City of Oakland

ITS Strategic Plan

UPDATE

FINAL report
February 2014

Prepared for

CITY of OAKLAND

Prepared by

Kimley-Horn
and Associates, Inc.

Executive Summary

City of Oakland
ITS Strategic Plan
UPDATE

Vision

Intelligent Transportation Systems (ITS) is the application of technologies and management strategies—in an integrated manner—to increase the safety and efficiency of the transportation system. Over the past 10 years, Oakland has successfully deployed several ITS projects. The vision of this ITS Strategic Plan Update is to continue to address critical issues in the Transportation Services Division by cost-effectively enhancing and expanding the ITS infrastructure and assets to equip City staff with the tools for:

- improving traffic operations and analysis,
- optimal and proactive traffic management,
- efficient signal and ITS maintenance, and
- strategic deployment of future ITS devices.

ITS in Oakland: Key Milestones

- 2003: Oakland ITS Strategic Plan
- 2004: East Bay SMART Corridors Project (San Pablo Ave)
- 2006: AC Transit RAPID Bus Project (Telegraph Ave)
- 2010: Traffic Signal Central System Upgraded
- 2011: Transportation Management Center Opens
- 2012: Video Management Server Installed
- 2012: Oakland Airport ITS Project
- 2012: 12th Street ITS (part of Reconstruction project)
- 2013: Broadway Fiber Interconnect
- 2013: I-80 ICM Project

Goals and Objectives

The continued maturity of the City's ITS network and the ongoing evolution of technologies require the City to refocus and develop refined ITS goals and objectives to enhance the longevity and sustainability of the system. The goals and objectives for the Update are:

1. Document all existing, planned, and ongoing ITS projects.
2. Identify areas of expansion of ITS deployment and integration opportunities.
3. Identify future projects and how to fill-in gaps with existing projects.
4. Develop implementation criteria for ITS deployment.
5. Identify funding strategies and opportunities to integrate ITS elements into other capital projects.
6. Establish goals and expectations for ITS Support staffing.

Deployment Projects

ITS projects improve level-of-service for all modes on the City's existing roadway network facilities by improving traffic flow and reducing congestion. The following table summarizes the key achievements and number of ITS elements at each stage of the timeline.

Proposed ITS projects fall into two categories:

Corridor Projects – Upgrade ITS equipment and deploy fiber-optic communication network along major roadway corridors.

Parking Management Projects – Manage parking in the downtown/uptown area and convey real-time information to the public.

Timeframe	Short term (0-5 year horizon)	Medium term (5-10 year horizon)	Ultimate (10+ year horizon)
Key Achievements	• Establish communications hub at Eastmont Station • Complete the transition away from legacy traffic signal system • Continue joint ITS deployment with key projects • Institute downtown parking management strategy established	• Expand fiber links around Eastmont Station • Complete fiber loop around Lake Merritt • Key downtown corridors connected • Downtown parking garages connected • Complete downtown parking management strategies	• 90%+ of traffic signals interconnected • Install redundant fiber communications links to improve system reliability • Transition Eastmont Station communications to City fiber network
Signals Online	165 (+105)	281 (+116)	540 (+259)
Fiber Cable Miles [Total (Net Increase)]	26.5 (+18.5)	42.5 (+16.0)	77.5 (+35.0)

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City of Oakland

ITS Strategic Plan UPDATE

Executive Summary (cont.)

Funding Sources

Grants. Oakland has successfully identified and obtained grants to assist with the capital deployment of ITS elements, including CMAQ, TLSP, DOE, and HSIP. Many of these funding opportunities are still available and the City should continue to seek out funding from these sources, as well as seek out other grant opportunities.

Incorporation with Other Projects. Oakland has also incorporated ITS elements such as traffic signal upgrades and fiber communication links into other roadway projects. Recent examples include 12th Street Reconstruction and Lakeside Green Streets Projects. The City has other opportunities to include ITS elements in other projects.

City Funds. Oakland uses City general revenue funds to pay for the operations and maintenance needed for the ITS system. An impact fee has been successfully used as a funding source for ITS in other jurisdictions and should be considered for the City of Oakland.

Operations and Maintenance

In order to achieve and maintain the full benefits from ITS infrastructure investments, adequate staff resources are required to properly operate and maintain the traffic system. With more than 600 signals to maintain, Oakland is currently understaffed with only two traffic engineers and two maintenance technicians, which is up to 75% and 90% deficient from the FHWA maintenance staffing guidelines for engineers and technicians, respectively.

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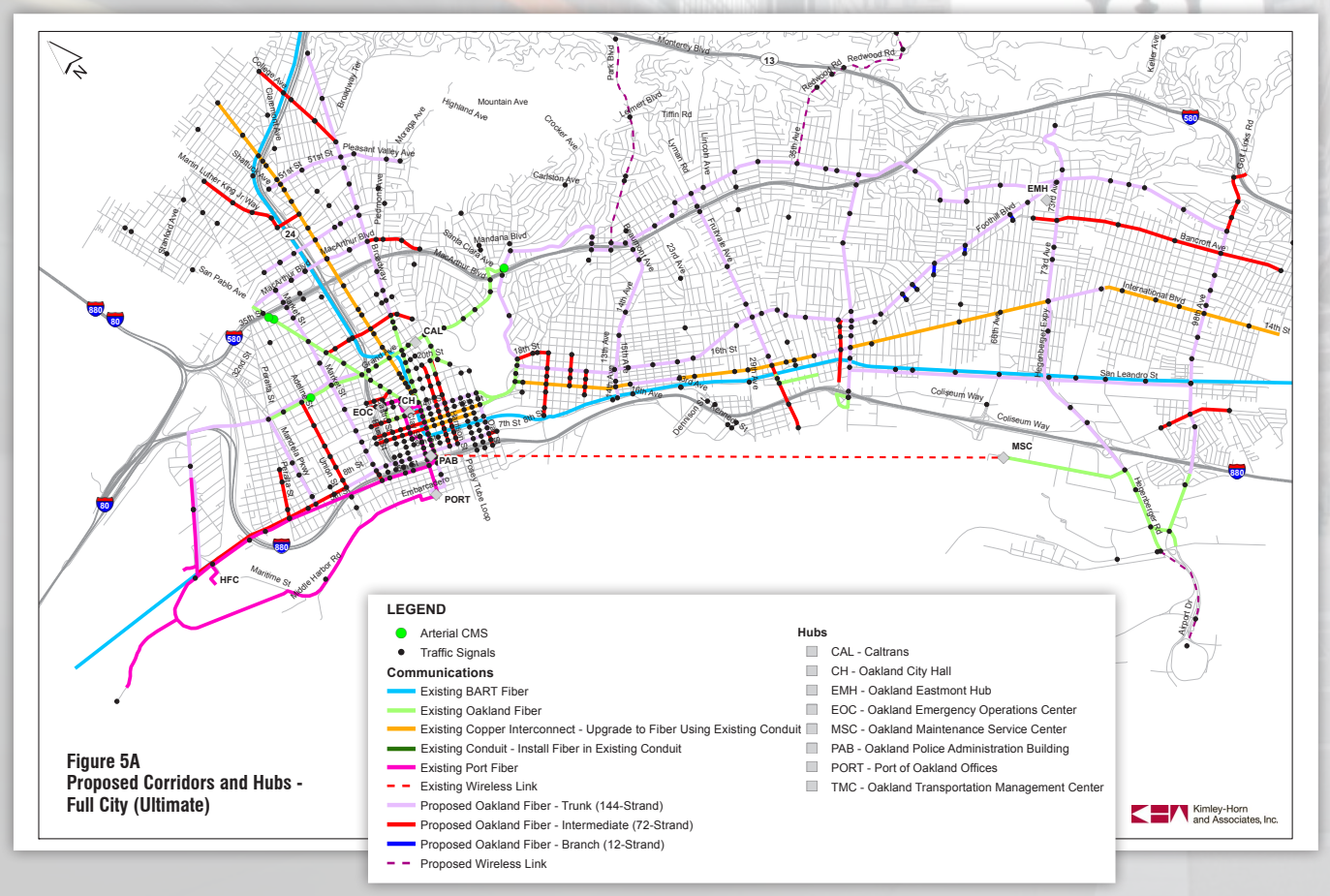

Figure 5A
Proposed Corridors and Hubs - Full City (Ultimate)

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City of Oakland
ITS Strategic Plan
UPDATE

City of Oakland

Intelligent Transportation System (ITS) Strategic Plan Update

FINAL Report

February 2014

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City of Oakland ITS Strategic Plan UPDATE

Contents

I. INTRODUCTION

A. 2013 Strategic Plan Update

The Oakland ITS landscape has changed significantly since the *City of Oakland Citywide ITS Strategic Plan (September 2003)* was prepared. Since 2003, the City of Oakland has successfully deployed an a traffic signal communications network, upgraded the traffic signal system, deployed a transit signal priority and a Rapid Bus system, commissioned a Transportation Management Center (TMC), laid the groundwork for an Integrated Transportation Network, and been a cornerstone partner for the Interstate 80 Integrated Corridor Mobility project (built upon the East Bay SMART Corridor project). The benefits of this ITS deployment have enabled the City to do the following:

1. Monitor transportation system from centralized location;
2. Faster response and update of signal timing patterns; and
3. Remote maintenance and monitoring of equipment.

The City's traffic signal network has grown from around 500 traffic signals to more than 600, and a core ITS network is now in place. There is a greater need for flexibility and responsiveness, as well as sharing of information and resources between City departments and with regional partners.

The 2013 Strategic Plan Update seeks to reestablish and reprioritize the City's ITS vision for the next 10-20 years. The 2013 Strategic Plan Update reaffirms the original goals of the 2003 Strategic Plan and builds upon the relevant successes of the original 2003 ITS Strategic Plan to present a deployment-oriented plan. Specific projects are listed as part of a Strategic Growth Initiative. These projects will continue the expansion of the communications network and the deployment of more field devices. New program areas include Parking Management and other network hubs.

The 2013 Strategic Plan objectives include the following:

1. **Document all existing, planned and ongoing ITS projects.**
2. **Identify areas of expansion of ITS deployment and integration opportunities**
3. **Identify future projects (with preliminary cost estimate) for fill in system gaps.**
4. **Develop implementation criteria for ITS deployment.**
5. **Discuss recommended operations and maintenance requirements of the systems**
6. **Identify funding strategies and opportunities to integrate ITS elements into other capital projects.**

B. 2003 City of Oakland Citywide ITS Strategic Plan

The *City of Oakland Citywide ITS Strategic Plan (September 2003)* was developed to provide a vision and direction for the City's then-fledgling ITS Program. The ITS Strategic Plan improves LOS for all modes on the City's existing roadway network facilities and facilitates the City's ability to implement General Plan objectives and policies. The goals and objectives developed in partnership with City and regional stakeholders are listed in Table 1.1 below:



Updated Table 1.1: City of Oakland ITS Vision Goals and Objectives[1]

Goals	Objectives
Reduce congestion and regulate traffic flow by developing an integrated roadway and traffic demand management system that provides an appropriate mix of mobility and accessibility throughout the City. Improve the environment by reducing fuel consumptions and air pollutants caused by vehicles.	• Regulate vehicle travel times in congested corridors by coordinating traffic signals and responding to changing traffic conditions. • Provide travelers with good information to enable trip-making decisions. • Coordinate transportation operations with other major transportation agencies in the Oakland area, including Port of Oakland, SMART Corridors, and Caltrans.
Promote alternative transportation options; reduce dependency on the automobile by providing facilities that support use of all transportation modes.	• Expedite movement of transit vehicles on transit corridors. • Coordinate transportation operations with major transit providers in the Oakland area, including BART and AC Transit.
Provide safe streets.	• Improve safety and security of motorists, transit users, bicyclists, and pedestrians. • Coordinate transportation operations with emergency service providers in response to incidents and emergencies.

The 2003 Strategic Plan also included review of program areas consistent with applicable portions of the regional and National ITS Architecture, summarized possible technologies for deployment, and outlined five, ten, and twenty-year plans for ITS deployment in the City of Oakland.

C. Stakeholder Participation

The 2013 Strategic Plan Update was led by the City of Oakland Transportation Services Division with input from other City Departments and regional stakeholders. Other City Departments included Information Technology Division, Electrical Services Division, and Police Department. Invited regional stakeholders included Alameda County Transportation Commission (Alameda CTC), Metropolitan Transportation Commission, and AC Transit. Coordination included project kick-off meeting, project brainstorming section, and update presentation.

1 Table 1.1, City of Oakland Citywide ITS Strategic Plan, Final Report (September 2003)



II. EXISTING ITS DEPLOYMENT

Since the 2003 Strategic Plan was prepared, the City of Oakland has been able to leverage the strategies of that plan to fund the deployment and expansion of the following:

- Communications network to key corridors;
- Replacement of legacy traffic signal equipment with Model 2070L controllers and video detection cameras;
- Deployment of transit signal priority and a Rapid Bus system on key corridors;
- Commissioning of the Transportation Management Center (TMC);
- Replacement of legacy traffic signal central server; and
- Laid the groundwork for an Integrated Transportation Network connecting the Maintenance Service Center, Police Administration Building, and Emergency Operations Center to the TMC.

The following is a summary of the existing and in-construction ITS elements in the City of Oakland as of February 2014. All maps were constructed based on existing GIS shape files. The use of GIS allows for the City to easily update and track progress of the ITS deployment.

A. Oakland ITS Core Network

Oakland's ITS Core Network consists of various hubs, project corridors and field elements connected into an integrated system. **Figures 1A and 1B** illustrate the existing and in-construction corridors. Key hubs include the Oakland Transportation Management Center (TMC) and the Emergency Operations Center (EOC) Field equipment deployment may include some or all of the following as required by City of Oakland ITS standards: traffic signal controller upgrades, transit signal priority, traffic cameras (video detection, intersection PTZ), arterial Changeable Message Signs (CMS), and trailblazer signs. Further design details can be found in **Appendix D: Oakland ITS Design Guidelines**.

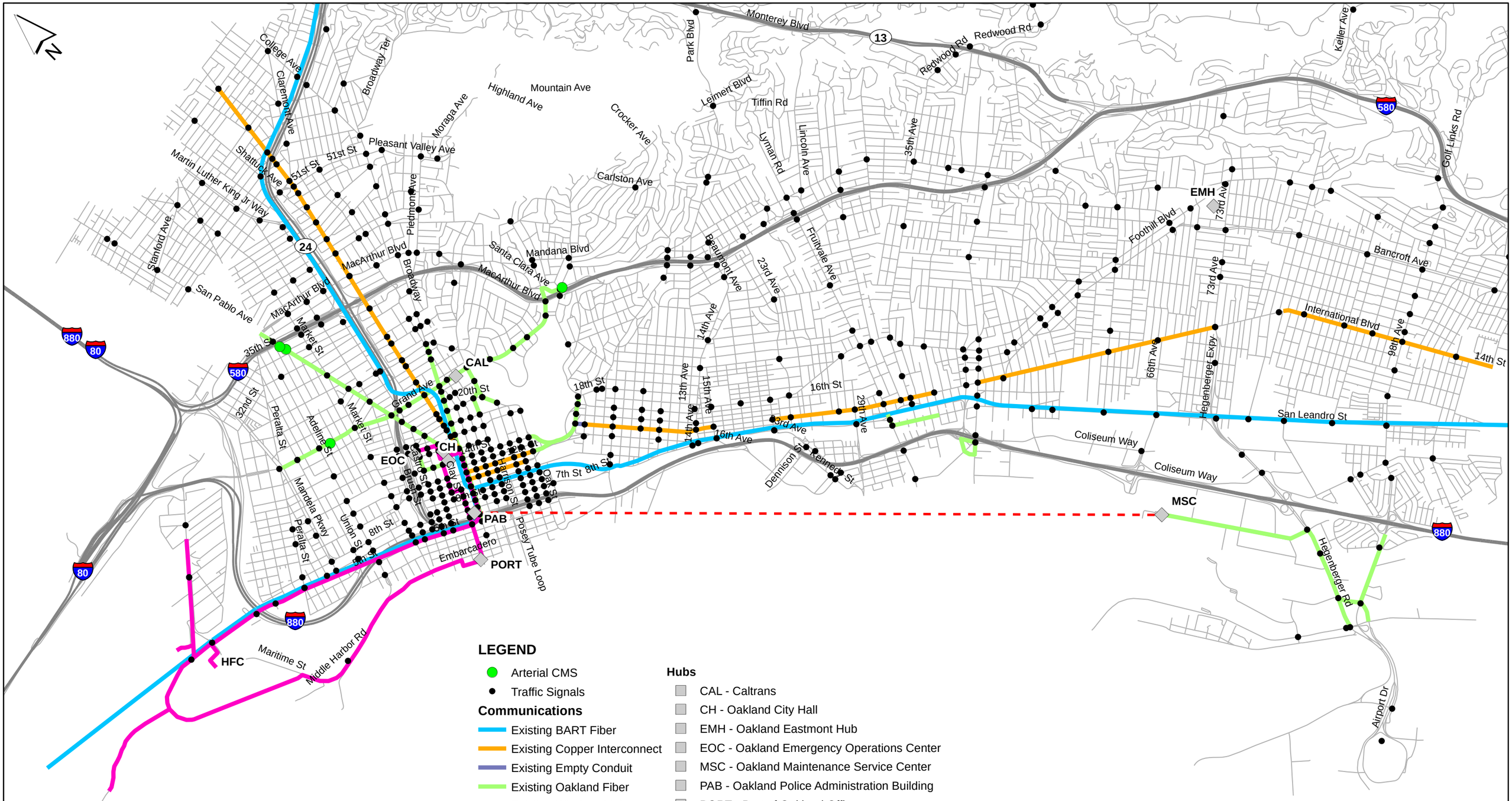
Key projects include the following:

- East Bay SMART Corridors Project (San Pablo Ave, W. Grand Ave) – *2003-2004*
- International-Telegraph RAPID Bus Project (Telegraph Ave, Broadway, 11th St, 12th St, International Blvd) – *2005-2006*
- Transportation Management Center System Integration Project (TMC, EOC) – *2007-2010*
- San Pablo Avenue Traffic Signal Controller Upgrade Project– *2010*
- Oakland Airport ITS Project (Hegenberger Rd, 98th Ave) – *2012*
- 12th Street Reconstruction Project – *2012*
- Broadway Interconnect Project – *2013*
- I-80 Integrated Corridor Mobility (ICM) San Pablo Corridor (San Pablo Ave, W. Grand/ Grand Ave) –*2013*
- ITS elements incorporated into other projects – *in construction*
    - Kaiser (Broadway), 23rd/29th Interchange , Oakland Airport BART Connector, 14th Ave Streetscape, 42nd-High St Access , Foothill Phase 1

In addition to traffic signal coordination plans along key corridors, the City is also in the process of implementing Traffic Responsive Coordination plans on Hegenberger Rd and 98th Ave from I-880 to Oakland Airport.

B. Traffic Monitoring Cameras

Figure 2 shows the location of existing and in-construction traffic cameras in the City. These traffic cameras consist of the following intersection PTZ cameras, intersection video detection cameras and the East Bay SMART Corridor/ I-80 ICM video monitoring stations. Additional details for each of these camera types can be found in **Appendix D: Oakland ITS Design Guidelines**



LEGEND

- Arterial CMS
- Traffic Signals

Communications

- Existing BART Fiber
- Existing Copper Interconnect
- Existing Empty Conduit
- Existing Oakland Fiber
- Existing Wireless Link
- Existing Port Fiber

Hubs

- CAL - Caltrans
- CH - Oakland City Hall
- EMH - Oakland Eastmont Hub
- EOC - Oakland Emergency Operations Center
- MSC - Oakland Maintenance Service Center
- PAB - Oakland Police Administration Building
- PORT - Port of Oakland Offices
- TMC - Oakland Transportation Management Center

Figure 1A
Existing Corridors and Hubs - Full City
February 2014

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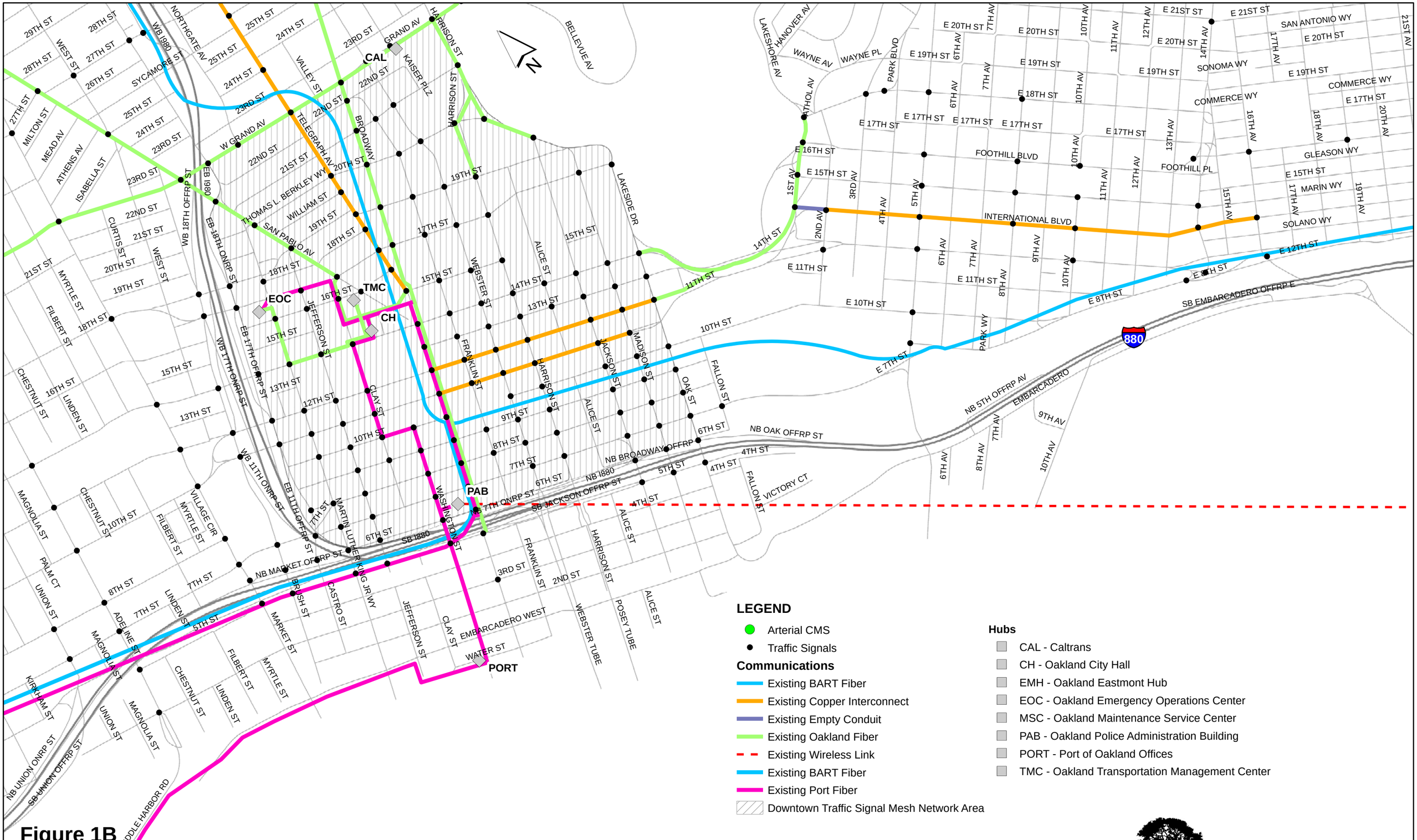

LEGEND

- Arterial CMS
- Traffic Signals

Communications

- Existing BART Fiber
- Existing Copper Interconnect
- Existing Empty Conduit
- Existing Oakland Fiber
- Existing Wireless Link
- Existing BART Fiber
- Existing Port Fiber
- Downtown Traffic Signal Mesh Network Area

Hubs

- CAL - Caltrans
- CH - Oakland City Hall
- EMH - Oakland Eastmont Hub
- EOC - Oakland Emergency Operations Center
- MSC - Oakland Maintenance Service Center
- PAB - Oakland Police Administration Building
- PORT - Port of Oakland Offices
- TMC - Oakland Transportation Management Center

Figure 1B
Existing Corridors and Hubs - Downtown
February 2014

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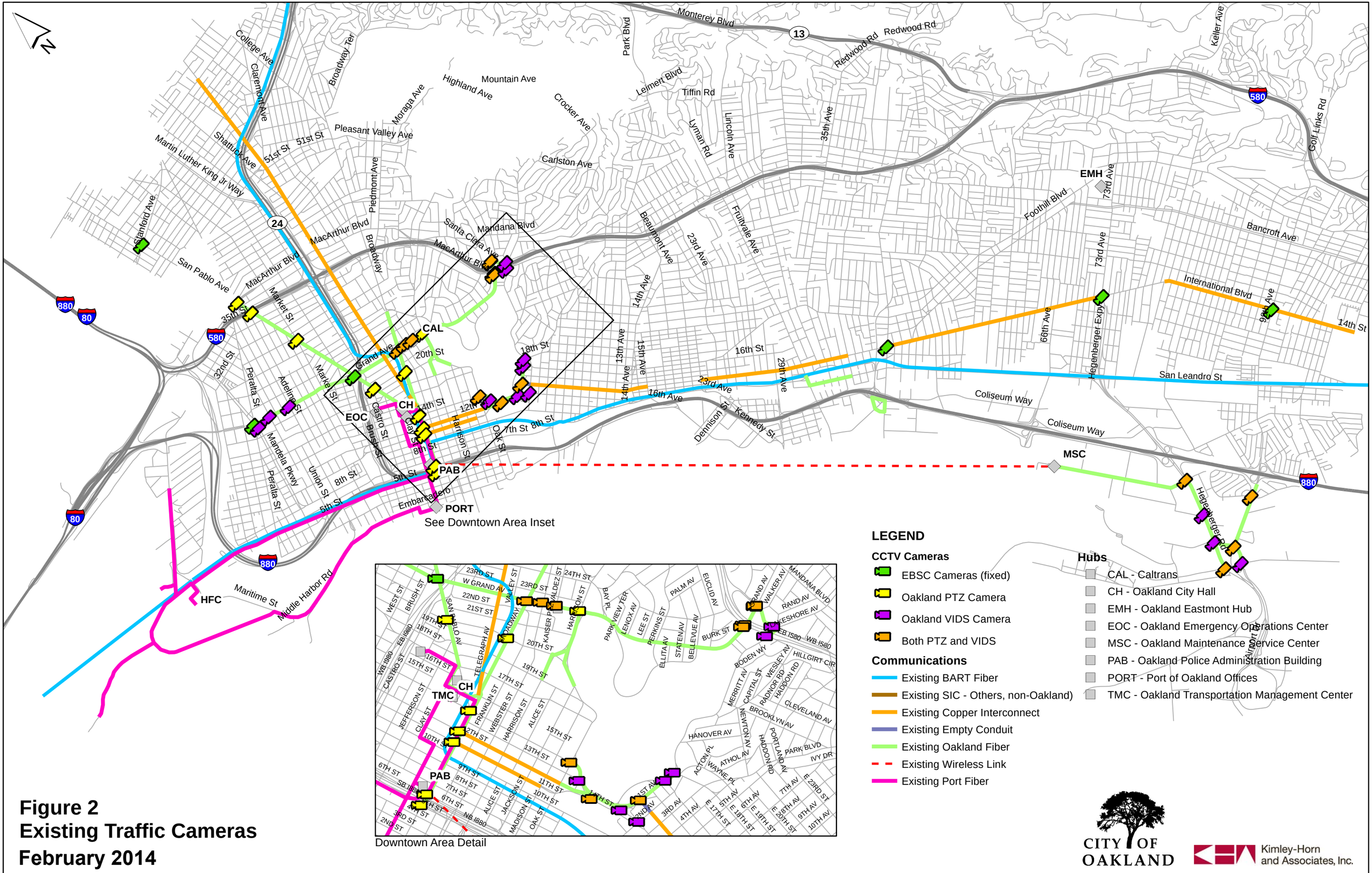

LEGEND

CCTV Cameras

- EBSC Cameras (fixed)
- Oakland PTZ Camera
- Oakland VIDS Camera
- Both PTZ and VIDS

Communications

- Existing BART Fiber
- Existing SIC - Others, non-Oakland)
- Existing Copper Interconnect
- Existing Empty Conduit
- Existing Oakland Fiber
- Existing Wireless Link
- Existing Port Fiber

Hubs

- CAL - Caltrans
- CH - Oakland City Hall
- EMH - Oakland Eastmont Hub
- EOC - Oakland Emergency Operations Center
- MSC - Oakland Maintenance Service Center
- PAB - Oakland Police Administration Building
- PORT - Port of Oakland Offices
- TMC - Oakland Transportation Management Center

Figure 2
Existing Traffic Cameras
February 2014

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III. ITS PROGRAM STRATEGIC GROWTH INITIATITIVE

This section presents projects that focus on the expansion and enhancement of the City's ITS network over a short-term (0-5 years), medium-term (5-10 years), and ultimate (10+ years) timeframe. The intent of this implementation plan is to outline a logical deployment for building Oakland's ultimate vision for its transportation management network. These projects are categorized as Corridor Projects and Parking Management Projects. An overview of the purpose, elements included, and other assumptions for these projects are described below.

