styled bases and light fixtures. The new OCS support poles/streetlights will be built near the existing poles, maintaining the existing acceptable pole-to-pole spacing, with new foundations located within three to five feet of existing foundations. The existing pole, lighting, and overhead contact system will remain in place while the new poles are constructed and fully commissioned, thereby minimizing traffic disruptions and maintaining lighting and MUNI transit throughout the construction phase. The method of construction for this approach is known as "overbuilding" the new OCS above and offset from the existing one. When completed, the new OCS is cut in and lowered as the old system is removed.

ES.3 Cost Summary

Table ES-1: Project Cost Estimate Summary

Note: L.S. = Lump Sum, L.F. = Linear Feet, C.Y. = Cubic Yard, S.F. = Square Feet. EA. = Each

Bid Item Description	Estimated Quantity	Unit	Unit Price	Extension
Pole Removal & Sidewalk Restoration Work	1	L.S.	$1,342,927	$1,343,000
Electrical Work	1	L.S.	$11,669,591	$11,670,000
Structural Work	1	L.S.	3,078,911	$3,079,000
Mobilization/Demobilization (5%)	--	L.S.	--	$805,000
Traffic Routing Cost (8%)	--	L.S.	--	$1,287,000
			Subtotal	**$18,183,000**
Prime Contractor Overhead (10%)	--	L.S.	--	$1,818,000
General Contractor Profit (10%)	--	L.S.	--	$1,818,000
			Construction Cost	**$21,820,000**
			With 3.5% Escalation over 2.5 years	$22,584,000
			Construction Contingency (15%):	$2,258,000
			Design Cost (10%)	$2,258,000
			Construction Management Cost (15%)	$3,388,000
			Engineering Support Cost (8%)	$1,807,000
			Project Contingency (10%)	$3,229,000
			TOTAL BID PRICE	**$35,524,000**

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1-0 Introduction and Project Description

1.1 Introduction and Project Objectives

The San Francisco County Transportation Authority (Authority), in cooperation with the Federal Transit Administration (FTA) and the San Francisco Municipal Transportation Agency (SFMTA), proposes to implement Bus Rapid Transit (BRT) improvements along Van Ness Avenue and South Van Ness Avenue in San Francisco (from Mission Street in the south to North Point Street in the north). As part of a projected integrated citywide network of rapid transit, it will improve transit performance relative to driving, reduce delays, increase rider capacity, improve pedestrian safety, and accommodate current and future travel demands.

The Van Ness BRT OCS Support Poles/Streetlights Project arose as a specialized sub-project of the BRT Project. The objective of the Van Ness BRT Overhead Contact System (OCS) Support Poles/Streetlights Project is to plan, design, and construct multi-functional poles to support pedestrian lights, roadway illumination, and trolley cables for the San Francisco Municipal Railway (MUNI), while maintaining the aesthetics of the Van Ness corridor from Mission Street to North Point Street along the eastern and western sidewalks of Van Ness Avenue.

In December, 2008, the San Francisco Directors Working Group (DWG) directed the Authority, Department of Public Works, SFMTA, and the Public Utilities Commission (PUC) to develop an interagency contract addressing the OCS Support Poles/Streetlights Project. The contract Scope of Work calls for DPW to develop the poles and streetlights component of the Van Ness Avenue BRT Project. As part of the California Environmental Quality Act (CEQA) and National Environmental Policy Act (NEPA) environmental review processes, the BRT project considers the following four alternatives:

Alternative 1: No Project

Alternative 2: Side Lane BRT

Alternative 3: Center Lane BRT – Right side loading / dual medians

Alternative 4: Center Lane BRT – Left side loading / center median

Figures 1.1-1.3 show conceptual designs for the three build alternatives. Note that these designs do not necessarily reflect the look and design of the new poles, their look and detailed features will be considered at a later phase of project development.

The objective of this Conceptual Engineering Report (CER) for the Van Ness OCS Support Pole/Streetlight Project is to summarize the poles' existing conditions, assess engineering requirements for OCS support and street lighting, propose design guidelines for each BRT alternative, and develop a conceptual pole design for each alternative. The CER will serve as a basis for the design and layout of the Van Ness Avenue BRT OCS Support Poles/Streetlights Project. This CER also addresses the pole requirements of Alternative 1 in the event the City decided to replace the entirety of the OCS support poles/streetlights.

It is noted that if Alternative 3 or 4 is chosen, the poles would have more tension on them since they would remain in their current relative position (as seen from the cross-sectional view) on the sidewalk, while the OCS would be moved from over the curbside lane to over the center lanes. Thus, stronger poles would be needed to support the added tension, as compared with the tension in Alternative 2 . Another implication of using Alternative 3 or 4 is that because the corresponding new OCS would need to be located in the middle of the street instead of its current side-running location, the configuration of all of the intersections with cross-street OCS would need to be changed. The project would therefore be more complex using Alternative 3 or 4.

1.2 Project History and Background

Van Ness/South Van Ness Avenue is one of San Francisco's key north-south arterials, designated as US 101, connecting freeway entrances and exits at the south of the City through Lombard Street and the Golden Gate Bridge at the north. Van Ness Avenue is a bustling six-lane roadway that carries a mix of automobiles, transit, pedestrians, and bicycles. The proposed BRT project would be implemented along a 2.2 mile stretch of Van Ness and South Van Ness, between Mission and North Point Streets.

The Van Ness Avenue Municipal Railway line was completed on August 15, 1914. Completed in less than five months, the streetcar was established in anticipation of the 1915 Panama Pacifica International Exposition. The track was flanked by 259 trolley (OCS support) poles. Street lights were added to the OCS support poles in the following year,1915.

Built from reinforced concrete, the poles are reminiscent of Corinthian columnar design, light colored, and are of a slender, tapered form with a decorative foliated finial and base. Originally located six feet outward on the street, the poles were moved in 1936 to their present location during the widening of Van Ness Avenue in anticipation for the opening of the Golden Gate Bridge. Under a separate contract, the newly moved poles were adorned with new lighting standards. City and County of San Francisco Public Utilities Commission (SFPUC) designed the spiraling brackets and tear drop luminaries. The bracket design alluded to the same classical imagery as the originals developed in the wake of the Exposition in 1914.

As the popularity of automobiles grew in the years following World War II, Van Ness Avenue became an increasingly congested artery for both local and regional traffic on U.S. Route 101. The poles came to carry a wide array of signage and traffic signals. With such varied and intensive use, the concrete poles suffered notable deterioration, including spalling of concrete and corrosion of both bases and brackets. Largely to augment poles overloaded with tension and weight, MUNI and other city transportation authorities added a number of modern metal poles into the system, designed to provide supplemental support to MUNI OCS and other vehicular traffic signals.

By the mid-1980's, internal correspondence of the City and County of San Francisco repeatedly expressed concern over the condition of the poles, stating that, "many are in such deteriorated condition that they no longer can support overhead trolley wires." The remedy of inserting supplementary metal poles was increasingly seen as unsatisfactory, adding to the visual clutter of the sidewalk. The SFPUC has included replacement of the now non-standard 5 kVA lighting power system and non-standard luminaires with modern equipment into their capital budget. However, lack of funding and consensus over the appropriate course of action precluded any holistic replacement or rehabilitation of the poles and lighting system.

On June 15, 1997, the contractor W.J. Whatley, Inc. was commissioned by the San Francisco Public Utilities Commission to replace missing cast iron bases with fiberglass replicas. Over half of the poles now have fiberglass base replacements. In 2003, San Francisco voters called for an integrated citywide network of rapid transit including BRT on Van Ness by approving Prop K by a 75% margin. The Van Ness BRT Project arose from this event, and sets out to improve the 20,000 daily trips along the corridor. The San Francisco Department of Public Works (DPW) has done an observational inspection to determine the structural integrity of the existing OCS support poles/streetlights. Based on the results, DPW has found that the existing poles:

- Do not meet SFMTA standards to support the gravity and tension loads for Alternatives 3 and 4, nor are they tall enough for these Alternatives.
- Are beginning to fail, with more than half of the poles visibly showing signs of compromised structural integrity.
- Cannot accommodate internal conduit, since they are built of solid concrete. Lighting conduit has been installed on exterior faces of the poles, which is not in compliance with modern code requirements.
- Do not meet SFPUC standards for electrical system specifications. This has resulted in gradually increasing electrical failures and higher maintenance and operating costs.
- Do not meet Illuminating Engineering Society (IES) RP-08 minimum illumination levels for safe roadway lighting on a major arterial/state highway such as Van Ness Avenue.
- Have nonstandard foundations which, in combination with the above deterioration, result in a safety hazard.

Consistent with the findings and recommendations from the draft Historic Resources Inventory and Evaluation Report (HRIER), completed as part of the environmental review processes, the existing poles are anticipated to be ineligible for listing in the National Register of Historic Places (NRHP) and the California Register of Historical Resources, and the poles have not previously been identified on a City historic list.

1.3 Project Description

This section discusses the specific pole project alternatives considered. The scope of this conceptual engineering report is applicable to each Alternative under consideration, 1 through 4.

For Alternative 1 (no BRT project), the Van Ness Avenue OCS support poles/streetlights would be replaced by SFMTA MUNI, in cooperation with SFPUC, per a schedule and funding plan determined jointly by the agencies. This effort may be implemented as a comprehensive replacement project under a Capital Improvement Program, or as a phased maintenance program that would replace poles on a priority basis, with the most structurally compromised poles prioritized for replacement. Compared with Alternative 1, pole replacement in Alternative 2 would include upgrades such as additional height and strength, as well as new contact and guy wires for replacement of the OCS. Under Alternative 3 or 4, since the poles would have more tension on them due to the relocation of the OCS to the center lanes, poles with greater strength would be needed to support the added tension compared with Alternatives 1 and 2.

The Alternatives discussed in this report all involve completely replacing the existing poles and lighting fixtures with decorative steel poles and new roadway and pedestrian lights. The new poles examined in the CER were not designed as replicas; instead, designs call for structurally upgraded poles to be embellished with historically styled bases, fixtures, and adornments. All poles would have combined functionality, supporting sidewalk lights, roadway lights, and OCS cables. Construction of new poles will remain within close proximity to existing poles, maintaining both longitudinal and sectional spacing, which meets both SFMTA MUNI OCS support and SFPUC lighting spacing requirements.

Notable design challenges anticipated with this project include the presence of existing sub-sidewalk basements, vaults and manholes, as well as other objects such as existing fire hydrants, curbs ramps, and traffic signals. These existing features will pose challenges in the detailed placement of the foundations of the new poles.

Alternatives considered for the poles but rejected are listed below and summarized in Table 1-1. It should be noted that a number of design options were also considered and rejected, including replacement of the poles with replicas, and will be discussed in Chapter 6, general design considerations.

:

1. **Rehabilitate / restore existing poles for dual OCS support / streetlight function.** This approach was rejected because the shape, height, and foundation of existing poles cannot provide adequate support for existing levels of OCS tension. Even with significant restoration efforts, the existing poles would not be structurally able to support the OCS. This option also would involve facets that would be impossible to implement. For example, the poles could not be moved during the replacement of the foundation without undergoing further damage. The current poles are not tall enough to meet SFMTA's OCS requirments. In the case of Alternatives 3 and 4, they are not tall enough to meet the tension loads of OCS over the center of the roadway. In addition, the poles current fixtures cannot meet IES RP-08 standards. Thus, they would need to be significantly altered in order to bring them into compliance, including running conduit on the outside of the poles because they are made of solid concrete and changing the light fixture to high pressure sodium (HPS). Also, the current poles do not allow for pedestrian lighting. This pole option would require significantly higher capital costs as well as maintenance and operating costs than replacement with poles with modern materials and a round shape. Further, during construction, as temporary pole would need to be created, costing a similar amount to a permanent pole (see Chapter 7, Section 7.2), thus increasing the costs even more. Finally, the poles would be likely to fail again if they were built with similar materials and designs.
2. **Rehabilitate / restore existing poles for streetlight function, and add additional new poles for OCS support function.** This approach was rejected for a number of

reasons. First, the need for two sets of poles would increase the visual clutter on Van Ness Avenue, which would degrade the aesthetic feel of the street, particularly in the Civic Center Historic District. It would also increase the project cost by at least 100% over building one set of more modern poles. In addition, the existing poles would need to be significantly altered in order to bring them into compliance the IES RP-08 lighting standards, including running conduit on the outside of the poles because they are made of solid concrete and changing the light fixture HPS. Also, additional fixtures would need to be added in order to provide for pedestrian lighting. These changes would significantly alter the look and feel of the pole, thus defeating one of the presumed purposes of keeping them – having the street maintain the exact look of the 1915 poles. Finally, similar to the first option, it would be impossible to move the poles while creating new foundations without fatally damaging them.

3. **Rehabilitate / restore some (e.g., those within the Civic Center Historic District) or all existing poles for decorative use and add new poles for the OCS support / streetlight function, either from the sidewalks or the middle.** This approach was rejected because having two sets of poles would increase the visual clutter on Van Ness Avenue, which would degrade the aesthetic feel of the street, particularly in the Civic Center Historic District. In the case of Alternative 3, the BRT could not function with the trolley poles in the middle. In addition, it would be impossible to move the poles while creating new foundations without fatally damaging them. It would also greatly increase the capital costs of the poles project. Finally, part of what contributes to the historic significance of the poles (see HRIER) is the fact that they are the City's first attempt to combine trolley OCS support and street lighting, as they were built for the Pan American Exhibition. Thus, removing one of the functions of the poles would defeat the purpose of restoring them.
4. **Rehabilitate / restore poles for streetlight function and discontinue trolley operation.** This approach was rejected because discontinuance of existing trolley operation is counter to SFMTA zero emissions policies and would greatly increase the capital costs for building the poles and for storing and maintaining the additional motorcoaches. In addition, as with previous options, it would be impossible to move the poles while creating new foundations without fatally damaging them. Finally, in order to meet the standards of IES RP-08, they would require the same alterations described in Options 1 and 2 above. With these changes, and by removing one of their functions, they would also lose their historic significance, which is assumed to be one of the main reasons for restoring them.

Table 1-1: Summary of Pole Replacement/Restoration Options Considered

	Desired Characteristics of Poles						
Option	Structurally Feasible to Implement for BRT (Meets SFMTA Standards)	Structurally Feasible to Implement for Lighting (Meets SFPUC /IES RP-08 Guidelines)	Does not Promote Significant Visual Clutter	Not Cost Prohibitive (Capital)	Not Cost Prohibitve (Maintenance/ Operation)	Maintain SFMTA Zero Emissions Standards	Maintains Historic Significance Through Exact Look and Function of Existing Poles
Rehabilitate / restore some or all of the poles for OCS and streetlight functions			**X**			**X**	**X**
Rehabilitate/ restore some or all of the poles for streetlight function only. Build new poles for OCS support	**X**			**X?**	**X?**	**X**	
Rehabilitate/ restore poles for decorative purposes only. Build new poles for streetlight and OCS function.	**X**	**X**				**X**	
Rehabilitate/restore poles for streetlight function only. Discontinue trolley operation	**X**						
Replacement of poles with modern poles containing a context sensitive design	**X**	**X**	**X**	**X**	**X**	**X**	

1.4 Tentative Project Schedule (as part of Van Ness BRT Project)

Table 1-1: Tentative Project Schedule

Phase	Start	Complete
Conceptual Planning and Design	2005	2007
Preliminary Design and Environmental Studies	2008	2011
Final Design	2011	2012

Construction and Mitigation	2012	2013

1.5 Project Cost Estimate Summary

Table 1-2: Project Cost Estimate Summary

Note: L.S. = Lump Sum, L.F. = Linear Feet, C.Y. = Cubic Yard, S.F. = Square Feet. EA. = Each