A. Project Prioritization Criteria

The following factors have been considered in developing the ITS Program Strategic Growth Initiative Project list:

1. **Build ITS network/ leverage existing ITS deployment** - A Project may be able to leverage and improve existing ITS corridor deployment, improving benefits, as well as expanding the communications network and providing redundancy.
2. **High Benefit-Cost Ratio** - Projects on high AADT roadways and congested corridors would provide the most benefit in trips impacted and delay reduced.
3. **Inclusion with other on-going or planned projects** - It may be cost effective to include some or all of the ITS projects in other projects on a corridor. (Additional suggestions for mainstreaming ITS deployment in other capital projects are included in Section V – ITS Toolbox.) Some possible project opportunities include:
    a. City of Oakland roadway repaving projects;
    b. City of Oakland corridor Redevelopment/ Streetscape/ Safety improvement projects;
    c. City of Oakland IT/ communication projects;
    d. Current and planned projects by other agencies in the City of Oakland, such as
        i. BART Oakland Airport Connector
        ii. I-880 ICM Northern Segment Project
        iii. I-80 ICM System Integration Project
        iv. AC Transit International Boulevard/East Bay Bus Rapid Transit (BRT) Project
        v. AC Transit Line 51 Project
        vi. AC Transit Grand-MacArthur BRT Project
4. **Projects that benefit other strategic partners**- These partners include AC Transit, BART, Caltrans, Port of Oakland, and other Oakland Departments (PD, IT)
5. **Reduce other City costs** - Projects may be able to reduce or eliminate recurring City costs, such as T1 leased-lines or rent/ access fees to private agency duct banks.

B. Corridor Projects

Though the City of Oakland has over 600 signals, only approximately 100 traffic signals are currently connected and configured on the City's traffic signal communications network. The City of Oakland currently maintains two traffic signal systems – the current Naztec ATMS.now server and a legacy



McCain QuicNet server (~60 signals). A top priority of the City is to transition traffic signals to the current ATMS.now server and to establish a communication network that extends throughout the City. The corridor projects focus on creating fiber backbones and upgrading ITS equipment to current standard (See Appendix A) along major roadway corridors. Proposed projects also emphasize network redundancy by creating field hubs and communication rings that would provide failover protection due to broken or failed communication links. The three types of corridor communications projects are:

- Install new fiber-optic corridors
- Upgrade existing copper interconnect corridor to fiber
- Utilize wireless communications

As discussed with various City Departments, there is general agreement that a new hub should be located at the Eastmont Public Safety Facility ("Eastmont Hub").

C. Parking Management Projects

The City operates and/or manages 15 garages in the downtown area, and there are approximately 30,000 parking spaces in the downtown/ uptown area (including garages, on-street spaces, and privately-owned lots.) Ultimately, the City wants to fully link on-street and garage parking in a real-time fully-networked system. Such projects that have been successfully deployed in other metropolitan areas include integrating on-street parking with off-street (garage) parking, parking guidance systems, and dynamic pricing. The objective of Parking Management projects to effectively manage and convey parking information to the public. The benefits of the system is that it would reduce street circulation when searching for parking.

A Downtown Transportation and Parking Plan was completed in 2003, and the City recently completed an inventory of all on-street parking in the Downtown area as a partial update. A Parking Master Plan can build upon this information and should include discussion and implementation for the following Parking Management elements:

- Connecting City Garages – these projects could leverage the ITS communications network deployed in the downtown area and provide the foundation for future projects
- Technological improvements and upgrades – these include upgrading parking meters, real-time parking space sensors
- Implementation of a Central Management System – this provides real-time information on the use of garages that can be shared with the public
- Parking Guidance System – this provides real-time information to the public via dynamic sign and the internet
- Dynamic Pricing Study – could be used for special downtown events, or to direct parking patterns toward under-parked areas



D. Proposed Project List

Appendix A: Strategic Growth Initiative Projects provide details on projects proposed for implementation in the short-term (0-5 year), medium-term (5-10 year), and ultimate (10+ year) timeframes. These projects were selected based on the criteria laid out in Section IIIA Project Prioritization Criteria (Page 8). **Figures 3 through 5** illustrate the various proposed corridor projects for the respective time frames. **Figure 6** shows the parking management district area study area (short-term). Key projects for each timeframe are summarized in the tables below.

Short term projects (0-5 years)
Projects in the short-term timeframe establish another field communication hub, transition controllers away from the legacy traffic signal server, and coordinate with projects from key partners.

Table 3.1: Key ITS Projects (Short-term)

Project	Limits	Cost	Meets Criteria*	Priority
Hegenberger Rd/ 73rd Avenue Fiber and Hub installation	Edgewater to MacArthur/ Eastmont Hub	$2,896,000	1, 2, 3, 4, 5	A
Parking Master Vision and Implementation Plan	Downtown/ Uptown area bounded by Grand Ave, I-980, 5th St, and Oak St/ Lakeside Dr	$300,000	1, 2, 3	B
International Blvd Signal Cable Upgrade	1st Ave to 105th Ave	$4,528,000	2, 3, 4, 5	A
Broadway Corridor Fiber Expansion	Broadway: 27th St to SR-24; College Ave: Broadway to Claremont	$3,626,000	1, 2, 3	B
12th Street Signal Cable Upgrade	Broadway to Oak Street	$933,000	2, 3,	B
11th Street Signal Cable Upgrade	Broadway to Madison Street	$692,000	2, 3	B
Telegraph Avenue Signal Cable Upgrade	Broadway to Alcatraz	$3,615,000	2	C

** Project Prioritization Criteria from Section IIIA (Page 8) summarized below:*

1. *Build ITS network/ leverage existing ITS deployment*
2. *High Benefit-Cost Ratio*
3. *Inclusion with other on-going or planned projects*
4. *Projects that benefit other strategic partners*
5. *Reduce other City costs*



Medium-term projects (5-10 years)

Key medium-term projects build upon the expanding the communication network (including connecting parking garages) around key hubs in the downtown area and Eastmont Hub.

Table 3.2: Key ITS Projects (Medium-term)

Project	Limits	Cost (k)	Meets Criteria*
5th Avenue	E. 8th Street to E. 18th	$1,206,000	
E. 18th Street	Lakeshore Ave to 5th Ave	$678,000	3
7th Street	Broadway to Webster	$2,796,000	
Adeline Street	7th Street to Grand	$1,326,000	
Market Street	6th Street to W. Grand	$1,679,000	
Oakland Army Base Connection	Grand Avenue: Mandela to Maritime Maritime: Grand to 7th St.	$1,051,000	4
Downtown Wireless Mesh Network		$660,000	2, 4, 5
14th Ave	E. 8th to Foothill	$764,000	
High St	I-880 to Foothill	$738,000	1, 2
Foothill	High Street to MacArthur	$2,517,000	1, 2
MacArthur	73rd to 98th	$1,632,000	1,
98th Ave	I-880 to International	$1,598,000	1,
98th Ave	International to I-580	$1,829,000	1,
Connect downtown garages to ITS network	8 City-owned garages	480,000	4

** Project Prioritization Criteria from Section IIIA (Page 8) summarized below:*

1. *Build ITS network/ leverage existing ITS deployment*
2. *High Benefit-Cost Ratio*
3. *Inclusion with other on-going or planned projects*
4. *Projects that benefit other strategic partners*
5. *Reduce other City costs*

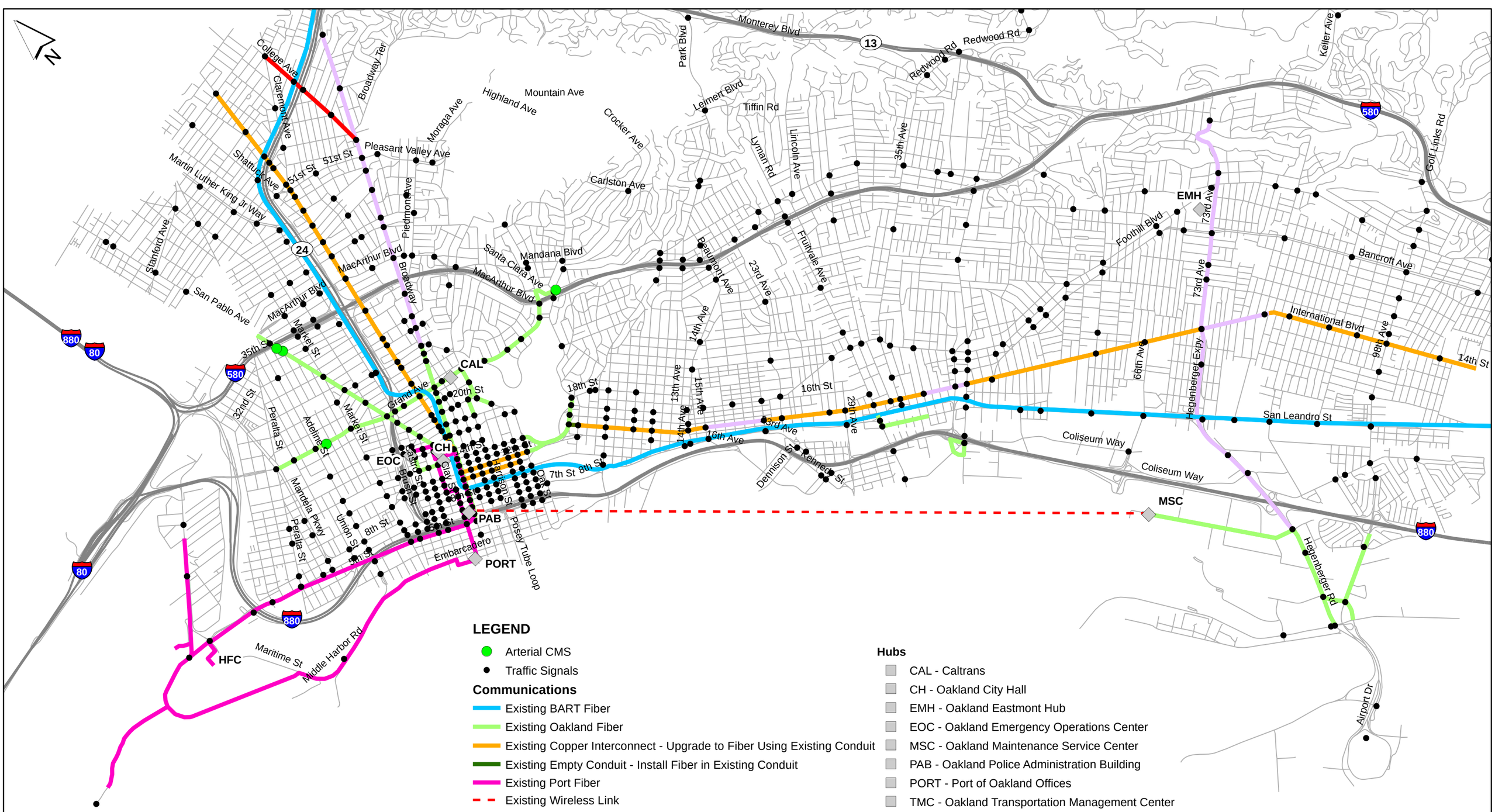
Ultimate projects (10+ years)

The ultimate vision for the ITS program is to have communications to all traffic signals on key corridors and the majority of other signals connected to the TMC. In addition, fiber ring and redundancy for the Oakland ITS system would be built out, which would allow for the communications connection to the Eastmont Hub to be backed up if the BART fiber connection was disrupted. Key projects for this phase are summarized in the table below.

Table 3.3: Key ITS Projects (Ultimate)

Project	Limits	Cost	Meets Criteria*
40th St	Market St to Broadway	$1,447,000	1
Foothill Blvd	1st Ave to Crosby St	$4,312,000	1, 2
Foothill Blvd	High St to Crosby St	$719,000	1, 2
High St	International Blvd to I-580	$1,980,000	2
MacArthur Blvd	Park Blvd to Fruitvale Ave	$2,328,000	2,3
MacArthur Blvd	Fruitvale Ave to High St	$1,894,000	2,3
MacArthur Blvd	High St to 73rd Ave	$193,000	2,3
San Leandro St	High St to 98th Ave	$2,999,000	2

** Project Prioritization Criteria from Section IIIA (Page 8)*



LEGEND

- Arterial CMS
- Traffic Signals

Communications

- Existing BART Fiber
- Existing Oakland Fiber
- Existing Copper Interconnect - Upgrade to Fiber Using Existing Conduit
- Existing Empty Conduit - Install Fiber in Existing Conduit
- Existing Port Fiber
- Existing Wireless Link
- Proposed Oakland Fiber - Trunk (144-Strand)
- Proposed Oakland Fiber - Intermediate (72-Strand)

Hubs

- CAL - Caltrans
- CH - Oakland City Hall
- EMH - Oakland Eastmont Hub
- EOC - Oakland Emergency Operations Center
- MSC - Oakland Maintenance Service Center
- PAB - Oakland Police Administration Building
- PORT - Port of Oakland Offices
- TMC - Oakland Transportation Management Center

Figure 3A
Proposed Corridors and Hubs- Full City (Short-Term)
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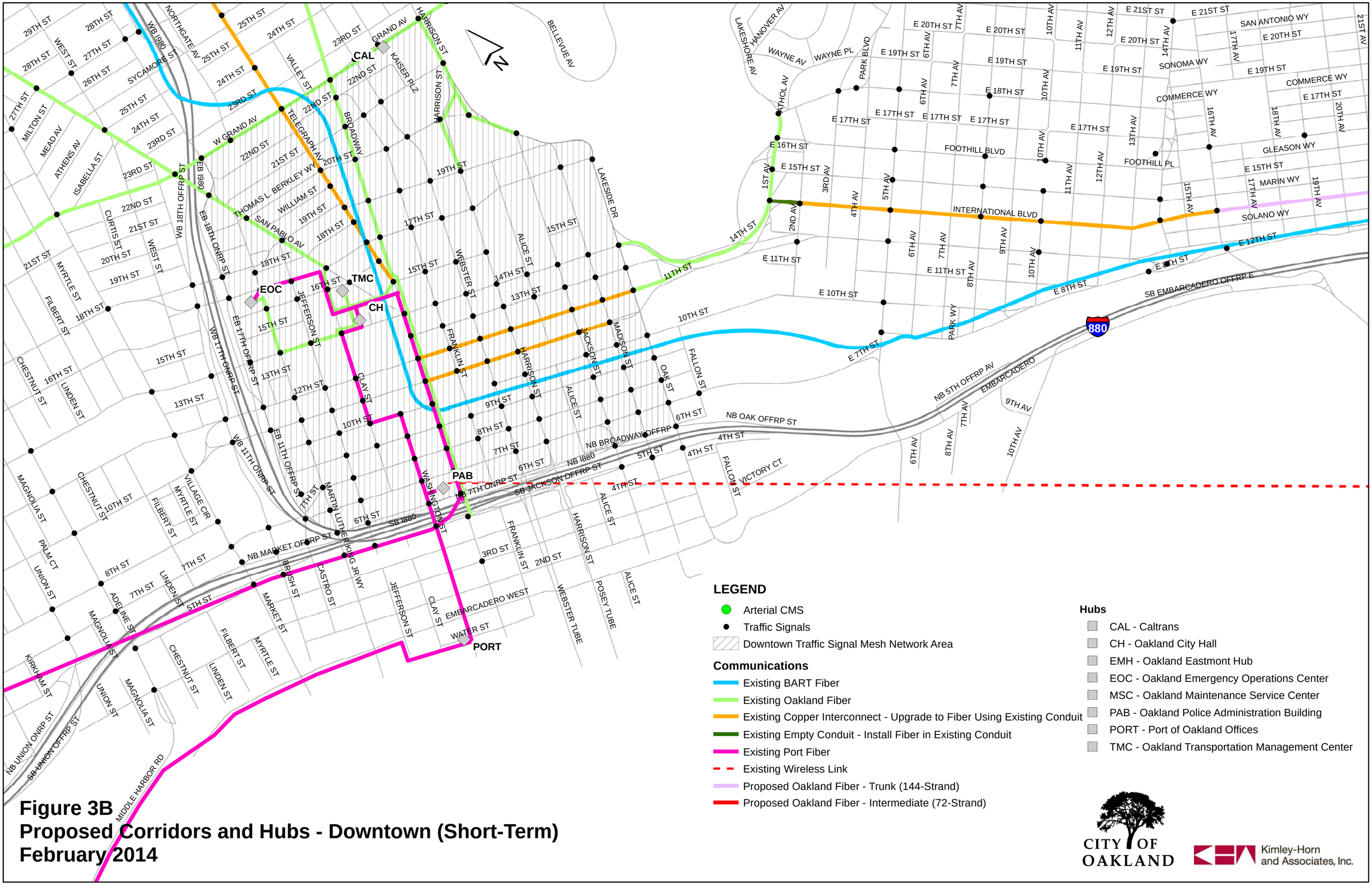

Figure 3B
Proposed Corridors and Hubs - Downtown (Short-Term)
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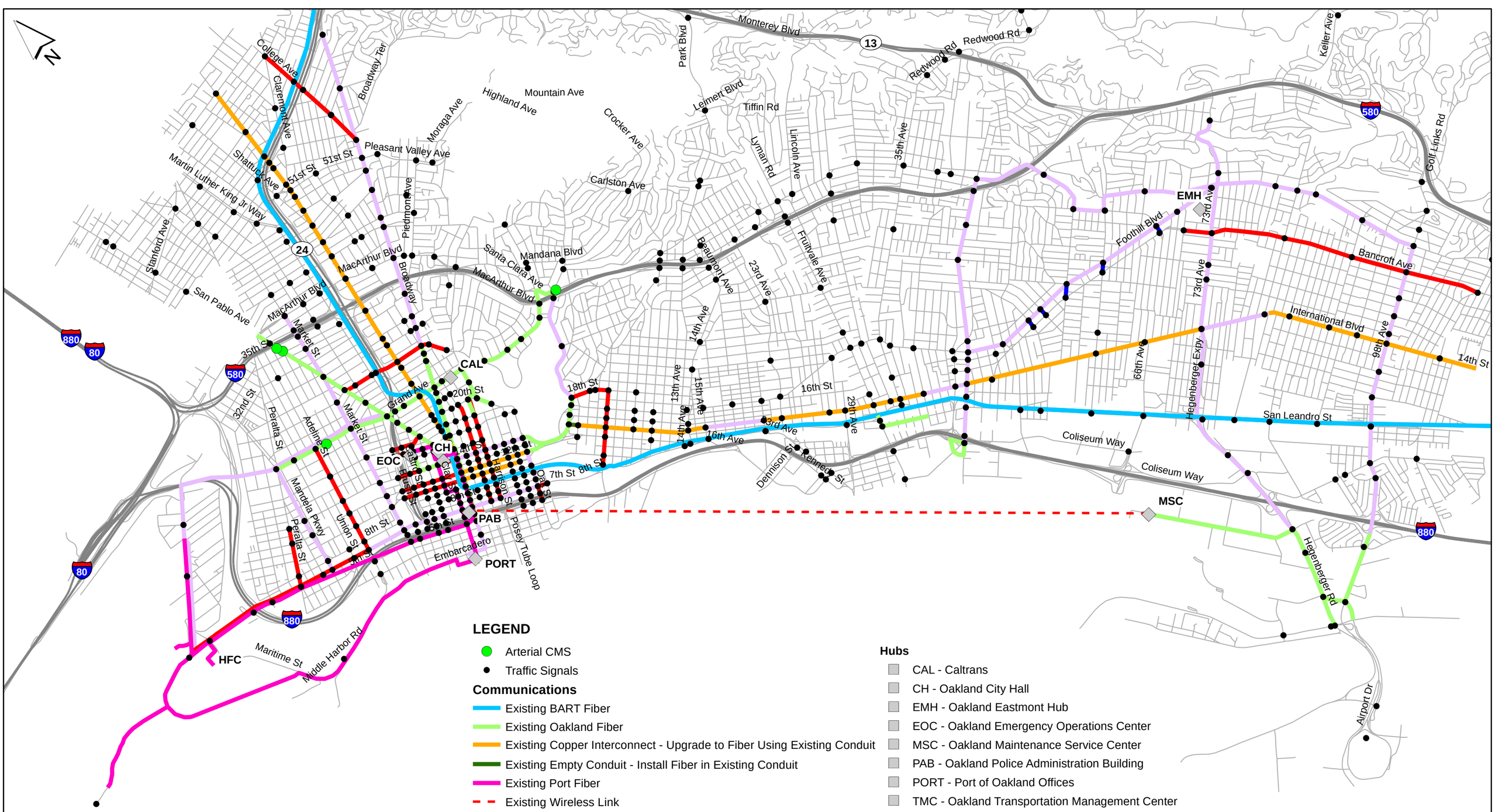

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- Proposed Oakland Fiber - Branch (12-Strand)

Hubs

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- MSC - Oakland Maintenance Service Center
- PAB - Oakland Police Administration Building
- PORT - Port of Oakland Offices
- TMC - Oakland Transportation Management Center

Figure 4A
Proposed Corridors and Hubs- Full City (Medium-Term)
February 2014

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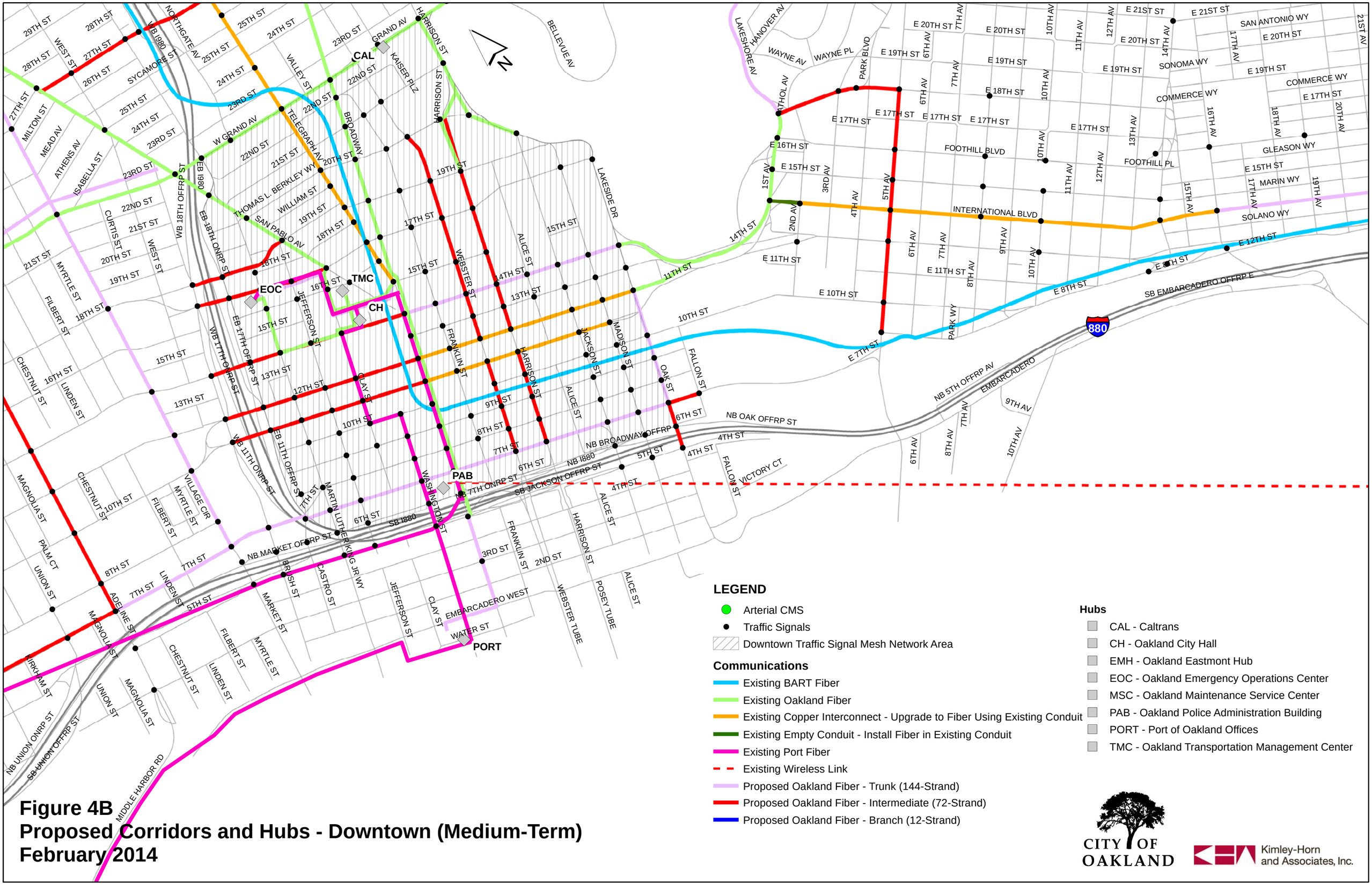

Figure 4B
Proposed Corridors and Hubs - Downtown (Medium-Term)
February 2014

LEGEND

- Arterial CMS
- Traffic Signals
- Downtown Traffic Signal Mesh Network Area

Communications

- Existing BART Fiber
- Existing Oakland Fiber
- Existing Copper Interconnect - Upgrade to Fiber Using Existing Conduit
- Existing Empty Conduit - Install Fiber in Existing Conduit
- Existing Port Fiber
- Existing Wireless Link
- Proposed Oakland Fiber - Trunk (144-Strand)
- Proposed Oakland Fiber - Intermediate (72-Strand)
- Proposed Oakland Fiber - Branch (12-Strand)

Hubs

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- CH - Oakland City Hall
- EMH - Oakland Eastmont Hub
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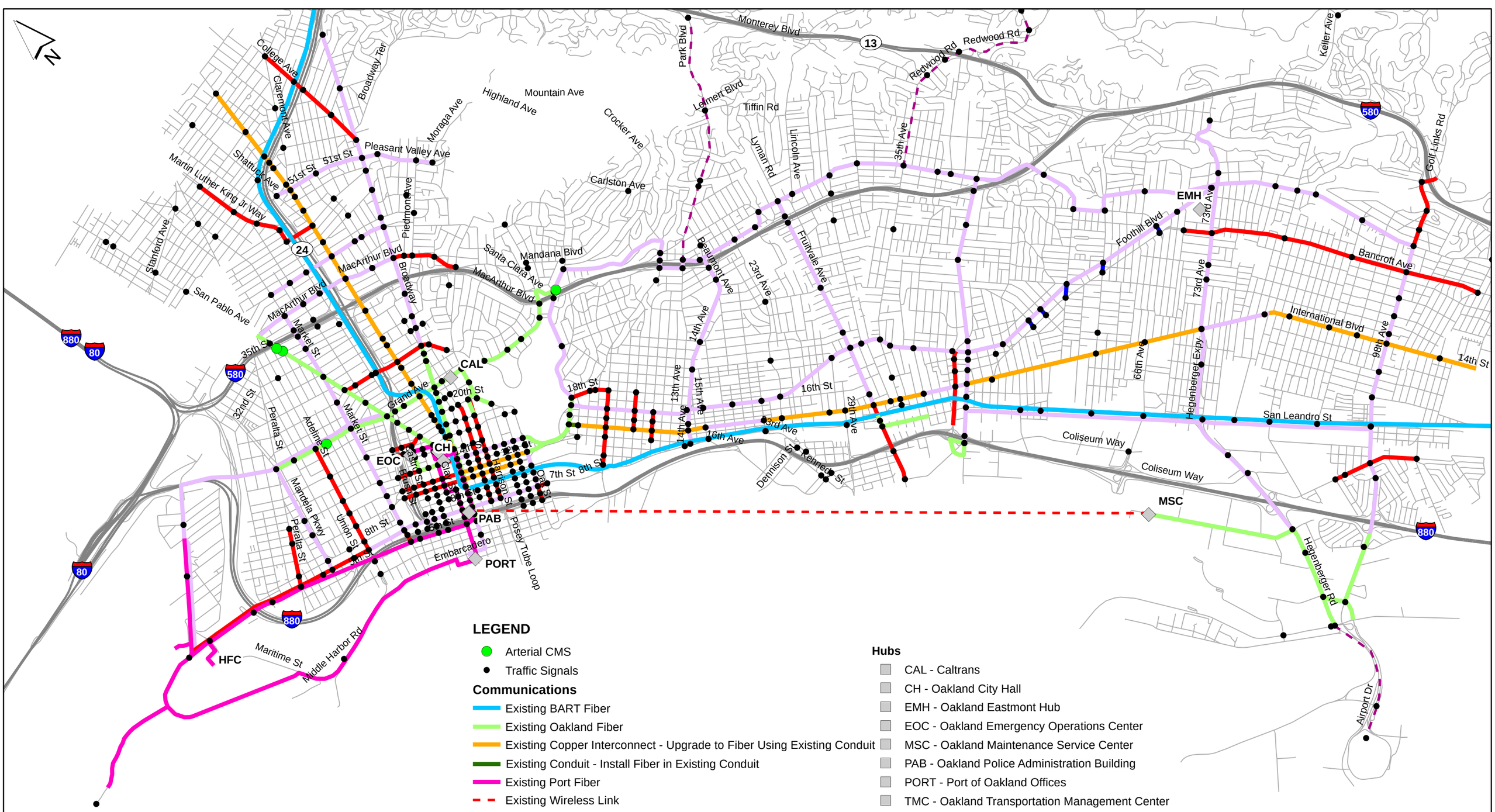

LEGEND

- Arterial CMS
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Communications

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- Proposed Oakland Fiber - Intermediate (72-Strand)
- Proposed Oakland Fiber - Branch (12-Strand)
- Proposed Wireless Link

Hubs

- CAL - Caltrans
- CH - Oakland City Hall
- EMH - Oakland Eastmont Hub
- EOC - Oakland Emergency Operations Center
- MSC - Oakland Maintenance Service Center
- PAB - Oakland Police Administration Building
- PORT - Port of Oakland Offices
- TMC - Oakland Transportation Management Center

Figure 5A
Proposed Corridors and Hubs- Full City (Ultimate)
February 2014

CITY OF OAKLAND

Kimley-Horn and Associates, Inc.

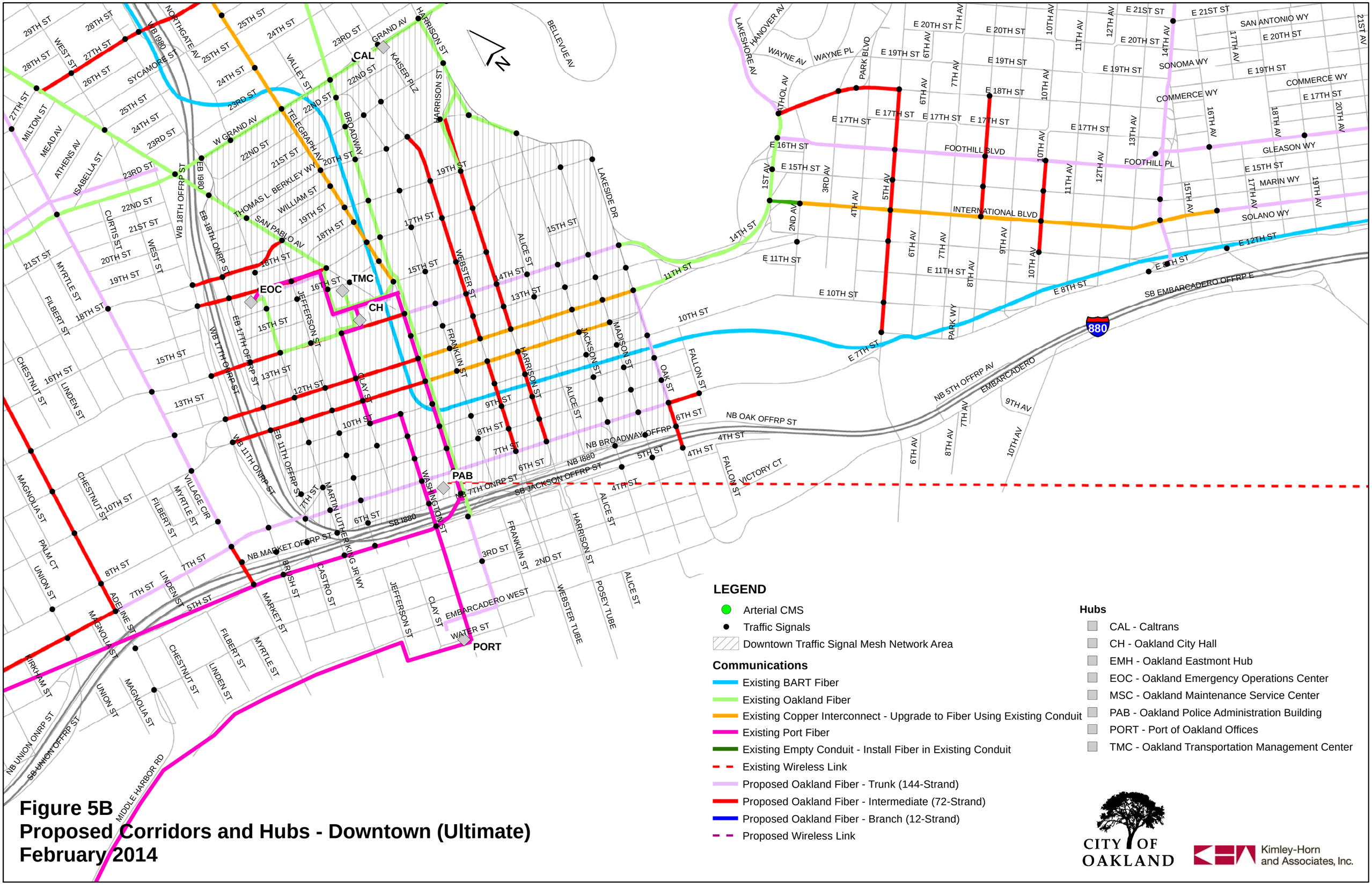


Figure 5B
Proposed Corridors and Hubs - Downtown (Ultimate)
February 2014

LEGEND

- Arterial CMS
- Traffic Signals
- Downtown Traffic Signal Mesh Network Area

Communications

- Existing BART Fiber
- Existing Oakland Fiber
- Existing Copper Interconnect - Upgrade to Fiber Using Existing Conduit
- Existing Port Fiber
- Existing Empty Conduit - Install Fiber in Existing Conduit
- Existing Wireless Link
- Proposed Oakland Fiber - Trunk (144-Strand)
- Proposed Oakland Fiber - Intermediate (72-Strand)
- Proposed Oakland Fiber - Branch (12-Strand)
- Proposed Wireless Link

Hubs

- CAL - Caltrans
- CH - Oakland City Hall
- EMH - Oakland Eastmont Hub
- EOC - Oakland Emergency Operations Center
- MSC - Oakland Maintenance Service Center
- PAB - Oakland Police Administration Building
- PORT - Port of Oakland Offices
- TMC - Oakland Transportation Management Center

CITY OF OAKLAND

Kimley-Horn and Associates, Inc.

Prepared by: City of Oakland ,Department of Planning and Building, September 2013

Figure 6: Oakland Parking Management District Study Area

IV. OPERATIONS AND MAINTENANCE

Oakland has made significant strategic investments in developing its transportation and ITS network. In order to reap the full benefits of its investment, sufficient staff resources are required to properly operate and maintain the system. It should be noted that while the expanded deployment will increase staff cost, there will be more than that in staff time savings from the new system, and that such investments will allow staff to be more effective in maintaining the system.

A. Peer Agencies Comparison

Proper staffing is crucial for the long-term sustainability of the system. In an effort to quantify and establish an appropriate context for evaluation of the City's current staffing levels, several municipalities in Northern California with similar population and traffic signal deployments were explored to document the complexion of their current staffing. These selected "peer" agencies provided key metrics such as the number of traffic signals, the number of staff (engineering and maintenance), and miles of communications infrastructure. **Table 4.1** provides a summary of that data in comparison to the City of Oakland's current staffing.

Table 4.1 – Peer Agency ITS Support Staffing Comparison

Agency	# Signals+	# TOC Staff++	TOC Staff Ratio+++	Interconnect* (miles)	Notes
Sacramento County	500 (250/250)	23 (6/17)	84 / 30	29 / 60	89 CCTVs, 4 CMSs, TOC opened in 2001
City of Sacramento	850 (415/385)	12 (6/6)	142 / 142	100 / 200	89 CCTVs, TOC opened in 1996
City of Oakland	~600 (100/500)	4 (2/2)	300 / 300	8 / 12	24 CCTVs, 4 CMSs, TOC opened in 2011

\+ # Signals reported as **# Total (# connected/# isolated)**
++ # TOC Staff reported as **# Total (# engineers/# maintenance technicians)**
+++ TOC Staff Ratio reported as **# Signals per engineer / # Signals per technician**
* # Miles of Interconnect reported as **# Miles Fiber (SMFO and MMFO) / # Miles Copper**

As depicted in **Table 4.1**, although the peer agencies have similar traffic signal deployments, they have varying sized ITS infrastructure and dedicated TOC staffing levels. Sacramento County has a ratio of 83 signals per engineer and 29 signals per technician. The City of Sacramento has a ratio with 142 signals per engineer, and 142 signals per technician. **In comparison, the Oakland appears to be severely understaffed in the ratio of traffic signals to traffic engineers (300 signals per engineer) and to maintenance technicians (300 signals per technician).**

B. FHWA maintenance staffing guideline comparison

As a point of reference for these staffing ratios, FHWA reports the following additional maintenance staffing guidelines:

- 75-100 signals per engineer with agencies over 150 signals. Smaller cities will have lower ratio due to economies of scale.
- 30-40 signals per signal tech with agencies over 150 signals. Smaller cities will have lower ratio due to economies of scale.

In comparison to these guidelines, Oakland's staffing is up to 75% and 90% deficient for engineers and technicians, respectively.

V. INCORPORATING ITS ELEMENTS IN OTHER PROJECTS

ITS projects may be stand-alone improvement projects, but it is more common and cost-effective for ITS elements to be included as part of other capital improvement projects. For example, a new roadway project can include additional conduit and fiber without substantial increase in cost. Most capital improvement projects can incorporate various ITS elements. These project types and possible ITS elements include:

- Roadway (construction and widening): sidewalk, streetscape, streetscape, repaving, utility work
  - *Possible ITS elements - Communication links, traffic signal (new or modification)*
- Interchange/ intersection, pedestrian crossings
  - *Possible ITS elements - traffic signal (new or modifications)*
- Pedestrian/ Bicycle: trails, sidewalk, streetscape, pedestrian mall and kiosks
  - *Possible ITS elements - Communication links,*
- Transit: Bus stop improvements or installations, Transit Villages,
  - *Possible ITS elements - Bus Rapid Transit, Transit Signal Priority, Automated Vehicle Location*
- Emergency Response:
  - *Possible ITS Elements: Communication hubs, communication links, Emergency Vehicle Preemption*

A quick reference guide of potential ITS solutions that could be added to these projects types is located in **Appendix B: ITS Solutions Toolbox**. Each ITS solution identified includes a description of the ITS elements, deployment considerations, benefits, and costs, as well as the necessary information to go to the next step of mainstreaming ITS into the planning process. "Mainstreaming" refers to processes that provide for the systematic and strategic consideration of ITS in all aspects of transportation planning whether it is being done on a local, corridor or regional level, or specifically tied to smart growth projects. The goal of mainstreaming is to ensure that ITS strategies and technologies are an integral component of the project implementation process.

VI. FUNDING

A. Transportation Funding Programs

The City has several continuing funding sources dedicated to its transportation network listed below. These could be used for implementation of various ITS elements as part of the "mainstreaming" techniques mentioned in Section V.

- **Gas Tax Funds -** Gas Tax Funds account for the $0.18 per gallon state tax on fuel used to propel motor vehicles or aircraft. The State Board of Equalization administers the tax and the State Controller distributes the revenues from the tax. Gas Tax funds largely "support street maintenance and traffic engineering operations, and are limited to research, planning, construction, improvement, maintenance, and operating of public streets and highways or public transit guideways." [2] Currently, Gas Tax Funds are understood to be primarily used in the City for roadway resurfacing and other associated maintenance activities.
- **Alameda County Measure B (Transportation Sales Tax) and Measure F (Vehicle Registration Fee) –** In 2000, Alameda County voters approved Measure B, a half-cent transportation sales tax to deliver essential transportation improvements and services for 20-years. In 2010, Alameda County voters approved Measure F Vehicle Registration Fee Program that places a $10 per year vehicle registration fee on Alameda County residents. Implementation guidelines have been developed to specify the requirements that local jurisdictions must follow in their use of Measure B pass-through funds and Measure B and Vehicle Registration Fees (VRF) discretionary funds as authorized under Alameda County Transportation Commission Master Program Funding Agreements. The City of Oakland receives pass-through payments from these two measures that that are the largest continuing source of streets and roads funding in the City.

B. Grant Funding Sources

The City been successful at identifying and obtaining numerous grants that leverage the City's existing funding to advance deployment of the existing network. While some of these funding sources are not ITS-specific per se, ITS elements can be incorporated into capital improvement projects using the techniques listed in the ITS Solutions Toolbox in Section V. Often, specific ITS projects that promote sustainability, such as signal synchronization or transit signal priority, can be used to justify the cost of upgrading communication networks or adding traffic signals.

Obtaining grant funding has become a very competitive process, and there is no guarantee that funding will be awarded. **Table 6.1** below summarizes grant funding programs reflecting the relevant agencies/departments, feasible ITS opportunities, strategies for a successful application, and the likelihood of successfully obtaining grant funding. This Strategic Plan is a long term planning document.

2 California Streets and Highways Code Sections 2106, 2107, and 2107.5

These grant programs are relevant today, but it is important to keep abreast of future local, regional, and state funding sources in the future.

Table 6.1 – ITS Element Grant Funding Sources and Strategies

Grant Name	Administering Agency	Sample feasible ITS Elements	Strategy for Grant Application	Likelihood of being applicable
CMAQ	Caltrans (MTC/ ACTC programs funds)	Traffic signal interconnect; transit signal priority; CCTV cameras; arterial CMS	Demonstrate benefits to air quality (e.g., reduce GHG, delay, number of vehicles, stop time, emissions)	High
STIP	Caltrans/CTC ACTC/MTC for TIP	Freeway interchange improvements with ITS elements; Smart Corridor enhancements; ITS on state-owned arterials	Multi-modal and multi-jurisdictional projects; high cost-benefit ratio; benefits are increased capacity, reduced delay	Medium
HSIP	Caltrans	ITS projects mainstreamed into highway safety projects	Promote safety, including traffic signal upgrades and part of safety improvements	Medium
Active Transportation Program	Caltrans	ITS Projects that promote sustainability – Bicycle and pedestrian signal improvements, signal timing,	Promote active transportation and increased safety for non-motorized modes	Low
Program for Arterial System Synchronization (PASS)	MTC via STP/CMAQ	Signal synchronization, traffic signal upgrades, traffic signal interconnect	Signal systems that interact with freeways, involve multiple jurisdictions, are regionally significant, provide priority for transit vehicles	High
One Bay Area Grant Program	MTC via MAP-21	ITS Projects that promote sustainability – transit signal priority, signal timing	Transportation categories such as Transportation for Livable Communities, local street reservation, ped/bike improvements, and SCS	Medium
Regional Measure 2 (and future extensions)	MTC	ITS projects mainstreamed into other capital projects	Projects that reduce congestion or help travel to bridge corridors	Low
TFCA	BAAQMD	Traffic signal controller upgrades; traffic signal interconnect	Demonstrate benefits to air quality (e.g., reduce GHG, delay, number of vehicles, stop time, emissions)	High
Measure B discretionary grants	ACTC	ITS projects mainstreamed into other capital projects; Signal synchronization, traffic signal upgrades, traffic signal interconnect	Improve local streets and roads; reduce congestion within the County expenditure plan	High
Measure F discretionary grants	ACTC	Signal synchronization, traffic signal upgrades, traffic signal interconnect	Sustain transportation network; reduce traffic congestion and vehicle-related pollution	Medium



- **Congestion Mitigation and Air Quality Program (CMAQ)** - This program was established by the 1991 Federal Intermodal Surface Transportation Efficiency Act (ISTEA) and continues to be re-authorized with the passage of MAP-21 (Moving Ahead for Progress in the 21st century) in 2013. CMAQ funds are directed to transportation projects and programs that contribute to the attainment or maintenance of National Ambient Air Quality Standards in nonattainment or air quality maintenance areas for ozone, carbon monoxide, or particulate matter under provisions in the Federal Clean Air Act. Eligible projects are as follows: public transit improvements; high occupancy vehicle (HOV) lanes; Intelligent Transportation Infrastructure (ITI); traffic management and traveler information systems (e.g., electric toll collection systems); employer-based transportation management plans and incentives; traffic flow improvement programs (signal coordination); fringe parking facilities serving multiple occupancy vehicles; shared ride services; bicycle and pedestrian facilities; flexible work-hour programs; outreach activities establishing Transportation Management Associations; fare/fee subsidy programs; engine diesel retrofits; alternative fuel vehicles; vehicle congestion pricing; freight intermodal projects; idle reduction projects; and under certain conditions, PM-10 projects.
- **State Transportation Improvement Program (STIP) -** The State Transportation Improvement Program (STIP) is a multi-year capital improvement program resource management document to assist the State and local entities to plan and implement transportation improvements, and to utilize resources in a cost-effective manner. All STIP projects must be capital projects (including project development costs) needed to improve transportation. These projects generally may include, but are not limited to, improving State highways, local roads, public transit (including buses), intercity rail, pedestrian and bicycle facilities, grade separations, transportation system management, transportation demand management, soundwalls, intermodal facilities, safety, and environmental enhancement and mitigation projects. STIP funding is split 25 percent to Interregional Transportation Improvement Program (ITIP) projects nominated by Caltrans, and 75 percent to Regional Transportation Improvement Program (RTIP) projects decided by regional agencies. Projects are presented as part of a complete ITIP or RTIP to the California Transportation Commission (CTC) for approval and inclusion in the STIP. The CTC, upon review of the ITIP or RTIP, can accept or reject the program in its entirety.
- **Highway Safety Improvement Program (HSIP) -** The Moving Ahead for Progress in the 21st Century Act (MAP-21) went into effect on October 1, 2012 and It continued the Highway Safety Improvement Program (HSIP) as a core Federal-aid program. The goal of the program is to achieve a significant reduction in traffic fatalities and serious injuries on all public roads, including non-State-owned public roads and roads on tribal lands. The HSIP requires a data-driven, strategic approach to improving highway safety on all public roads that focuses on performance. Funding is administered by Caltrans.
- **Active Transportation Program –** Created by senate Bill legislation to combine federal and state transportation including Bicycle Transportation Account, Safe Routes to Schools, and Transportation Alternatives Program. Funding is a combination of federal and state money administered by Caltrans. Projects are developed at the City or Regional level. Although ITS is not the primary focus, there is an opportunity to obtain funding for ITS-related improvements for traffic signal upgrades with pedestrian countdown timers, video detection that assists bicycles, etc.
- **Program for Arterial System Synchronization** - This program is administered by MTC for Cycle 2

STP/CMAW funds. The program is specifically for traffic signal projects that impact the region because they are multi-jurisdictional or have an influence on regionally significant roads or freeways. This program is nearing its funding limit, but there may be a future extension or a new phase.

- **OneBay Area Funding Program** – This program was started by MTC to provide funding for projects that further the Sustainable Communities Strategy and Senate Bill 375 (Climate Change policy). The program is federally funded by MAP 21. The typical projects that are included are projects that further the Transportation for Livable Communities initiative, road preservation, and bicycle and pedestrian improvements. This funding area is not specific to ITS, but ITS projects can be shown to increase operational efficiency and decrease greenhouse gases when they are incorporated into larger projects.
- **Regional Measure 2 (3+)** – The Regional Measure 2 program is managed by MTC and funded by toll roads in the Bay Area. The purpose of the program is to fund capital and operating improvements on roads that or transit systems that reduce congestion on toll roads. The RM2 program is currently mostly allocated, but there may be future extensions or similar programs with a similar goal. ITS projects are eligible, depending on location or purpose, but often larger roadway projects with an ITS component will be more competitive.
- **Transportation Fund for Clean Air (TFCA)** - The Bay Area Air Quality Management District (BAAQMD) funds TFCA Grants that have been used for signal coordination (including traffic signal controller upgrades) and multi-modal improvements. Eligible projects must demonstrate a reduction in Greenhouse Gas Emissions (GHG) and show a cost-effectiveness ratio in the reduction of pollutants. Projects must also comply with existing transportation plans.
- **Alameda County Measure B (Transportation Sales Tax) –** This program funds projects that meet the stated regional priorities of expand mass transit, Improve highway infrastructure, Improve local streets and roads, Improve bicycle and pedestrian safety, and expand special transportation for seniors and people with disabilities. Projects include capital roadway projects as well as signal timing and coordination projects.
- **Alameda County Measure F (Vehicle Registration Fee)**– This program allocates funding among for local road repair and improvements, Pedestrian & Bicycle safety/access, transit for congestion relief and local transportation technology. An equitable share of the VRF fund is distributed among four geographical sub-areas in the County. Oakland is in Planning Area 1. Projects that have been funding in Oakland through Measure F include East Bay Smart Corridors, traffic signal interconnect and traffic signal upgrades.

C. Impact Fees

In addition to the funding sources listed above, some jurisdictions have implemented impact fee programs to defray the costs of providing infrastructure and to mitigate impacts of new development. Aside from a small program for the Leona Quarry area, Oakland does not currently have any impact fees. Examples of other cities that currently have impact fee programs include Alameda, Berkeley, Emeryville, Concord, Fremont, San Francisco, and San Jose.

There are two types of impact fees where cities have successfully allocated funding for ITS deployment: development impact fees and transportation impact fees. Development impact fees are charged to



developers to defray the costs of providing infrastructure required to support the new development. This may include underground utilities, parks, and roadway improvements. Transportation impact fees are charged to developers based on expected trips generated from the new development and are allocated to offsetting improvements required to mitigate impacts of traffic. The fee is typically assessed based on the square footage, number of units, or number of trips generated by the development.

Many cities have successfully used both development impact fee and transportation impact fees to fund critical ITS improvements. Per California law, impact fees can only be assessed to a list of projects or improvements determined to meet nexus requirements from impacts of development, or a combination of the two. Specific ITS solutions may not be explicitly identified in an approved project list, but could be included as part of roadway or traffic signal projects to support further ITS deployment.

The City has a valid opportunity to evaluate the development of other Development Impact Fee/ Traffic Impact Fee Programs as a mechanism to fund future ITS enhancements identified in this Strategic Plan.

VII. PARTNERING WITH OTHER AGENCIES OR DEPARTMENTS

Implementing ITS improvements, particularly communications infrastructure, can be very costly as a stand-alone project. Many cities are looking for opportunities to collaborate with other departments and other cities to cost-effectively advance ITS deployment projects through sharing available conduit infrastructure or unused fiber strands to expand the communications network. MTC recently funded a Regional Communications Assessment, which identified opportunities across the Bay Area for sharing infrastructure as a means of optimizing existing infrastructure and meeting the needs of each partner. This Assessment is a starting point for creating other opportunities to utilize existing infrastructure, or to collaborate on future ITS deployment needs.

Within the City of Oakland, there is acknowledgement that there are several opportunities for collaborating with different departments to expand infrastructure. The Transportation Services Division (TSD), Information Technology Division (ITD), Police, Emergency Services, Port of Oakland, and BART have all been part of recent collaborative discussions. The results of these discussions have led to an integrated communications network between the Frank H. Ogawa Plaza campus, Emergency Operations Center, Police Administration Building, and the Port of Oakland, with future plans to integrate with the Maintenance Service Yard and Eastmont Police Substation.

A. Use and Access to Oakland ITS assets

As a result of the limited staff resources demonstrated previously in this report, the City has to be selective and carefully review requests to use or access ITS assets. **Appendix C Oakland ITS Assets Use Policy** provides a process and guidelines for Transportation Services to use to effectively manage this important City resource. This policy requires that requests to use or access ITS assets be submitted in writing and a review meeting scheduled. New ITS construction should generally conform to the City of Oakland ITS Strategic Plan and should not cause undue increases in City maintenance effort without compensation.

B. Cost Sharing

In order to have successful collaboration and partnering on infrastructure projects, all involved parties need to have some type of infrastructure sharing agreement in place. The agreement needs to contain the following elements, at a minimum:

- ***Description of infrastructure and limits*** – defines the infrastructure that is associated with the agreement.
- ***Asset assignments*** – define who is assigned to what assets (e.g., on 48-strand cable, TSD is assigned strands 1-12, ITD is assigned strands 13-36, and Police are assigned strands 37-48).
- ***Restrictions on Use*** – define how the shared strands can be used.
- ***Access points and restrictions*** – identify specific points that partners can access the fiber for splicing.
- ***Ownership and Maintenance*** – define the overall owner of the infrastructure and maintenance responsibilities (cost and resource commitment).
- ***Terms of use*** – set limits on the duration of the agreement and options/restrictions by each partner for amending the agreement.
- ***Replacement cost*** – define conditions on replacement costs and responsibilities (e.g., cost sharing between partners).

An infrastructure sharing agreement should be in place before partners agree to share infrastructure.

City of Oakland
ITS Strategic Plan
UPDATE

Appendix A
Strategic Growth Initiative Projects

OAKLAND ITS STRATEGIC PLAN UPDATE
APPENDIX A: STRATEGIC GROWTH INITIATIVE- PROJECT LIST
Short-term list (0-5 years)
2/6/2014

These projects upgrade traffic signals and expand the ITS communications network along corridors. Traffic signal upgrades include new controllers, edge switches, video detection systems. PTZ CCTV monitoring cameras are installed at key intersections (assume apprroximately 1 camera for 4 intersections). Also included is a placeholder unit cost for installation of corridor system detection and traffic responsive signal timing.
The focus of short-term projects is to establish other communications hubs, transition controllers connected to the legacy traffic signal server, and to coordindate with projects from key partners.

Project Corridor	Hub Work	Description/ Comments	Corridor Cost*	Hub Cost*	Total Cost*	Project Benefits	No. signals	New Fiber and Conduit (miles)	Upgrade to Fiber (miles)**
Hegenberger Rd/ 73rd Street Corridor (Edgewater to MacArthur/ Eastmont Hub)	Eastmont Hub BART (Colesium Station) City Hall	Install new fiber and conduit. Upgrade traffic signal controllers Install fiber connection to BART (Colesium station) and new communications hub at Eastmont Hub. Install hub equiment at Eastmont Hub. Reroute fiber connections from MSC hubto BART (for City Hall) or Eastmont. (Existing microwave connection to remain as back-up)	$ 2,818,400	$ 78,000	$ 2,896,400	1. Overlaps with Oakland Airport BART Connector Project [Current City project] 2. Utilizes existing BART to City Hall fiber connection for direct fiber link between City and MSC and Eastmont hubs. Reduces leased-line costs. More bandwidth than existing microwave link to MSC. 5. 73rd Avenue is a high AADT corridor translating into a high cost/benefit per vehicle rate.	10	2.7	
International Blvd Corridor (1st Avenue to 105th Avenue)	N/A	Install new fiber in existing SIC conduit. Upgrade traffic signal controllers.	$ 4,528,000	$ -	$ 4,528,000	1. Overlaps with International BRT Project by AC Transit [Key partner]. This project will repave corridor which will be a good opportunity to install new fiber and conduit. 2. Upgrades controllers currently connected to Oakland legacy signal system. 3. Eliminates dial-up connection costs	27	0.5	6
Broadway Corridor Expansion (includes College Ave from Broadway to Claremont Ave)	N/A	Install new fiber in existing SIC conduit. Upgrade traffic signal controllers.	$ 3,626,000	$ -	$ 3,626,000	1. Overlaps with Line 51 Rapid Bus Project by AC Transit [Key partner]. 2. Broadway is an extremely high AADT corridor translating into a high cost/benefit per vehicle rate. 3. Certain segments of College Ave correspond with City of Oakland Paving Projects anticipated in the next year.	18	2.5	
12th Street (Broadway to Oak Street)	N/A	Install new fiber in existing SIC conduit. Upgrade traffic signal controllers.	$ 933,500	$ -	$ 933,500	1. Overlaps with International BRT Project by AC Transit [Key partner]. 2. Upgrade controllers previously connected to Oakland legacy signal system.	7		0.5
11th Street (Broadway to Madison)	N/A	Install new fiber in existing SIC conduit. Upgrade traffic signal controllers.	$ 692,650	$ -	$ 692,650	1. Overlaps with International BRT Project by AC Transit [Key partner]. 2. Upgrade controllers previously connected to Oakland legacy signal system.	5		0.45
Telegraph Ave SIC Upgrade (Broadway to Alcatraz)	N/A	Install new fiber in existing SIC conduit. Upgrade traffic signal controllers.	$ 3,615,400		$ 3,615,400	1. Certain segments of the corridor correspond with City of Oakland Paving Projects anticipated in the next year. 2. Telegraph Avenue is an extremely high AADT corridor translating into a high cost/benefit per vehicle rate.	26		3.2
							105	8.3	10.15

** Cost includes construction cost + 20% Design (Develop PS&E Package)*
*** Assume exisitng conduit used.*

OAKLAND ITS STRATEGIC PLAN UPDATE
APPENDIX A: STRATEGIC GROWTH INITIATIVE- PROJECT LIST
Medium-term (5-10 years)
2/6/2014

These projects upgrade traffic signals and expand the ITS communications network along corridors. Traffic signal upgrades include new controllers, edge switches, video detection systems. PTZ CCTV monitoring cameras are installed at key intersections (assume apprroximately 1 camera for 4 intersections). Also included is a placeholder unit cost for installation of corridor system detection and traffic responsive signal timing.
Medium-term project build upon downtown and eastmont Hub. Some consideration given to freeway?

Project Corridor	Description/ Comments	Corridor Cost*	Project Benefits	No. signals	New Fiber and Conduit (miles)	Upgrade to Fiber (miles)**
5th Avenue (E. 8th Street to E. 18th St)		$ 1,206,200		7	0.6	
E. 18th Street (Lakeshore Ave to 5th Avenue)		$ 677,600	1. Corresponds with City of Oakland Paving Project anticipated in the next year.	4	0.3	
7th Street (Broadway to Webster)		$ 2,796,400	1. Corridor overlaps with I-880 ICM Northern Segment Project. 2. Corridor overlaps with Line 51 Rapid Bus Project.	15	1.7	
Adeline Street (7th Street to W. Grand)		$ 1,326,600	1. Certain segments of the corridor correspond with City of Oakland Paving Projects anticipated in the next year.	7	0.8	
Market Street (6th Street to W. Grand)		$ 1,679,000	1. Creates communication ring when combined with Grand Ave, 7th Street, and Broadway Fiber lines. 2. Certain segments of the corridor correspond with City of Oakland Paving Projects anticipated in the next year.	9	1	
Oakland Army Base Connection	Fiber connection to Oakland Army Base from West Grand/Mandela Parkway	$ 1,050,850		3	0.8	1.25
Establish Wireless Mesh Network in Downtown	Assumes corridor intersections are already upgraded.	$ 660,000	Possible integration with other City IT department projects to provided City owned communication to City Buildings throughout Downtown.	30		
14th Ave (E. 8th Street to Foothill)	Install fiber communication in existing empty 3" conduit.	$ 763,500		5	0.25	
High St (I-880 to Foothill)		$ 737,800	1. Corridor overlaps with I-880 ICM Northern Segment Project. 2. High Street is an extremely high AADT corridor, translating into a high cost/benefit per vehicle rate. 3. Would provide direct connect to upgrades signals and interconnect currently being installed as a part of the High Street/42nd Ave Access Improvements Project. 4. Certain segments of the corridor correspond with City of Oakland Paving Projects anticipated in the next year.	4	0.4	
Foothill (High Street to MacArthur)		$ 2,517,400		10	2.2	
MacArthur (73rd to 98th)		$ 1,632,000	1. Combined with other MacArthur Corridor Projects and a connection to the new fiber installed as part of the I-80 ICM project on Grand Ave., a secondary communication path between Eastmont hub and EOC/TMC would be created.	6	1.5	

OAKLAND ITS STRATEGIC PLAN UPDATE
APPENDIX A: STRATEGIC GROWTH INITIATIVE- PROJECT LIST
Medium-term (5-10 years)
2/6/2014

These projects upgrade traffic signals and expand the ITS communications network along corridors. Traffic signal upgrades include new controllers, edge switches, video detection systems. PTZ CCTV monitoring cameras are installed at key intersections (assume apprroximately 1 camera for 4 intersections). Also included is a placeholder unit cost for installation of corridor system detection and traffic responsive signal timing.
Medium-term project build upon downtown and eastmont Hub. Some consideration given to freeway?