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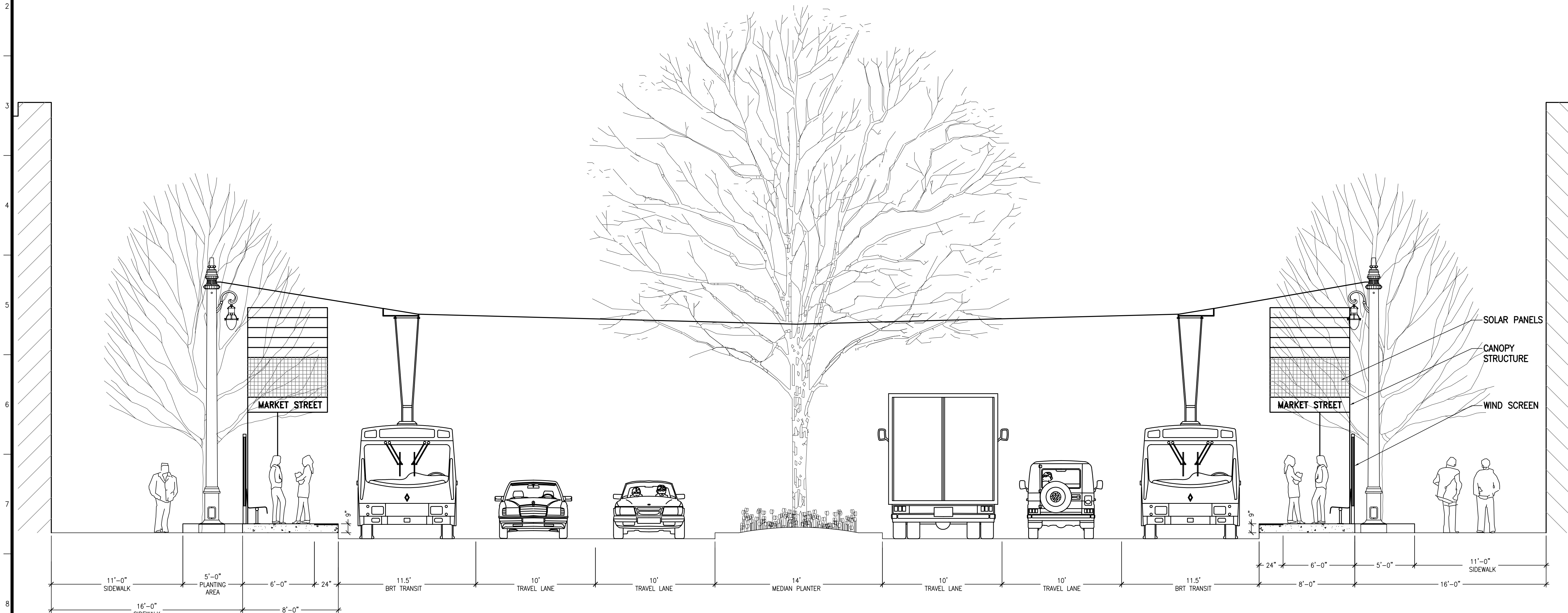

Figure 1.1: Alternative 2, Cross Section of Side Running Transit

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1"=50'-0"

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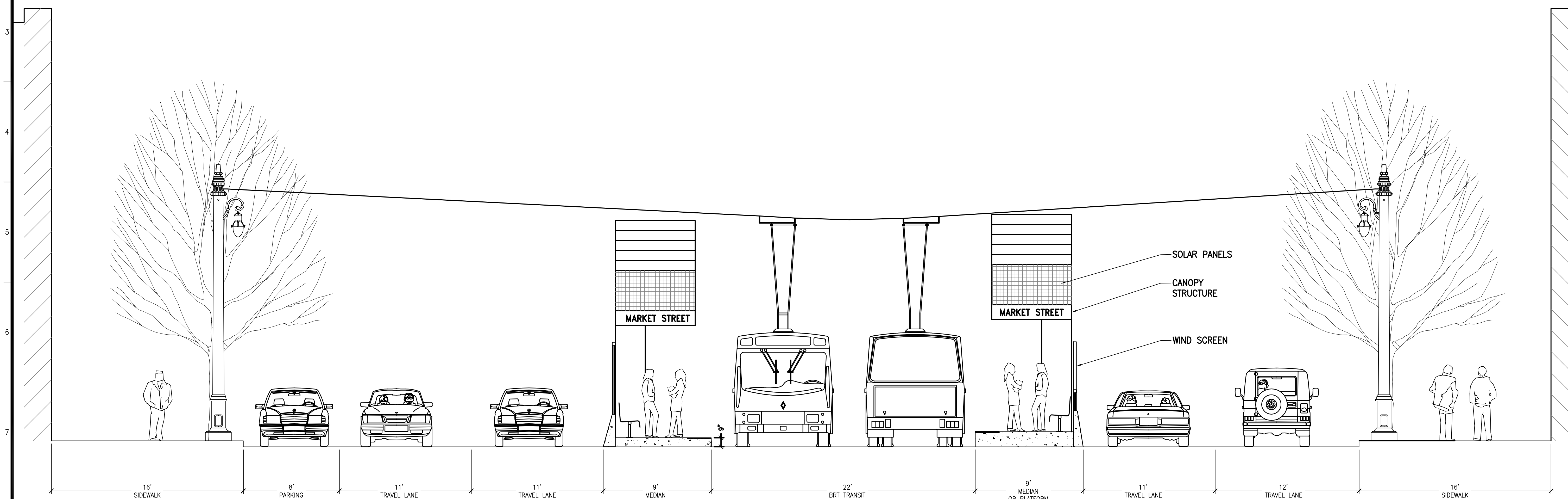

Figure 1.2: Alternative 3, Cross Section of Center Running Transit, Side Platform

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DEPARTMENT OF PUBLIC WORKS

CITY AND COUNTY OF SAN FRANCISCO

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BUS RAPID TRANSIT STUDY
SAN FRANCISCO, CALIFORNIA
ALTERNATIVE 3
CENTRAL LANE BRT W/ SIDE LOADING PLATFORMS
STATION CROSS-SECTIONS

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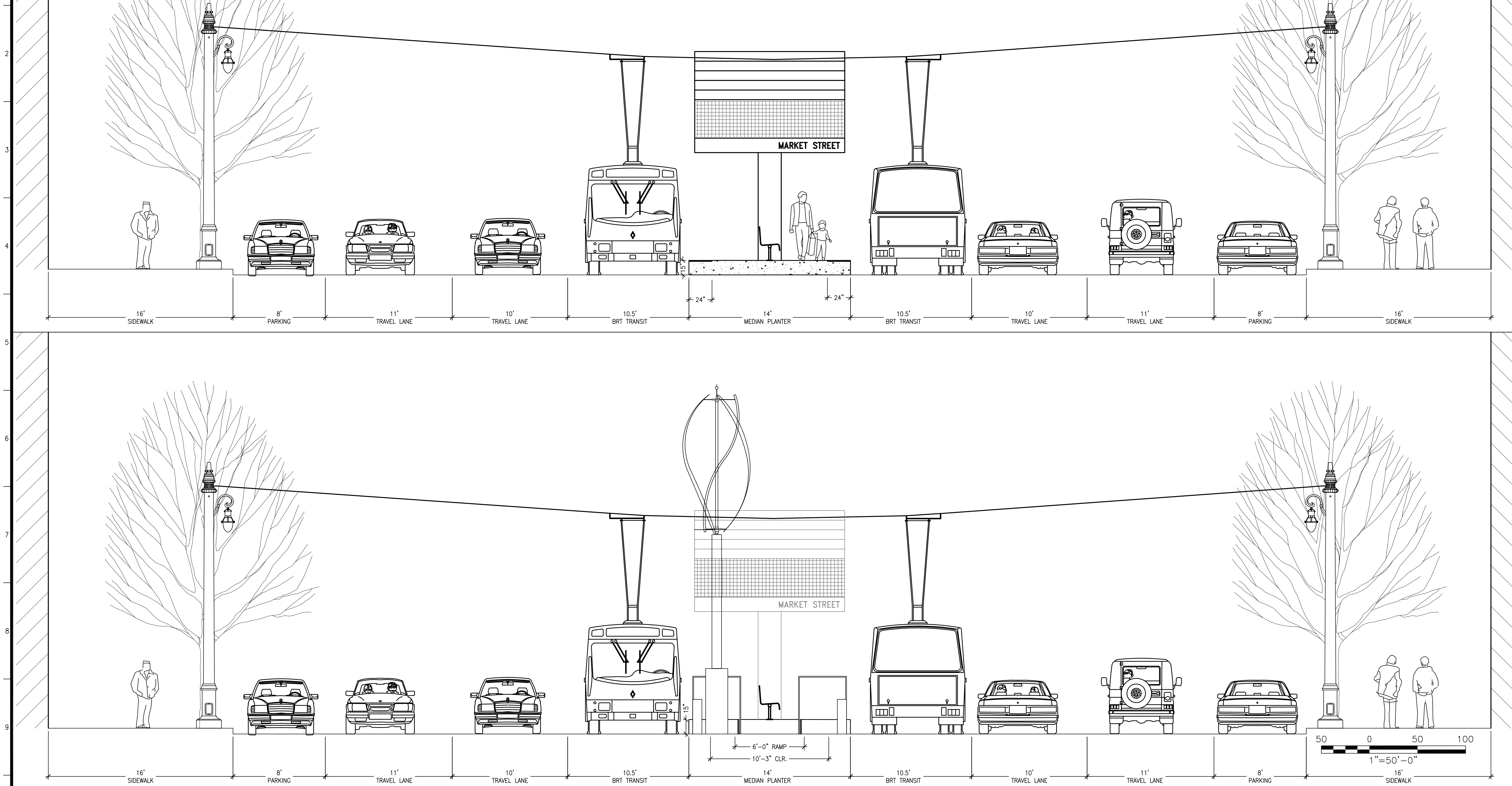
Figure 1.3: Alternative 4, Cross Section of Center Running Transit, Center Island



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STATION CROSS-SECTIONS

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2.0 Existing Conditions

2.1 Introduction

The existing poles on Van Ness Avenue support both streetlights and the OCS wires powering trolley buses. The existing concrete poles were originally installed in 1914, and both the poles and the lighting infrastructure have deteriorated due to continued exposure and increasing usage during the past 94 years[1]. In 1936, the poles were relocated from their original location in order to accommodate the widening of Van Ness Avenue. The poles originally supported one streetcar wire over each north/south streetcar trolley track; now the poles support two overhead contact wires over each north/south bus route, thus doubling the gravity load on the wire, and adding to the tensile load on the poles. In addition, every intersection is currently more complex than when the poles were relocated, creating more tension at intersections due to the combination of weight and distance from the pole to the attachment point in the OCS. Also, over the years, additional features, such as traffic signals and directional signage, have been attached to the poles, adding to the weight on the poles.

Numerous poles exhibit spalling of concrete, with resultant exposed rebar and corrosion of the exposed rebar. Some poles have been entirely replaced with new steel poles; some of the poles that are still standing have insufficient structural integrity, and have new metal poles erected next to them to support the OCS loads including both gravity and tension loads.

This section discusses engineering issues related to the existing pole conditions, including:

- Operational / core function issues
- Safety
- Maintainability
- Efficiency

2.2 Structural Integrity

The existing poles were built in 1914, and the existing foundations were built in 1936. The structural condition of the existing poles has deteriorated since then. During a recent visual inspection, concrete cracks, spalls, rebar corrosion and out of plumb poles were observed. The results of inspection determined that the existing poles will be unable to support any additional loads from the OCS and most of the deteriorated existing poles are not even adequate to continue to support the current trolley system.

Based on information from SFMTA, approximately 10% of the original poles along Van Ness Avenue have been abandoned for use in supporting the OCS. Of the abandoned poles,

[1] Bigger, articulated buses do not in and of themselves increase the tension, since the bus arms (collector poles) are spring loaded to push upwards.

roughly 60% of them still stand as streetlight only poles, requiring the use of eyebolts embedded into buildings or the addition of nearby steel poles that support the OCS. The remaining 40% of the abandoned poles have been demolished entirely and replaced with newer combination OCS Support Poles/Streetlights. These combination poles have been constructed with various designs and do not attempt to replicate the existing light poles.

By the mid-1980s, internal correspondence repeatedly expressed concern over the condition of the poles. Pole replacement has been on SFMTA's list of desired Capital Improvement Projects for approximately 10 years.

To determine structural integrity of the existing poles to provide OCS support, per agreement with SFMTA and the Authority, a visual inspection was conducted of three sample segments along Van Ness Avenue. The three sampled segments were:

- Segment 1: Between Market and Hayes Street
- Segment 2: Between Grove and McAllister Street
- Segment 3: Between Chestnut and North Point Street

Segments 1 and 3 were chosen to provide a range of pole types and to bound the environmental conditions, with Segment 3 being closer to the marine environment, and Segment 1 being in the heart of the urban environment. Segment 2 was chosen because it is within the Civic Center Historic District.

Structural integrity was evaluated based on visual inspection, and was measured / indicated by the following:

- Concrete cracking and spalling
- Rebar exposure and corrosion
- Out of plumb poles

The visual inspection in the sample segments revealed that about 50 percent of the existing poles have differing levels of structural damage. The damage on about half of them is relatively severe, including concrete cracks, spalls, and rebar corrosion. Since foundations are a subterranean feature, they cannot be inspected, but based on the observation of out of plumb poles, the conclusion can be made that some existing foundations are inadequately designed for overturning loads.

With respect to the remaining 50% of the poles, even though they did not show severe structural damage based on visual inspection, due to their age and increased usage, more detailed evaluation and material testing would be required in order to verify their structural integrity adequacy for continued long-term usage. Representative existing conditions of the poles are shown in Photo Documentation Figures 2.1 – 2.6.

Based on the results of the visual inspections, this report recommends replacement of the OCS support poles/streetlights for any of the alternatives, due to the additional loads that will be imposed by the new OCS and due to the high percentage of damaged poles already compromised by the current trolley system, as had been planned in SFMTA's Capital Improvement Program.

To ensure continuity of service the poles would need to be replaced in the short to medium term. Build alternatives 3 and 4 would create increased tension and gravity loads due to the relocation of the OCS to the middle of the street. Also, current SFMTA standards dictate that the poles' height would need to be increased for any of the build alternatives. Even in the event of no BRT project, the structurally damaged poles are recommended for replacement, and more detailed evaluation and material testing are recommended for the remaining poles.

2.3 Existing Electrical System Integrity

The existing lighting infrastructure was installed in 1915. To determine the electrical integrity of the existing poles / infrastructure, DPW consulted SFPUC, which indicated that Van Ness Avenue is a roadway that has needed streetlight system replacement for over twenty years. The current system is outdated with products that are not in production anymore. Also the electrical system is such that a failure at any pole will result in the outage of the entire circuit, due to the series wiring of the system.

The existing poles use a non standard electrical system. This has resulted in the deterioration in the electrical system integrity and inability to meet the electrical needs of the Alternatives 1-4 because this system is long past its useful life and needs to be replaced with a modern more efficient lighting system. Lead conduction wires for street lights are embedded in the concrete without conduits. The current system consists of 4 circuits in a 5kV series loop. The teardrop luminaries have 20 Amp incandescent lamps, which can no longer be purchased because they are no longer manufactured. The SFPUC is relying on their on-hand supply of spare lamps. The lamps have 12% the life of high pressure sodium bulbs. In addition, many transformers are no longer functional or replaceable requiring refurbishment by an outside vendor. Lighting energy and maintenance cost are three times that of standard street lighting systems.

In addition, the current system does not conform to today's roadway lighting standards (IES RP-08) for illumination of a major arterial/state highway. Also, the current system integrity is such that it does not conform to current electrical codes for safety. In this respect maintenance solutions must be fabricated in the field to protect both the public and maintenance personnel. In order to bring the current system up to current electrical and illumination standards it would require replacement in its entirety of the electrical circuits, transformers, lamps and lamp housings. New poles that have been built to replace or supplement existing poles demonstrate no consistency. Some poles have cobra head light fixtures whereas others are adorned with pendant style fixtures.

The need to replace the lighting infrastructure has been identified by SFPUC since 1986, and SFPUC's capital program has included a placeholder for a project since 1986. SFPUC has applied patch-type fixes onto the poles not only to keep them standing, but to shield the electric circuitry within the base plates. To remedy numerous base plates that had corroded through, fiberglass bases were added in 1986 to provide protection from high-voltage exposed circuitry.

Drawings of the existing OCS are included in the appendix.

2.4 Photo Documentation

Figure 2.1: Out of Plumb, Fell and Van Ness Avenue (Pole 16)

Figure 2.2: Supplementary Steel Pole, North Point and Van Ness Avenue (Pole 315)

Figure 2.3: Concrete Spall, Hayes and Van Ness Avenue (Pole 17)

Figure 2.4: Exposed Rebar, Hayes and Van Ness Avenue (Pole 18)

Figure 2.5: Cracked Base, Francisco and Van Ness Avenue (Pole 297)

Figure 2.6: Detached Fiberglass Replacement, Bay and Van Ness Avenue (Pole 308)

2.5 Existing Drawings (From 1936 and 1986)

2.5.1 Street Layout

Four Drawings Attached

2.5.2 Poles

From 1936 Relocation Project

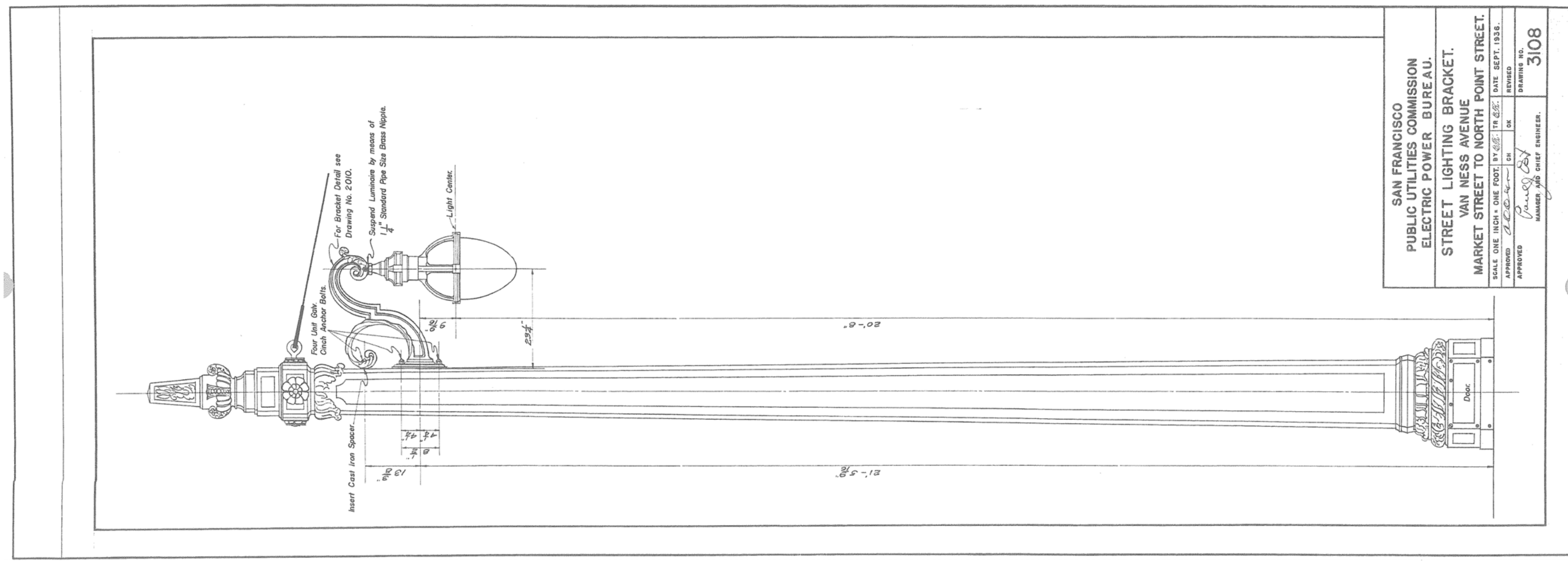


Figure 2.11: Street Light Bracket Drawing from 1936 Relocation Project

2.5.3 Foundation

From 1936 Relocation Project

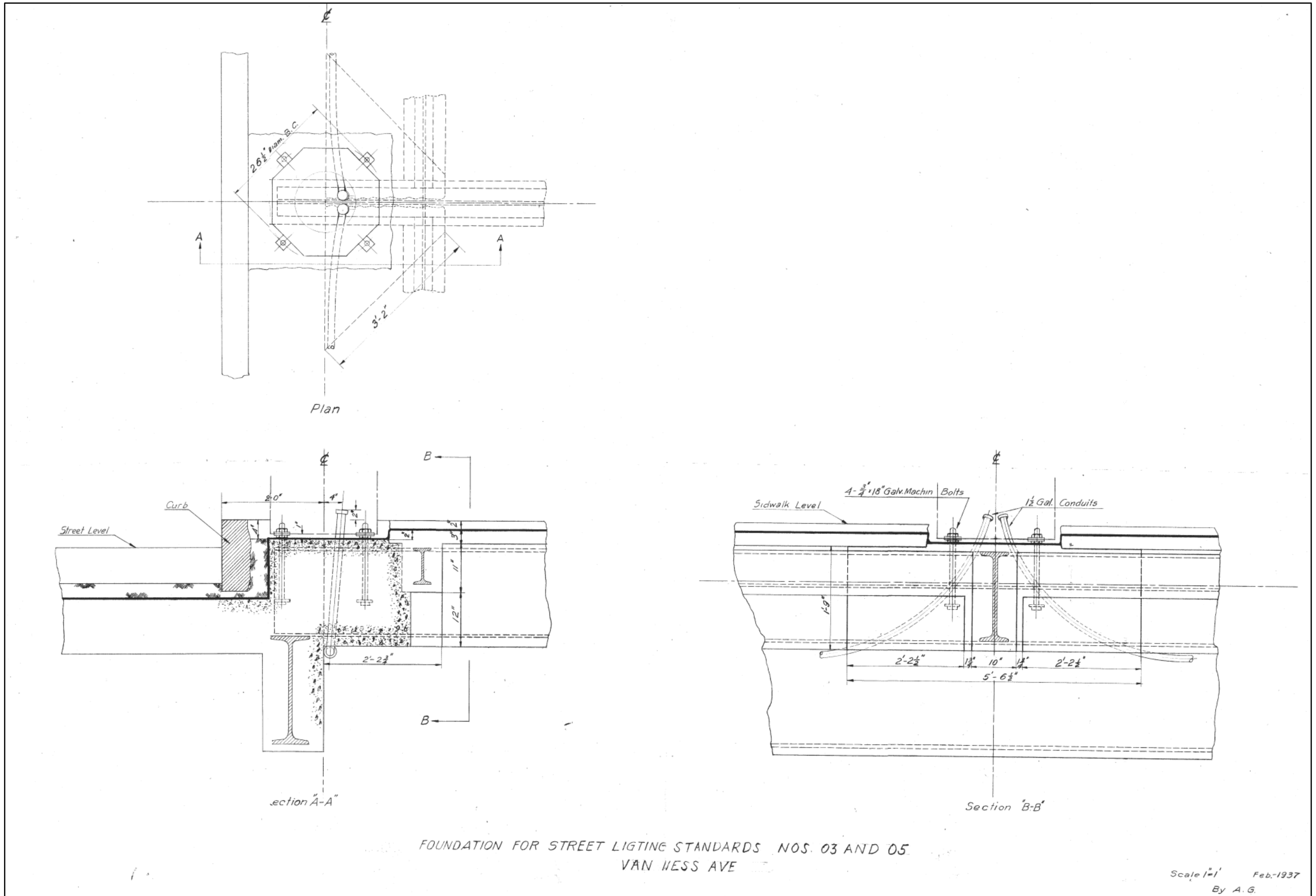


Figure 2.12: Street Light Foundation Drawings from 1936 Relocation Project

2.5.4 Lighting Bracket

From 1936 Relocation Project

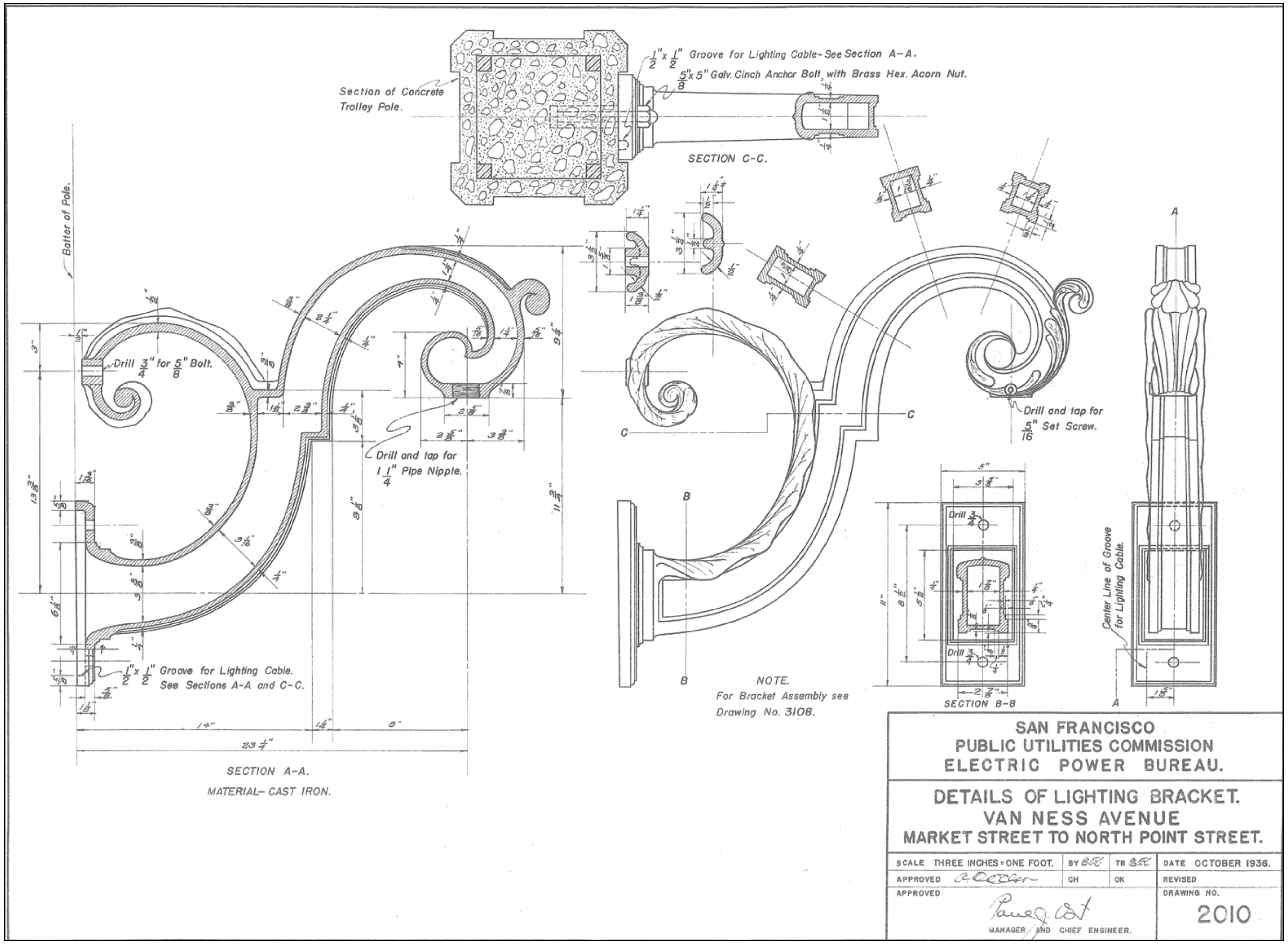
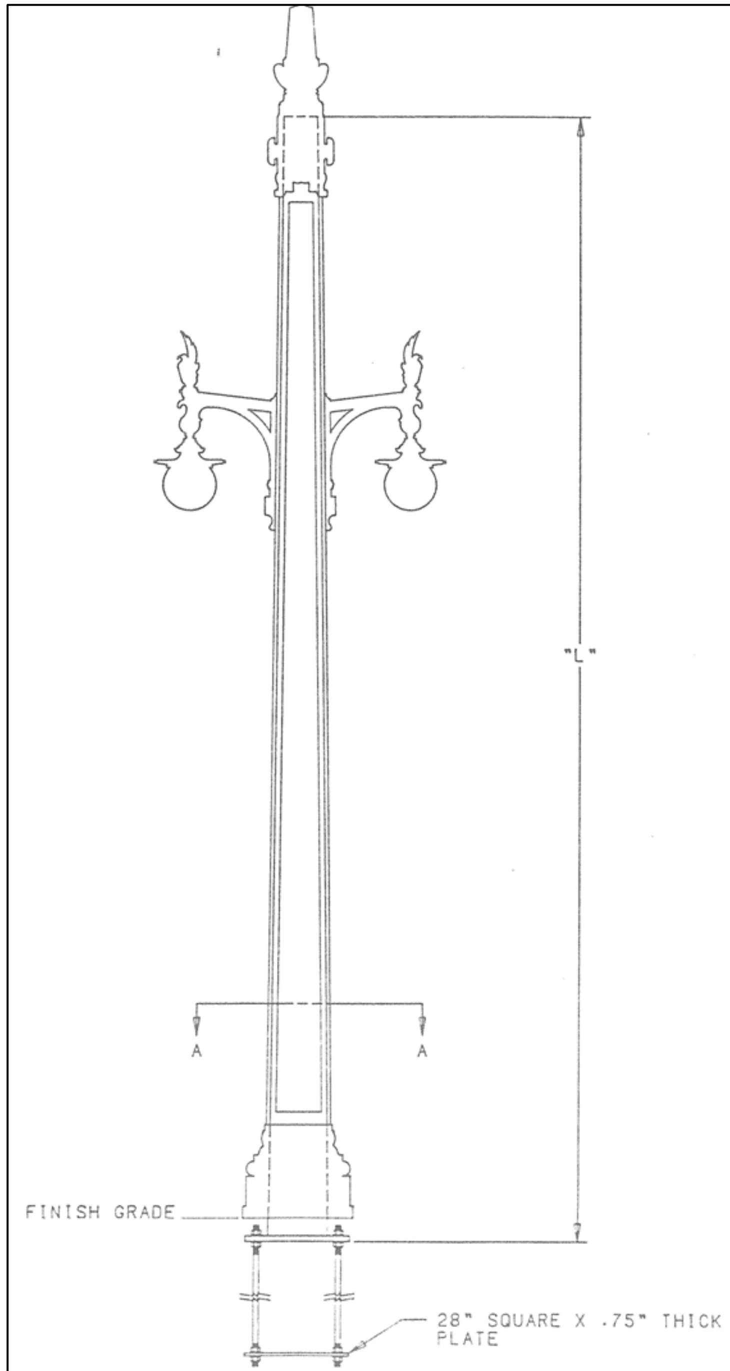


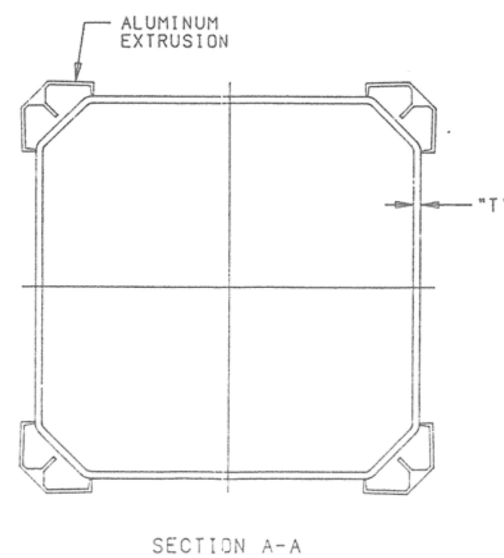
Figure 2.13: Details of Lighting Bracket from 1936 Relocation Project

2.5.5 Poles

From 1986 Rehabilitation Project



POLE SHAFT					ANCHOR BOLTS		BASE PLATE	
MAXIMUM ALLOWABLE MOMENT (KIP-FT)	OVERALL LENGTH "L" (FT)	OUTSIDE DIAMETER AT BUTT. (INCHES)	OUTSIDE DIAMETER AT TOP (INCHES)	WALL THICKNESS "T" (INCHES)	DIAMETER (INCHES)	LENGTH (INCHES)	SQUARE (INCHES)	THICKNESS (INCHES)
183	30	16.00	11.80	0.3750	2.00	131	28	1.75
45.6	30	16.00	11.80	0.1793	1.25	84	28	1.25



COMPONENT PART	ASTM OR DESCRIPTION	MINIMUM YIELD KSI
183 KIP-FT POLE SHAFT	A572 GRADE 55	55
45.6 KIP-FT POLE SHAFT	COMMERCIAL QUALITY HOT ROLLED COIL MEETING THE CHEMICAL COMPOSITION OF ASTM A595 GRADE A	45
BASE PLATE	A572 GRADE 42	42
ANCHOR BOLTS	A36 MOD 55	55
ANCHOR BOLT BEARING PLATE	A572 GRADE 65	65