Project Corridor	Description/ Comments	Corridor Cost*	Project Benefits	No. signals	New Fiber and Conduit (miles)	Upgrade to Fiber (miles)**
98th Ave (I-880 to International Blvd)		$ 1,597,500	1. Overlap with I-880 ICM Northern Segment Project. 2. High Street is an extremely high AADT corridor, translating into a high cost/benefit per vechicle rate.	7	1.25	
98th Ave (International to I-580)		$ 1,829,500	1. Combined with other 98th Ave Corridor Project and MacArthur Corridor Project (	9	1.25	
Downtown Parking Communications Connection	Assumes connection to eight (8) city-owned downtown parking garages.	$ 480,000	Use downtown backbone			
				116	12.05	1.25

** Cost includes construction cost + 20% Design (Develop PS&E Package)*
*** Assume exisiting conduit used.*

OAKLAND ITS STRATEGIC PLAN UPDATE
APPENDIX A: STRATEGIC GROWTH INITIATIVE- PROJECT LIST
Ultimate-term (10+ years)
2/6/2014

These projects upgrade traffic signals and expand the ITS communications network along corridors. Traffic signal upgrades include new controllers, edge switches, video detection systems. PTZ CCTV monitoring cameras are installed at key intersections (assume apprroximately 1 camera for 4 intersections). Also included is a placeholder unit cost for installation of corridor system detection and traffic responsive signal timing.
Medium-term project build upon downtown and eastmont Hub. Some consideration given to freeway?

Project Corridor	Description/ Comments	Corridor Cost*	Project Benefits	No. signals	New Fiber and Conduit (miles)	Upgrade to Fiber (miles)**
40th Street (Market to Broadway)		$ 1,447,000	1. Certain segments of the corridor correspond with City of Oakland Paving Projects anticipated in the next year.	7	1	
Foothill (1st Ave to Crosby Street)	Project Includes branches to Bancroft traffic signals	$ 4,312,200		23	2.5	0.6
Foothill (High Street to Crosby Street	Install fiber communication in existing empty 3" conduit.	$ 719,200		5		0.6
High St (International to I-580)		$ 1,980,000	1. Certain segments of the corridor correspond with City of Oakland Paving Projects anticipated in the next year. 2. High Street is an extremely high AADT corridor, translating into a high cost/benefit per vechicle rate. 3. Certain segments of the corridor correspond with City of Oakland Paving Projects anticipated in the next year.	9	1.5	
MacArthur (Park Blvd to Fruitvale)	Project includes intersections along Park Blvd and 14th Ave (branch cables)	$ 2,328,000	1. Overlaps with Grand-MacArthur BRT Project. 2. Combined with other MacArthur Corridor Projects and a connection to the new fiber installed as part of the I-80 ICM project on Grand Ave., a secondary communication path between Eastmont hub and EOC/TMC would be created.	12	1.5	
MacArthur (Fruitvale to High)		$ 1,894,100	1. Overlap with Grand-MacArthur BRT Project. 2. Combined with other MacArthur Corridor Projects and a connection to the new fiber installed as part of the I-80 ICM project on Grand Ave., a secondary communication path between Eastmont hub and EOC/TMC would be created.	8	1.55	
MacArthur (High to 73rd)		$ 1,993,200	1. Combined with other MacArthur Corridor Projects and a connection to the new fiber installed as part of the I-80 ICM project on Grand Ave., a secondary communication path between Eastmont hub and EOC/TMC would be created.	6	2.1	
San Leandro Street (High Street to 98th)		$ 2,999,000	1. Overlap with I-880 ICM Northern Segment Project.	10	3	
				80	13.15	1.2

** Cost includes construction cost + 20% Design (Develop PS&E Package)*
*** Assume exisitng conduit used.*

OAKLAND ITS STRATEGIC PLAN UPDATE
APPENDIX A: STRATEGIC GROWTH INITIATIVE- COST ASSUMPTIONS
2/6/2014

Project Element	Sub Elements	Unit Cost	Project Design	Unit
COMM (New)	2-3" Conduit and Fiber	$ 475,200.00	$ 95,040.00	Mile
	No. 6 Pull Boxes (Assume 600 foot spacing)	$ 11,180.00	$ 2,236.00	Mile
	N48 Splice Boxes (assume 2 for each mile of new corridor)	$ 5,000.00	$ 1,000.00	Mile
	Trunk Fiber Terminations at End(assume 2 per corridor)	$ 10,000.00	$ 2,000.00	LS
	Total Planning Level Cost For New Fiber and Conduit per Mile			**$ 602,000.00**

Project Element	Sub Elements	Unit Cost	Project Design	Unit
COMM (Replace or In Empty Conduit)	Fiber	$ 132,000.00	$ 26,400.00	Mile
	N48 Splice Boxes (assume 2 for each mile of new corridor)	$ 5,000.00	$ 1,000.00	Mile
	Fiber Splicing (assume 2 per corridor)	$ 10,000.00	$ 2,000.00	LS
	Total Planning Level Cost For New Fiber in Existing Conduit per Mile			**$ 177,000.00**

Project Element	Sub Elements	Unit Cost	Project Design	Unit
System Detection (assumes 3 detector stations per corridor and 2 lanes in both directions, will be connected to existing cabinet)	Integration	$ 3,000.00	$ 600.00	EA
	Loops	$ 24,000.00	$ 4,800.00	LS
	Total Planning Level Cost For System Detection per Corridor			**$ 33,000.00**

Project Element	Sub Elements	Unit Cost	Project Design	Unit
Traffic Signal Upgrades	PTZ Camera and Encoder	$ 11,000.00	$ 2,200.00	EA
	Vehicle Detection	$ 30,000.00	$ 6,000.00	LS
	PPB Audibles	$ 12,000.00	$ 2,400.00	LS
	Ped Heads	$ 7,000.00	$ 1,400.00	LS
	Switch	$ 5,000.00	$ 1,000.00	EA
	Conduits	$ 9,600.00	$ 1,920.00	LS
	Paint, Signs	$ 5,000.00	$ 1,000.00	LS
	Controller and Cabinet	$ 12,000.00	$ 2,400.00	EA
	Fiber Splice	$ 5,000.00	$ 1,000.00	LS
	Total Planning Level Cost For New Fiber and Conduit per Mile			**$ 116,000.00**

Project Element	Sub Elements	Unit Cost	Project Design	Unit
Wireless Mesh Connection (per Intersection)	Wireless Radio (Pole Mounted) - Assume 2 radio attenna	$ 10,000.00	$ 2,000.00	Mile
	Switch	$ 5,000.00	$ 1,000.00	Mile
	Integration	$ 3,000.00	$ 600.00	LS
	Total Planning Level Cost For New Wireless Mesh Connection Per Intersection			**$ 22,000.00**

Project Element	Sub Elements	Unit Cost	Project Design	Unit
Parking cost per block (Assumes 20 parking spaces per block)	Parking space sensors (not integrated with pay station)	8000	1600	LS
	Wireless Nodes (collection info from sensors)	2500	500	LS
	Pay station (One pay station per 5 parking spaces)	160000	32000	LS
	Total Planning Level Cost For New Parking System Per Block			**$ 205,000.00**


City of Oakland
ITS Strategic Plan
UPDATE

Appendix B
ITS Solutions Tool box

CITY OF OAKLAND
ITS SOLUTIONS TOOLBOX

Kimley-Horn
and Associates, Inc

Using the ITS Solutions Tool Box

The ITS Solutions Toolbox identifies how to "mainstream" ITS elements into other capital improvement projects. "Mainstreaming" refers to processes that provide for the systematic and strategic consideration of ITS in all aspects of transportation planning whether it is being done on a local, corridor or regional level, or specifically tied to smart growth projects. The goal of mainstreaming is to ensure that ITS strategies and technologies are an integral component of the project implementation process.

Once a need is established for a particular project type, Oakland has a number of different options for filling this need through the application of technology. This **ITS Solutions Toolbox** is a quick reference guide to considering ITS solutions for any capital improvement project. A planner or project developer can consult this toolbox to identify possible ITS solutions that can enhance a capital improvement project or the ITS solution could be a stand-alone project.

To identify potential solutions, the user first identifies the project type category of the project. Project types are grouped into the following categories:

- Arterial
- Emergency Management Systems
- Bicycle
- Pedestrian
- Transit
- Parking
- Commercial Vehicle Operations
- Ports

With each category, the user determines the type of project that is being considered in the second column of the Toolbox. Mapped to each project type is a list of potential ITS solutions that could be added to a project that would provide some additional benefit (i.e., cost savings, streamlined process).

Each ITS solution identified is expanded in the second table, including a description of the solution, deployment considerations, benefits, and costs. This table also provides the necessary information to go to the next step of mainstreaming ITS into the planning process.

ITS Solutions	Project Types	Solution Descriptions	Deployment Considerations	Cost	Cost Considerations	Benefits to Project or Agency (of Concurrent ITS Deployment)	Benefits to Public (of ITS Deployment)
Arterial							
CCTV cameras	• Roadway Construction • Roadway Widening • Traffic Signal • Communication Cable • Communication Conduit • Interchange Reconstruction	Includes pan-tilt-zoom (PTZ) or fixed camera, enclosure, cabling, pole/mounting, foundation, power and communications infrastructure	• Pan-tilt-zoom (PTZ) or fixed camera? • New or existing structure? • Is there an existing central video system? • Is there an existing communications infrastructure? • Communications medium (leased, copper, fiber, wireless) • Structure needs to support a camera • Where to draw power?	$8,000-50,000 each ***O&M Cost*** $2,000-3,000 per camera per year	Cost depends on installation on existing or new structure and other design considerations; distance to cabinet, power, and communications; includes equipment and installation	• Cost savings in construction (traffic control, mobilization) • Camera provides faster identification and response to incidents • Improve performance of traffic signal system by monitoring conditions remotely • Cost savings allows budget for additional transportation projects • Improved staff efficiency when troubleshooting or verifying field issues	• Minimize disruption to traffic • Improved traffic flow from proactive use of cameras • Improved information for travel planning using real-time images • Quicker incident response
Arterial Changeable Message Sign (CMS)	• Roadway Construction • Roadway Widening	Sign, structure, foundation, power and communications infrastructure	• Use currently deployed signs? (San Pablo Ave, Grand Ave, W. Grand) • Consider: size, connection, power connections	$75,000-250,000 each. (Current deployed sign: $161k per sign) ***O&M Cost*** $3,000-6,000 per sign per year	Depends on technology, size of sign, type of structure; distance to cabinet, power, and communications; includes equipment and installation-	• Cost savings in construction (traffic control, mobilization) • With CMS, have ability to disseminate traffic condition information • Cost savings could lead to additional transportation projects	• Minimize disruption to traffic • Travel information made available to public

ITS Solutions	Project Types	Solution Descriptions	Deployment Considerations	Cost	Cost Considerations	Benefits to Project or Agency (of Concurrent ITS Deployment)	Benefits to Public (of ITS Deployment)
Arterial							
Emergency Vehicle Preemption (EVP)/Transit Signal Priority (TSP)	• Traffic Signal • Bus Rapid Transit (BRT)	Device on existing traffic signal mast arm, cabling to signal cabinet, emitter on vehicle to allow emergency preemption or transit vehicle priority	• If for Transit Signal Priority (TSP), can existing controller support the function? • Which approaches are required? • GPS- or Optical-based	$6,000-18,000 per intersection ***O&M Cost*** $800 per intersection per year	Depends on number of approaches and number of vehicles	• Cost savings in construction (traffic control, mobilization) • Provide ability to improve response time of emergency vehicles to incidents • Provide opportunity to offer enhanced transit service • Improved travel time reliability for transit vehicles • Potential to reduce fleet size	• Faster incident response • Enhance reliability of transit schedules
Communications Conduit	• Sidewalk • Roadway Construction • Traffic Calming • Roadway Widening • Streetscaping • Repaving projects • Utility Work • Traffic Signal • Interchange Reconstruction	Underground conduit (3”), pull boxes, splice vault at key locations for future communications cable for traffic signal interconnect or other devices	• Adequate conduit sweeps if fiber is used • Other design elements may be different depending on communications • Pull box spacing • Placement in roadway or behind curb • Are multiple conduits needed?	$300,000 per mile ***O&M Cost*** Minimal	Costs vary depending on number and size of conduit and frequency of pull boxes	• Major cost savings in construction (traffic control, mobilization, installation) – costs are substantial if done separately • Provides private infrastructure to improve traffic flow through traffic signal coordination • Provides a private infrastructure for communications to other equipment • Cost effective when combined with other larger projects • Savings could open budget for additional transportation projects • Little to no recurring costs	• Minimize disruption to traffic

ITS Solutions	Project Types	Solution Descriptions	Deployment Considerations	Cost	Cost Considerations	Benefits to Project or Agency (of Concurrent ITS Deployment)	Benefits to Public (of ITS Deployment)
Arterial							
Communications Cable (Fiber or Copper)	• Sidewalk • Roadway Construction • Traffic Calming • Roadway Widening • Streetscaping • Utility Work • Traffic Signal • Interchange Reconstruction	Copper twisted pair, fiber optic, or wireless antennas; communications transmitter/receiver; termination panels to coordinate traffic signal timing	• Communications medium • Tie to existing system? • Ability to interface with end equipment	$10,000-60,000 per mile ***O&M Cost*** $1,000 per mile per year	Depends on communications medium, does not include conduit (see above) Additional O&M costs if leased lines are used	• Major cost savings in construction (traffic control, mobilization, installation) – costs are substantial if done separately • Provides private infrastructure to improve traffic flow through traffic signal coordination • Provides a private infrastructure for communications to other equipment • Cost effective when combined with other larger projects • Savings could lead to additional transportation projects • Provide infrastructure for multi-department Intranet/ City LAN. • Little to no recurring costs unless leasing communications	• Improved traffic flow along a corridor • Minimize disruption to traffic
Mid-block Vehicle Detection	• Roadway Construction • Roadway Widening • Streetscaping	Vehicle detection equipment; communications to signal cabinet	• Detection technology (in-pavement vs. non-intrusive)	$3,000-20,000 per location ***O&M Cost*** $1,000-2,000 per location per year	Depends on technology, communications infrastructure, and installation/ mounting requirements	• Cost savings if added to another project (traffic control, mobilization) • Disruption to traffic is minimized • Reliable source of traffic data	• Real-time traffic flow data could be available for local streets • No privacy issues compared with other technologies

ITS Solutions	Project Types	Solution Descriptions	Deployment Considerations	Cost	Cost Considerations	Benefits to Project or Agency (of Concurrent ITS Deployment)	Benefits to Public (of ITS Deployment)
Arterial							
Wireless Mesh Network (Downtown Traffic Signals)	• Traffic Signal	Equipment in signal cabinet to allow build out of wireless mesh network to allow city staff (field personnel) to remotely access city network, link remote downtown City facilities	• Is there adequate space in the cabinet for additional equipment? • Proximity to existing City fiber-optic line/ network. • Proximity to other hotspots • Place exterior equipment to avoid vandalism	$22,000 per traffic signal ***O&M Cost*** $500 per year	Depends on whether firewalls are required	• Cost effective method of providing remote access to network • Can be either public (leased) or private (owned) • Opportunities for shared infrastructure with multiple agencies	• Public/Private partnerships can result in added coverage for wireless access to the Internet

ITS Solutions	Project Types	Solution Descriptions	Deployment Considerations	Cost	Cost Considerations	Benefits to Project or Agency (of Concurrent ITS Deployment)	Benefits to Public (of ITS Deployment)
Emergency Management Systems							
Emergency Vehicle Preemption	• New Emergency Vehicles • Traffic Signal • Transit Signal Priority • Bus Rapid Transit	Device on existing traffic signal mast arm, cabling to signal cabinet, emitter on vehicle to allow emergency vehicles to preempt a traffic signal for a green phase	• Which approaches are required? • Which vehicles are to be equipped? • Utilize encoding to prevent unauthorized use? • GPS- or Optical-based	$6,000-18,000 per intersection ***O&M Cost*** $800 per intersection per year	Depends on number of approaches and number of vehicles	• Cost savings in construction (traffic control, mobilization) • Provide ability to improve response time of emergency vehicles to incidents	• Faster incident response
Media Integration (e.g., Public Broadcasting)	• Communication System Upgrades • Emergency Operations Center • TOC Enhancements	Identification of communications link, end equipment to allow public broadcasting of traveler information	• Need to establish agreements with media companies? • What are the limitations of access (viewing only)?	$25,000-150,000 ***O&M Cost*** $5,000 per year	Depending on extent of integration, number of connections, customization, and information made available	• Traveler information can be disseminated to public via radio or television • Media outlets have a larger viewing audience	• Easier access to traveler information • Overall quantity and quality of traveler information is improved

ITS Solutions	Project Types	Solution Descriptions	Deployment Considerations	Cost	Cost Considerations	Benefits to Project or Agency (of Concurrent ITS Deployment)	Benefits to Public (of ITS Deployment)
Emergency Management Systems							
TMC Collocation and Integration	• Emergency Operations Center • TOC upgrade	Physical cabling, end equipment, software development to enhance sharing of information	• Where will the combined center reside? • What information will be shared? • Lead agency/ staffing? • Need to establish agreements between agencies involved	$20,000-1,000,000 ***O&M Cost*** $100,000 per year	Depending on extent of integration; assumes use of existing facility; assumes labor is accounted for	• Potential for substantial savings of equipment costs by requiring less equipment • Potential reduction in staff costs • Recurring facility costs are reduced • Better coordination during emergency situations	• Improved emergency response and clearance
511 Integration	• Communication System Upgrades • Emergency Operations Center	Software development to allow incidents and emergency services to access and provide information to 511 to enhance information available through 511	• What is the extent of information disseminated? • To what extent will the systems be integrated? • What agencies or departments will be integrated?	$100,000-500,000 ***O&M Cost*** $50,000-$100,000 per year	Depending on extent of integration to existing emergency operations databases; O&M costs	• Able to adjust 511 information dynamically to account for emergency situations	• Enhanced traveler information services by including impacts of emergency situations
Dynamic Route Guidance	• Communication System Upgrades • Emergency Operations Center • Roadway Construction • Roadway Widening • Arterial CMS	Integrated system of field equipment and information dissemination to provide alternate real-time information in response to traffic flow impacts	• Is there an existing system interface? • What physical means of providing the information is desired (e.g., electronic signs, media)?	$125,000-200,000 ***O&M Cost*** $1,000-5,000 per year	Depending on extent of integration and deployment of equipment	• Enhanced use of traveler information by public	• Dynamic traveler information that responds to current conditions

ITS Solutions	Project Types	Solution Descriptions	Deployment Considerations	Cost	Cost Considerations	Benefits to Project or Agency (of Concurrent ITS Deployment)	Benefits to Public (of ITS Deployment)
Emergency Management Systems							
Automatic Vehicle Location (AVL)	• New Emergency Vehicles • Communication System Upgrade • Emergency Operations Center	AVL unit on vehicles, central equipment to identify location of vehicles for real-time arrival or location status	• Is there an existing system to support the collection and distribution of data? • Communications network available?	$300,000 per system ***O&M Cost*** $20,000 per year	Will vary depending on the number of vehicles. Cost does not include a comprehensive communications infrastructure.	• Provides an automated mechanism to track vehicles, on-time performance and data for schedule adjustments • Processes real-time monitoring data on status of transit vehicle elements for operations and maintenance • Provides efficient use of communications system (voice and data) • Enables greater degree of security for drivers/passengers with emergency alarms	• Provides an accurate means for real-time location of vehicles

ITS Solutions	Project Types	Solution Descriptions	Deployment Considerations	Cost	Cost Considerations	Benefits to Project or Agency (of Concurrent ITS Deployment)	Benefits to Public (of ITS Deployment)
Bicycle							
Surveillance (Closed Circuit Television cameras)	• Bicycle storage	Includes pan-tilt-zoom (PTZ) or fixed camera, enclosure, cabling, pole/mounting, foundation, power and communications infrastructure	• Pan-tilt-zoom (PTZ) or fixed camera? • New or existing structure? • Is there an existing central video system? • Is there an existing communications infrastructure? • Communications medium (leased, copper, fiber, wireless) • Structure needs to support a camera • Where to draw power?	$8,000-50,000 each ***O&M Cost*** $2,000-3,000 per camera per year	Cost depends on installation on existing or new structure and other design considerations; distance to cabinet, power, and communications; includes equipment and installation	• Cost savings in construction (traffic control, mobilization) • Camera provides faster identification and response to incidents • Improve performance of traffic signal system by monitoring conditions remotely • Cost savings allows budget for additional transportation projects • Improved staff efficiency when troubleshooting or verifying field issues	• Minimize disruption to traffic • Improved traffic flow from proactive use of cameras • Improved information for travel planning using real-time images • Quicker incident response
Bicycle Detection	• Bicycle Lanes • At-Grade Crossings • Traffic Signal	Detection device, cabling to signal cabinet, power to detect bicycles at intersections	• Detection technology (in-pavement vs. non-intrusive) • Extent of integration with traffic signals	$3,000-10,000 per location ***O&M Cost*** $1,000 per location per year	Depends on technology and installation/ mounting requirements	• Cost savings in construction (traffic control) • Reliable source of traffic data	• Real-time traffic flow data could be available • No privacy issues compared with other technologies
Bicycle Parking (lockers, storage)	• Bicycle storage	Advanced technology to increase security of bicycle parking	• What technology is desired?	$10,000-50,000 per site ***O&M Cost*** $1,000-5,000 per location per year	Depending on technology and extent of deployment	• Promotes bicycling • Improves safety of leaving bicycles in a secured location • Encourages a greater use of bicycles	• Greater feeling of safety when parking bicycles

ITS Solutions	Project Types	Solution Descriptions	Deployment Considerations	Cost	Cost Considerations	Benefits to Project or Agency (of Concurrent ITS Deployment)	Benefits to Public (of ITS Deployment)
Pedestrian							
Pedestrian Detection	• Pedestrian Crossing • Traffic Signal • Intersection striping or restriping • ADA ramps	Detection device, cabling to signal cabinet, power to detect pedestrians at intersections	• Detection technology (in-pavement vs. non-intrusive) • Extent of integration with traffic signals	$3,000-20,000 per location ***O&M Cost*** $1,000 per location per year	Depends on technology and installation/ mounting requirements	• Improved coordination by only servicing pedestrians when present • Improve safety at intersections	• Information to pedestrians on safe crossing time • Raise awareness of pedestrians to drivers
New Signal or Existing Signal Modification to include Pedestrian Countdown Heads	• Pedestrian Crossing • Traffic Signal • ADA ramps	Pedestrian head equipment, civil modifications (ADA ramps, curb/gutter to accommodate pedestrians and bicycles)	• Is there sufficient pedestrian activity? • Can or will a developer be required to pay/construct?	$10,000-20,000 per crossing ***O&M Cost*** $500 per location per year	Depends on extent of improvements and whether existing equipment needs to be replaced/upgraded	• Improve safety at intersections by indicating how long pedestrians have to cross intersection	• Information to pedestrians on safe crossing time • Raise awareness of pedestrians to drivers
In-Pavement Lighting or Warning	• Pedestrian Crossing • Traffic Signal • Intersection striping or restriping • ADA ramps • Roadway Construction • Re-paving projects • Roadway Widening	Enhance the driver's ability to see pedestrians or bicycles crossing a roadway	• What is the condition of the pavement to support these devices?	$25,000-45,000 ***O&M Cost*** $3,000-5,000 per year	Does not include street improvements (striping or decorative crosswalk)	• Improve safety at intersections and pedestrian crossings	• Improve safety at pedestrian crossings

ITS Solutions	Project Types	Solution Descriptions	Deployment Considerations	Cost	Cost Considerations	Benefits to Project or Agency (of Concurrent ITS Deployment)	Benefits to Public (of ITS Deployment)
Pedestrian							
Traveler Information Kiosk	• Pedestrian Mall • Livable Communities • Bus Stop Enhancements	Kiosk equipment, power, communications for displaying traveler information	• What information will be displayed? • Most effective location to place the signs • What systems will be integrated with the kiosk?	$10,000-200,000 per kiosk ***O&M Cost*** $1,000 per kiosk per year	Depends on how much information is made available; interface development requirements	• Better integration with other facilities versus a stand-alone installation	• Provides a mechanism for pedestrians to gain information and plan trips accordingly

ITS Solutions	Project Types	Solution Descriptions	Deployment Considerations	Cost	Cost Considerations	Benefits to Project or Agency (of Concurrent ITS Deployment)	Benefits to Public (of ITS Deployment)
Transit							
Real-Time Information Signs	• Bus Stop Improvements or Installations • Transit Villages	Sign, post, power, communications cabling for displaying vehicle arrival times or other information	• Is there an existing system to disseminate information to signs? • How many signs are needed? • Is there power near the locations of the signs?	$12,000-25,000 per sign, not including software ***O&M Cost*** $500-1,000 per sign per year	Depends on sign technology, size, quantity, power and communications. Does not include the real-time information system (hardware and software).	• Provides a mechanism to inform passengers of arrivals/departures • Improves system reliability	• Reduces passenger frustration due to unpredictable arrival times • Increases ridership
Traveler Information Kiosks	• Bus Stop Improvements or Installations • Transit Villages	Kiosk equipment, power, communications for displaying traveler information	• What information will be displayed? • Most effective location to place the signs • What systems will be integrated with the kiosk?	$10,000-200,000 per kiosk ***O&M Cost*** $1,000 per kiosk per year	Depends on how much information is made available, interface development requirements.	• Better integration with other facilities versus a stand-alone installation	• Provides a mechanism for passengers to gain information and plan their trips accordingly
Bus Rapid Transit / Queue Jump	• Bus stop improvements • Intersection striping or restriping • Traffic signal modifications	Device on existing structure, cabling to signal cabinet, emitter on vehicle, signal heads, signs for enhanced bus service	• Can existing controllers support the function? • Will the geometry support a queue jump lane? • Will BRT operate in dedicated lane?	$10,000-50,000 per intersection ***O&M Cost*** $1,000 per intersection per year	Includes on-board equipment, does not include integration or upgrade of existing equipment, depends on extent of geometric improvements	• Enhances performance of transit	• Enhance reliability and performance of transit operations

ITS Solutions	Project Types	Solution Descriptions	Deployment Considerations	Cost	Cost Considerations	Benefits to Project or Agency (of Concurrent ITS Deployment)	Benefits to Public (of ITS Deployment)
Transit							
Transit Signal Priority	• New Fleet • Traffic Signal • Traffic Signal modifications • Emergency Vehicle Pre-emption • Bus Rapid Transit	Device on existing structure, cabling to signal cabinet, emitter or GPS on vehicle to allow transit vehicles priority phasing (not preemption)	• Can existing controllers support the function? • Integration with an existing transit management/scheduling system. • Use GPS-based or Infrared-based	$6,000-18,000 per intersection ***O&M Cost*** $1,000 per intersection per year	Includes on-board equipment, does not include integration or upgrade of existing equipment, does it include communications to a central system.	• Cost savings in construction (traffic control, mobilization) • Provide opportunity to offer enhanced transit service • Improved travel time for transit vehicles • Potential to reduce fleet size	• Enhance reliability and performance of transit operations
Railroad Collision Avoidance	• At-Grade Railroad Crossings • Railroad crossing equipment upgrades	In-vehicle and on-board equipment, crossing equipment for collision avoidance	• What detection technology will be used?	$100,000-150,000 per crossing ***O&M Cost*** $2,000-3,000 per crossing per year	Includes equipment at crossing and on vehicles. Does not include communications to a central facility.	• Equipment on vehicles can be installed during initial vehicle production rather than after-market • Operate safer crossings	• Safer railroad crossings

ITS Solutions	Project Types	Solution Descriptions	Deployment Considerations	Cost	Cost Considerations	Benefits to Project or Agency (of Concurrent ITS Deployment)	Benefits to Public (of ITS Deployment)
Parking							
Parking reservation systems	• Parking Facility or structure	Allow drivers to reserve a parking space at a specific location	• Is there an existing parking management or guidance system to integrate with?	$50,000-200,000 ***O&M Cost*** $5,000-10,000 per year	Costs could vary significantly depending on level of integration and number of parking facilities participating	• Potential to raise revenue by utilizing more parking spaces • Provide more efficiency for finding parking • Enhanced use of traveler information by public	• Reduce the amount of time driving around looking for parking
Parking Availability (511 Integration)	• Parking Project • Parking Guidance System	Provide information to drivers regarding parking availability	• Interface/ communications with drivers in real-time • Share information with 511?	$100,000-200,000 ***O&M Cost*** $5,000-10,000 per year	Depends on extent of features to be developed	• Provides for additional service to 511. • Enhanced use of traveler information by public	• Ability to coordinate rides to reduce the number of vehicles on the road
On-Street Parking Management District	• Repaving Projects • Parking Facility or structure • Communications Project	System designed to manage on-street parking, provide information of available spaces, dynamic pricing	• Centralized parking management system? • Communications media • Interface/ communications with drivers in real-time	$100,000-200,000 (per downtown block) ***O&M Cost*** $5,000-10,000 per year	Depends on extent of features to be developed	• Provides for additional service to 511. • Enhanced use of traveler information by public	• Ability to gain information regarding parking utilization and direct drivers to available spaces.