VANNESS AVENUE LIGHTING IMPROVEMENTS
CITY AND COUNTY OF SAN FRANCISCO
PUBLIC UTILITIES COMMISSION

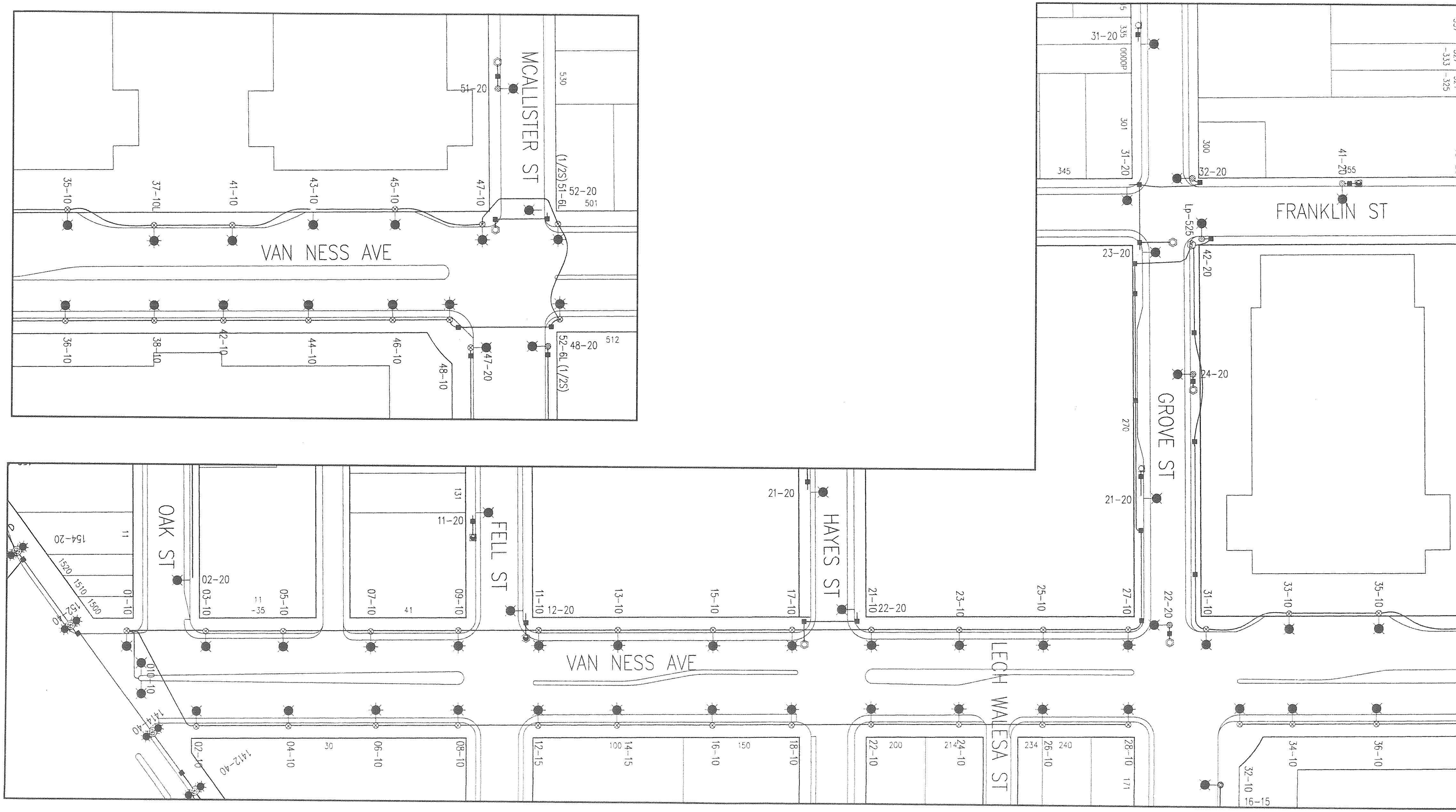
VALMONT INDUSTRIES, INC
VALLEY, NEBRASKA 68064
(402) 359-2201
ELECTRICAL PRODUCT DIVISION

VALMONT ORDER	DATE	DRWN	CHK
	8-26-86	RV	

TITLE: SQUARE TROLLEY POLE
SHEET 1 OF 1
DRAWING NO. L-DSF0111

REV. DATE | REVISION | BY | CHK

Figure 2.14: Square OCS Support Pole/Streetlight Drawing from 1986 Rehabilitation Project



Van Ness Ave. Loop 525-Market to McAllister Sts.

Legend:

Existing Pole and Streetlight

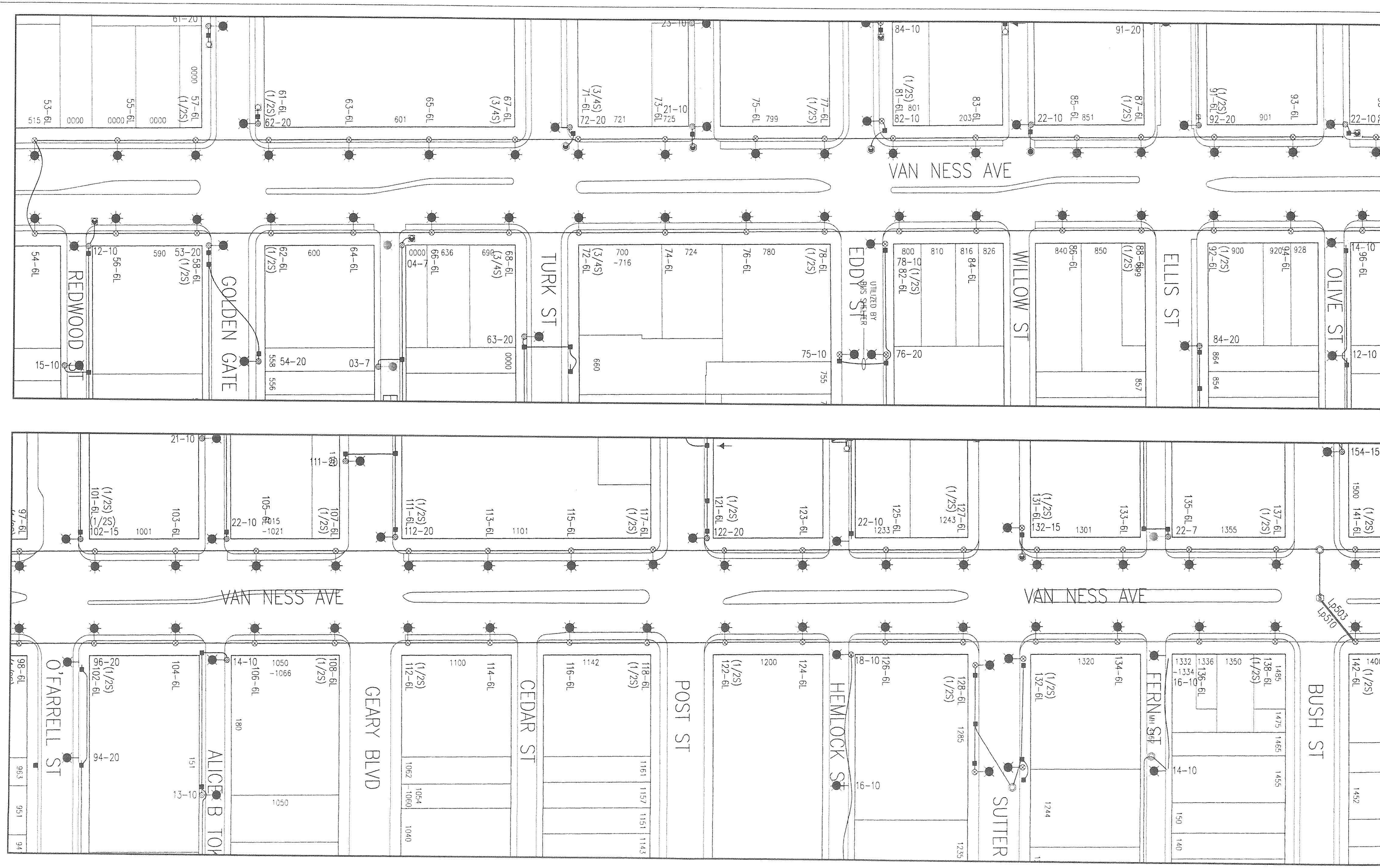
Figure 2.7: Existing Van Ness Avenue Light/Trolley Pole Layout – Market to McAllister

1"=100'

NORTH

All streetlighting facilities are diagrammatic and correct for general information only. Actual locations must be verified in the field.

Data Source: BLHP streetlighting CAD/GIS



Legend:

Existing Pole and Streetlight

Van Ness Ave. Loop 510-McAllister to Bush Sts.

Figure 2.8: Existing Van Ness Avenue Light/Trolley Pole Layout – McAllister to Bush St.

1"=100'

NORTH

All streetlighting facilities are diagrammatic and correct for general information only. Actual locations must be verified in the field.

Data Source: BLHP streetlighting CAD/GIS

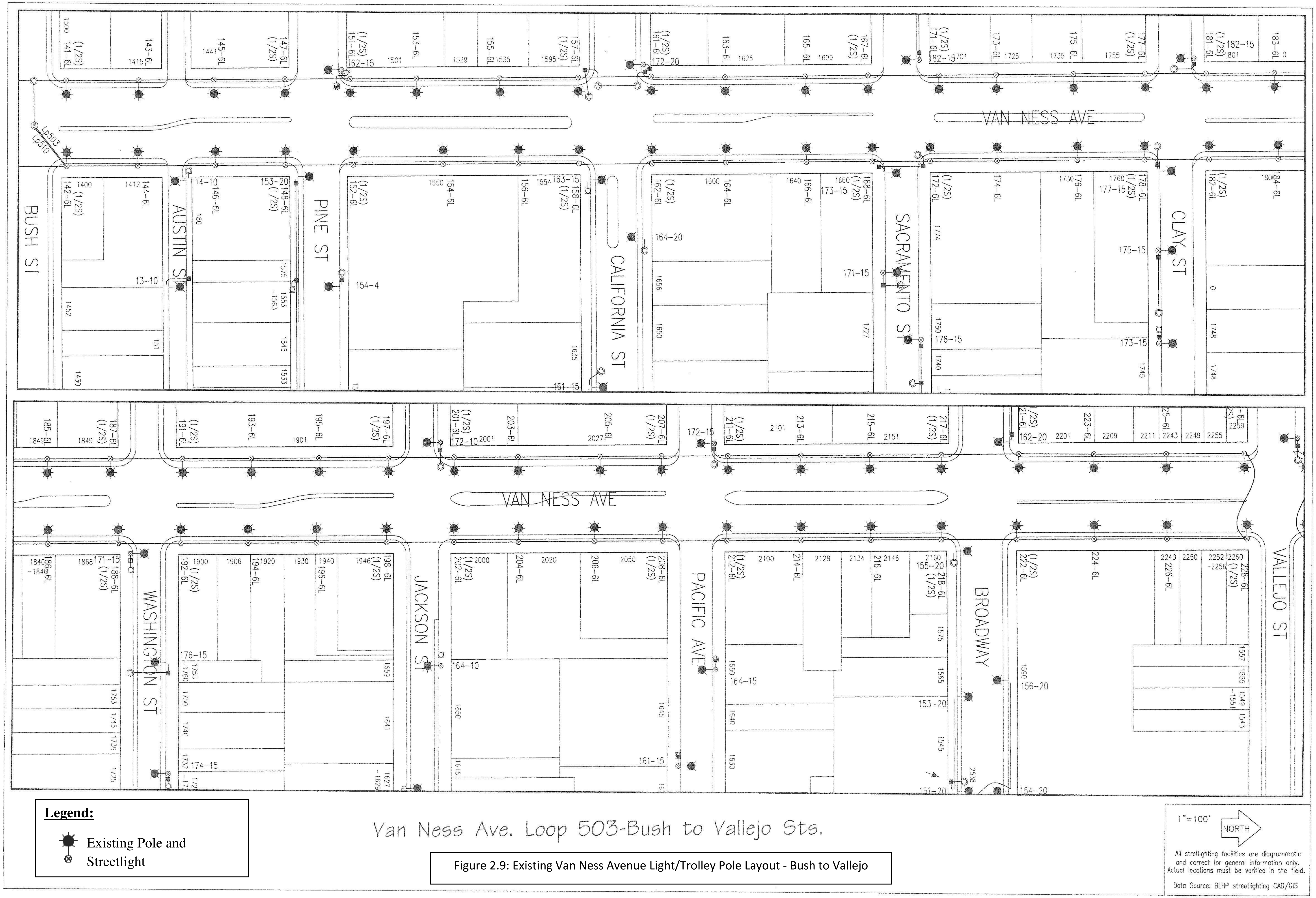


Figure 2.9: Existing Van Ness Avenue Light/Trolley Pole Layout - Bush to Vallejo

Figure 2.10: Existing Van Ness Avenue Light/Trolley Pole Layout – Vallejo to North Point

3.0 Design Criteria

3.1 General

The following section presents the criteria and procedures to be used in the structural and electrical design. Details of the structural and electrical components and their integral architectural features and aesthetic design requirements will be finalized during detailed design phases. The criteria presented in this section apply to the structural and electrical design and requirements. The design criteria and material selection for these structures are in accordance with current industry practice, applicable building codes, local regulations, and USACE publications.

When OCS support is involved, SFMTA design standards typically control, and SFMTA generally is responsible for the structural design and requirements of OCS support poles/streetlights. SFMTA uses a standard series of poles: the 700 series, comprising four types of poles with varying load capacities. Poles from this 700 series are likely to be used in this application (see Chapter 4: Structural Conceptual Design for all pole types and styles considered).

- All poles will be 30 feet in height.
- OCS support pole bands will be located at heights between 20-27 feet.
- Per SFMTA requirements, OCS poles must be placed no further than 100 feet apart, as measured along the Van Ness roadway corridor. SFPUC light pole spacing requirements call for a narrower spacing of 80’ to 90’ (discussed in section 3.3). Therefore, the spacing criteria for light and OCS support poles are compatible if the poles are between 80’ and 90’ apart.

3.2 Structural Design References

The following codes, standards, and specifications are an integral part of the design criteria. The applicable version of each document shall be the latest edition in force at the time the project design was started, unless noted otherwise. References to specific codes and standards are also included in the applicable technical specifications of the contract documents.

<u>References</u>

The following documents form a part of this chapter by reference thereto:

- American Association of State Highway and Transportation Officials (AASHTO) Standard Specifications
- American Society for Testing Materials and Standards (ASTM)
- American Welding Society (AWS), “Standard Welding Code” (AWS D1.4 & AWS D1.1)
- ACI, “Manual of Concrete Practice,” Parts 1, 2, 3, 4, and 5

- ACI 318-05/318R-05, "Building Code Requirements for Structural Concrete and Commentary", 2005
- ASCE 7-05, "Minimum Design Loads for Buildings and Other Structures," 2005
- "Architecture Metals", published by the National Association of Architectural Metal Manufactures (NAAMM)

The design shall conform to the latest editions of the standards and codes listed above. Specific standards have been listed to bring attention to the most applicable, but this list is not intended to be all-inclusive. Where the requirements of more than one code or standard are applicable, the more restrictive requirement shall be used.

3.2.1 Structural Design Loads

Design loads for each OCS support pole/streetlight shall be based on the location and tension force from the OCS. A standardized set of four different poles, all belonging to the 700 series, is recommended by SFMTA. The parameters of the four different pole models are listed under section 4.4. The allowable loads for each of model are following:

- Model 761: 45.6 kip-ft
- Model 765: 81.5 kip-ft
- Model 767: 126.6 kip-ft
- Model 770: 183.6 kip-ft

In general, model 761 will likely be sufficient for standard poles while model 770 may be required for intersections and special locations. The final selection of the poles will be based upon the completed design of the OCS. The design wind load shall be based on California Building Code or the requirements from Caltrans, whichever is more stringent.

3.2.2 Structural Steel Pole Foundation Design Criteria

The foundation of the OCS support poles/streetlights shall be reinforced cast-in-place concrete piers. The size and depth of concrete piers shall be decided based on the reaction loads from each individual OCS support pole/streetlight.

Potentially, some basements may be located under the street sidewalk at OCS support pole/streetlight locations. The basement's detailed information and locations are unknown at this time. For cost estimating purposes, a total of 10% of the poles are assumed to have basement issues which would need to be resolved during detailed design and construction.

3.3 Electrical Design Criteria

3.3.1 General

These design criteria will be used as the guidelines for design of the electrical and lighting components. These criteria establish the guidelines to be used in the final preparation of bid documents related with the design of the electrical lighting drawings and specifications.

3.3.2 References

Codes and Standards: The work will be performed in accordance with the latest provisions of codes and standards published by the following organizations:

- American National Standards Institute (ANSI)
- American Society for Testing and Materials (ASTM)
- California Electrical Code (CEC)
- City and County of San Francisco Electrical Code (SFEC)
- Electrical Testing Laboratories (ETL)
- Illuminating Engineering Society of North America (IESNA)
- Insulated Cable Engineers Association (ICEA)
- Institute of Electrical and Electronic Engineers (IEEE)
- Illuminating Engineer Society (IES)
- National Electrical Code (NEC)
- National Electrical Manufacturers Association (NEMA)
- National Electrical Safety Code (NESC)
- Underwriters Laboratories (UL)
- Occupational Safety and Health Act (OSHA)

3.3.3 Lighting Fixture Design Criteria

- Van Ness is part of route US 101 and classified as a Major roadway. Caltrans standards would apply, but San Francisco roadway lighting requirements are more stringent and so will govern.
- Lighting levels for Van Ness must maintain a minimum average of 1.7 foot candles, per IES RP-08.
- The roadway light fixtures shall be mounted to an arm (3'-6') off each pole, at about 30' high. Pedestrian fixtures shall be mounted at approximately 16' above the sidewalk. The final height of the roadway lights will be determined during the detailed design phase.

- Minimum spacing for lighting fixtures shall be between 80’ and 90’ apart, per SFPUC Power.
- The poles selected shall be rated to withstand SFMTA requirements.
- New electrical services shall be provided at 120/240 Volts (2 per block).
- New electrical connection must be provided for MUNI overhead cables (1 per 5 blocks).