ITS Solutions	Project Types	Solution Descriptions	Deployment Considerations	Cost	Cost Considerations	Benefits to Project or Agency (of Concurrent ITS Deployment)	Benefits to Public (of ITS Deployment)
Parking							
Parking Guidance System	• Parking Facility or structure • Roadway Repaving • Arterial CMS	System designed to coordinate direct drivers to parking opportunities for effectively	• Is there an existing system interface? • Communications media • What physical means of providing the information is desired (e.g., electronic signs, media)?	$100,000-200,000 ***O&M Cost*** $5,000-10,000 per year	Depends on extent of features to be developed	• Provides for additional service to 511.	• Reduce vehicle time and congestion
Ridesharing software/website - 511	• Rideshare or Carpool program	System designed to coordinate ridesharing opportunities	• What is the extent of services and routes being offered?	$100,000-200,000 ***O&M Cost*** $5,000-10,000 per year	Depends on extent of features to be developed	• Provides for additional service to 511.	• Ability to coordinate rides to reduce the number of vehicles on the road

ITS Solutions	Project Types	Solution Descriptions	Deployment Considerations	Cost	Cost Considerations	Benefits to Project or Agency (of Concurrent ITS Deployment)	Benefits to Public (of ITS Deployment)
Commercial Vehicle Operations							
Electronic Credentialing (with transponders or tags)	• Truck Facilities • Port Access and circulation projects	Transponder, in-vehicle equipment, central equipment for certifying permitting of CV	• Is there an existing system that will support the collection of this data?	$60,000-140,000 ***O&M Cost*** $1,000-3,000 per year	Costs do not include any integration into an existing system	• Improved efficiency at truck scales	• Tracking truck movements and directing them away from neighborhoods
Commercial Vehicle Operations (CVO) – specific info for 511	• Truck Facilities • Port Access and circulation projects	Software development and integration to interface with 511 to provide traveler information or route guidance information for CVO	• What is the extent of information disseminated? • Is there any integration into an existing system?	$100,000-300,000 ***O&M Cost*** $0	Depending on extent of integration. O&M costs are already accounted for.	• Create a full service 511 system • Ability to impact and improve goods movement	• Give truck drivers the opportunity to change routes in response to an incident

ITS Solutions	Project Types	Solution Descriptions	Deployment Considerations	Cost	Cost Considerations	Benefits to Project or Agency (of Concurrent ITS Deployment)	Benefits to Public (of ITS Deployment)
Commercial Vehicle Operations							
CCTV Camera	• Truck Facilities • Port Access and circulation projects	Includes pan-tilt-zoom (PTZ) or fixed camera, enclosure, cabling, pole/mounting, foundation, power, communications, communications device for surveillance	• PTZ or fixed camera? • New or existing structure? • Is there an existing video system? • Leased line or agency-owned communications? • Communications medium. • Is there an existing communications infrastructure? • Structure needs to support a camera • Where to draw power for the camera and any associated electronics?	$8,000-40,000 each ***O&M Cost*** $2,000-3,000 per camera per year	Cost depends on installation on existing or new structure and other design considerations, and includes equipment and installation. Does not include communications and power installation.	• Cost savings in construction (traffic control, mobilization) • Camera provides faster identification and response to incidents • Improve performance of traffic signal system by monitoring conditions remotely • Cost savings could lead to additional transportation projects • Improved staff efficiency when troubleshooting or verifying field issues	• Minimize disruption to traffic • Improved traffic flow from proactive use of cameras • Improved information for travel planning using real-time images

ITS Solutions	Project Types	Solution Descriptions	Deployment Considerations	Cost	Cost Considerations	Benefits to Project or Agency (of Concurrent ITS Deployment)	Benefits to Public (of ITS Deployment)
Ports							
Automatic Vehicle Location (AVL)	• Port Access and Circulation Projects	AVL unit on vehicles, central equipment to identify location of vehicles for real-time arrival or location status	• Is there an existing system to support the collection and distribution of data?	$300,000 per system ***O&M Cost*** $20,000 per year	Will vary depending on the number of vehicles. Cost does not include a comprehensive communications infrastructure.	• Provides an automated mechanism to track vehicles, on-time performance and data for schedule adjustments • Can process real-time monitoring data on status of transit vehicle elements for operations and maintenance • Provides efficient use of communications system (voice and data) • Enables greater degree of security for drivers/passengers with emergency alarms • Provides a mechanism for schedule-based transit priority	• Provides an accurate means for real-time information • Improved security with emergency alarm capabilities
Dynamic Route Guidance	• Port Access and Circulation Projects	Integrated system of field equipment and information dissemination to provide alternate real-time information in response to traffic flow impacts	• Is the necessary equipment available to support analyzing alternate routes?	$100,000-150,000 ***O&M Cost*** $1,000-5,000 per year	Depending on extent of integration	• Enhanced use of traveler information by public	• Dynamic traveler information that responds to current conditions


City of Oakland
ITS Strategic Plan
UPDATE

Appendix C
Oakland ITS Assets Use Policy

OAKLAND ITS ASSETS USE POLICY

February 2014

PURPOSE

- To allow City to strategically manage limited City Transportation Infrastructure assets. Transportation Services Division (TSD) has made large strategic investments in developing the transportation system and investment must be protected.

ASSETS COVERED

- This policy includes access to and/or use of the following assets:
    - Conduit – Traffic signal
    - Traffic Signal Interconnect cables (including unused strands, pair)
        - Copper cables
        - Fiber-optic cables
    - Traffic Cameras
        - Video feed
        - Camera control (e.g. pan, tilt, zoom)
        - Video Management Server
    - Network Switches
    - Desktops

POLICY

- All requests to use or interface with the City of Oakland ITS Assets must be made in writing and submitted to the TSD Manager or TSD Supervising Civil Engineer for consideration. As a minimum, the request should include the following information:
    - Asset for use or access
    - Location/ interface point
    - Purpose of use
    - Length of use
- Following receipt of request, a meeting will be set up with applicant and TSD to discuss details.
- Approval of use does not relieve applicant from complying with the City of Oakland permit process or other review process.

GENERAL GUIDELINES

- New construction should generally comply with current City of Oakland ITS Strategic Plan
- Projects should not cause undue increases in City maintenance effort.
- No direct access to traffic cameras shall be permitted. Access to camera video feeds and control shall be done through the TSD Video Management Server.
- City of Oakland Information Technology Department guidelines shall be followed.
- Oakland TSD does not record video feeds from traffic cameras.

DISCLAIMER: TRANSPORTATION SERVICES DIVISION RESERVES THE RIGHT TO REJECT ALL REQUESTS FOR USE AND ACCESS TO ITS ASSETS.


Appendix D
Oakland ITS Design Guidance

OAKLAND ITS DESIGN GUIDANCE

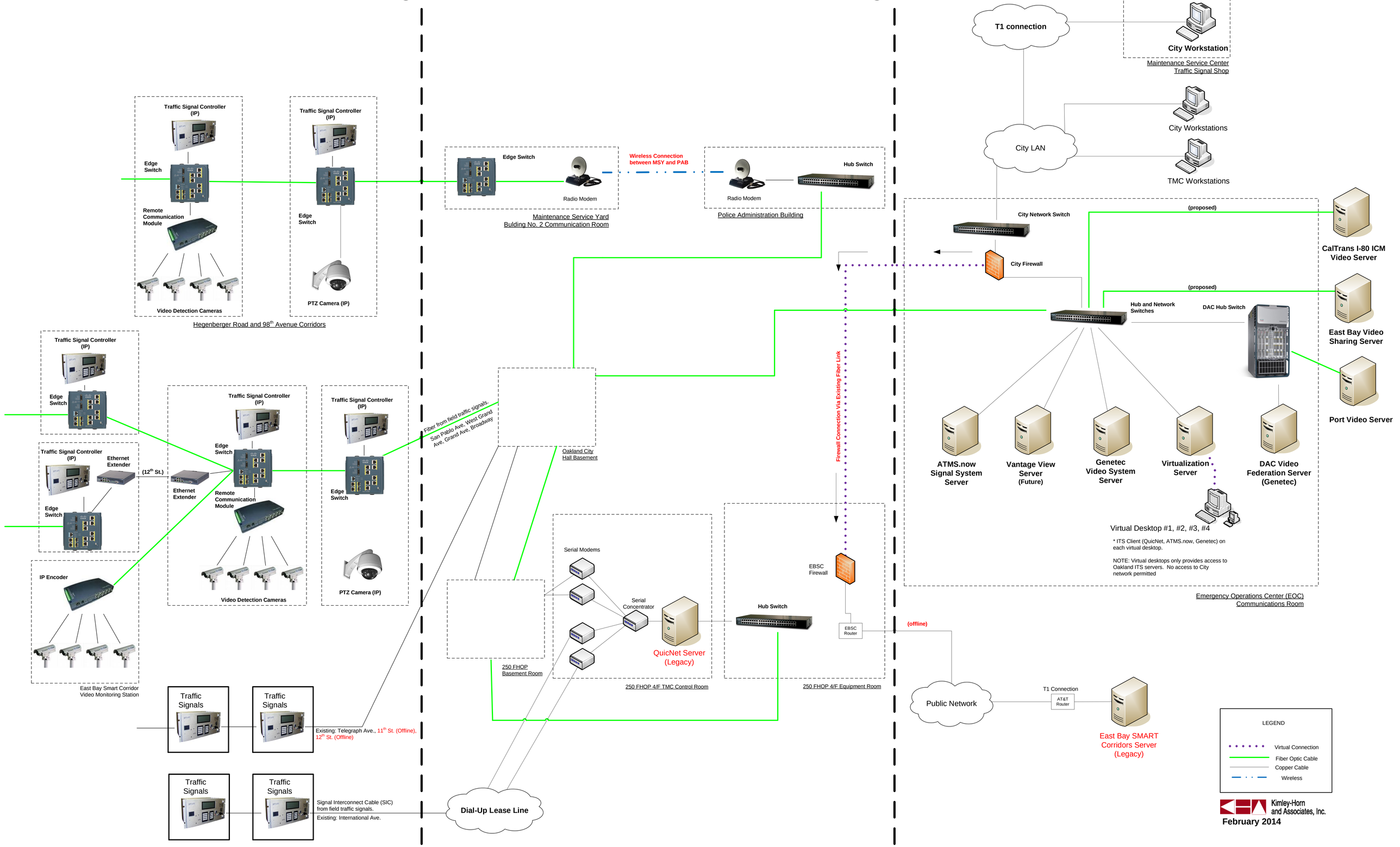
Purpose – The purpose of this Appendix is to provide additional technical details on the Oakland ITS Network System, equipment, and specifications. Such information is provided for information only and is subject to change and review by City of Oakland at any time.

OAKLAND ITS CORE NETWORK DIAGRAM

Figure D-1 shows the current deployment of the Oakland ITS Core Network connecting field equipment, various hubs, and servers into an integrated system. A core fiber communications network connects the various City downtown hubs of Emergency Operations Center (EOC) data center, City Hall, and Transportation Management Center (TMC) together. The City has a legacy traffic signal system server (McCain QuicNet 4) at the TMC and a new Naztec ATMS.now traffic signal system server at the EOC. The City has also recently installed a Genetec Video Management Server at the EOC. VantageView Server (for viewing and configuring Video Detection System Cameras) is a future deployment.

City staff has access to these servers over the City's network via virtual desktops provided by a virtualization server located at the EOC. The use of virtual desktops allows access from any City desktop while limiting the load on the City's network. There are currently 4 virtual desktops set up.

Figure D-1: Oakland ITS Core Network Diagram



TRAFFIC MONITORING CAMERA TYPES

The following traffic monitoring cameras are in use in the City of Oakland

- Intersection PTZ cameras
  - City standard: Axis Q6034 (IP-based HD camera with H.264/ Mpeg-4 encoding)
- Intersection Video Detection cameras
  - City standard: Iteris Video detection system
  - IP encoding of video feeds requires Remote Communications Module (RCM) – not currently installed at all intersections
- East Bay SMART Corridor Video Monitoring stations
  - Fixed cameras at key signalized intersections (EBSC initial deployment)
- I-80 Integrated Corridor Mobility (ICM) Project
  - PTZ cameras on new poles at on-ramps

ITS DEPLOYMENT DETAILS

- New fiber cables
  - Trunkline: 144-strand SMFO cable
  - Intermediate: 72-strand SMFO cable
  - Branch/ drop: 12-strand SMFO cable
- New fiber conduit installations
  - 3" PVC/ HDPE conduits, installed at 36" depth
- Fiber pull boxes
  - Pull boxes installed approximately every 600 feet
  - No. 6 (min) pull boxes shall be used when there is fiber cable
  - No. 6E pull boxes shall be used for branch splices.
- Cabinet Fiber Terminations shall be wall-mounted, pre-terminated units.
  - Realm Communications Wall Mount MBDU or approved equivalent.
- Assumed product replacement cycle and replacement cost

ITS equipment	Replacement cycle[1]	Replacement cost
Traffic Signal controller	20 years	$10,000
Edge switch	5-10 years	$7,000
PTZ CCTV Camera	10 years	$18,400
Changeable Message Sign	10 years	$250,000
Traffic Signal Central System	15-20 years	$200,000

[1]Actual replacement rates will depend on environmental conditions (i.e., extreme temperatures, dust), actual failures, staff capacity, and funding availability for preventive maintenance.

- Attention directed to City of Oakland Electrical Standard Special Provision (Sections 209 and 307) for additional details, including cabinet equipment.

OAKLAND ELECTRICAL ITS STANDARD SPECIAL PROVISIONS (3/20/13)

SECTION 209 -- STREET LIGHTING AND TRAFFIC SIGNAL MATERIALS

209-1 GENERAL.
ADD NEW PARAGRAPH TO THE END OF SUBSECTION 209-1 TO READ:

Before any work is started the Contractor shall file with the Engineer the names, addresses and telephone numbers of at least three people capable of responsible action in the event of any emergency outside of regular working hours. The locations of electrical system elements shown are approximate.

The locations of electrical system elements shown are approximate; the Engineer determines the final location.

209-3 MATERIALS.
209-3.1 City furnished material list
ADD NEW SUBSECTION 209-3.1 TO READ:

City of Oakland Electrical Services Dept will furnish splice chamber part #'s A27, A28, A29, and F24 per standard detail drawing E-57. All other materials required shall be supplied by the Contractor.

209-3.2 Anchor bolts, Nuts, and Washers.
ADD NEW PARAGRAPH TO THE END OF SUBSECTION 209-3.2 TO READ:

City standard street light pole anchor bolts shall be the type and size shown on plans and according to City standard detail drawing E-21. Anchor bolts for signal standard shall conform to Caltrans Standard Plans and Specifications.

209-3.3 Standards.
209-3.3.1 General.
ADD NEW PARAGRAPH TO THE END OF SUBSECTION 209-3.3.1 TO READ:

The signal standard shall conform to Caltrans Standard Plans and Specifications. Rectangular corrosion-resistant metal identification tags conforming to Caltrans Standard Provision shall be attached on all standards and poles. Street light poles shall conform to City of Oakland street light design manual.

209-3.3.3.2 Steel Standards.
REPLACE SUBSECTION 209-3.3.3.2 WITH THE FOLLOWING:

Unless otherwise specified in the Special Provisions, steel standards shall comply with Caltrans Standard Provision Section 86-2.04. All standards shall be galvanized unless other specified.

209-3.3.4 Fiberglass Standards.
DELETE SUBSECTION 209-3.3.4 Fiberglass Standards.

209-3.4 Mast Arms.
ADD NEW PARAGRAPH TO THE END OF SUBSECTION 209-3.4 TO READ:

The signal mast arm shall conform to Caltrans Standard Plans and Specifications.

209-3.5 Conduit.
209-3.5.1 General.
ADD NEW PARAGRAPH AT THE END OF SUBSECTION 209-3.5.1 TO READ:

City conduits shall be HDPE unless otherwise notes and of the following sizes:

1. Street Lighting – 2-inch HDPE Schedule 80 Conduit
2. Traffic Signal – 3-inch HDPE Schedule 80 Conduit

3. Interconnect – 3-inch HDPE Schedule 80 Conduit
4. Inductive Loop Detector Lead-In-Cable - 2-inch HDPE Schedule 80 Conduit
5. Between Street Light Foundation and City #5 Curb Box – 2-inch Rigid Steel Conduit (RSC)
6. Between Traffic Signal mast arm pole foundation and City #6 Curb Box – 3-inch Rigid Steel Conduit (RSC)
7. Between Traffic Signal (non signal mast arm) foundation and City #6 Curb Box - 2-inch Rigid Steel Conduit (RSC)
8. Between Controller Cabinet Foundation and City #6 Curb Box – two (2) 3-inch HDPE Schedule 80
9. Between Tesco Foundation and City #6 Curb Box – one (1) 3-inch HDPE Schedule 80
10. Between Tesco Foundation and PG&E Service Box – one (1) 3-inch PVC Schedule 80. Contractor is responsible for verifying and providing the PG&E conduits per their requirements.
11. Riser on PG&E pole and stub into City Curb Box or PG&E Service Box – Contractor is responsible for verifying and providing the PG&E risers and conduits per their requirements.

209-3.7 Pull Boxes.

ADD NEW PARAGRAPH TO THE END OF SUBSECTION 209-3.7 TO READ:

All non-traffic rated curb boxes shall be precast, non-concrete fibrelyte, conforming to Electrical Standard Drawing E-9.

Pull boxes for street lighting circuits only shall be City standard #5 per standard drawing E-9. Pull box covers to be installed in low-voltage lighting systems shall be inscribed “CITY OF OAKLAND” “STREET LIGHTING”.

Pull boxes for traffic signal circuits shall be City standard #6 per standard drawing E-9. Pull box covers to be installed in signal systems or combined signal and low-voltage lighting systems shall be inscribed “CITY OF OAKLAND” “TRAFFIC SIGNAL”.

Pull box covers to be installed in fiber optic cable only lines shall be inscribed “CITY OF OAKLAND” “INTERCONNECT”.

Curb boxes located within travel roadway or otherwise noted on plans must be traffic rated. Traffic rated curb boxes shall be in accordance with Caltrans Standard Specifications 86-2.07, “Traffic Pull Boxes.”

209-3.8 Splice Insulation.

209-3.8.1 General.

ADD NEW PARAGRAPH TO THE END OF SUBSECTION 209-3.8.1 TO READ:

Splicing for street light circuit shall conform to Electrical Standard Detail E-29.

209-3.12 Service Pedestal.

ADD NEW SUBSECTION 209-3.12 TO READ:

Circuit breakers shall be the cable-in/cable-out type, mounted on non-energized clips. All circuit breakers shall be mounted vertically with the up position of the handle being the “ON” position.

Each service shall be provided with up to two main circuit breakers, which shall disconnect ungrounded service entrance conductors. Where the “Main” circuit breaker consists of two circuit breakers as shown on the plans or required in the special provisions, each of the circuit breakers shall have a minimum interrupting capacity of 10,000 A, rms.

The neutral conductor shall run from the service equipment enclosure to the controller Cabinet without splicing to any other neutral conductor.

Contractor to furnish and install ground rod at Tesco panel foundation.

Service Pedestal shall conform to Caltrans Electrical Systems Service Equipment.

209-3.12.1 Single Meter Service Pedestal

ADD NEW SUBSECTION 209-3.12.1 TO READ:

Single Meter Type III-AF, 120/240 V, 100 A, service pedestal (Tesco Controls, Inc model # 26-100 or approved equal) for unmetered street light and metered traffic signal. Exterior shell of service pedestal shall be galvanized steel painted Silver (PEB 18994) unless otherwise noted in plans.

209-3.12.2 Dual Meter Service Pedestal

ADD NEW SUBSECTION 209-3.12.2 TO READ:

Dual Meter Type III-CF, 120/240 V, 100 A, service pedestal (Tesco Controls, Inc model # 28-102 or approved equal) for unmetered street light, metered traffic signal, metered irrigation controls, and holiday lights, etc. Exterior shell of service pedestal shall be galvanized steel painted Silver (PEB 18994) unless otherwise noted in plans.

209-4 STREET LIGHTING SYSTEM MATERIALS.

209-4.2 Wire/Conductors.

209-4.2.1 General.

REPLACE FIRST SENTENCE OF PARAGRAPH WITH THE FOLLOWING:

Unless otherwise noted in plans, street light wire (both underground and pole riser) shall be No. 6 AWG single, stranded copper conductors insulated with 60 mils THWN OR THHN insulation rated at 600 volts as shown on plans (Black, Red, Green).

209-4.3.2 Fuse Splice Connectors.

REPLACE SUBSECTION 209-4.3.2 WITH THE FOLLOWING:

In-line water tight fuseholder and fuse in the adjacent curb box as follows:
Fuseholder shall be waterproof, 600V, 30A to accept 13/32" dia. X 1-1/2" long fuse. Reference: Buss Tron HEX-AA fuse.

Fuse shall be 250VAC 5 Amp 13/32" dia. X 1-1/2" long: Reference: Buss KTK-5

For 120 V Street Light, video cameras (if not individually protected through 5 Amp circuit breakers in controller cabinet), and IISNS, Fuseholder HEB-AA, Fuse 5A KTK

For 240 V Street Light, Fuseholder HEX-AA, Fuse 5A KTK

209-4.4 High Pressure Sodium (HPS) Luminaires.

ADD NEW SUBSECTION 209-4.4 TO READ:

Street Light luminaires shall be City standard HPS flat glass cobra head manufactured by GE or approved equal as referenced in electrical/traffic signal plans.

Luminaire ballast shall be multi-tap for 120V/240V circuit.

209-4.7 Photoelectric Control.

ADD NEW SUBSECTION 209-4.7 TO READ:

Photoelectric control shall be Type IV.

Photoelectric controls shall conform to the provisions in Section 86-6.07 "Photoelectric Controls", of the State Standard Specifications and these special provisions.

209-4.9 Light Emitting Diode (LED) Luminiares.

ADD NEW SUBSECTION 209-4.9 TO READ:

The LED Cobra Head street Light shall be the new City standard as follows:

209-4.9.1 General

The complete luminaire designated shall be a LED Series roadway luminaire, to operate one or more optimized LED arrays from a nominal (specify 120, 208, 240, 277, 347, 480, 120-277 or 347-480) volt, 60 Hz power source and shall be capable of starting and operating the light engine(s) within the limits specified by the LED manufacturer.

The luminaire shall contain completely prewired integral drivers and optical assembly "Light Engine(s)" that shall provide a distribution type (specify according to photometric type table). Labeling shall be in accordance with ANSI standards. All units shall be UL/cUL Certified.

Manufacturer must have a minimum of a 15-year history of designing and manufacturing

outdoor luminaires and at least 10 years of LED design history in some form of outdoor application which can include signage, traffic signals or roadway/parking fixtures.

The fixture offering shall range from 3,000 total lumens at 4000K and 43 watts to 22,000 total lumens at 5700K and 270 watts in the 120-277 volt range (no more than 5% additional watts at 480V). There shall be options for various photometrics to include a minimum offering of Narrow Asymmetric Medium, Asymmetric Short and Asymmetric Medium. The photometric options shall be able to offer solutions that are based on both Illuminance and luminance. The fixture shall have a minimum street side coefficient of utilization of 74% (maximum of 26% for House Side). The contoured Cobrahead–shape housing shall closely resemble representative HID/LED Cobrahead fixtures that exist today.

209-4.9.2 Optical/LED Array

- On units that contain more than one light engine, there shall be a provision to specify that at least one light engine unit (closest to the electrical cavity) can offer photometry in the house side direction.
- Aluminum clad metal core printed circuit board assembly, designed to operate as a class I circuit.
- There shall be a separate, single precision die cast removable bezel to hold a glass lens in place, covering the entire optical enclosure.
- The circuit board shall be attached to a machined surface on the precision casting so as to maximize heat transfer and mechanical adherence over the life of the fixture.
- Each fixture shall contain one single translucent tempered glass lens designed to maximize efficiency of light output and minimize the effect of dirt depreciation.
- The lens shall have a single long life silicon gasket.
- The silicon gasket shall be “channeled” so as to form around both sides of the glass lens.
- There shall be no caulk of any kind used to seal any parts of the fixture optical enclosure for IP65 applications.

209-4.9.3 Luminaire Requirements

- Off-state power draw of 0 watts (excluding PE or remote control devices).
- 3-prong locking ANSI C136.10 photocell receptacle with tool-less orientation.
- A minimum system power factor of 0.90 tested and specified at 120v input and maximum load conditions.
- Maximum THD < 20% tested and specified at 120v input and maximum load conditions.
- Nominal LED forward current of 525 mA as the standard, with options for 350mA and 700mA typical.
- Driver life expediency 100,000 hours.
- Operating temperature range of -40º C to 50º C.
- UL Class 1 power supply units (i.e. drivers) operating in DC constant current mode.
- Drivers shall be pre-wired to the light engine and have a “quick pinch” disconnect from the power door.
- Mode supplying DC forward current for LED operation (no pulsed operation allowed).
- EMI compliance with FCC 47 CFR Part 15 Class A.
- Class A sound rating.
- The luminaire shall contain the factory-installed driver supplied with the light engine.
- The light engine assembly and housing shall be from the same manufacturer.
- The drivers shall reliably start and operate the light engine at ambient temperatures from -40°C to 50°C

Surge Protection

- For the 120-277 VAC single phase luminaire, the standard protection for the electrical system shall survive 120 repetitive surge events of "B2" (B2 - 4kV/1.2 x 50uS, 2kA/8 x 20uS) waveforms at 1 minute or less intervals. B2 waveforms are as defined in IEEE/ANSI C62.41.-1991, Scenario 1 Location Category B2. Events shall be 5 of each phase/polarity (45, 90, 270 - Positive, 90, 225, 270 - Negative) and mode (L1-L2, L1-G, L2-G, L1/L2-G).

Power Door Assembly

- The fixture shall have a precision die-cast aluminum “power door” .
- There shall be a secondary retention latch to avoid the power door from dropping down once the screw is backed out but prior to the operator/installer needing the door open. The latch can be easily pushed by the operator/installer to allow the power door to swing down.
- Shall contain hinge latches that do not require any tools to remove from the fixture.
- Warranty shall not be affected by opening the power door and/or accessing the electrical cavity.
- Shall have all of the needed electrical and electronic components for the fixture attached to it with quick disconnect connectors that can be squeezed and pulled apart. The exception to this is for the high capacity surge protection which will be inside the cavity due to the size.
- Must have terminal block shall be “lineman friendly” and angled within the electrical cavity so as to allow for easy wire connections.

Mechanical Construction

- The luminaire shall be comprised of precision die-cast aluminum housing, scaled to the appropriate wattage and lumen requirement output.
- The housing construction will incorporate heat sink fins that are integrally cast with the housing to maximize heat transfer and minimize thermal impacts of environmental conditions such as debris-clogged fins.
- The luminaire shall meet ANSI 2G vibration standards with an option to meet 3G vibration standards.
- Slipfitter in the housing shall not pass through the housing and tighten from the arm directly to mount on 1.66” to 2.375” O.D. horizontal tenons, and provide +/- 5 degrees of tilt adjustment.
- The effective Projected Area (EPA) shall not to exceed 1.4 square foot maximum.

209.4.9.4 Photometric Requirements

- High brightness LED’s.
- A nominal Correlated Color Temperature (CCT) of 4000 ºK and 5700 ºK typical binned per ANSI C78.377-2008.
- A typical Color Rendering Index (CRI) ≥ 70.
- An IESNA TM-15 UL/UH rating of 0.
- A minimum initial Luminaire Efficacy ≥ 74 lm/W with a typical at 80 lm/W depending on CCT

209.4.9.5 Performance Claims

- LED performance claims shall be independently verified from the LED manufacturer. Verification shall include lumen output, life and color properties.
- CCT and CRI and shall be tested and measured in accordance with LM-79. Lumen depreciation data shall be measured in accordance with LM-80.
- Lumen Maintenance projections shall not exceed 6X of the available system-level lumen depreciation test data.
- A normal operation temperature from -40º C to 50º C.
- Substitution of a non-approved driver shall result in void of warranty.
- System shall be rated at L85 for no less than 50,000 hours.
- LED module(s)/array(s) shall deliver at least 85% of initial lumens, when installed for a minimum of 50,000 hours.

209.4.9.6 Measurement/Performance/Safety Standards:

1. LM-79-08 Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products.
2. LM-80-08 Approved Method: Measuring Lumen Maintenance of LED Light Sources.
3. Luminaire is UL Listed to UL1598.
4. LM-79 tests and reports shall be available and be performed in accordance with IESNA standards.

5. Shall be UL/cUL listed, suitable for wet locations.
6. Shall be IP 65 rated optical enclosure per ANSI C136.25-2009.
7. Shall be RoHS compliant.

209-5 TRAFFIC SIGNAL MATERIALS.

209-5.1 Steel Pedestrian Standards and Pedestals for Controller Cabinets.

ADD NEW PARAGRAPHS AT THE BEGINNING OF SUBSECTION 209-5.1 TO READ:

Push button post shall be 4'6" tall Caltrans Type 1-B standard and comply with Caltrans Standard Specifications Section 2.04.

209-5.3 Conductors and Cable.

209-5.3.1 General.

ADD NEW PARAGRAPHS AT THE END OF SUBSECTION 209-5.3.1 TO READ:

Traffic signal cable shall consist of 12, No. 14 AWG conductors. Conductors shall be solid and conform to the requirements of ASTM Designation B3. The conductors shall be individually insulated with polyethylene compound. Cable shall comply with IMSA Specification 19-1. The insulation shall be approved as Type TW Underwriters' Laboratories, Inc.