4.0 Structural Conceptual Design

4.1 Introduction

The structural design shall include steel poles, reinforced concrete foundations and the attachments between poles and foundations. The capacity requirements of each pole shall be based on the tension force from the OCS and the foundation design shall be done accordingly, based on the reactions at each individual pole.

The conceptual design applies to all 4 possible Alternatives, 1-4.

4.2 Rehabilitation vs. Replacement

Rehabilitation of existing poles is not being considered for this project due to the irreparability of their current condition (see Chapter 1, Section 1.3 for full set of options considered). Complete replacement of poles would be required for each build alternative to safely support additional weight loads and tensions from BRT OCS wires, as well as from added lights and signage.

The option of keeping the existing poles and installing new vehicular and pedestrian lighting only was considered, but rejected for the following reasons:

Too many of the existing poles exhibit compromised structural integrity, and therefore are potentially unsafe. They would need to be rehabilited, adding to the capital cost of the project.

Since the existing poles are solid concrete, new conduit would be externally mounted, which is not per current electrical code requirements

New OCS poles would be installed near existing poles, causing pole clutter, which is not in keeping with the City's general planning goals

The poles were originally design to function as OCS support; removing this function would not be in keeping with the goals of this project nor its definition.

Currently, eyebolts attached to the buildings are used to support the OCS at some locations. SFMTA intends to keep these connections in service for their strength and ease of maintenance. While SFMTA intends to preserve existing eyebolt connections, all OCS support poles/streetlights shall still be designed to have enough capacity to support the OCS in order to maintain uniformity along the Van Ness corridor and accommodate future needs.

4.2.1 New Overhead Contact System

Per the consensus of the CER Poles Team, several items vital to the OCS and traffic aspects of the BRT are not developed in this Van Ness Bus Rapid Transit OCS Support Poles/Streetlights Project CER. These items are listed and discussed below, and are included for reference only.

- Construction of new OCS
- Guy wire and pole attachments

- Existing OCS support-only poles
- Traffic signal poles

While the construction of a new overhead contact system is not developed with this CER, it is a vital aspect to the overall BRT project. The majority of the guywires are structural, supporting the trolley wires from which buses will be continually powered. Thicker power feeder wires will run from every fourth pole into the trolley wires. The power feeder wires also serve as a structural support wire for their location. For the overall BRT project, guywires, pole attachments, and other related OCS work will be needed.

The new OCS shall be constructed above and offset from the existing system, keeping the existing OCS live during construction. This will allow for transit service during construction. However, even if this "overbuild" scheme is utilized, the demolition of the existing OCS and the lowering of the new OCS to correct height will need to occur simultaneously. The final height of the new system will be at the same height as the existing system, therefore at some point, the existing service system will be affected by the construction. This will need to be considered when developing the construction sequencing plan as it could require diesel bus substitutions, night work, and shorten work windows which can substantially impact project cost and schedule. However, this disruption is usually a short period of time. If center running alternatives (3 or 4) are selected, it will further complicate construction sequencing as the trolley wire alignment will be substantially different from the existing system.

Poles located at intersections with crossing overhead trolley lines will usually need to be poles higher in the 700 series, in order to support the special work (crossings, switches, curve segments) needed at such intersections.

Also, currently there are a number of OCS support-only poles supporting the OCS, particularly near intersections. These poles are not included in this CER. The overall BRT project shall determine if these poles will remain and whether they will be augmented/painted to match the new OCS support/streetlight combination poles. The BRT project shall also coordinate the inclusion of traffic signal poles into the overall project.

4.3 OCS Support Pole/Streetlight Design

Given the decision to replace the current poles with one set of poles that can perform all necessary functions (supporting the OCS, streetlights, and pedestrian lights -- see Chapter 1, Section 1.3) there were a number of designs considered but rejected. As a first design criteria, only poles options that were located on the side of the street, near where the current poles exist were considered. Locating the OCS support poles and streetlights in the center was rejected for the following reasons:

- **Historical Precedent.** The current poles have been located on the side of the street. At 30 feet in height, building the poles to the center of the street would add a new element to the visual and physical landscape which does not currently exist. Aesthetically, the trolley wires blend in with their background after approximately one-half block of distance. Poles in the center would be visible from a much greater distance. This is of particular concern in the Civic Center Historic

District, where increased visual impacts could be considered an adverse impact. Since the center poles could not provide pedestrian lighting, poles would need to be built on the side, thus increasing the amount of visual clutter and running counter to the goal of using one set of poles.

- **Cost.** A Capital Improvement Project (CIP) cost estimate written by SFMTA in 2009 an increased cost to build OCS support poles in the center versus the side. In addition, lights in the center would not provide pedestrian lighting. so cost of building additional poles on the side would be in addition to the 10% increased cost.

- **Maintenance/Operations.** Performing upgrades and repairs to poles located on sidewalks is generally less disruptive than performing similar work on poles located in the median. This is because a repair crew can access the poles from the sidewalk or from a parking space taken out of service, whereas poles in the center of the street often require closing a lane of traffic. In the case of Alternatives 3 and 4, this would mean forcing the BRT vehicles to operate in mixed traffic. The buses would not be able to do this in Alternative 3 because the trolley wires extending from the bus would not be able to clear the station platforms.

Exact replication of the poles were considered, but rejected for a number of reasons. First, current SFMTA standards require pole height to be increased to 30'. This height increase would be necessary in order to structurally support OCS in Alternatives 3 and 4, due to the increased tension of supporting the OCS from the center. The increased height would also be preferable for OCS operations and maintenance for all alternatives, and would make it more possible to achieve IES RP-08 lighting standards and pedestrian lighting. In addition, structural steel was chosen as the preferred pole material. Concrete and square cross-section were rejected in favor of SFMTA standard round, slightly tapered steel poles for the following reasons:

- **Height.** Steel poles can be readily made to the required height of 30 feet, whereas concrete poles would need to be custom designed.

- **Strength.** Given a standard diameter, steel poles are stronger than concrete.

- **Size.** Round steel poles would have a smaller base, making them less likely to be hit by a vehicle.

- **Safety.** Steel poles offer some "give" if a vehicle impacts them, whereas concrete does not.

- **Cost.** Initial estimates indicate that steel poles would cost approximately half the amount of concrete poles

- **Maintenance.** Steel poles are significantly more easily maintained by SFMTA

- **Spares.** Due to the easy availability of the poles in the catalog, steel poles would be easily replaceable by SFMTA in the event of significant damage. Custom concrete poles would not be available in this manner.

- **Aesthetics.** Standard round poles are normally built with a slight taper, desirable for appearance

- **Adornments/modifications.** Round poles can readily accommodate standard pole fixtures and mounting brackets in the need to hang banners (a requirement) and use special adornments such as arms, pole caps, scrolls, finials and bases.

Poles will be ultimately selected from the standard SFMTA round cross-sectional pole series shown in Table 4-1. The OCS support pole/streetlight design are based on four standard poles used by SFMTA: 761, 765, 767, and 770 series poles. The specifications are provided below:

Table 4-1: 700 Series OCS Support Pole/Streetlight Specifications

Pole No.	L	Db	Dt	t	P	La	D2	D1	y(P)	y(2/3*P)	Adjusted y(2/3*P)
761	9144	254	147	6.1	10911	8687	247.9	146.3	479	319	351
765	9144	305	198	7.9	20399	8687	297.1	195.4	370	246	271
767	9144	305	198	12.1	29935	8687	292.9	191.2	372	248	273
770	9144	330	224	15.9	44787	8687	314.1	213.4	335	224	246

PARAMETERS:

y = Deflection of pole at point of application of load P (mm)
P = Transverse load applied to pole (N)
E = Modulus of Elasticity (200,000 N/mm^2)
pi = 3.1416
t = Wall thickness of pole (mm)
L = Length of pole above ground (mm)
La = Length of pole above ground to point of application of load (mm)
Db = Diameter at base (mm)
Dt = Diameter at tip (mm)
D2 = Db-t = Outside diameter of pole at ground line minus wall thickness (mm)
D1 = {Db-(Db-Dt)*La/L)-t = Outside diameter of pole at point of application of load P minus wall thickness (mm)

Based on the recommendations from SFMTA, the poles will be constructed of tapered steel. Roadway lights will be mounted at the highest elevation and the OCS will be suspended from brackets on the poles. Sidewalk lights will have an elevation of about 16 feet. Spacing between each component is necessary to prevent equipment clearance issues and improve ease of maintenance and serviceability.

Aesthetic / architectural considerations are discussed further in sections 6.2 and 6.3. Removable covers at base of the poles are recommended. Decorative pole base covers can serve to enhance visual appeal. Additionally, poles may need to be adorned with steel bracket arms to support lighting fixtures. Design of the poles will be subject to review by the San Francisco Civic Design Review Committee (see Section 9 relating to permits and local approvals) and a Certificate of Appropriateness will need to be obtained from the Historic Preservation Commission for the poles in the Civic Center Historic District..

For the cost estimate purpose, based on the recommendations from SFMTA, 65% of all poles were assumed to be moderate duty poles (Model 761); and 35% of poles were assumed to require heavy duty poles (Model 770), to serve at intersections and locations of increased load. The current pole sizing estimate encompasses all BRT alternatives. However, the percentage distribution between heavy duty and moderate duty poles may vary slightly for different alternatives.

4.4 OCS Support Pole/Streetlight Foundation Design

A foundation shall be provided for each individual pole. The foundation shall be reinforced concrete piers and the design shall base on the reactions from poles. The size and depth of concrete pier are estimated to be of the order of 3 feet diameter, 10 feet deep. The foundation dimensional estimate shall be reevaluated based on the finalized reaction loads from OCS support poles/streetlights during the design phase.

5.0 Electrical Conceptual Design

5.1 Introduction

This section of the report will identify the lighting conceptual design criteria along Van Ness Avenue, from Mission Street to North Point Street. It should be noted that the area from Market Street to McAllister Street is considered part of the San Francisco Civic Center, a National Historic Landmark, and City designated historic district. Architectural design considerations related to this are discussed further in Chapter 6. Ornamental accents and features assumed include a decorative base, top, and arm, which are available in many various designs from SFMTA preferred vendors Valmont and Union Metal Corp, as well as from luminaire manufactures.

The conceptual design applies to all 3 possible BRT Alternatives as well as the no-build alternative (Alternative 1).

5.2 Roadway Illumination

The principal purpose of roadway lighting is to provide quick, accurate, and comfortable visibility at night. These qualities of visibility may safeguard, facilitate and encourage vehicular and pedestrian traffic. Good design of roadway lighting has been proven to:

a. Reduce number of night accidents
b. Aid police and enhance sense of security
c. Facilitate traffic flow
d. Promotion of business and the use of public facilities during the night hours

The *Illuminance* method for roadway lighting design is the most standard and accepted method for determining safe lighting levels. This method provides recommended light levels based on roadway type and classification. Other considerations for lighting design include best energy management principles. This would incorporate the following:

a. Efficient luminaries and lamps design for the application
b. Appropriate mounting height and luminaire positioning
c. Good maintenance program to maintain design lighting level

Van Ness Avenue is classified as Major roadway, as it is a principal network for thru traffic connecting State route 101 to the Golden Gate Bridge via Lombard St. There is also a high volume of pedestrian and traffic conflict, as the Van Ness corridor serves commercial and residential areas. The final parameter for determining the roadway is classification based on roadway reflectance. For this project the roadway mode of reflectance is mixed with diffuse and specular elements. This gives a roadway classification of R2/R3 characteristics. With the roadway type and classification the illuminance levels can be determined using the IES RP-8, (recommended practice manual) Illuminance Method Table. Utilizing this table to effectively illuminate the major roadway, the IES recommends minimum maintained light levels in the range of 1.0 to 1.7 foot candles (fc), with a ratio of average to minimum values of 3 using the illuminance method.

For reasons described in Chapter 1, Section 1-3, poles will provide support to the OCS for the and lighting fixtures. SFMTA's standards include 30' height for OCS support poles. The roadway lighting fixture will be suspended from an arm near the top of the pole (approximately 28'). Next the OCS support cables for BRT will be attached below the roadway fixture. Then the pedestrian sidewalk fixtures will be mounted to the pole below the cables at approximately 16'. New poles will be constructed, ideally, within 3-5' of the existing pole locations. This will maintain the existing spacing of the poles at approximately 80' on center, which meet the requirements of both SFMTA and SFPUC.

Once a fixture has been selected, a full photometric analysis must be performed to identify optimal mounting heights and lamp wattages for illuminating the roadway, with attention to mounting height to reduce glare to the driver.

5.3 Sidewalk Illumination

Van Ness Ave has a high level of pedestrian night activities, and there is a need to provide visibility for drivers in order to create a reasonably safe environment for pedestrians. Where the public right of way is used for pedestrian use, a number of factors must be considered. The drivers' tasks must include seeing objects in the roadway, as well as pedestrians, parked cars and other elements. Therefore the lighting system design must include pedestrian lighting, security lighting, and façade lighting. Thus the impact to surrounding buildings and pedestrians must be considered. Vertical surfaces such as pedestrians and buildings should be illuminated to create a bright environment. Illuminating building facades by using a small amount of uplight will reduce shadows and produce "fill light" to enhance the architectural facades at night and provide an increased sense of security. Another consideration is the pedestrian traffic conflict areas at intersections. IES recommends illuminance values with an average of 2 fc and a minimum level of 1 fc in areas with pedestrian/traffic conflict such as intersections, and 1 fc average with 0.5 fc minimum at pedestrian only areas. Once a fixture has been selected a full photometric analysis must be performed to identify optimal mounting heights and lamp wattages for illuminating the right of way and conflict area.

5.4 Equipment

The electrical lighting will require two electrical 120/240 Volts, single phase, electrical utility services per block. From there conduit and wire consisting of 1-1/2" GRS conduit 2-#8 wires will be run to a Type I pullbox for each pole location. Inside each pullbox will be a fuse and fuse holder. Wire can then be run from the pullbox up thru the pole to the luminaries. For ease of maintenance and replacement SFPUC recommends the following lighting fixtures: LUMEC Renaissance Series, and Holophane Esplanade.

The cutoff classification of these fixtures must be selected to both reduce light pollution and effectively illuminate the transportation corridor. Full cutoff fixtures decrease the amount of light that is emitted above the horizontal plane of the luminaire. However, they also induce shadows at facades and decrease the maximum spacing distance of fixtures required to provide adequate illuminance levels at the roadway. Using a semi cutoff restricts 95% of total candelas above the horizontal plane of the fixture, reducing light pollution while providing wider light distribution and better sense of security at facades. It is recommended that a study be performed which reviews mounting heights, lamp wattages, and cutoff classifications to identify the best combination of parameters for a successful lighting design. The fixtures will have High Pressure Sodium (HPS) lamps and multi-tap universal voltage ballasts. Photo sensors shall be provided for each pole for on/off switching.

Also required will be electrical connection for the guy wires. These connections are required on every 5th pole. The connections will consist of 500 kcmill positive or negative feeder cables, and will run in 2” GRS conduit. These conduits will be located on the inside of the poles. SFMTA operates the system at 615VDC from below grade substations. These conduits will be routed to manholes that contain their utilization voltage. The pole, fixture, and power requirements must be met for Alternatives 2, 3, and 4. The only exception is for Alternative 1 (no BRT). With this alternative, however pole and lighting fixture replacement are still recommended due to the number of poles that are near structural failure, and the non-standard voltage system that currently operates Van Ness street lights.

5.5 Alternative Light Source

A new technology that is starting to come into the street lighting market place is Light Emitting Diode (LED) lighting. This technology uses solid state technology to create lighting using phosphorous coated diodes. LED light has been proclaimed a green technology due to the increased lamp life and decreased power consumption. Recently a number of new products have been developed and studied for use in parking lots and residential roadways. There are a number of differences in the type and quality of light produced by these fixtures compared to traditional HPS lighting.

A benefit of the LED is that it is a directional light source meaning that by using optics and LED placement the light produced will be more distributed than an omni-directional HPS light source. It is this reason that manufacturers claim that an LED product can produce better average distributions than an HPS, with lower overall lumen output and thus lower wattage consumption. This may be true, and the white light of the LED produces better color rendering and visual acuity than its HPS counterpart too. But using today’s standard methods for lighting design calculations, the LED technology would be required to produce increased lumen levels above their current capabilities for a one to one replacement over HPS fixtures.. Therefore either a decrease in pole spacing or possibly two fixtures per pole would be required to satisfy illumination level requirements. Therefore the cost of energy savings would be offset by the increase cost for the LED fixtures, and possibly the addition of more fixtures and therefore increased power consumption to satisfy illumination level requirements. It is for this reason that it is not recommended to replace the fixtures on Van Ness Ave with LED fixtures *at this time,* especially where safety to persons and property is a top priority. However, by the time this project goes to design and construction, advances in LED technology may result in a suitable replacement of 250 Watt HPS with an LED product. SFPUC will review and evaluate these products, if appropriate at a future date during the design phase of this project. It should also be noted that the white LED light makes controlling glare more difficult, therefore significant attention must be paid to lamp location, mounting height, and orientation to successfully avoid glare to the driver with LEDs. As technology improves, the efficacy of the LED is likely to increase and the costs will likely decrease. Current cost estimates for an LED fixture is more than 220% greater than an HPS fixture with similar aesthetics, on a one to one basis. In addition, as noted previously, more LED fixtures would likely be required than with HPS in order to achieve currently acceptable lighting levels.