Traffic signal conductor identification, numbering, and color coding shall conform to City standard drawing E-34.

Mast arm traffic signal heads shall be connected with 5-conductor, No. 14 AWG cable between head and terminal block inside traffic signal mounting adapter. The cable shall meet the above specifications for 12-conductor cable.

CHANGE A SENTENCE IN THE THIRD PARAGRAPH OF SUBSECTION 209-5.3.1 TO READ:

From "conforming to IMSA 9-1" to "IMSA Specification 19-1".

209-5.3.4 Fiber Optic Cable

REPLACE SECTION 209-5.3.4 WITH THE FOLLOWING TO READ:

209-5.3.4.1 General All cable shall be in accordance to these specifications and to the latest City of Oakland Telecommunications Standards. Submittals specified in the standard specifications and in the latest City of Oakland Telecommunications Standards shall be submitted for approval following the procedure set forth in Section 2-5.3 of the standard specifications.

All fiber optic cable shall be armored, loose tube, gel-free, single-mode fiber optic (SMFO) cable with a wavelength of 1,310/1,550nm and a maximum attenuation of 0.35/0.2dB/km.

All fiber optic cable shall be manufactured by Corning, or approved equal. 12-strand SMFO cable shall be used as the branch cable to connect the main trunk cable to the field devices as shown on the Plans.

209-5.3.4.2 SMFO Trunk Cable

Each length of cable shall be permanently identified by specifying the manufacturer and type of cable at intervals not greater than 6 feet along the outside of the outer jacket. Each length of cables shall be permanently marked with length marking intervals not greater than 3 feet.

The Contractor shall submit certification from the manufacturer that the above requirements have been met by the cable supplied to the project. Documentation of factory results shall be provided to the Project Engineer prior to shipping.

209-5.3.4.3 12 SMFO Branch Cable

Furnish and install 12 SMFO branch cable that has factory terminated Male SC-type connectors on all twelve fibers at one end of the cable. The end opposite the connectors shall be left bare for fusion splicing in a fiber optic splice box. Branch cable shall meet or exceed the applicable provisions of the following documents:

- CFR 1755.900, RUS Specification for Filled Fiber Optic Cables;
- ANSI, C8.47-1983, American National Standard for Armored Polyolefin-insulated Thermoplastic Jacketed Communication Cables;
- EIA-455-27A, Method of Measuring (Uncoated) Diameter of Optical Waveguide Fibers;
- EIA-455-28B, Method for Measuring Tensile Failure Point of Optical Waveguide Fibers;
- EIA-455-34, Interconnection Device Insertion Loss Test;
- EIA/TIA-455-82A, Water Penetration Test;
- EIA-455-95, Absolute Optical Power Test for Optical Fibers and Cables;
- EIA-455-103, Buffered Fiber Bend Test; and
- EIA-359-A-1, Special Colors.

209-5.3.4.4 Fiber Optic Jumper Cable

Furnish and install jumper cables that meet the following requirements:

- 250 μm buffering of each fiber
- 900 μm buffering of each fiber applied after the initial 250μm buffering
- Maximum factory measured insertion loss of 0.5 dB per EIA/TIA 455-171
- Less than 0.2 dB loss when subjected to EIA/TIA-455-1B, 300 cycles, 1.1 lbs
- Aramid yarn strength member
- Rugged 0.12 inch (approximate) PVC sheathing
- Minimum bend radius of 12.5" following installation, 25" during installation
- Minimum tensile strength of 100 lbf
- ST connectors as needed, factory terminated with strain relief
- Comply with NEC requirements for indoor cable when used indoors
- Rated by the manufacturer for use in outdoor field cabinets

Use either single fiber or duplex jumper cables. Provide permanent markings on duplex jumper cables that provide a visual distinction between the two fibers. Provide strain relief for jumper cables at both ends and elsewhere as needed. Adhere to manufacturer recommended installation and minimum bend radius requirements.

209-5.3.4.5 Fiber Optic Pigtails

Fiber optic pigtails shall meet the requirements for jumper cable, except as amended by this subsection. Pigtails need not have a 0.12 inch PVC jacket. Use pigtails that have a factory installed male SC type connector on one end. Leave the other end of the pigtail bare for splicing to fiber.

209-5.3.4.6 Underground Fiber Splice Closures

Underground fiber splice closures shall be butt-end style, corrosion resistant, watertight, and meet the latest requirements of GR-771-CORE. Underground splice closures shall seal, bond, anchor, and provide efficient routing, storage, organization, and protection for fiber optic cable and splices. The splice closure shall provide an internal configuration and end cap with a minimum of two express ports for entry and exit of backbone cable and a minimum of three additional ports for distribution and branch cables. Splice closures shall have a reliable dual seal design with both the cable jackets and core tubes sealed, without the use of water-blocking material. The splice closures shall be capable of being opened and completely resealed without loss of performance.

The fiber splice closures shall be equipped with splice trays that are designed specifically for housing single-mode fusion splices protected by heat-shrink sleeves, are easy to install and remove, and have provisions for a minimum number of splices accommodated by the splice closure. At a minimum, the splice closure shall accommodate 48 splices. The splice closure maximum dimensions shall not exceed 17”L x 9”W x 7.5”H.

209-5.3.4.7 Fiber Termination Panel.

The fiber termination panel shall be REALM Distribution System (RDS) 1RU Patch and Splice Panel or approved equal. The panel shall be of:

1) 1.75" in height and 17.5" in width
2) Allows for 3 adapter plates and up to 72 fibers using LC duplex adapters (Per rack unit)
3) Dual sliding tray system allows front panel slide out access without straining rear mounted cable
4) Mounts in 19" or 23" racks or cabinets
5) Can be pre-loaded with adapter plates, adapters, pigtails or splice cartridges
6) Custom or standard loading options available
7) Front door locking option available

The fiber splice cartridge shall be of:

1) From 6 to 24 fiber configurations
2) Based on standard footprint of 118mm between mounting holes
3) Cartridge is available to include: laser safety smoked polycarbonate cover, bulkhead adapters, color coded pigtails, splice sleeve holder and splice sleeves
4) Pigtails can be 900um tight or loose buffered (900um loose buffer saves space & allows for easy splicing of 250um-250um fiber in loose tube cable
5) Pigtail end can be configured with ribbon fiber
6) Back side of cartridge has port ID chart for up to 24 terminations
7) Provision of optional MPO style connector/s at the rear port for quick plug & play applications
8) Heavy duty cable clamp and waterfalls included
9) Optional screw down metal cover

209-5.3.4.8 Ethernet Edge Switch.

The Ethernet Edge Switch shall be a Cisco IE-3000-8TC (Layer 2) or approved equal which has successfully been installed and operated in the City of Oakland for a period of one year as determined by the City of Oakland IT Division.

Cisco IE-3000-8TC shall include the following items:

- 100Mbps Single Mode Rugged SFP (2 fibers per port)
- Field hardened power transformer

The Edge Switch shall be environmentally hardened and intended for industrial applications and shall meet or exceed the NEMA TS2 2003 environmental requirements. The switch shall meet, at a minimum, the following requirements:

- A minimum of two (2) 100BASE-FX ports (transmit and receive) capable of transmitting Ethernet data at 100 Mb/s over singlemode fiber, full duplex (SFP ports)
- A minimum of six (6) autosensing 100BASE-TX / 10BASE-T RJ45 ports capable of transmitting Ethernet data at 10 or 100 Mb/s, full duplex.
- Switch shall be capable of operating using an input voltage of 120VAC at 60Hz with a maximum power consumption of 20 watts, or shall come equipped with power supplies capable of doing so.
- Switch ports shall comply with the following standards:
  - IEEE 802.3 10Base-T
  - IEEE 802.3u 100Base-TX
  - IEEE 802.3u 100Base-FX
  - IEEE 802.3ab 1000Base-T
  - IEEE 802.3z 1000Base-SX and 1000Base-LX
  - IEEE 802.1P priority queuing
  - IEEE 802.3X flow control
- Wire speed switching on all ports simultaneously, non-blocking

- IEEE 802.1Q VLAN Tagging 4 port trunking groups with up to 2~4 ports per group with support for 256 VLANS
- Meets Bellcore GR-63-CORE vibration and shock specifications for NEBS Level III compliance (optional)
- Operating temperature = -34 to +74 degrees Celsius
- Relative humidity = 10% - 90%, non-condensing
- UL listed (UL1950), cUL, CE
- Emissions meet FCC Part 15, Class A
- Minimum MTBF of 8 years (Bellcore Method)
- Packet Filtering and Port Security Destination MAC
- MAC address learning with a minimum of 1028 MAC addresses and ≥ 1028 static MAC addresses
- IEEE 802.1p QoS Classification based on: Port based priority VLAN Priority field in VLAN tagged frame DS/TOS field in IP packet UDP/TCP logical ports
- IEEE 802.1w Rapid Spanning Tree Algorithm
- IP Multicast Filtering through IGMP Snooping
- Support Telnet, SNMP v1 & v2, RMON, Web Browser, Port Mirroring (RFC 1757, TFTP, FTP and CLI management tools
- MIB statistics counters for all ports
- Management and configuration shall be able to be performed through an integrated web interface
- Support remote reset and remote management
- Support remote turn on/off of 10/100 Base-T ports

The switch shall have a minimum MTBF of 60,000 hours. The MTBF shall be calculated in accordance with the methods described in Mil-Std HDBK 217F for a temperature of 55ºC for naval sheltered.

209-5.3.4.9 Hub Switch.

The hub switch shall be Enterasys C5 (Model No. C5K125-48P2) or approved equivalent.

The hub switch shall have:

- (48) 10/100/1000 PoE (.af +.at) auto-sensing, auto negotiating MDI/MDI-X RJ45 ports
- (2) Combo SFP ports
- (2) SFP+ ports
- (2) dedicated stacking ports
- (1) DB9 console port
- (1) RPS port

The hub switch shall support fiber optic communications. The hub switch shall have use Enterasys 1 Gb GBIC (Model No. MGBIC-LC09) or approved equivalent from same manufacturer.

GBIC shall have the following features:

1) 1000BASE-LX,
2) IEEE 802.3 SM,
3) 1310 nm Long Wave Length, 10 km,
4) LC SFP

209-5.4 Controllers.

209-5.4.1 General.

ADD TO THE END OF SUBSECTION 209-5.4.1 TO READ:

Unless otherwise noted in the plan, the controller shall be the “lite” version Model 2070L (Caltrans Rack Mount type) ATC traffic controller per California Department of Transportation’s (Caltrans) Specification, shall be registered on the current Caltrans Pre-Qualified Product List (QPL). The controller shall be equipped with the following modules:

2070-1B	CPU with 8MB RAM and Ethernet Port
2070-2A	Field I/O Module for 332 cabinets
2070-3B	8x40 Line Display and dual keyboard panel

2070-4B	Heavy-Duty 3A Power Supply Module
2070-7A	Dual Serial Port Card, RS-232
OS-9	Microware OS9 v3.2 or higher operating system

Firmware shall be latest version of Apogee with remote traffic responsive functionality.

Two copies of the software operations manual shall be provided with each Model 2070L controller delivered.

209-5.4.1a Central Control System Seat License

ADD NEW SECTION 209-5.4.1a TO READ:

Expand the controller field connection licenses for the existing City's Advanced Traffic Management System (ATMS) software, Naztec ATMS.now, to accommodate the field controller(s) added or replaced by the project.

209-5.4.1b GPS-Based Time Source Receiver

ADD NEW SECTION 209-5.4.1b TO READ:

The GPS-based time source data receiver shall meet the environmental requirements of NEMA TS2, and include mounting hardware and weather gaskets for top-of-cabinet installation. The GPS time source shall include fused power connections to the 24VDC Model 206 cabinet power supply, and a 4800-baud RS-232 data connections cable to the controller unit (CU) Model 2070-7A serial port communications card. An NMEA standard GPS-based time source receiver unit supplied shall be a Garmin International Model GPS-16A, or City approved equal, with Model 2070-7A controller data and power supply cables. If GPS time source is installed in a cabinet with a controller other than a Model 2070, the GPS time source shall be compatible with the existing controller, and it shall be approved by the City.

209-5.4.3 Cabinets.

209-5.4.3.1 General.

ADD TO THE BEGNINNING OF SUBSECTION 209-5.4.3.1 TO READ:

Unless otherwise noted in the plan, the controller cabinet assembly shall be Model 332 and wired with all auxiliary equipment required to control the system and shall conform to Caltrans Standard Specifications.

209-5.5 LED Vehicle Signal Faces and Signal Heads.

ADD THE FOLLOWING TO THE BEGINNING OF SECTION 209-5.5 TO READ:

The traffic signal faces and signal heads shall comply with the following specifications:

1. Signal module shall be 12-inch and of Dialight Corp or approved equal which has successfully operated in the City of Oakland for a period of one year as determined by the City of Oakland Electrical Services Division.
2. Each traffic signal shall be complete with metal housing, glass lenses, metal or glass reflectors, sockets visors and other parts, all in accordance with these specifications. Tabs shall be located at 45-135-225-315 degree positions of the visor.
3. The signal heads shall conform to the specifications of the Institute of Traffic Engineers' (ITE) Technical Report Number 1, 1970 Revision. Visor shall also conform to the ITE Publication ST-008B.
4. Each Signal head, as a minimum, shall display three round colored lenses arranged vertically with "Red" on top, "Yellow" in the middle and "Green" at the bottom in addition to the following:
   - The 3-section mast arm signal shall include a MV_1 (Caltrans MAS) plumbizer.
   - The RED Circular and Arrow indications shall be the Dialight Corporation LED modules or approved equal. The catalog numbers are as follows:
     - 12-inch Red Arrow LED module – Model #435-1314-001 Tinted
     - 12-inch Red Circular LED module – Model #433-1210-003 Tinted
   - The GREEN Circular and Arrow indications shall also be the Dialight Corporation LED modules or approved equal. The catalog numbers are as follows:
     - 12-inch Green Arrow LED module – Model #435-2324-001 Tinted

- 12-inch Green Circular LED module – Model #433-2220-001 Tinted

- The YELLOW Circular and Arrow indications shall also be the Dialight Corporation LED modules or approved equal. The catalog numbers are as follows:
  - 12-inch Yellow Arrow LED module – Model #435-3334-001 Tinted
  - 12-inch Yellow Circular LED module – Model #433-3230-001 Tinted

209-5.6 Countdown LED Pedestrian Signals.

REPLACE SECTION 209-5.6 WITH THE FOLLOWING TO READ:

Pedestrian module shall be Dialight Corp's LED countdown head (#430-6479-001X) or approved equal which has successfully operated in the City of Oakland for a period of one year as determined by the City of Oakland Electrical Services Division.

209-5.7 Signal Mounting Assemblies.

REPLACE SECTION 209-5.7 WITH THE FOLLOWING TO READ:

Signal mounting assemblies shall confirm with Caltrans Standard Plans and Specifications. All pole mounted signal mounting assemblies shall be Caltrans "with terminal compartment" type.

209-5.8 Detectors.

209-5.8.4 Video Detection Camera.

ADD NEW SUBSECTION 209-5.8.4 TO READ:

Unless otherwise specified, the video detection camera shall be Vantage RZ-4 Advanced WDR by Iteris, Inc. or approved equal which has successfully been installed and operated in the City of Oakland for a period of one year as determined by the City of Oakland Electrical Services Division.

The video detection camera shall be a complete functioning system with color cameras, processors, all necessary video and power cabling, mounting brackets, lightning and surge protection as recommended by the manufacturer, video detection processors, 17" rack mounted video monitor at each controller cabinet and extension modules capable of processing the number of cameras and phase combination video sources shown on the plans. Ethernet remote communications module and Windows XP-based remote access software shall be also be provided as part of the complete system if Ethernet communication is available or will be provided by the project at the controller cabiner,

209-5.9 Accessible Pedestrian Signal (APS) Push Button Assemblies.

REPLACE SUBSECTION 209-5.9 WITH THE FOLLOWING TO READ:

Unless otherwise specified, APS Push Button Assemblies shall be Polara Navigator 2-wire ENAV system, or approved equal which has successfully operated in the City of Oakland for a period of one year as determined by the City of Oakland Electrical Services Division.

APS Push Button Assemblies shall be in accordance with Caltrans Standard Specifications 86-5.02, California Manual on Uniform Traffic Control Devices (California MUTCD), Americans with Disabilities Act (ADA) and Institute of Transportation Engineers.

The Contractor shall furnish metal type housing pedestrian push button (PPB) including sign with appropriate arrow indication. Sign shall be in accordance with California MUTCD Sign R10-4b. The sign shall fit completely within the assembly frame. Braille shall not be provided. The sign shall be fabricated from aluminum with Type III High Intensity sheeting.

Pedestrian Push Button shall be in accordance with Caltrans Standard Specifications Section 86-5.02, "Pedestrian Push Button Assemblies," and these special provisions.

209-5.10 Splice Chamber

ADD NEW SUBSECTION 209-5.10 TO READ:

City Electrical Services Dept will furnish Splice Chamber part #s A27, A28, A29, and F24 per standard detail drawing E-57. All other splice chamber parts/components shall be furnished by the Contractor.

209-5.11 Internally LED Illuminated Street Name Sign (IISNS)

ADD NEW SUBSECTION 209-5.11 TO READ:

IISNS shall be Temple Edge Lit model R409, or approved equal which has successfully operated in the City of Oakland for a period of one year as determined by the City of Oakland Electrical Services Division.

209-5.12 Pan-Tilt-Zoom (PTZ) Closed Circuit Television (CCTV) Camera System.

ADD NEW SUBSECTION 209-5.12 TO READ:

The pan-tilt-zoom (PTZ) camera a system shall consist of an IP-based camera with pan/tilt and dual-mode (day/night), receiver/driver, connectors, mounting hardware, and weather-tight enclosure. The camera shall be installed in a dome enclosure with traffic signal pole mounting bracket. The camera system shall be furnished as a complete unit. The PTZ CCTV Camera shall be shall be Axis Q6034-E or approved equal which has successfully been installed and operated in the City of Oakland for a period of one year as determined by the City of Oakland Transportation Services Division.

209-5.13 Emergency Vehicle Premption (EVP)/Transit Signal Priority (TSP) System.

ADD NEW SUBSECTION 209-5.13 TO READ:

The Contractor shall furnish and install, where shown on the Plans, 3M Opticom Model 752 Series detection system or equivalent approved by the City of Oakland Electrical Services Division, functional with existing City systems, and conforming to the Alameda County Congestion Management Agency SMART Corridors and Rapid Bus Program.

A. General.

The equipment as referred to in these Special Provisions shall include, but not be limited to, of the following:

1. Optical Detection Unit and Mounting
2. Discriminator Module
3. System Chassis
4. Card Rack
5. Green Sense Harness
6. Detector Cable
7. All associated power cables, accessories, and components recommended by the manufacturer and/or necessary to accomplish a fully functional EVP installation.

B. Functional Capabilities.

The EVP/TSP equipment will provide traffic signal priority to transit vehicles and preemption to emergency vehicles by altering the phasing of the traffic signals depending on the phase selection criteria. Each modulated light signal detection system shall consist of an optical emitter assembly or assemblies located on the appropriate vehicle and an optical detector\discriminator assembly or assemblies located at the traffic signal. Emitter assemblies are not required for this project except units for testing purposes to demonstrate that the systems perform as specified. The Contractor shall conduct the test in the presence of the Engineer as described below under “System Operation” during the signal test period. The Contractor shall give the Engineer a minimum of two working days notice prior to performing the tests.

Each system shall permit detection of two classes of authorized vehicles. Class I

(mass transit) vehicles shall be capable of being detected at any range of up to 1000' (300 m) from the optical detector. Class II (emergency) vehicles shall be capable of being detected at any range up to 1800' (550 m) from the optical detector.

Class I signals (those emitted by Class I vehicles) shall be distinguished from Class II signals (those emitted by Class II vehicles) on the basis of the modulation frequency of the light from the respective emitter. The modulation frequency for Class I signal emitters shall be 9.639 Hz ±0.110 Hz. The modulation frequency for Class II signal emitters shall be 14.035 Hz ±0.250 Hz.

A system shall establish a priority of Class II vehicle signals over Class I vehicle signals, and shall conform to the requirements in Section 25352, of the California Vehicle Code.

C. Optical Detection\Discriminator Assembly.

Optical detection\discriminator assembly shall conform to the following:

i) General.

Each optical detection\discriminator assembly shall consist of one or more optical detectors, connecting cable and a discriminator module. Each such assembly, when used with standard emitters, shall have a range of at least 300 m for Class I signals and 1800' (550 m) for Class II signals. Standard emitters for both classes of signals shall be available from the manufacturer of the system. Range measurements shall be taken with all range adjustments on the discriminator module set to "maximum".

ii) Optical Detector.

Each optical detector shall be a waterproof unit capable of receiving optical energy from two separately aimable directions. The horizontal angle between the two directions shall be variable from 180 degrees to 5 degrees. The reception angle for each photocell assembly shall be a maximum of 8 degrees in all directions about the aiming axis of the assembly. Measurements, of reception angle will be taken at a range of 1000' (300 m) for a Type I emitter and at a range of 1800' (550 m) for a Type II emitter.

All internal circuitry shall be solid state, and electrical power shall be provided by the associated discriminator module.

Each optical detector shall be contained in a housing, which shall include two rotatable photocell assemblies, an electronic assembly, and a base. The base shall have an opening to permit its mounting on a mast arm or a vertical pipe nipple, or suspension from a span wire. The mounting opening shall have female threads for Size 21 conduit. A cable entrance shall be provided which shall have male threads and gasketing to permit a waterproof cable connection. Each detector shall have mass of less than 2.4 lb (1.1 kg) and shall present a maximum wind load area of 35.6 in2 (230 cm2). The housing shall be provided with weep holes to permit drainage of condensed moisture.

Each optical detector shall be installed, wired and aimed as specified by the manufacturer.

iii) Cable.

Optical detector cable (EV-DLC) shall meet the requirements of IPCEA S 61-402\NEMA WC 5, Section 7.4, 600-V control cable, 170°F (75°C), Type B, and the following:

a. The cable shall contain 3 conductors, each of which shall be No. 20 (7 x 28) stranded, tinned copper with low-density polyethylene insulation. Minimum average insulation thickness shall be 0.025" (0.63 mm). Insulation of individual conductors shall be color coded: 1 yellow, 1 blue, 1 orange.
b. The shield shall be either tinned copper braid or aluminized polyester film with a nominal 20 percent overlap. Where the film is used, a No. 20 (7 x 28) stranded, tinned, bare drain wire shall be placed between the insulated conductors and the shield and in contact with the conductive surface of the shield.
c. The jacket shall be black polyvinyl chloride with minimum ratings of

600 V and 175°F (80°C) and a minimum average thickness of 0.04" (1.1 mm): The jacket shall be marked as required by IPCEA\NEMA.

d. The finished outside diameter of the cable shall not exceed 0.35" (8.9 mm).
e. The capacitance, as measured between any conductor and the other conductors and the shield, shall not exceed 157 pf per meter at 1000 Hz.
f. The cable run between each detector and the controller cabinet shall be continuous without splices or shall be spliced only as directed by the detector manufacturer.

D. Discriminator Module.

Each discriminator module shall be designed to be compatible and usable with a Model 2070L controller unit and to be mounted in the input file of a Model 332 or Model 336 controller cabinet, and shall conform to the requirements of Chapter I of the State of California, Department of Transportation, "Traffic Signal Control Equipment Specifications".

Each discriminator module shall be capable of operating two channels, each of which shall provide an independent output for each separate input.

Each discriminator module, when used with its associated detectors, shall be capable of:

a. Receiving Class I signals at a range of up to 1000' (300 m) and Class II signals at a range of up to 1800' (550 m).
b. Decoding the signals, on the basis of frequency, at 9.639 Hz ±0.119 Hz for Class I signals and 14.035 Hz ±0.255 Hz for Class II signals.
c. Establishing the validity of received signals on the basis of frequency and length of time received. A signal shall be considered valid only when received for more than 0.50 second. No combination of Class I signals shall be recognized as a Class II signal regardless of the number of signals being received, up to a maximum of ten signals. Once a valid signal has been recognized its effect shall be held by the module in the event of temporary loss of the signal for a period adjustable from 4.5 seconds to 11 seconds in at least 2 steps at 5 seconds ±0.5 second and 10 seconds ±0.5 second.
d. Providing an output for each channel that will result in a "low" or grounded condition of the appropriate input of a Model 2070L controller unit. For Class I signals the output shall be a 6.25 Hz ±0.1 percent, rectangular waveform with a 50 percent duty cycle. For Class II signals the output shall be steady.

Each discriminator module shall receive electric power from the controller cabinet at either 24 VDC or 120 VAC.

Each channel together with its associated detectors shall draw not more than 100 mA at 24 VDC nor more than 100 mA at 120 VAC. Electric power, one detector input for each channel and one output for each channel, shall terminate at the printed circuit board edge connector pins listed below:

BOARD EDGE CONNECTOR PIN ASSIGNMENT

A	DC ground		
B	+24 VDC	P	(NC)
C	(NC)		
D	Detector input, Channel A	R	(NC)
E	+24VDC to detectors	S	(NC)
F	Channel A output (C)	T	(NC)
		U	(NC)
H	Channel A output (E)	V	(NC)
J	Detector input, Channel B	W	Channel B Output (C)
K	DC Ground to detectors	X	Channel B Output (E)
L	Chassis ground	Y	(NC)
M	AC-	Z	(NC)
N	AC+		

(C) Collector, Slotted for Keying
(E) Emitter, Slotted for Keying
(NC) Not connected, cannot be used by manufacturer for any purpose.

Two auxiliary inputs for each channel shall enter each module through the front panel connector. Pin assignment for the connector shall be as follows:

a. Auxiliary detector 1 input, Channel A
b. Auxiliary detector 2 input, Channel A
c Auxiliary detector 1 input, Channel B
d. Auxiliary detector 2 input, Channel B

Each channel output shall be an optically isolated NPN open collector transistor capable of sinking 50 mA at 30 V and shall be compatible with the Model 2070L controller unit inputs.

Each discriminator module shall be provided with means of preventing transients received by the detector from affecting the Model 2070L controller assembly.

Each discriminator module shall have a single connector board and shall occupy one slot width of the input file. The front panel of each module shall have a handle to facilitate withdrawal and the following controls and indicators for each channel:

a. Three separate range adjustments each for both Class I and Class II signals.
b. A 3-position, center-off, momentary contact switch, one position (down) labeled for test operation of Class I signals, and one position (up) labeled for test operation of Class II signals.
c. A "signal" indication and a "call" indication each for Class I and for Class II signals. The "signal" indication denotes that a signal above the threshold level has been received. A "call" indication denotes that a steady, validly coded signal has been received. These two indications may be accomplished with a single indication lamp; "signal" being denoted by a flashing indication and "call" with a steady indication.
d. In addition, the front panel shall be provided with a single circular, bayonet-captured, multi-pin connector for two auxiliary detector inputs for each channel. Connector shall be a mechanical configuration equivalent to a MIL C-26482 with 10 4 insert arrangement, such as Burndy Trim Trio Bantamate Series, consisting of:
   1. Wall mounting receptacle, G0B10-4PNE with SM20M-1S6 gold plated pins.
   2. Plug, G6L10-4SNE with SC20M-1S6 gold plated sockets, cable clamp and strain relief that shall provide for a right angle turn within 2.56” (65 mm) maximum from the front panel surface of the discriminator module.

E. Cabinet Wiring.

The Model 332 cabinet has provisions for connections between the optical detectors, the discriminator module and the Model 2070L controller unit.

Wiring for a Model 332 cabinet shall conform to the following:

a. Slots 12 and 13 of input file "J" have each been wired to accept a 2 channel

module.

b. Field wiring for the primary detectors, except 24-VDC power, shall terminate on either terminal board TB 9 in the controller cabinet or on the rear of input file "J", depending on cabinet configuration. Where TB 9 is used position assignments shall be as follows:

Position	Assignment
4	Channel A detector input, 1st module (Slot J-12)
5	Channel B detector input, 1st module Slot J-12)
7	Channel A detector input, 2nd module (Slot J-13)
8	Channel B detector input, 2nd module (Slot J-13)

The 24 VDC cabinet power will be available at Position 1 of terminal board TB 1 in the controller cabinet.

All field wiring for the auxiliary detectors shall terminate on terminal board TB O in the controller cabinet. Position assignments are as follows:

FOR MODULE 1 (J-12)		FOR MODULE 2 (J-13)	
Position	Assignment	Position	Assignment
1	+24VDC from (J-12E)	7	+24VDC from (J-13E)
2	Detector ground From (J-12K)	8	Detector ground from (J-13K)
3	Channel A auxiliary detector input 1	9	Channel A auxiliary detector input 1
4	Channel A auxiliary detector input 2	10	Channel A auxiliary detector input 2
5	Channel B auxiliary detector input 1	11	Channel B auxiliary detector input 1
6	Channel B auxiliary detector input 2	12	Channel B auxiliary detector input 2

F. Installation.

The Contractor shall install the detector unit(s), mounting hardware, cabling, discriminator unit(s), system chassis, card rack(s), and green sense harness and shall coordinate with 3M representative for programming and calibration of the detector and discriminator units. The Contractor shall follow step-by-step instructions provided by the equipment manufacturer and supplier to provide a fully functional installation.

G. System Operation.

The Contractor shall demonstrate that all of the components of each system are compatible and will perform satisfactorily as a system. Satisfactory performance shall be determined using the following test procedure during the functional test period:

Each system to be used for testing shall consist of an optical emitter assembly, an optical detector, optical detector cable and a discriminator module.

The discriminator modules shall be installed in the proper input file slot of the Model 2070L controller assembly.