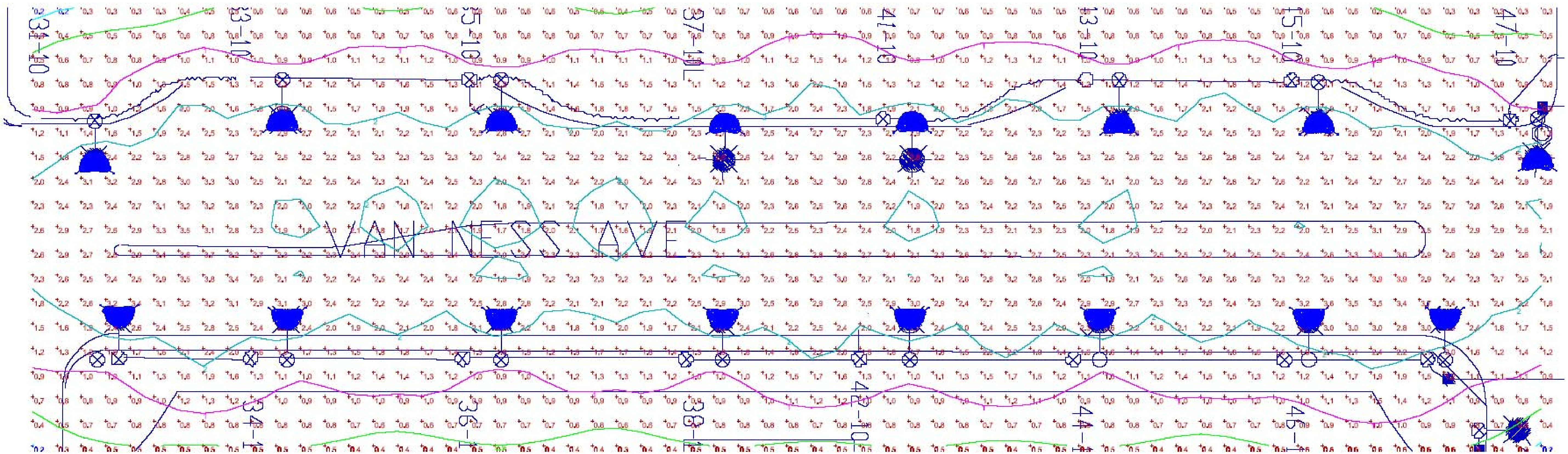
Figure 5.1 (see following pages in the chapter for Figures explained in this paragraph) is a plot of a photometric calculation of a sample area of one block of Van Ness Avenue using a 250W HPS fixture (shown in figure 5.2). The blue objects are the fixtures. These fixtures are located in 3D with a mounting height of 28'. The program plots the foot candle measurement based on the fixture height, location, fixture type, lamp type, and surface reflectivity. The area has been detailed with masks (the colored lines) indicating a range of foot candle levels as defined by the legend. The numbers in the grid pattern are the actual foot candles at that location, measured at the driving surface. Figure 5.2 is the statistical analysis showing that this fixture maintains the minimum average of 1.7fc as required by RP-08. Figure 5.3 is a similar calculation using an LED fixture shown in figure 5.4. Notice the statistical analysis indicates that this fixture (based on a similar layout to HPS) does <u>not</u> meet average minimum foot candle requirements, having the value of only 1.1fc, shown in Figure 5.4. On figure 5.3 the blue objects are the fixtures. Notice the lower foot candle ranges in the center of the roadway. This is the area where conflict exists with traffic turning and making lane changes. In order to consider LED products for this application the industry must improve the fixture performance to provide a cost effective design.

Another product that has useful applications in outdoor lighting is the induction lamp. Since there is not an internal filament, the lamp is less susceptible to damage from vibration and heating. These large lamps are suitable for decorative style fixtures that are recommended for this project. The benefit of this technology is that the lamp has very long life at 100,000 hours. This will significantly reduce maintenance cost, as well as maintaining a minimal lumen deprecation of the life of the lamp. Another benefit of this technology it that by using electronic ballast to drive the lamp, it has a high power factor and operates at 98% efficiency compared to other systems. The color rendering of these lamps are better than that of HPS with a “whiter” appearance in color. However, the induction lamp market has not seen the growth of the LED market, and initial costs are high compared to an HPS solution. Therefore product selection is low and cost is high without the foreseeable improvements anticipated in the LED market. But at 100,000 hours or 27 years, the life cycle cost is greatly reduced compared to a HPS system with similar characteristics.

5.6 Conclusion

This report shall provide adequate information for preliminary design and lighting layout for Van Ness Avenue BRT corridor. SFMTA has provided their pole requirements, and SFPUC has indicated fixture types, spacing, and power requirements. Illumination of vertical surfaces, sidewalks, and roadways within the San Francisco Civic Center Historic District may require unique lighting design within the project limits. Using this report as a guideline, a preliminary design can be developed and studied to ensure that it conforms to IES guidelines as detailed in RP-08. From an electrical standpoint the BRT project and poles subproject will benefit the street lighting with increased reliability, reduced risk to maintenance staff due to a new standardized electrical service, and decreased operational costs. Additional benefits would include reduction of pole clutter in the pedestrian right of way.

250W HPS Teardrop Photometrics
Van Ness Ave - Grove to McAllister



LEGEND

Figure 5.1: Photometric Calculations for HPS Lamps

> 2.0 foot candles

1.0 – 2.0 foot candles

0.5 – 1 foot candles

0 – 0.5 foot candles

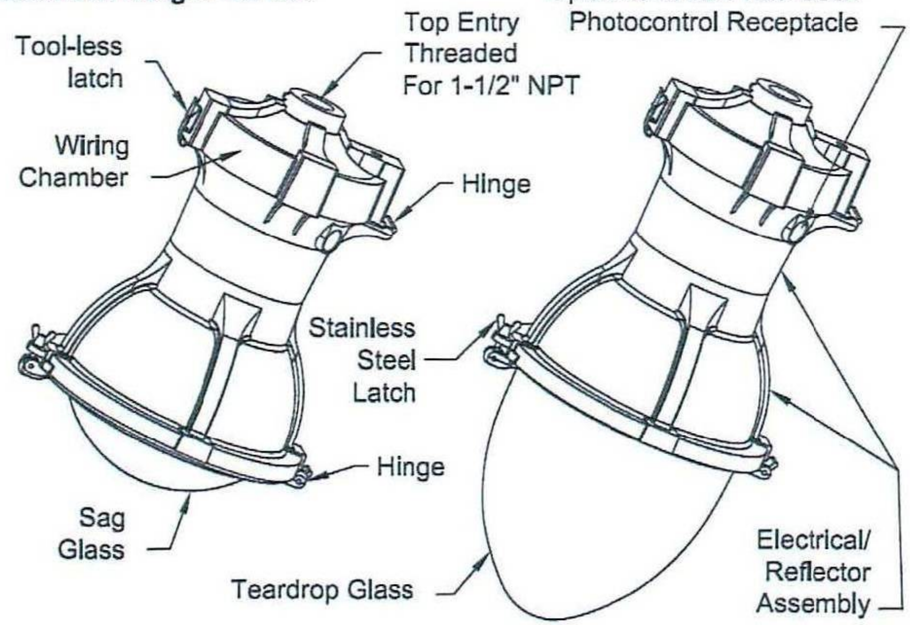
LUMINAIRE SCHEDULE

Symbol	Label	Qty	Catalog Number	Description	Lamp	File	Lumens	LLF	Watts
●	A	16	ESU250HP00X4DS	ESPLANADE	250W CLEAR HPS	250W HPS.ies	28000	1.00	289

STATISTICS

Description	Symbol	Avg	Max	Min	Max/Min	Avg/Min
Calc Zone #3	+	1.7 fc	3.9 fc	0.2 fc	19.5:1	8.5:1

Maximum Effective Projected Area - 2.37 ft²
Maximum Weight - 66 lbs.



HOLOPHANE® LEADER IN LIGHTING SOLUTIONS An Acuity Brands Company

DECORATIVE OUTDOOR

Esplanade® Utility

VISUAL

VAN NESS BRT - CER
HOLOPHANE
250W HPS TEARDROP

Designer
FS

Date
Jul 23 2009

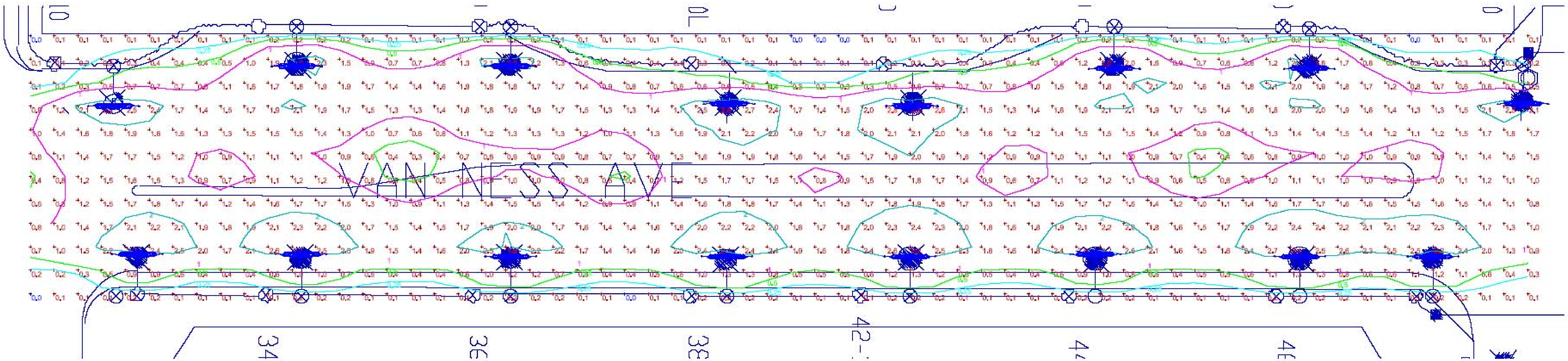
Scale
NTS

Drawing No.

1 of 1

Figure 5.2: Photometric Calculation Summary for HPS Lamps

LED Streetlighting Photometrics
Van Ness Ave - Grove to McAllister



LEGEND

> 2.0 foot candles

0.5 – 1 foot candles

0.25 – 0.5 foot candles

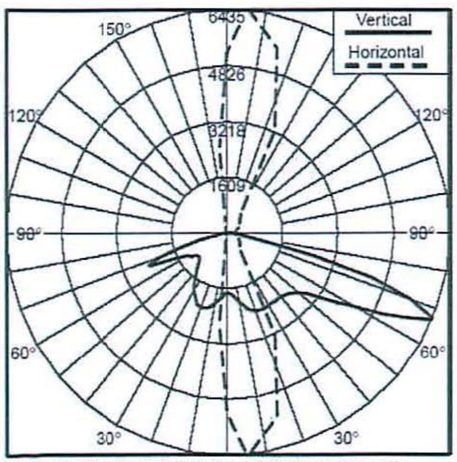
Figure 5.3: Photometric Calculations for LED Lamps

LUMINAIRE SCHEDULE

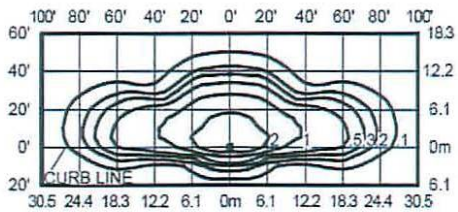
Symbol	Label	Qty	Catalog Number	Description	Lamp	File	Lumens	LLF	Watts
▌	A	16	BLD-STR-2B-__-068-LED-B-525 BXSL0G068B-U (525mA)	80 LED BETA TYPE II LEDway STREET LIGHT WITH INTEGRAL BACKLIGHT SHIELDING DRIVEN AT 525mA		2B-SL_80LED_525mA.IES	5870	1.00	150.4

STATISTICS

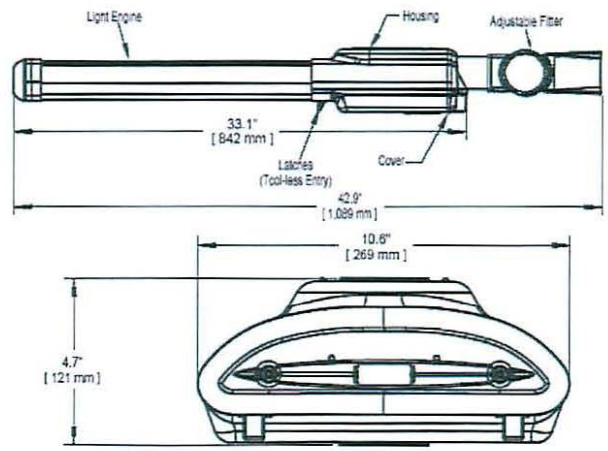
Description	Symbol	Avg	Max	Min	Max/Min	Avg/Min	Max/Avg
Calc Zone #3	+	1.1 fc	2.8 fc	0.0 fc	N / A	N / A	2.55



Independent Testing Laboratories certified test. Report No. ITL61332. Candlepower distribution curve of 80 LED Type II luminaire with backlight control and 6,120 initial delivered lumens operating at 525mA. **All published luminaire photometric testing performed to IESNA LM-79-08 standards.**



Isofootcandle plot of 80 LED Type II luminaire with backlight control at 25' A.F.G. Luminaire with 6,120 initial delivered lumens operating at 525mA. Initial FC at grade.



BLD-STR-T2-AA **IP66 LEDway™ Streetlight – Type II**

Beta Catalog#: BLD - STR - - AA - 068 - LED-B - - SV - IP66

Figure 5.4: Photometric Calculation Summary for LED Lamps

VISUAL

Van Ness BRT
VAN NESS BRT- CER
BETA LED
80 - LED STREET LIGHT

Designer
FS

Date
Jul 23 2009

Scale
NTS

Drawing No.

1 of 1

6.0 General Design Considerations

6.1 Introduction

The Project is expected to encounter numerous unique design concerns due to the completely urbanized, heavily trafficked area this project encompasses. In addition, the changing landscapes, topographical gradients, and varying physical features, structures and utilities of each block will require detailed examinations prior to design and construction.

All design issues discussed apply to Alternatives 1, 2, 3 and 4. Proposed improvements can be broadly characterized as pole replacement under Alternative 1, and pole replacement and upgrade under Alternatives 2, 3 and 4. If Alternatives 2, 3 or 4 were to be chosen, complexities would be added to design and construction. First, the poles would have more tension on them, requiring larger sized and taller poles to resist this tension. Second, for Alternatives 3 and 4, the new OCS would run in the middle lanes, instead of the existing curb lanes' location, creating more tension forces and requiring greater structural strength than Alternative 2. This would change the configuration of all of the intersections with cross streets also having OCS. This second factor would cause the project to be much more complex, requiring reconnections of the new poles to the new contact wire and special work at intersections with cross-street OCS. While the costs associated with moving the OCS system from the curb lanes to the middle lanes are not part of this Report's cost estimate, the actual construction work would need to be part of the same contract as that of the pole replacement and, possibly, part of the BRT project. In addition to the structural and electrical designs in the previous chapters, the following sections identify the various issues to consider during the design process.

6.2 Locations of Poles

Spacing between poles is constrained by SFMTA requirements, SFPUC lighting standards, and aesthetics. According to SFMTA, the maximum allowable distance between contact support wires is 100 feet. The spacing requirements for lighting, according to SFPUC Power Enterprise, are approximately 80 to 90 feet.

Existing pole locations satisfy both SFMTA and lighting needs. New poles are proposed to be built 3 to 5 feet from existing supports. The sectional spacing, spanning the width of Van Ness Avenue with the present setback from curb, will remain at the present distance. The goal is to maintain overall uniformity throughout the Van Ness Corridor while satisfying both SFMTA and lighting standards.

There are numerous existing subterranean features, such as building basements extending under sidewalks, utility vaults, and manholes in the project area. Since these features are in the street right-of-way, the owner may be requested to modify the features, upon written request. Above-ground features include fire hydrants, traffic signal poles, and trees. Again, agreements must be reached with the respective agencies responsible.