Two tests shall be conducted; one using a Class I signal emitter and a distance of 1000’ (300 m) between the emitter and the detector, the other using a Class II signal emitter and a distance of 1800’ (550 m) between the emitter and the detector. All range adjustments on the module shall be set to "Maximum" for each test.

Each above test shall be conducted for a period of one hour, during which the emitter shall be operated for 30 cycles, each consisting of a one minute "on" interval and a one minute "off" interval. During the total test period (1) the emitter signal shall cause the proper response from the Model 2070L controller unit during each "on" interval and (2) there shall be no improper operation of either the Model 2070L controller unit or the monitor during each "off" interval.

SECTION 307 - STREET LIGHTING AND TRAFFIC SIGNALS

307-1 GENERAL.

ADD NEW SENTENCE AFTER THE FIRST SENTENCE OF SUBSECTION 307-1 TO READ:

The work shall include trenching, backfilling, foundations (street light, traffic signal, Tesco Panel), anchor bolts, conduits, curb boxes, pull ropes, street lights and traffic signals, and the restoration of street surfaces: sidewalk, roadway, curb and gutter, ADA ramps, tree wells, etc. Work shall also include modification to existing foundations, as well as extension and connection to existing conduits, boxes and foundations. The contractor shall safe-guard all its installation until the City accept and utilize the work.

ADD NEW PARAGRAPH AT THE END OF SUBSECTION 307-1 TO READ:

All materials furnished and used shall be new and conform to the requirements shown in the standard drawings, except such used materials as may be specifically provided for on the plans. The materials shall be manufactured, handled, and used in a workman like manner to insure complete work in accordance with the plans and specifications.

The location of signals, standards, signs, controls, services and appurtenances are shown on the plans. Any relocation required due to obstructions shall be done under the Engineer's direction.

All systems shall be complete and in satisfactory operating conditions at the time of contract acceptance.

The contractor shall contact the City of Oakland Electrical Department at (510) 615-5438 at least five working days prior to start working for field markings of all City electrical and traffic signal facilities.

All salvaged equipment removed by the Contractor shall be delivered to the Maintenance Service Yard of the City of Oakland. The Contractor shall notify the Engineer 48 hours in advance before delivering any salvage material. The address and contact of the Maintenance Service Yard is:

City of Oakland; Department of Public Works Maintenance Service Yard
7101 Edgewater Drive; Oakland, CA 94621
Attn: James Womack; Tel: (510) 615-5435

307-1.1 Equipment List and Drawings.

ADD NEW SENTENCE AT THE END OF THE FIRST PARAGRAPH OF SUBSECTION 307-1.1 TO READ:

Where the Contractor installs electrical equipment as detailed on the plans, the submission of detailed drawings and diagrams will not be required.

REPLACE THE LAST PARAGRAPH OF SUBSECTION 307-1.1 WITH THE FOLLOWING:

Upon completion of the Work, the Contractor shall submit two complete sets of "as-built" Plans showing in detail all construction changes. Specifically one of these two sets shall be delivered to PWA Electrical Services. Further, a reduced set of 11"x17" shall be made of the "as-built" Plans and delivered to PWA Electrical Services.

307-2 Maintenance of Existing and Temporary Systems.

ADD FIVE NEW PARAGRAPHS AT THE END OF SUBSECTION 307-2:

1. Prior to start of work, contractor shall perform functional test of existing street lighting and/or traffic signal system and submit a repair request to Electrical Services. Contractor shall be responsible for all maintenance and repairs of electrical systems during the entire duration of construction (up til project completion sign off).
2. Relocation or reconnection of existing street light systems shall be completed before nightfall of the same day.
3. All existing street lights and street light circuits shall be in operation during the regular lighting schedule as defined by the serving utility.
4. All existing street lighting systems to be modified shall remain in operation until final connections are made

5. Should the Contractor fail to meet the above requirements, City personnel will do any required work to meet the above requirements at the Contractor's expense. Similarly, any damage to existing electrical facilities due to the Contractor's construction activities will be repaired by City personnel and deducted from any monies due to the Contractor.

307-2.1 Maintaining Existing Intelligent Transportation System (ITS) Elements During Construction

ADD NEW SUBSECTION 307-2.1 TO READ:

Intelligent Transportation System (ITS) elements include, but are not limited to communication system, video vehicle detection system, microwave vehicle detection system, loop detection system, changeable message sign (CMS) system, PTZ camera system, red light camera system, fiber optic system and wireless communication system.

Existing ITS elements, including detection systems, shown and located within the project limits must remain in place and be protected from damage. If the construction activities require existing ITS elements to be nonoperational or off line, and if temporary or portable ITS elements are not shown, the Contractor must provide for temporary or portable ITS elements. The Contractor must receive authorization on the type of temporary or portable ITS elements and installation method.

Before work is performed, the Contractor shall contact the Engineer to conduct a pre-construction operational status check with City's Electrical Division and Transportation Service Division staff of all ITS elements and each element's communication status with the Traffic Management Center (TMC) including existing ITS elements not shown and elements that may not be impacted by the Contractor's activities.

The Contractor must obtain authorization at least 72 hours before interrupting existing ITS elements and its communication with the TMC.

If existing ITS elements are damaged or fail due to the Contractor's activity, where the elements are not fully functional, the Engineer must be notified immediately. If the Contractor is notified by the Engineer that existing ITS elements have been damaged, have failed or are not fully functional due to the Contractor's activity, the damaged or failed ITS elements, excluding structure-related elements, must be repaired or replaced, at the Contractor's expense, within 24 hours. For a structure-related elements, the Contractor must install temporary or portable TMS elements within 24 hours. For non-structure-related ITS elements, the Engineer may authorize temporary or portable TMS elements for use during the construction activities.

If fiber optic cables are damaged due to the Contractor's activities, the Contractor must install new fiber optic cables from an original splice point or termination to an original splice point or termination, unless otherwise authorized. Fiber optic cable must be spliced at the splice vaults or splice pull box. The amount of new fiber optic cable slack in splice vaults or splice pull box and the number of new fiber optic cable splices must be equivalent to the amount of slack and number of splices existing before the damage or as directed by the Engineer. Fusion splicing will be required.

The Contractor must demonstrate that repaired or replaced elements operate in a manner equal to or better than the replaced equipment. If the Contractor fails to perform required repairs or replacement work, the City may perform the repair or replacement work and the cost will be deducted from monies due to the Contractor.

If the pre-construction operational status check identified existing ITS elements, then the Contractor, the Engineer, and City's Electrical Division and Transportation Service Division staff must jointly conduct a post construction operational status check of all existing ITS elements and each element's communication status with the TMC. ITS elements that cease to be functional between pre and post construction status checks must be repaired at the Contractor's expense.

The Engineer will authorize the schedule for final replacement, the replacement methods and the replacement elements, including element types and installation methods before repair or replacement work is performed. The final TMS elements must be new and of equal or better quality than the existing ITS elements.

307-2.2 Scheduling of Work.

ADD NEW SUBSECTION 307-2.2 TO READ:

1. Work shall be so scheduled that each traffic signal and lighting system shall be completed and ready for operation prior to opening the corresponding roadway section to traffic.
2. The traffic signal system shall be placed in operation for use by public traffic without the energizing of street lighting at the intersection to be controlled if street lighting exists or is being installed in conjunction with the traffic signals.
3. The Contractor will aim all traffic signal heads and level all luminaires under the Engineer's direction before placing either system in operation.
4. Traffic signal systems will not be placed in operation prior to the Engineer's acceptance.
5. After the intersection is placed in operation, a five-day fully operational test period will begin. The Contractor shall correct any failures or malfunctions occurring in that five-day period. After such corrections are completed, a new five-day test will recommence.
6. Street lighting circuits shall be energized in the presence of the Engineer between normal working hours of 9:00 a.m. to 3:00 p.m.
7. Lighting circuits shall be energized individually. After confirming circuit connections, all lighting circuits shall be connected and shall remain energized for a period of not less than fourteen (14) days, on the regular lighting schedule as defined by the serving utility. This period will be used as part of the functional test provisions for street lighting. The Contractor shall correct any failures or malfunctions that may occur in this period. After corrections have been completed, a new test period will recommence.

307-7 EXCAVATION AND BACKFILL.
ADD THE FOLLOWING TO THE END OF THE 3RD PARAGRAPH OF SUBSECTION 307-7.1 TO READ:
307-7.1. General. The work site shall be in a presentable condition at the end of the workday or at the completion of work to the satisfaction of the City.

ADD THE FOLLOWING TO THE END OF SUBSECTION 307-7.1 TO READ:
307-7.1. General. The contractor shall provide all required tools, equipment, shoring, boring, steel plating and traffic safety-warning devices.

307-7.2 Trenches.

ADD NEW SUBSECTION 307-7.2 TO READ:

Open trench shall be in accordance with plans and specifications and in accordance with the requirements in Drawings D-30 and D-31 of the Standard Details for T-section.

a. All concrete and asphalt trenching shall be done using a trencher which cuts and trenches at the same time. One lane at a time will be closed while cutting and trenching.

b. Trenching shall be done along score lines requiring complete flag removal.

c. All trenches will be filled with slurry. Backfill shall be per Section 306-1.3.4. – Backfilling Narrow Trenches. All concrete capping shall be no less than six inches thick and five inches wide. Concrete capping shall be continuous with no mechanical reinforcement. Transit ready mix vehicles shall be used. No hand or portable mixing shall be allowed.

d. The contractor shall properly dispose of all spoil (including concrete, asphalt or dirt) including all contaminated soil and waste at no additional cost to the City. The contractor shall bear all costs to remove all excavated material from the work site – including transportation costs, dump fees, permits, etc.

e. T-section repair is required for open trenching – 6-inch width T-cut shall be installed on both side of the trench in accordance with Drawing D-30 and D-31 in the Standard Details.

f. All sidewalk replacement will match existing condition.

307-8 FOUNDATIONS, FOUNDATION CAPS AND SLABS.

307-8.2 Foundations.

ADD NEW PARAGRAPHS AT THE END OF SUBSECTION 307-8.2 TO READ:

Foundation construction shall conform to the Standard Details, Caltrans Standard Specifications Section 86-203, or as otherwise detailed on the construction plans and specifications. Position of poles, controller cabinet and service cabinet shall be marked and verified by the Contractor for approval by the Engineer prior to excavation for foundations. The contractor shall verify the position by potholing to check for conflicts with underground utilities prior to marking the locations. The Engineer shall approve the foundation location before any concrete is poured.

When a foundation is to be abandoned in place, the top of foundation, anchor bolts, and conduits shall be removed to a depth of not less than 0.50 feet below the surface of sidewalk or unimproved ground. The resulting hole shall be backfilled with material equivalent to the surrounding material. Dispose of foundations removed.

Streetlight shall be installed at designated locations according to plans and specifications and in accordance with the requirements in Drawings E-72, E-73 and E-74.

In unpaved areas, construct a raised concrete pad around each controller cabinet, service pedestal, curb box, and/or street light pole.

Contractor shall be responsible to adjust all existing street light foundations and traffic signal foundations to allow 1" to 2" grout thickness between the bottom of pole baseplate and finished sidewalk grade. Based on the utility location and depth, the Engineer shall direct the contractor on use of foundation type. Street light foundations shall be per Detail E-72 or E-73. Traffic signal pole foundations shall be per Caltrans standards.

307-8.2a Cast-In-Drilled-Hole Concrete Pile Foundations.

ADD NEW SUBSECTION 307-8.2a TO READ:

Materials used in reinforced Cast-In-Drilled-Hole (CIDH) concrete pile foundation shall comply with Caltrans Standard Specifications Section 86-2.03B.

307-8.5 Measurement.

DELETE SUBSECTION 307-8.5

307-8.6 Payment.

REPLACE SUBSECTION 307-8.6 WITH THE FOLLOWING SUBSECTION 307-8.6 TO READ:

Payment for foundations shall be considered as included in the Contract Unit Price or lump sum price in the Bid for the work that required foundation.

307-10 STANDARDS, PEDESTALS AND MAST ARMS.

307-10.1 General.

REPLACE THE FIRST PARAGRAPH OF SUBSECTION 307-10.1 TO READ:

Street lighting, and traffic signal Standard, pedestals for cabinets, mast arm and other similar equipment furnished shall be as shown on the Plans, Standard Plans, Caltrans Standard Plans and/or Caltrans Standard Specifications and conform to 209.

307-10.3 Measurement.

REPLACE SUBSECTION 307-10.4 WITH THE FOLLOWING TO READ:

Standard and/or mast arms shall be measured by each type and size.

307-10.4 Payment.

REPLACE SUBSECTION 307-10.4 WITH THE FOLLOWING TO READ:

Payment for standards and/or mast arms shall be at the Contract Unit Price or lump sum prices in the Bid for each size and type. This shall include all labor, materials, tools, equipment, incidentals, required to install concrete foundation, pedestal, anchor bolts, conduit, grout, pothole investigation, abandon existing pole foundation, modify existing conduits and sweeps, modify existing sidewalk, and complete in place, in accordance with the Plans and Specifications, and Standard.

The unit price for "Removing Existing Pole and Foundation" shall be measured on an each basis and shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals and performing the work involved in abandonment of existing foundation, saw cutting, excavation, backfill, disposal of materials, restoration of sidewalk, curb ramp and pavement, modify existing conduits and sweeps, and salvage of existing standard.

307-11 PULL BOXES.
307-11.1 General.

ADD NEW PARAGRAPHS AT END OF SUBSECTION 307-11.1 TO READ:

In concrete areas, a minimum of four inches (4") of concrete will be integrally poured around the box. The Contractor shall field locate all new pull box locations. The proposed locations shall be staked by the Contractor and approved by the Engineer prior to installation.

All curb boxes indicated on the plans shall be as follows unless otherwise noted:

1. For streetlight circuit only - size No. 5.
2. For Traffic Signal circuit– size No. 6
3. For Controller Cabinet – size No. 6E
4. For Tesco Pedestal service– PG&E size No. 2
5. For Traffic Signal Interconnect – size No. 6 with 12-inch extension

Pull boxes shall not be installed in any part of a driveway, curb ramp or other traveled way unless otherwise specified or approved by the Engineer.

All existing concrete street lighting curb boxes shall be replaced with new No. 5 curb boxes. All existing traffic signal concrete curb boxes shall be replaced with new No. 6 curb boxes. All existing curb boxes replaced with new shall be conditioned to new per City Standard Detail E-7.

Contractor shall be responsible to adjust all new electrical curb boxes to match finish sidewalk grade.

Contractor shall be responsible to replace all existing City electrical curb boxes with new to match finish sidewalk grade. Any curb box that requires to be raised/lowered shall be replaced with new. Traffic loops, video camera cables, traffic inter-connect cable and fiber optic cable shall not be spliced except where there are current splices. Traffic signal cable may only be spliced with the Engineer's approval and if splice chambers are installed.

307-11.3 Payment.

ADD NEW PARAGRAPH TO THE END OF SUBSECTION 307-11.3 TO READ:

The unit price of pull boxes shall include full compensation to furnish all labor, materials, tools, equipment, and incidentals required to install pull boxes, complete in place, in accordance with the Plans, Specifications and Standard Details. The work includes, but not limited to, pothole investigation, removal of existing pull box, saw cutting concrete and asphalt pavement, furnishing and installing pull boxes, excavation and backfill, disposal of materials, restoring sidewalk, curb ramp, pavement, stripping, and appurtenance damaged during construction.

307-12 CONDUIT.
307-12.1 General.
DELETE THE FIRST SENTENCE IN THE SIXTH (6^{TH}) PARAGRAPH.

ADD NEW PARAGRAPHS AT THE END OF SUBSECTION 307-12.1 TO READ:

Unless otherwise approved by the Engineer, HDPE conduit shall be joined with the butt fusion techniques.

Mandrels shall be at least three inches long and shall have a diameter that is at least eighty percent (80%) of the inside conduit diameter. Any conduit run which will not allow the mandrel to pass will not be accepted until the obstructions have been corrected.

Conduit laid in open trench shall not be covered nor shall any trench or inspection hole be backfilled until the Engineer has approved the installation.

Conduits terminating in a curb box shall be brought into the box on a gradual upward sweep of up to 45 degrees. The Engineer will not permit any 90-degree bends into the box bottom. The conduit shall not extend into the box more than 2" beyond the inside face of the box. Longitudinal conduit runs entering curb boxes shall enter at their respective ends of the curb box. Lateral conduit runs shall enter at the respective side.

The conduit runs shall be as shown on the attached plans. The line to be followed by each run of conduit, as indicated on the plans, is necessarily approximate. The Contractor shall determine and make such deviations from the lines indicated on the plans as may be reasonably necessary in order to clear other underground utilities or structures, subject to the Engineer's approval. It is not contemplated or intended that any existing underground pipes, conduits, or other existing underground structures shall be changed or moved in order to permit carrying out the work covered by these specifications.

a. All conduits shall be installed beneath official sidewalk or roadway areas excepting riser conduits. Conduit under a street or roadway shall be placed at a minimum depth of 36 inches for conduit intended for interconnect and 30 inches for others below the roadway surface. Conduit under railroad right-of-way shall be installed 36 inches below bottom of tie. Conduit placed in the ground under sidewalks shall, as far as practicable, be placed at a minimum depth of 18-inches below adjacent curb grade. Conduit under sidewalks shall be placed as near the adjacent existing curb position as is practicable without making repeated bends to clear poles, water meters, and similar obstructions.
b. Conduit may be laid on top of the existing pavement within curbed medians being constructed on top of said pavement.

The Contractor shall install as per Plans, Specifications and Standard Details and be entirely responsible for the correct conduit installation method i.e. open trench, in pavement cuts, or in holes bored through the ground from one excavation to another.

The following restrictions shall apply in appropriate circumstances:

a. The Contractor shall consult with the proper utility companies or agencies to determine the location of their conduits, ducts, underground pipes, cables, sewers or other underground structures.
b. The Contractor shall open, by hand digging, test holes to locate existing conduits, cables, sewers or other underground structures which could be damaged by the new installation.
c. No conduit shall run through catch basins, drainage ducts or other underground installations.
d. The Contractor shall have full responsibility for repairing any underground structure damaged by operations.
e. The City shall have the right to require any additional inspection holes the Engineer finds necessary.
f. Tunneling under streets or trenchless boring will be allowed in accordance with the Plans and Specifications, and as permitted bythe Engineer. The Contractor is required to obtain video scan of all sewer laterals before commencement of the boring and at the end of the bore and per the direction of the Engineer.
g. Each conduit run terminating in a Pacific Gas and Electric (PG&E) Company structure shall terminate not less than one-half (1/2) inch or more than one inch short of the inside wall, leaving a recess which shall be grouted smooth into a funnel shape. The Contractor shall schedule and meet with PG&E to determine the exact location where the conduit will terminate in the PG&E structure. The Contractor shall repair any damage to the structure walls to the satisfaction of PG&E.

Extreme care must be exercised to avoid stepping on cable or supports or otherwise injuring cables. No smoking or other open flames will be allowed in manholes.

307-12.6 Payment.

REPLACE "each" WITH "all" IN SUBSECTION 307-12.6.

307-13 WIRES, CONDUCTORS AND CABLES.

307-13.1 General.

ADD NEW PARAGRAPHS TO THE END OF SUBSECTION 307-13.1 TO READ:

Wire and cable shall be installed in continuous lengths from luminaire to curb box and from curb box to curb box without intermediate splices.

The Contractor shall provide sufficient slack wire in curb boxes so that finished loops may extend at least two feet beyond the enclosure limits.

Wire, cable and pull tape or rope shall be carefully pulled in at the same time so that crossings and wrapping are avoided. The conduit system is designed as a multipurpose system; additional electric system will be installed in available conduit space.

Cable entering a curb box shall be protected from water during the construction period. The Contractor may be required to replace part or all of a cable length when an unprotected end has been in water.

Splicing chambers and fuse kits shall be carefully assembled so that they are watertight.

The Contractor shall seal conduit ends with sealing compound after wire is installed. Sealing compound shall be non-hardening, putty-like, adhesive material.

Water and/or a special lubricant approved by the Electrical Services Division are the only permissible lubricants.

All street light circuits shall be tagged in service boxes and in every curb box where more than one circuit appears. Circuits shall be identified using 3/8-inch plastic tape with letters printed with a tapewriter. The self-adhesive tape shall be wrapped around the conductors and folded back on itself to form a tag. The description shall be printed on the tail of the tag.

All detector lead-in cables shall be tagged in the curb box where they splice to the loop and magnetometer head lead-in and in the local controller. The tagging method shall be the same as described for street light circuits.

All traffic signal cables and wires shall be tagged in the curb box per Cable/Conductor Schedule shown in plans.

307-13.2 Splices.

ADD NEW PARAGRAPHS TO THE END OF SUBSECTION 307-13.2 TO READ:

Street lighting splices shall generally use approved compression type devices, Burndy Type YC-C, or equal. For "T" splices, the through conductor shall not be broken. Handmade splices may be used but procedure must be approved before making up the splices.

The splice shall be taped to 1-1/2 times the thickness of the original insulation with 3/4" wide, 7 mil, electrical tape, or approved equal. Each layer shall lap 1/4" over the preceding layer along the original insulation. Apply waterproof sealer to finished splice and allow drying before placing in the box.

307-13.3 Payment.

REPLACE SUBSECTION 307-13.3 WITH THE FOLLOWING TO READ:

Payment for wire, conductor, cable (except fiber optic cable and locator wire), splicing wire, splice chamber, and/or fuses shall be considered as included in the Contract Unit Price or lump sum price in the Bid for conduit.

Full compensation for adding or reconnecting wires, conductors, cables (except fiber optic cable and locator wire), splicing wires, splice chambers, and/or fuses in existing conduits and pull boxes shall be considered as included in the Contract Unit Price or Lump Sum price in the Bid each item that requires new wires, conductors, cables (except fiber optic cable and locator wire), splicing wires, splice chambers, and fuses.

307-13.4 Bonding and Grounding.

ADD NEW PARAGRAPHS TO THE END OF SUBSECTION 307-13.4 TO READ:

Conduit bonding and the ground rod location in curb boxes shall conform to the Standard Plans.

Ground rods shall be installed in curb boxes and/or foundations as shown on the plans.

ADD NEW SUBSECTION 307-13.5 TO READ:

307-13.5 Restoration of Existing Wires and Cables.

All existing streetlights are fully functional and the Contractor shall not modify any of the existing streetlight wirings. At locations where the Contractor must remove existing conductors to install the new substructure, the Contractor is responsible for ensuring that existing wirings are reconnected exactly as found or as specified in the plans and are left fully functional after new wires and cables are installed. The Contractor shall restore any damages they make on the existing wirings. The Contractor shall conduct tests, in the presence of the Engineer, to record the operational condition of existing wires and cables prior to completion if it is suspected that such wires or cables are not currently fully functional.

307-14 SERVICES

307-14.1 General.

ADD NEW PARAGRAPHS TO THE END OF SUBSECTION 307-14.1 TO READ:

Streetlight and traffic signal services shall be connected to the service utility's wires at those locations shown on the plans. The Contractor shall be responsible for coordinating the service installation with the serving utility.

At all new and modified service locations, the Contractor shall furnish conduit, curb box, conductors, and all other necessary material to complete the installation to the service location in accordance with the serving utility's rules and regulations. The Contractor shall pay all utility company connection.

Service arrangement for meter, fuses and circuit breakers are shown on the Plans, Standard Details or Specifications.

307-14.2 Services on Utility-Owned Poles.

ADD NEW PARAGRAPH TO THE END OF SUBSECTION 307-14.2 TO READ:

Service riser conduit shall terminate with a service head or shall be sealed to prevent the entrance of water, as approved by the serving utility.

ADD NEW SUBSECTION 307-14.6 TO READ:

307-14.6 Service Pedestal. For installation of new street lights or traffic signal system, a service pedestal that conforms to 209-3.10.2 is required.

ADD NEW SUBSECTION 307-14.7 TO READ:

307-14.7 Measurement. Service Pedestal shall be measured by each unit implemented.

ADD NEW SUBSECTION 307-14.8 TO READ:

307-14.8 Payment.

Payment for Service Pedestal shall be made for each unit implemented complete with the material, the foundation, conduit(s) for the utility service and conduits for street light/traffic signal, ground rod, pull rope, anchor bolts, circuit breakers and all other materials and labor needed to complete the installation.

The contract unit price paid for furnishing and installing the PG&E Spec Box and connecting service feeders to the PG&E service point shall include full compensation for all labor, materials, tools, equipment, and incidentals required for furnishing and installing the equipment as shown in the Plans, specified in the Specifications and the Special Provisions, as required by PG&E, and as directed by the Engineer.

REPLACE SUBSECTION 307-15.1 TO READ:

307-15.1 General. Circuit breakers conforming to 209-3.11 shall be constructed at the locations shown on the Plans. Circuit breakers used shall be enclosed in a Service Pedestal that conform to 209-3.10.2.

307-16 STREET LIGHTING CONSTRUCTION.

REPLACE SUBSECTION 307-16.2 WITH THE FOLLOWING:

307-16.2 Pull Box Covers. Pull box covers shall be inscribed “CITY OF OAKLAND” “ELECTRICAL.”

307-16.4 Wiring/Conductors.

REPLACE THE THIRD PARAGRAPH OF SUBSECTION 307-16.4 WITH THE FOLLOWING:

Each multiple lighting circuit shall be protected by a fuse mounted in a watertight inline fuse holder installed in each ungrounded conductor. The fuses shall be located in the adjacent curb box as shown on the plans and be readily accessible. Fuse Splice Connectors shall meet the requirements of Special Provisions 209-4.3.2.

307-16.7 Service.
DELETE THE ENTIRE SUBSECTION.

307-16.8 Luminiares.
REPLACE THE SUBSECTION 307-16.8.1 WITH THE FOLLOWING:
307-16.8.1 General. HPS Luminiares shall conform to 209-4.4 in the General Provisions, and LED Luminiares shall conform to 209-4.9 in the Special Provisions unless otherwise noted in the Plans and Specifications.

307-17 TRAFFIC SIGNAL CONSTRUCTION.
307-17.1 General.
ADD NEW PARAGRAPHS TO THE END OF SUBSECTION 307-17.1 TO READ:

City personnel shall energize and de-energize all traffic control circuits as needed and make any necessary changes to the existing controller.

The Contractor shall deliver the controller and/or controller cabinet assembly to City's Electrical Services Division for testing and/or programming. The Contractor shall notify the Engineer 48 hours in advance before delivering any material to the following address:

City of Oakland; Department of Public Works Maintenance Service Yard
7101 Edgewater Drive; Oakland, CA 94621
Attn: James Womack; Tel: (510) 615-5411

When testing and/or programming is/are done, the Contractor will be notified to pick up the controller and/or controller cabinet assembly for installation.

307-17.2.5 Measurement.
ADD THE FOLLOWING TO THE END OF THE FIRST WORD OF SUBSECTION 307-17.2.5 TO READ:
,controller cabinet assembly, and controller cabinet assembly and foundation

307-17.2.6 Payment.
ADD THE FOLLOWING TO THE END OF THE THIRD WORD OF SUBSECTION 307-17.2.6 TO READ:
,controller cabinet assembly, and controller cabinet assembly and foundation

ADD THE FOLLOWING TO THE END OF SUBSECTION 307-17.2.6 TO READ:

Payment for controller cabinet assembly shall include all labor, materials, tools, equipment, incidentals, required to install concrete foundation, pedestal, anchor bolts, conduit, grout, pothole investigation, remove and salvage existing controller and/or controller cabinet assembly, modify existing conduits and sweeps, remove existing foundation, modify existing sidewalk, and complete in place, in accordance with the Plans and Specifications, and Standard. The contractor shall deliver salvaged existing controller and/or controller cabinet assembly to The City of Oakland Municipal Service Yard.

307-17.3 Pull Box Covers.
REPLACE SUBSECTION 307-17.3 WITH THE FOLLOWING:

Pull box covers to be installed in signal systems or combined signal and low-voltage lighting systems shall be inscribed "CITY OF OAKLAND" "TRAFFIC SIGNAL."

307-17.5 Wiring, Conductors and Cable.
307-17.5.1 General.
ADD TO THE END OF THE THIRD PARAGRAPH OF SUBSECTION 307-17.5.1:

and approved splicing chambers.

DELETE THE SECOND LAST PARAGRAPH OF THIS SUBSECTION.

ADD NEW PARAGRAPH AT THE END OF SUBSECTION 307-17.5.1 TO READ:

Traffic signal cables shall be spliced in watertight splicing chambers. City Electrical Services Dept will furnish Splice Chamber part #s A27, A28, A29, and F24 per standard detail drawing E-57. All other splice chamber parts/components shall be furnished by contractor.

Each traffic signal circuit shall be protected by a fuse mounted in a watertight inline fuse holder installed in each ungrounded conductor. The fuses shall be located in the curb boxes as shown on the plans. Fuse kit requirements are shown in the Standard Details.

307-17.5.5 Fiber Optic Cable.

307-17.5.5.1 General

ADD NEW PARAGRAPHS TO THE END OF SUBSECTION 307-17-5.5.1 TO READ:

Fiber optic cable shall be furnished, installed, spliced, terminated, and tested by the Contractor per the standard specifications and the latest City of Oakland Telecommunications Standards. A No. 10 AWG orange jacketed locator wire shall be installed in conduit along with the SMFO cable(s).

Following splicing, the Contractor shall ensure that the underground splice closures are sealed watertight and secure.

307-17.5.5.2 Installation.

REPLACE THE LAST PARAGRAPH OF SUBSECTION 307-17.5.5.2 WITH THE FOLLOWING:

The contractor shall perform all final length measurements and order cable accordingly.

Installation procedures shall conform to the procedures specified by the cable manufacturer for the specific cable being installed, and these Special Provisions. All existing cables in existing conduit shall be removed prior to new cable installation and shall be reinstalled with new cable, if required.