6.2.1 Layout Conceptual Drawings

Conceptual layout drawings were prepared (figure 6.1 and 6.2), using the existing pole spacing layout drawings as a guide. New poles were conceptually placed near existing poles, verifying the conceptual layout to be in compliance with the governing SFPUC pole-to-pole spacing requirement of 80 to 90 feet apart.

6.2.2 Sectional Conceptual Drawings and Pole Accessory Option Drawing

Sectional drawings were prepared for Alternatives 2, 3, and 4 (figures 6.3-6.6). Various base covers, suggested arms, scroll options, finials and pole caps options, and approved luminaires are shown in the five details at the top of drawings 6.3 through 6.5, with additional pole accessory design options presented in Figure 6.6. The sectional and accessory option drawings present possible combinations of base cover, arm, scroll, pedestrian luminaire, and roadway luminaire, for inspection and comment. As a note, the luminaires include a "dark sky" feature, which minimizes stray upward light in order to reduce light pollution.

The pole accessory option drawing shows detailed choices for base, pole support arm, and pole cap, with varying dimensions and styles for each type of feature presented. The various options show varying base heights; reproductions of the existing cap design and arm; variations on the pedestrian arm and luminaire design; and varying degrees of ornamentation. The refinement of the poles' ultimate appearance will be done during the design phase, including obtaining input from project stakeholders and review committees.

As a note, the possibility of reusing some of the existing poles' accessories: base, support arm or caps; was considered. The use of existing bases and support arms were rejected because of their overall poor condition or the fact that their square configuration would not fit properly on a round pole. The possible use of the existing pole caps adorning new poles was also rejected for the following reasons by SFMTA and a steel pole vendor:

- **Function.** Caps are needed, in general, to keep rainwater out of the interior of hollow poles. The square pole cap attached to a round pole would not provide a sufficiently tight seal to serve this function.
- **Maintenance.** Removal of pole caps would be required in order for occasional inspection of the interior of the poles. The square pole caps could not be easily removed and replaced due to the need for a custom fit on the round poles (see below).
- **Structural Infeasibility.** It might not be possible to securely fix the square pole cap on the round pole while meeting the numerous applicable standards.
- **Cost.** If this option were to be structurally feasible, a custom flange would be required to transition from the pole to cap There would be a significant engineering cost to detail the flange design. In addition, the condition of the existing caps would require rehabilitation

6.3 Pole Color Scheme

The new steel poles could be painted a variety of colors. Possible pole colors include dark blue to match the existing ironwork fences surrounding City Hall, and white, in deference to the color of the existing poles. All of the poles could be painted the same color in order to establish a uniform color for the Van Ness Avenue corridor poles as a whole. Decisions on the design of the poles, including color, will be made at a later stage, will have input from the community, and will be subject to review by the San Francisco Civic Design Review Committee and the Historic Preservation Commission (for poles within the Civic Center Historic District).

6.4 Existing Utilities

In the Van Ness Avenue Corridor, there are numerous existing utilities. Drawings from SFMTA's Department of Parking and Traffic indicate the location of existing utilities. Further research in obtaining existing utility information should be done by issuing Notices of Intent (NOI's) to all known utilities. Information gathered from the NOI process should be compiled and added to SFMTA Department of Parking and Traffic's existing utility composite drawing. This utility drawing should be used as a base plan during the design phase, to help avoid as many utility conflicts as possible during the construction phase.

The Department of Public Works hosts monthly utility coordination meetings at their offices on 875 Stevenson. The title of the hosting committee is "Committee for Utility Liaison on Construction and Other Projects", or CULCOP. The project has appeared before CULCOP to present the project, and received feedback from the various utility and governmental agencies represented on the committee. A notice of intent should be sent at the appropriate time to all utilities, followed by a presentation to CULCOP after an alternative is chosen. As a note, the Van Ness BRT Project Team has entered this project in the 5 year City-wide paving forecast plan.

6.5 Sub-Sidewalk Basements

Constructing new poles next to the existing poles presents possible conflicts, including interference with sub-sidewalk basements. Typical foundations are three feet in diameter and ten feet deep. In some cases, the new pole may need to be placed outside of the ideal three to five feet allowance or require the removal of sub-sidewalk basements. These possible issues are expected to increase cost and delay construction. As such, the conceptual engineering cost estimates have appropriated an extra line item, assuming that 10% of poles will need basement modifications in order to accommodate foundations.

6.6 Curb Ramp Coordination

The new poles shall not impinge upon the path of travel, including the intersection corner curb ramps. When feasible, new poles will not be located any further towards curb ramps than existing pole locations, and all new pole locations will be in full compliance with Americans with Disabilities Act (ADA) standards.

As a note, new curb ramps are not included in this phase of the cost estimate, although all curb ramps along the BRT corridor will be brought into compliance with ADA standards as part of the BRT project.

7.0 Construction Plan

7.1 Introduction

The Van Ness BRT Project Team has prepared an overall Van Ness BRT Draft Project Construction Plan as part of the environmental process, dated April 21, 2009. This CER will address pole-specific construction plan issues.

The goal in construction sequencing is to minimize traffic disruptions and maintain lighting and MUNI transit throughout the construction phase. To achieve this goal, the existing pole, lighting, and catenary system will remain in place while the new poles are constructed and fully commissioned.

7.2 Constraints

Continuing to provide lighting and MUNI service during construction is a priority. Construction will need to minimize disruptions and/or provide alternatives to meet lighting and public transportation constraints.

If poles must be placed in existing locations, temporary poles and foundations will be required to provide uninterrupted lighting and transit service. However, the cost of a temporary pole and foundation is comparable to that of constructing a new pole and foundation, and as such, this approach should be minimized.

Since the existing pole layout meets SFMTA's spacing constraint of 100' maximum spacing and SFPUC's 80'-90' pole-to-pole spacing requirements, constructing the new poles, in general, within 3 to 5 feet of existing pole locations at the same distance from the curb as the existing poleswill help maintain the pole-to-pole spacing requirements. The new foundations will require a minimum 3' radius around the new pole to allow new foundations to be poured, hence the 3 foot minimum separation. For ease of construction, the new pole can be located nominally 5 feet away from an existing pole, hence the 3 to 5 foot guideline. Where new pole placement cannot be maintained within 3 to 5 feet from an existing pole, care shall be taken to ensure that the corridor pole spacing does adhere to the 80-90 foot overall pole-to-pole spacing.

The new Overhead Contact System (OCS) will be installed at a height greater than the existing OCS height; in other words, the new system will be constructed over the existing system. The existing OCS system will remain functional during the construction of the new system. The existing lighting shall also remain in service until full functionality of the new lighting system is in place.

7.3 Demolition Sequencing

Construction and demolition sequencing will focus on minimizing disruptions to the public. As mentioned above, demolition, in general, will occur after construction. Since this is in reverse of the demolition sequencing of many construction projects, the demolition activities' dependence on construction and commissioning of the new equipment must be called out clearly in the

Contract Documents. Demolition work must conform to the City's waste management and construction debris recycling requirements.

In accordance with city ordinance No. 27-06, all construction and demolition debris shall be transported off-site by a Registered Transporter and taken to a Registered Facility that can process and divert a minimum of 65% of the material generated from construction and demolition from landfill. The excavated poles shall be retained as owner's property. Once the poles are removed, the old foundation shall be filled in, down to three feet below the ground surface. The volume of the foundation three feet below the surface can be left in place. Following the foundation replacements, sidewalks will need to be repaved.

The new foundations will be approximately 3 feet in diameter and approximately 10 feet deep. This would result in a volumetric excavation of 71 ft^3 per pole. The total volumetric excavation for the 277 poles would therefore be approximately 19,600 ft^3.

7.4 Construction Sequencing

The construction sequencing plan is being developed by the Van Ness BRT Project Team as part of the Project Construction Plan, and will be finalized during the detailed design phase. The cross sectional view of the new poles built alongside the existing poles is shown in Figures 7.1-7.3. As shown in the drawings, the existing poles will continue to support trolley cables as the new system is built over the existing system.

7.5 Traffic Routing

The traffic routing plan is being developed by the Van Ness BRT Project Team as part of the Project Construction Plan, and will be finalized during the detailed design phase.

SHEET NOTE:

A. THIS IS A TEMPOARY CONSTRUCTION PLAN. ONCE NEW OCS IS CONSTRUCTED, EXISTING OCS WILL BE DEMOLISHED.

B. NEW OCS WILL BE LOWER TO THE EXISTING HEIGHT ONCE EXISTING OCS IS DEMOLISHED.

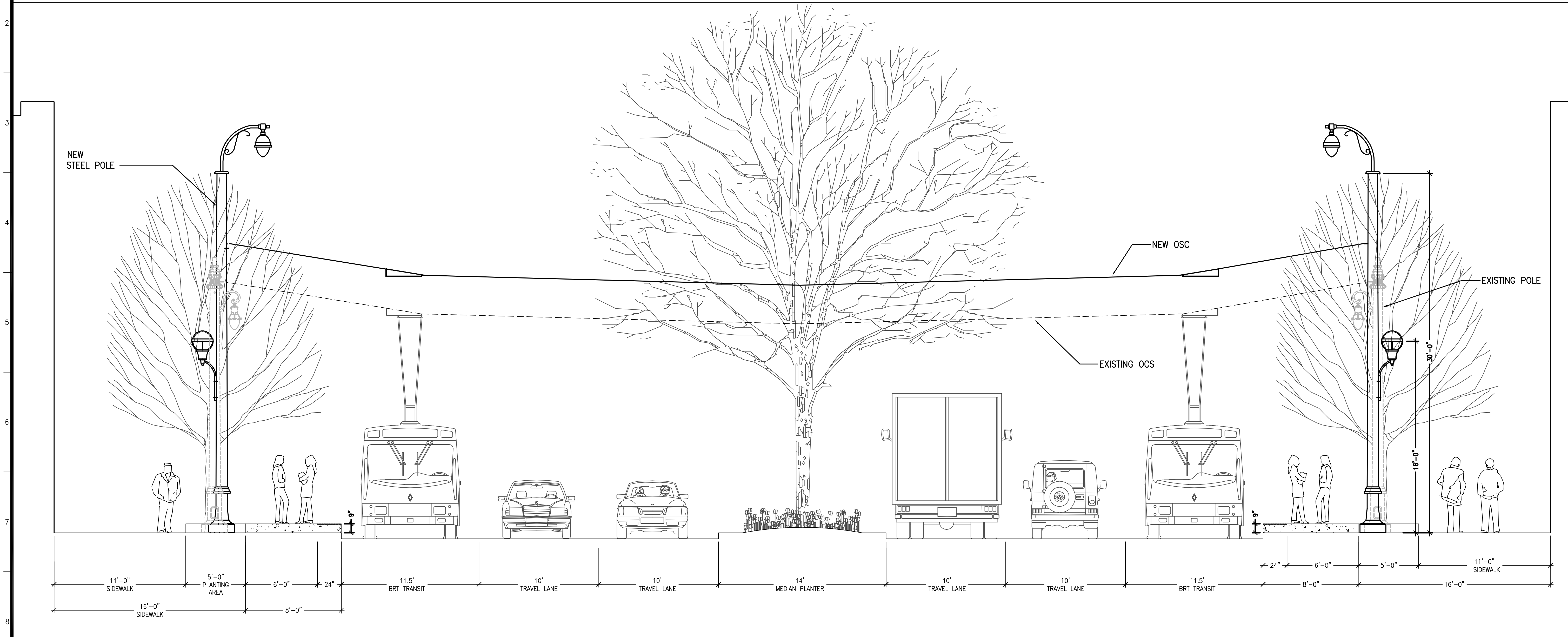


Figure 7.1: Construction Plan for Alternative 2 Cross Section with New and Existing Poles

50 0 50 100

1"=50'-0"

NO.	DATE	DESCRIPTION	BY	APP.

TABLE OF REVISIONS

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REFERENCE INFORMATION & FILE NO. OF SURVEYS

SEAL OF THE CITY AND COUNTY OF SAN FRANCISCO

BUREAU OF ENGINEERING

DEPARTMENT OF PUBLIC WORKS

CITY AND COUNTY OF SAN FRANCISCO

DESIGNED:	DATE: 6/09	
DRAWN: EB	DATE: 6/09	
CHECKED: JC	DATE:	

APPROVED

SECTION MANAGER DATE:

DEPUTY BUREAU MANAGER DATE:

CITY ENGINEER DATE:

SCALE: 1"=50'-0"

SHEET OF SHEETS

OF

VAN NESS AVENUE

BUS RAPID TRANSIT STUDY

SAN FRANCISCO, CALIFORNIA

ALTERNATIVE 2

SIDE RUNNING TRANSIT

CONSTRUCTION PLAN

CONTRACT NO. CONTRACT NO.

DRAWING NO. ALT-2

FILE NO.

REV. NO.

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Plot Time: Thu, 01 Oct 2009 – 4:22pm

Xrefs: V:\1614J_Van_Ness_Light_and_Muni_Poles\BOES_TBD.dwg

Model Units: Inches

Measurement Units are English

SHEET NOTE:
A. THIS IS A TEMPOARY CONSTRUCTION PLAN. ONCE NEW OCS IS CONSTRUCTED, EXISTING OCS WILL BE DEMOLISHED.

B. NEW OCS WILL BE LOWER TO THE EXISTING HEIGHT ONCE EXISTING OCS IS DEMOLISHED.

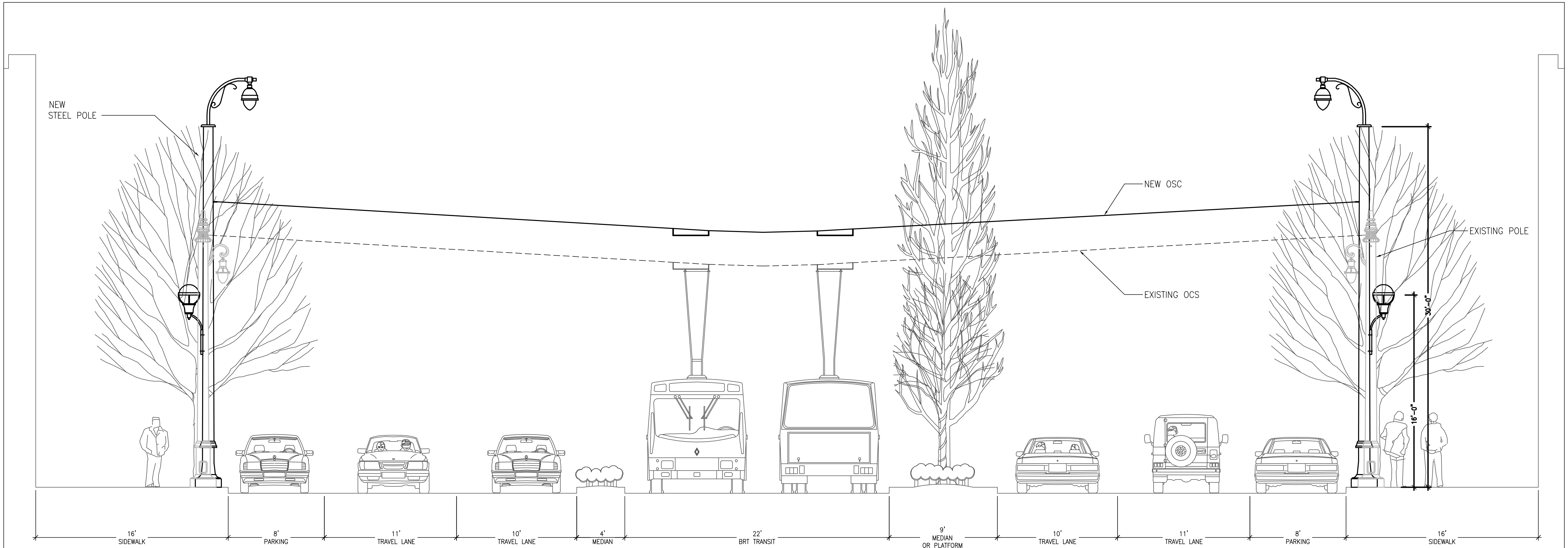

Figure 7.2: Construction Plan for Alternative 3 Cross Section with New and Existing Poles

50 0 50 100
1"=50'-0"

NO.	DATE	DESCRIPTION	BY	APP.

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BUREAU OF ENGINEERING
DEPARTMENT OF PUBLIC WORKS
CITY AND COUNTY OF SAN FRANCISCO

DESIGNED:	DATE:
FS	07/2009
DRAWN:	DATE:
CEC	07/2009
CHECKED:	DATE:
TA	07/2009

APPROVED
SECTION MANAGER DATE:
DEPUTY BUREAU MANAGER DATE:
CITY ENGINEER DATE:

SCALE:
SHEET OF SHEETS
XX OF XX

VAN NESS AVENUE
BUS RAPID TRANSIT STUDY
SAN FRANCISCO, CALIFORNIA
ALTERATIVE 3
CENTER RUNNIG TRANSIT SIDE PLATFORM
CONSTRUCTION PLAN

CONTRACT NO.
CONTRACT NO.
DRAWING NO.
ALT-3
FILE NO.
REV. NO.

Xrefs: V:\1614J_Van_Ness_Light_and_Muni_Poles\BOE5_TBD.dwg
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Model Units: Feet
Measurement Units are English

SHEET NOTE:

A. THIS IS A TEMPOARY CONSTRUCTION PLAN. ONCE NEW OCS IS CONSTRUCTED, EXISTING OCS WILL BE DEMOLISHED.

B. NEW OCS WILL BE LOWER TO THE EXISTING HEIGHT ONCE EXISTING OCS IS DEMOLISHED.

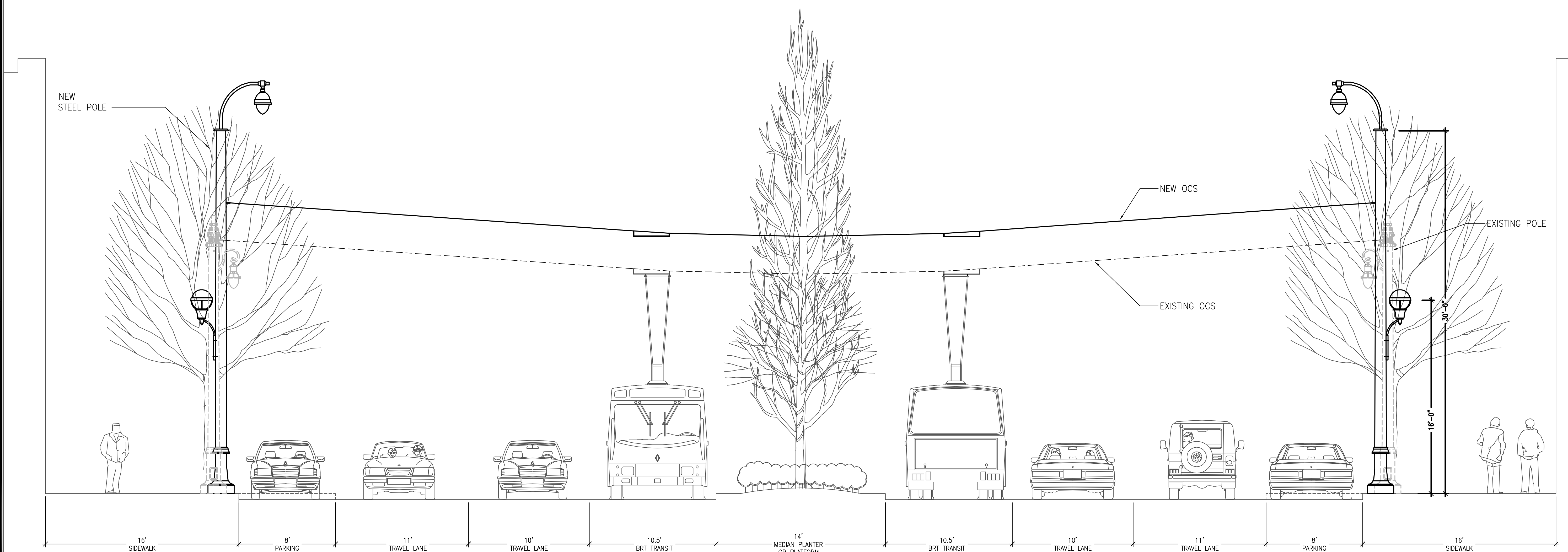

Figure 7.3: Construction Plan for Alternative 4 Cross Section with New and Existing Poles

50 0 50 100
1"=50'-0"

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REFERENCE INFORMATION & FILE NO. OF SURVEYS

BUREAU OF ENGINEERING

DEPARTMENT OF PUBLIC WORKS

CITY AND COUNTY OF SAN FRANCISCO

DESIGNED: FS	DATE: 07/2009
DRAWN: CEC	DATE: 07/2009
CHECKED: TA	DATE: 07/2009

APPROVED
SECTION MANAGER DATE:
DEPUTY BUREAU MANAGER DATE:
CITY ENGINEER DATE:

SCALE:
SHEET OF SHEETS: XX OF XX

VAN NESS AVENUE
BUS RAPID TRANSIT STUDY
SAN FRANCISCO, CALIFORNIA

ALTERNATE 4
CENTER RUNNING TRANSIT CENTER ISLAND
CONSTRUCTION PLAN

CONTRACT NO.
DRAWING NO. ALT-4
FILE NO.
REV. NO.

8.0 Cost Estimates

8.1 General

The conceptual engineering cost estimate is based on the proposed replacement of 277 OCS support poles/streetlights. Of the total, 65% or 180 poles are estimated to be standard 761 series poles. The remaining 35% or 97 poles are of the stronger 770 series, used in intersections and high tension locations. The 65%/35% estimate reflects pole requirements applicable to alternative 3 and 4. If alternatives 3 or 4 are chosen, the new OCS would be in the middle of the street, changing the configuration of all of the overhead intersections. This increases the complexity of re-connecting the new poles to the new contact wire and may require additional work at overhead intersections.

Alternative 2 would maintain the general existing OCS configuration. Consequently, Alternative 2 would be less costly (and quicker) to build. The cost estimate does not include labor and materials for the OCS – namely the new guy wires, vertical conduits, and contact wire attachments that will be needed for the OCS for all build alternatives.

The structural cost estimate provides the estimate of constructing the pole foundations. In addition to a 15% contingency, an extra line item for pole foundation is included to account for issues with sub-sidewalk basements/vaults.

The electrical estimate includes all 277 poles of grade per the 65%/35% split described above, roadway and pedestrian lights, and electrical equipment. It also includes a contingency for spare poles of each type.

8.2 Cost Estimate Summary

Table 8-1: Project Cost Estimate Summary

Note: L.S. = Lump Sum, L.F. = Linear Feet, C.Y. = Cubic Yard, S.F. = Square Feet. EA. = Each

Bid Item Description	Estimated Quantity	Unit	Unit Price	Extension
Pole Removal & Sidewalk Restoration Work	1	L.S.	$1,342,927	$1,343,000
Electrical Work	1	L.S.	$11,669,591	$11,670,000
Structural Work	1	L.S.	3,078,911	$3,079,000
Mobilization/Demobilization (5%)	--	L.S.	--	$805,000
Traffic Routing Cost (8%)	--	L.S.	--	$1,287,000
			Subtotal	**$18,183,000**
Prime Contractor Overhead (10%)	--	L.S.	--	$1,818,000
General Contractor Profit (10%)	--	L.S.	--	$1,818,000
			Construction Cost	**$21,820,000**
			With 3.5% Escalation over 2.5 years	$22,584,000
			Construction Contingency (15%):	$2,258,000
			Design Cost (10%)	$2,258,000
			Construction Management Cost (15%)	$3,388,000
			Engineering Support Cost (8%)	$1,807,000
			Project Contingency (10%)	$3,229,000
			TOTAL BID PRICE	**$35,524,000**

8.3 Demolition Estimate

Table 8-2: Pole Removal and Sidewalk Restoration Cost Estimate

DEMOLITION COST ESTIMATE														
	DESCRIPTION			CITY COST INDEX	MATERIAL		CITY COST INDEX		LABOR			TOTAL $	REMARKS
No.		QTY	UNIT		$/Unit	Amount($)		MH/Unit	Total MH	Rate$	Amount $		
1	Pole removal and sidewalk restoration would be about	277	EA	1	3,500.00	$969,500	1.375	0.0	0	85.00	$0.00	$969,500.00	Based on an earlier estimate for this project by lead overhead designer Tee Phang, assume inclusive of labor
	Sub-Total					**$969,500.00**					**$0**	**$969,500.00**	
[1] Sub-Total						$969,500					$0	$969,500	
[2] Contingency		15% of sub-total				$145,425					$0	$145,425	
[3] Sub-Total = [1] + [2]						$1,114,925					$0	$1,114,925	
[4] 9.5 sales tax = [3]x0.095						$105,918						$105,918	
*[5] Subcontractor's cost = [3]+[4]						$1,220,843					$0	$1,220,843	
*[6]10% profit for subcontractor = [5]x0.1						$122,084.29					$0.00	$122,084	
[11] Cost = [5]+[6]						**$1,342,927**					**$0**	**$1,342,927**	

8.4 Structural Estimate

Table 8-3: Structural Cost Estimate

					COST ESTIMATE		Performed by		SC		on	6/22/2009	
					MATERIAL				LABOR				REMARKS
No.	DESCRIPTION	Qty	UNIT	CITY COST INDEX	$/Unit	Amount($)	CITY COST INDEX	MH/Unit	Total MH	Rate$	Amount $	Total $	
1	Standard Pole Foundation	180	EA	1	3000.00	$540,000.00	1.375	24	5940	90.40	$536,976.00	$1,076,976.00	$5,805 per pole
2	Heavy Duty Pole Foundation	97	EA	1	3,500.00	$339,500.00	1.375	30	4001	90.40	$361,713.00	$701,213.00	$7006 per pole
3	Consider 10% of Poles have Basement Issue	28	EA	1	5,000.00	$140,000.00	1.375	128	4928	85	$418,880.00	$558,880.00	Additional $19,960 per pole in comparison to poles without basements
	Sub-Total					**$1,019,500.00**					**$1,317,569**	**$2,337,069.00**	
	[1] Sub-Total					$1,019,500					$1,317,569	$2,337,069	
	[2] Contingency	15	% of sub-total			$152,925					$197,635	$350,560	
	[3] Sub-Total = [1] + [2]					$1,172,425					$1,515,204	$2,687,629	
	[4] 9.5 sales tax = [3]x0.095					$111,380						$111,380	
	*[5] Subcontractor's cost = [3]+[4]					$1,283,805					$1,515,204	$2,799,010	
	*[6]10% profit for subcontractor = [5]x0.1					$128,380.54					$151,520.44	$279,901	
	[11] Cost = [5]+[6]					**$1,412,186**					**$1,666,725**	**$3,078,911**	

8.5 Electrical Estimate

Table 8-4: Electrical Cost Estimate

ELECTRICAL COST ESTIMATE (Performed by FS on 7/27/2009)														
					MATERIAL				LABOR					
No.	DESCRIPTION	Qty	UNIT	CITY COST INDEX	$/Unit	Amount($)	CITY COST INDEX	MH/Unit	Total MH	Rate$	Amount $	TOTAL $	REMARKS
1	Furnish and Install (F/I) 30' High Poles Standard	180	EA	1	$10,000	$1,800,000	1.375	20.0	4950	$85	$420,750	$2,220,750	65% of 277 total poles for trolley and lighting
2	Furnish Spare 30' High Poles Standard	18	EA	1	$10,000	$180,000	1.375	0.0	0	$85	$0	$180,000	10% Spare 761 Series Poles
3	F/I 30' High Poles Heavy Duty	97	EA	1	$20,000	$1,940,000	1.375	25.0	3334	$85	$283,422	$2,223,422	35% of 277 total pole for trollery intersection and lighting
4	Furnish 30' High Poles Heavy Duty	10	EA	1	$20,000	$200,000	1.375	0.0	0	$85	$0	$200,000	10% Spare 770 Series Poles
5	F/I Feeder Poles 1/5 of all	55.4	EA	1	$2,000	$110,800	1.375	20.0	1524	$86	$131,021	$241,821	1/5 of poles to have power feeder for BRT
6	F/I Pull Box type 1	277	EA	1.124	$500	$155,674	1.375	2.5	952	$85	$80,936	$236,610	
7	F/I Street Light (Fixture)	277	EA	1	$900	$249,300	1.375	2.8	1047	$85	$89,030	$338,330	Large Holophane teardrop quote 6/09
8	Furnish Spare Street Light (Fixture)	28	EA	1	$900	$25,200	1	0.0	0	$85	$0	$25,200	Large Holophane teardrop quote 6/10
9	F/I Pedestrian light (Fixture)	277	EA	1	$700	$193,900	1.375	2.7	1017	$85	$86,440	$280,340	Small Holophane teardrop quote 6/09
10	Furnish Spare Pedestrian light (Fixture)	28	EA	1	$700	$19,600	1	0.0	0	$85	$0	$19,600	Small Holophane teardrop quote 6/10
11	Fuse (20A)	277	EA	1.124	$2	$654	1.375	0.2	61	$85	$5,180	$5,834	
12	Fuse Holder (20A)	277	EA	1.124	$2	$592	1.375	0.2	61	$85	$5,180	$5,771	
13	Ballast (120/208/240/277 Volt)	277	EA	1.124	$117	$36,428	1.375	1.0	381	$85	$32,374	$68,802	Metal Halide, 175W
14	Spare Ballast (120/208/240/277 Volt)	28	EA	1.124	$117	$3,682	1.375	0.0	0	$85	$0	$3,682	10% Spare Ballast
15	Conduit 1 1/2"	38400	LF	1.124	$13	$561,101	1.375	0.3	13200	$85	$1,122,000	$1,683,101	GRS
16	Wire (1#6)	38400	LF	1.124	$1	$26,760	1.375	0.01	649	$85	$55,202	$81,963	Ground Wire
17	Wire (2#8)	76800	LF	1.124	$0	$34,961	1.375	0.01	1056	$85	$89,760	$124,721	
18	PG&E Service Connection Fee	79	EA	1	$8,000	$632,000	1.375	0.0	0	$85	$0	$632,000	Based on PUC desire for 2 services per block

19	Ground Rod 8'	356	EA	1.124	$15	$5,922	1.375	1.5	710	$85	$60,331	$66,253	Per pole foundation + PG&E service
	Sub-Total					**$6,176,573**					**$2,461,625**	**$8,638,199**	
[1] Sub-Total						$6,176,573					$2,461,625	$8,638,199	
[2] Contingency		15	% of sub-total			$926,486					$369,244	$1,295,730	
[3] Sub-Total = [1] + [2]						$7,103,059					$2,830,869	$9,933,929	
[4] 9.5 sales tax = [3]x0.095						$674,791						$674,791	
*[5] Subcontractor's cost = [3]+[4]						$7,777,850					$2,830,869	$10,608,719	
*[6]10% profit for subcontractor = [5]x0.1						$777,785					$283,087	$1,060,872	
[11] Cost = [5]+[6]						**$8,555,635**					**$3,113,956**	**$11,669,591**	

9.0 Required Documentation and Approvals

9.1 Hazardous Materials

The Van Ness BRT Project Team will provide the findings of the Hazardous Material Investigation, undertaken as part of the environmental process, as a basis for the Contract Documents' Hazardous Materials Specifications.

9.2 Environmental Documentation

The Van Ness BRT Project Team will prepare an environmental document that analyzes the project and meets the requirements for both an Environmental Impact Statement (EIS) in accordance with provisions of NEPA, and an Environmental impact Report (EIR) in accordance with the provisions of CEQA.

9.3 Local Permits and Approvals Required

Type of Approval (e.g., permit, approved motion of support, courtesy only, etc.)	**Agency / Body** e.g., HPC	**What is Approved**	**When in Project Development**
Notice of Intent (NOI)	SF Department of Public Works (DPW), Bureau of Streets and Mapping	Coordination of Project Alignment and Construction Schedule with multiple City and private agencies	Planning, Design
Civic Design Review	Art Commission Civic Design Review Committee	Above ground permanent construction	Design
Comment/Review	City Hall Preservation Commission	General Project Review	Design
Art Enrichment Program	Art Commission Public Art program	Review of implementation of 2% public art program	Design
ADA Access Review	DPW and/or MTA Disability Access Coordinators	Public path of travel	Design
Comment/Review	Architectural Review Committee	Above ground permanent construction in the Civic Center Historic District	Planning, Design
Certificate of Appropriateness	SF City Planning – Historic Preservation Commission	Above ground permanent construction in the Civic Center Historic District	Design (after certified EIR)
General Plan Amendments	Planning Commission	General project review	Design

General Plan Amendments	Board of Supervisors	General project review	After Planning Commission Approval
Electrical	SFPUC	Lighting Drawings	Design
Structural Components	SF Department of Building Inspection	Structural Components	Design
Roadway Modifications	Caltrans, with Legislative Approval by Board of Supervisors	Construction within Right of Way (ROW), between Mission St.. and Lombard St.	Design
Roadway Modifications	SF DPW, Bureau of Streets and Mapping, with Legislative Approval by Board of Supervisors	Construction within ROW, between Lombard St. and Northpoint St.	Design
Encroachment Permit	Caltrans	Construction within Right of Way (ROW), between Mission St.. and Lombard St.	Design, Construction
Encroachment Permit	SF DPW , Bureau of Streets and Mapping	Construction within ROW, between Lombard St. and Northpoint St.	Design, Construction