All cable installation work shall be carried out in accordance and consistent with the highest standards of quality and craftsmanship in the communication industry with regard to the electrical and mechanical integrity of the connections; the finished appearance of the installation; as well as the accuracy and completeness of the documentation.

The Contractor shall make a physical survey of the project site for the purpose of establishing the exact cable routing and cutting lengths prior to the commencement of any fiber optic work or committing any fiber optic materials. The fiber shall be continuous and only be spliced at the locations shown on the Plans unless otherwise approved by the Project Engineer.

All work areas shall be clean and orderly at the completion of work and at times required by the Project Engineer during the progress of work.

Installation of the fiber optics cable shall not cause damage to the environment from release of toxic chemicals and gasses over the life expectancy of the cable, and the materials utilized shall be non-toxic to the installers.

The City shall be given at least a 48-hour notice prior to the installation of fiber optic cable into any existing conduit. All installations within conduit shall be performed in the presence of an inspector. Any existing communication conduit and related infrastructure damaged by the Contractor's operation shall be restored within 48 hours at no additional cost to the City.

The Contractor shall monitor the supply reel during installation to prevent violation of the bend radius due to back wrapping, improper winding of the cable on the reel, or loosening of the cable on the reel. At all times, the Contractor shall use the proper tools and techniques for the installation of fiber optic cable. A fiber optic cable lubricant, compatible with the jacket material of the cable, shall be utilized during the installation into the conduit. Service loops shall be provided in pull boxes and splice vaults as shown on the Plans. Cable utilizing water-blocking gels shall be

capped to prevent the gel from flowing out of the cable. Fibers and buffer tubes shall be protected at all times to prevent accidental damage or breakage.

Neatly and separately coil each slack fiber optic cable in pull boxes or vault and secure each coil to the hook and rack assembly. See Plans for splice pull box installation details. The Contractor will provide 50 feet of fiber optic cable slack at each splice location and 10 feet of slack in all other pull boxes and at the base of each cabinet.

No. 10 AWG orange jacketed locator wire shall be installed into the conduit along with the SMFO cable. The No. 10 AWG orange jacketed locator wire shall be connected at each pull box using wire nuts to form a continuous circuit for the length of the installed fiber cable.

307-17.5.5.2a Installation in Conduit Occupied by Existing SIC

ADD NEW SUBSECTION 370-17.5.5.2a TO READ:

When new fiber cable is to be installed in conduit occupied by signal interconnect cable (SIC) to be removed and salvaged, the Contractor shall first remove existing SIC according to Section 86 and the Caltrans Standard Specifications. The Contractor shall then clean the conduit with a mandrel or wire brush before pulling the new fiber cable through the existing conduit. After cleaning the existing conduit, Contractor shall install fiber cable in the existing conduit according to the procedures specified by the cable manufacturer for the specific cable being installed and these Special Provisions. All trunk fiber cable shall be installed with an insulated locator wire or equal unless approved otherwise by the Engineer.

All existing SIC removed by the Contractor shall be salvaged and delivered to the City of Oakland unless approved otherwise by the Engineer. The Contractor shall notify the Engineer 48 hours in advance before delivering any salvage material. Contractor shall deliver the salvaged SIC to the following address:

City of Oakland; Department of Public Works Maintenance Service Yard
7101 Edgewater Drive; Oakland, CA 94621
Attn: James Womack; Tel: (510) 615-5435

307-17.5.5.2b Installation in Conduit Occupied by Existing Traffic Signal Cables and Other Cables

ADD NEW SUBSECTION 370-17.5.5.2b TO READ:

When new fiber cable is shown by the Project Plans for installation in conduit occupied by traffic signal conductors and or other cables, the Contractor shall remove the existing cables and reinstall them along with the new cable in accordance with Section 86 of the Caltrans Standard Specifications. At the Contractor's option, subject to Engineer's approval, the Contractor may install a type of conduit divider or inner duct to separate the existing conductors from the new cables or conductors. If approved by the Engineer, the Contractor may pull new cable over existing conductors. If power-pulling equipment is used to pull new cable over existing cable, then the following requirements apply:

- Use a silicon-based lubricant without micro-roller spheres such as Polywater Silicon NN-128 or approved equal, when pulling new cable over existing cable. Use 1.5 times the manufacturer's recommended amount of lubricant.
- Do not exceed 0.75 times the new cable manufacturer's recommended pulling tension when installing new cable over existing cable.

After installation of new cable in conduit occupied by existing cable, verify that the existing cable continues to function as it did prior to installation. Correct or replace any existing cable that does not function properly following Contractor's activities.

The Contractor shall be responsible for any damage to existing cable as a result of Contractor's operations. In addition, the Contractor is responsible for documenting and reconnecting existing cable and wiring as found, and ensuring that it is left fully functional after new cables are installed.

The Contractor may elect to inspect and conduct tests of existing cable prior to removal, in the presence of the Engineer, to record the operational condition of existing wires. The Contractor will not be held responsible for any cable damage found, documented, and noted by the Engineer, as part of the pre-removal inspection and testing.

307-17.5.5.3 Splicing of Fiber Optic Cable.

ADD THE FOLLOWING TO THE END OF SUBSECTION 370-17.5.5.3 TO READ:

The Contractor shall install underground splice closures in 6E pull boxes or vault as shown on the Project Plans.

The Contractor shall make splices and terminate branch cable at locations shown on the Plans, as approved by the Project Engineer.

The Contractor shall make all splices as shown on the Plans in accordance with the splicing details. Trunkline splicing shall be performed to provide continuity between similar strands (i.e., splice strand 1 of upstream cable to strand 1 of downstream cable). Lateral splicing shall be made to splice the trunk cable to the 12-strand branch cables at the individual field devices as shown on the fiber splice diagram in the plan set. Intermediate splices may be made for convenience to connect cable segments between designated splice locations, but no such splices shall be less than 3,300 feet apart without the approval of the Project Engineer. The Contractor must receive approval from the Project Engineer before performing any splices that are not indicated on the Plans.

All connectors shall be factory or factory-approved installed SC or SC-compatible connectors. All connector bodies shall be metallic and all ferrules shall be ceramic. Connectors shall have a maximum insertion loss of 0.50 dB and a back reflection of greater than 35 dB. After installation, all connectors shall be cleaned with alcohol wipes and a compressed cleaning gas.

The fiber optic cable splices shall be the fusion type and shall not exceed 0.05 dB loss per splice. Splice losses shall be measured and recorded by the splicing equipment. This measurement shall not be used in lieu of OTDR testing of the fiber. All splices shall be tested in accordance with the requirements of the following subsection of these specifications.

Splices shall be housed in a splice tray in a splice enclosure and in underground splice closures or fiber termination units as shown on the Plans or specified herein. All splices shall be protected with a thermal shrink sleeve. The Contractor shall perform all outdoor splices within a tent, truck or trailer. If the Contractor wishes to use another type of facility for splicing, it must be approved by the Project Engineer on a day-by-day basis.

Cable routed through a fiber optic splice box that requires no splicing shall have 50 feet of cable coiled within that pull box to accommodate future splicing. Cable shall be coiled in all other pull boxes and cabinets per Plans.

Only those fibers that are to be spliced shall be removed from the cable and buffer tubes. All other fibers shall remain in their tubes and shall be suitably protected. The Contractor shall seal all cables where the cable jacket is removed. The cable shall be sealed per the cable manufacturer's recommendation with an approved blocking material.

Contractor shall submit to the Project Engineer for approval the resumes with references of people who will be performing splices. Splices shall be performed only by experienced personnel with experience including successful completion of no less than 2000 fusion splices. Only those individuals approved by the Project Engineer shall be allowed to make fiber optic splices.

Prior to splicing or connectorizing the fiber optic cable, the cable shall be prepared in accordance with the method described below:

- Remove jacket without damaging buffer tubes.
- Expose fibers without damaging by removing buffer tube with purpose built tool.
- Clean fibers and buffer tubes using a solvent designed to remove all water blocking gel from each exposed fiber.
- Solvent must not remove any color from individual fibers or buffer tubes and must not be harmful to the MDPE cable jacket.
- Cleave tools shall be used during splicing to cut the individual fibers as close to a perfect 90° angle as possible, thus allowing the highest core to core alignment and therefore the

lowest dB splice loss. The manufacturers of cleave tools have established "end angle" cleave averages that are based on a minimum of 150 cuts utilizing a minimum of 10 cutters. Based on these test results, the City shall allow cleave tools that have minimum end angle averages as follows: Less than 0.70° average with no cut of the 150 cleaves exceeding 1.5°. Prior to the splicing of any fiber cable, the Contractor shall submit to the Project Inspector the part number and manufacturer of the cleave tool along with an "end angle" distribution chart that demonstrates the actual 150 cut end angles.

307-17.5.5.4 Fiber Optic Pigtails.

ADD NEW SUBSECTION 370-17.5.5.4 TO READ:

Fiber strands terminating at cabinets and communications hubs shall be terminated with a connectorized pigtail. Pigtails shall be factory assembled with SC connectors with an insertion loss of 0.5dB or less. Pigtails shall be constructed with an outer jacket and dielectric strength member. Pigtails shall of a suitable length to be routed from fiber splice trays to the fiber termination panels. Splice bare end of the pigtail to fiber. Match the color of single fiber pigtails with the color of the fiber to which it is spliced. Alternatively, single fiber pigtails may be routed through colored fan-out tubing that matches the fiber to which it is spliced.

307-17.5.5.5 Splice And Cable Logging/Cable Identification

ADD NEW SUBSECTION 370-17.5.5.5 TO READ:

The Contractor shall keep accurate detailed records of each splice and each splice location. These records shall include the date each splice was made, the name of the splicer, splice location, splice loss, fiber and tube color codes, splice tray number and position of the fiber within the tray. For each splice closure, the Contractor shall provide the Project Engineer with a chart indicating the source and destination of every fiber spliced in that enclosure, and indicating the tray and position within each tray. This also applies to fibers terminated at patch panels.

To log the fiber routes, terminations and splices, the Contractor shall use a series of numbers and letters to describe the cable, tube, fiber and location of the termination or splice. The following naming convention shall be used as a guide to developing your documentation:

Intersection Name – Sequential #

Segment Name – # Strands

Buffer Tube Color – Strand Color

The Contractor shall also provide identification and labeling for all new fiber optic cables. The contractor shall submit permanent identification tags or labels and the method of attachment, for approval by the Engineer. The cables shall be labeled at all pull boxes where cable is exposed and at the near the end at all cable termination points. As a minimum, the labels shall state; City of Oakland, city contact phone number, fiber strand count, fiber type, and To/From locations. Labeling shall be by mechanical methods and labels or tags shall be non-metallic type.

307-17.5.5.7 Ethernet Edge Switch and Hub Switch.

ADD NEW SUBSECTION 370-17.5.5.7 TO READ:

The contractor shall label each switch with its intended location and deliver all switches to the City of Oakland, Traffic Management Center (TMC) or to location directed by the Engineer for configurations prior to installation. When configurations are completed, the contractor will be notified to pick up the switches for installation.

The switches shall be installed in the field cabinet or on racks in a communication room. When the switches are installed in the field controller cabinet, field devices shall be connected to the switch in the following manner:

Port #1: Traffic Signal Controller
Port #2: Remote Communication Module of Video Detection Camera System
Port #3: PTZ Camera

The contractor shall furnish and install interface cabling and interface standard adapters needed to interconnect the equipment with the existing devices to be interfaced. Provide all jumper cables, power supplies/cables, GBIC and all necessary equipments required to connect to existing communication network.

Labeling shall be done in a neat, professional manner using permanent methods and products approved by the Engineer. The Contractor shall label cables with all necessary information to properly identify the cable and it's mating connection(s).

307-17.5.5.8 Payments.

ADD NEW SUBSECTION 370-17.5.5.8 TO READ:

SMFO Trunk with Locator Wire shall be measured on a linear foot basis measured horizontally from center of pull box to center of pull box or center of pull box to center of cabinet or termination location. The contract unit price shall include full compensation for furnishing all labor, materials, tools, equipment, labeling, and for performing and coordinating the work involved in placing fiber optic cable with No. 10 AWG orange locator wire in new and/or existing conduit, terminating cables (including furnishing and installing termination panels, connectors and jumper/patch cables), splicing and testing cable, removing, storing, transporting, replacing and disposing of components as specified in these Special Provisions. Slack/coil required in pull boxes shall be incidental to the pull box installation and will not be measured or paid separately. Removal and reinstallation of all other cables in existing conduit shall be incidental to the new cable installation and will not be measured or paid separately.

12 SMFO Branch with Locator Wire shall be measured on a linear foot basis measured horizontally from center of pull box to center of pull box or center of pull box to center of cabinet or termination location. The contract unit price shall include full compensation for furnishing all labor, materials, tools, equipment, labeling, and for performing and coordinating the work involved in placing, fiber optic cable with No. 10 AWG orange locator wire in new and/or existing conduit, terminating cables (including furnishing and installing termination panels, connectors and jumper/patch cables) splicing and testing cable, removing, storing, transporting, replacing and disposing of components as specified in these Special Provisions. Slack/coil required in pull boxes shall be incidental to the pull box installation and will not be measured or paid separately. Removal and reinstallation of all other cables in existing conduit shall be incidental to the new cable installation and will not be measured or paid separately.

Underground Fiber Splice Closure shall be measured by each unit. The contract unit price bid shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals as shown in the Project Plans, specified in these Special Provisions, or as directed by the Engineer.

Edge Switch shall be measured by each unit. This shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals for doing all work involved in furnishing, installing, setting-up, cabling, labeling, coordinating, testing, mounting hardware, and submittal as shown on the plans, specified in the Standard specifications and these special provisions, and as directed by the Engineer.

Hub Switch shall be measured by each unit. This includes full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all the work involved in furnishing and installing, setting-up, cabling, labeling, coordinating, testing, mounting hardware, and submittal as shown on the plans, specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

307-17.6 Signal Heads.

307-17.6.1 General.

REPLACE THE THIRD PARAGRAPH WITH THE FOLLOWING:

All indications shall be 12 inches.

ADD TO THE LAST PARAGRAPH OF SUBSECTION 307-17.6.1 TO READ:

Side-mounted adapters shall be mounted on the standard quadrant facing the property line. The Engineer must approve locations for traffic signal mounting before drilling.

307-17.6.2 Signal Head Mountings.
REPLACE SUBSECTION 307-17.6.2 WITH THE FOLLOWING:

Signal head mounting assemblies shall be installed as shown on the plans and Standard Details. Replaced signal mounting hardware shall be salvaged and delivered to the Maintenance Service Yard of the City of Oakland.

307-17.6.5 Measurement.
ADD THE FOLLOWING TO THE END OF THE SECOND WORD:
, and vehicular signal mounting

307-17.6.6 Payment.
ADD THE FOLLOWING TO THE END OF THE FIFTH WORD OF SUBSECTION 307-17.6.6:
and vehicular signal mounting

307-17.7.3 Inductive Loop Detectors.
SUBSTITUTE THE TWO PARAGRAPHS UNDER ITEM a) AND ITEM b) OF SUBSECTION 307-17.7.3.2 WITH THE FOLLOWING:

a) Detector loops shall be installed as detailed on the construction plans and specifications and in accordance with the Standard Details.

RENUMBER THE c) PARAGRAPH IN SUBSECTION 307-17.7.3.2 AS THE b) PARAGRAPH

REPLACE THE LAST SENTENCE IN THE PARAGRAPH UNDER ITEM c) OF SUBSECTION 307-17.7.3.2 WITH THE FOLLOWING SENTENCE:

The measurement shall be made using the nearest ground and the shield (if any) of the lead-in shall be grounded.

ADD THE FOLLOWING AT THE END OF THE SECOND LAST PARAGRAPH IN SUBSECTION 307-17.7.3.2 TO READ:

Sprinkle dry cement on top of the loop sealant to prevent lifting by vehicle tires during the setting period.

DELETE THE SECOND SENTENCE OF THE 8TH PARAGRAPH OF SUBSECTION 307-17.7.3.2.

307-17.7.4 Magnetometer Detectors.
SUBSTITUTE THE LAST PARAGRAPH OF SUBSECTION 307-17.7.4 WITH THE FOLLOWING:

The epoxy sealant for the slots and holes shall be as shown in the Standard Details, except the top 3 inches (76 mm) of the holes shall be filled with the epoxy sealant.

ADD NEW SECTION 307-17.7.5
307-17.7.5 Video Detection Camera. The Contractor shall furnish and install video detection camera and all components as specified in these Special Provisions. The video detection shall be mounted at best possible locations with approval from the Engineer.

The video detection complete system shall be installed and tested by supplier factory-certified installers and as recommended by the supplier. Proof of factory certification shall be provided.

The supplier of the vide detection system shall program and configure all equipment and components for the intended detection zones. The supplier shall work with the City to develop the detection zone requirements, program the detection zone and test the performance of the system.

Run coaxial cable serving the cameras shall be un-spliced between the camera and controller cabinet, with ten feet of slack provided in the controller cabinet.

307-17.8.3 Measurement.
ADD THE FOLLOWING TO THE END OF THE SECOND WORD:

, pedestrian signal mounting

307-17.8.4 Payment.
ADD THE FOLLOWING TO THE END OF THE FOURTH WORD:
, pedestrian signal mounting

REPLACE SUBSECTION 307-19 WITH THE FOLLOWING:
307-19 PAINTING AND GALVANIZING.

1. Upon receipt of the lighting standards, the Contractor shall spot-prime all damaged areas with a high quality automotive gray enamel primer equal to Sherwin Williams primer #B50N2.
2. Pole finish shall be galvanized or painted with an alkyd resin automotive enamel of one of the following four standard colors, as per the City Outdoor Lighting Standards: a) RAL 6011 Boxwood Green, b) RAL 6009 Dark Green, c) RAL 5020 Teal Green, and d) RAL 9004 Signal Black. The thickness of the finish enamel shall be 1.5-mil minimum.
3. Application shall be by brush or by spray without runs or holidays. The drying time between paint layers shall be as recommended by the manufacturer.
4. When completed, the lighting standard shall have a uniformly glossy appearance with a minimum of 2.5 mils of paint on the pole and an average thickness not less than 3 mils taken at five random points on the pole.
5. Before painting, all standards and pedestals shall be installed on their foundations and shall be painted with the standard bolted in place.
6. Standards used for streetlight and traffic signals shall have the bottom 10 feet painted with two coats of enamel. If a traffic signal mast arm is installed, it also shall have two coats of this enamel.
7. The traffic signal standards and controller cabinets shall be painted with two coats of enamel. Base covers and signal head mounting brackets shall be painted to match traffic signal head color.
8. After final painting has been accepted, the pole number shall be affixed on the quadrant facing traffic. Numbers shall read from top to bottom with the bottom numeral five (8) feet six (6) inches above sidewalk grade as per Standard Details.
9. Previously painted standards that are relocated shall be spot-primed and repainted with two coats of finished enamel applied as specified above.
10. Refer to Standard Details for painting colors and configurations.
11. Do not paint galvanized streetlight or traffic signal standards, galvanized mast arms or intermediate metal conduit standards.

307-20 SALVAGE.
ADD NEW PARAGRAPH AT THE END OF SUBSECTION 307-20 TO READ:

Where an existing system is to be modified, the existing material shall be reused in the revised system, or removed and returned to the City. The Contractor shall notify the Engineer 48 hours in advance before delivering any salvage material. The Contractor shall unload the salvage material in an area designated by the Engineer.

ADD NEW SECTION 307-21
307-21 Global Positioning System (GPS) Time Source
307-21.1 General. The Contractor shall furnish and install GPS Time Source per manufacturer's recommendations in providing a fully functional unit.
307-21.2 Payment. The unit contract price for GPS Time Source unit shall include full compensation for furnishing all labor, material, tools, equipment and incidentals, and for doing all work involved with this line item as shown on the Plans, as specified in these Special Provisions and as directed by the Engineer.

ADD NEW SECTION 307-22
307-22 Internally Illuminated Street Name Sign (IISNS)
307-22.1 General. The Contractor shall furnish and install IISNS per manufacturer's recommendations and according to details in the Plans and these Special Provisions to make the assembly completely operational.

307-22.1 Payment. The unit contract price for IISNS shall include full compensation for furnishing all labor, material, tools, equipment and incidentals, and for doing all work involved with this line item as shown on the Plans, as specified in these Special Provisions and as directed by the Engineer. Full compensation for all additional materials and labor, not shown on the plans or specified, which are necessary to complete the installation of the various systems, shall be considered as included in the prices paid for other items of work, and no additional compensation will be allowed therefore.

ADD NEW SECTION 307-23

307-23 Pan-Tilt-Zoom (PTZ) Closed Circuit Television (CCTV) Camera System

307-23.1 Installation. The Contractor shall furnish and install CCTV camera assemblies per manufacturer's recommendations and according to details in the Plans and these Special Provisions to make the assembly completely operational. All cables shall be concealed inside the pan-tilt unit, pole standard, and other mounting hardware.

After all cameras are installed and tested, the Contractor shall arrange an interactive session with the Project Engineer to fine tune the aiming and other adjustments at cameras, including the stop points and presets for moveable cameras. This session shall enable the Project Engineer to observe the images at the Oakland TMC while being in verbal communication with the Contractor at the camera. The Contractor shall make adjustments as directed by the Project Engineer to establish up to 4 preset views at each camera. The Project Engineer will continue to observe the image while adjustments are made and will direct further adjustments as needed during this session to achieve the desired view and picture quality. A representative of the Contractor shall accompany the Project Engineer in the TMC during this procedure.

The placement of equipment in traffic signal cabinets shall be as shown in the Plans and directed by the Project Engineer on a cabinet-by-cabinet basis. Equipment may be placed on shelves or attached to the underside of shelves or the wall of the cabinet.

All setup, configuration, and permanent data entry shall be performed by the Contractor with directions from the Engineer prior to entry. Installation and configuration of video equipment and cameras shall be performed by personnel experienced in the installation and configuration of similar systems. Such personnel shall be particularly experienced with CCTV, fiber optic cable termination equipment, and interfaces between such equipment.

Cameras shall use the electrical power supply 60 Hz signal for synchronization. After installation, the Contractor shall adjust the phase setting to synchronize all cameras, and other video sources where possible.

307-23.2 Payment. The PTZ CCTV Camera System shall be measured on an each basis. The contract unit price shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals and for performing the work involved including installation/mounting of camera, mounting hardware, camera cable installation, programming, configurations and testing as specified in these Special Provisions, and as directed by the Engineer.

Attachment 1 – Submittal List

CONTR=Contractor; SUPPL= Supplier Subsection 2-5.3.3

NO.	REQUIRED SIGNATURES		ITEM	TYPE	SPECIFICATION NO.
	CONTR	SUPPL	Electrical Components	Anchor Bolts, Nuts and Washers	209-3.2
	CONTR	SUPPL	Electrical Components	Standards	209-3.3
	CONTR	SUPPL	Electrical Components	Conduit	209-3.5
	CONTR	SUPPL	Electrical Components	Pull Box	209-3.8
	CONTR	SUPPL	Electrical Components	Service Pedestal	209-3.12
	CONTR	SUPPL	Electrical Components	Wire/Conductors	209-4.2
	CONTR	SUPPL	Electrical Components	Fuse	209-4.3.2
	CONTR	SUPPL	Electrical Components	HPS Luminaire	209-4.4
	CONTR	SUPPL	Electrical Components	Photocell	209-4.7
	CONTR	SUPPL	Electrical Components	LED Luminaire	209-4.9
	CONTR	SUPPL	Electrical Components	Signal Cable	209-5.3
	CONTR	SUPPL	Electrical Components	Fiber Optic Cable	209-5.3.4
	CONTR	SUPPL	Electrical Components	Underground Fiber Splice Closures	209-5.3.4.7
	CONTR	SUPPL	Electrical Components	Ethernet Edge Switch	209-5.3.4.8
	CONTR	SUPPL	Electrical Components	Hub Switch	209-5.3.4.9
	CONTR	SUPPL	Electrical Components	Controllers	209-5.4
	CONTR	SUPPL	Electrical Components	GPS Based Time Source Receiver	209-5.4.1b
	CONTR	SUPPL	Electrical Components	LED Signal Heads	209-5.5
	CONTR	SUPPL	Electrical Components	LED Countdown Ped Heads	209-5.6
	CONTR	SUPPL	Electrical Components	Signal Mounting Assemblies	209-5.7
	CONTR	SUPPL	Electrical Components	Video Detection	209-5.8.4
	CONTR	SUPPL	Electrical Components	Polara Push Button	209-5.9
	CONTR	SUPPL	Electrical Components	Splice Chamber	209-5.10
	CONTR	SUPPL	Electrical Components	IISNS	209-5.11
	CONTR	SUPPL	Electrical Components	PTZ Camera	209-5.12
	CONTR	SUPPL	Electrical Components	EVP	209-5.13

*All specification designations refer to the Standard Specifications for Public Works Construction (Green Book), 2009 Edition; these Special Provisions; and the City of Oakland Standard Details for Public Works Construction, 2002 Edition. This list is intended to be comprehensive, but no claim for their completeness is implied, and submittal of each and every item on the lists shall not relieve the Contractor of supplying all information needed, or of complying with any of the other requirements of the specifications. Revised lists may be issued and items may be added to the list supplied.

Attachment 14

CITY OF OAKLAND

INFORMATION TECHNOLOGY DIVISION (ITD)

TELECOMMUNICATIONS STANDARDS

21st Century Edition
March 1, 2012

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Data Cabling Standards and Specifications

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Bibliography

CITY OF OAKLAND OFFICE OF INFORMATION TECHNOLOGY

TELECOMMUNICATIONS WIRING STANDARD

February 27, 1991 Revision VI January 2000

Long Beach Unified School District Data Cabling Standards and Specifications
www.lbusd.k12.ca.us/technology/standards/datacabling.pdf

Technical Specifications for the Installation of Fiber Optic Cable (Campus, UC Berkeley)

System Installation and Wiring Guide, Oakland Unified School District
Research and Development Laboratory for Learning Technologies (Technology Services Department), January 2, 2001, Document # 001001, Version 1.0 Beta.

Data Cabling Standards and Specifications

Introduction and Special Notes

The City of Oakland's (hereafter referred to as "City") Telecommunications Wiring Standards and specifications are designed to provide building transmission requirements that meet the operational needs of City Government. The standard is designed to support the competitive bid process and does not unduly restrict serious providers of telecommunications equipment or services.

This document describes the requirements governing the installation of all telecommunications building wiring purchased and used by the City, California. For correlation with industry, this document refers to applicable building codes in force within the City, including the National Electrical Code (NEC). Where there is conflict with applicable building or electrical codes the more stringent requirement shall be used.

The City may determine if equipment meets these specifications by beta testing and evaluating a sample of the basic model/series of equipment at the testing facility at 150 Frank H. Ogawa Plaza Suite 7211, Oakland, California 94612, telephone (510) 238-4716.

Telecommunications wiring standards are required by the City to support all phases of the City Government's voice, video, and data activities and applications. Telecommunications activities supported involve the transportation of information within and between buildings in urban and industrial areas of the City of Oakland, utilizing any and all types of transmission media.

The City reserves the right to reject any transmission media if, in our professional opinion, it fails to exhibit compliance with this standard or appears unsuitable for specific requirements.

Comments regarding this standard should be addressed to Chief Technology Officer, Information Technology Division, 150 Frank H. Ogawa Plaza, Suite 7335 Oakland, California 94612, phone (510) 238-2023.

The City's goal is to have certified cable installations at all sites. Network Contractors **are required** to be certified by the appropriate manufacture(s) for the cabling plant that exists at the campus the work is requested. Installation must include a 15-year manufacture's warranty (Section 2.1). The City will specify the required standard and manufacture's requirement for each job.

Areas of special note:

Patch Cable Requirement. The following patch cables are to be included in any quote provided to the City for cabling installations at plaza and remote branch offices. Sufficient patch cables to populate 100% of the installation, plus 10% spares are required (Sections 2.3.2.2 & 2.3.2.3). Unless otherwise stated in the RFQ, the contractor will deliver:

- IDF (Copper) – 3 feet in length, CAT5E Certified. Color will be blue (Section 2.3.2.2)
- Station Cables to attach computers to network (Copper) – 10 feet in length, Cat5E Certified. Color will be Blue (Section 2.3.2.2)
- IDF/MDF (Fiber) – Fiber patch cables to match fiber installation. Two meters in length (Section 2.3.2.3).

Test Results

Each port must pass the appropriate test for the type of cable installed. Test results for each port will be delivered to the City in both printed and electronic formats. (Section 3.2-all sub-sections)

Labeling

Each port (fiber or Cat5E) must be labeled according to the standards listed in Sections 6.0, 6.1, 6.1.1, and 6.1.2.

As-Builts

As-builts are to be included for any cabling installed (Section 1.4.2.1). City requires a laminated copy of the final as-built, plus an electronic copy of the CAD file. Electronic drawings for the site will be provided to the contractor if they exist. If there are no electronic as-builts, the contractor will be expected to create an original CAD drawing. Work added to an existing as-built is to be "clouded" on the drawing and appropriate notes are to be added to the legend indicating the scope, contractor, and date of completion.

STRUCTURED TELECOMMUNICATIONS CABLING AND PATHWAY SYSTEM

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

CALIFORNIA BUILDING STANDARDS COMMISSION

California Electrical Code (CEC) (2001) Title 24, Part 3

ELECTRONIC INDUSTRIES ASSOCIATION (EIA)

EIA/TIA TSB-75	(1996) Additional Horizontal Cabling Practices for Open Offices
EIA/TIA-455-21	(1988) FOTP-21 Mating Durability of Fiber Optic Interconnecting Devices

EIA-492AAAA	(1989) 62.5 uM Core Diameter/125 uM Cladding Diameter Class Ia Multi-mode, Graded-Index Optical Waveguide Fibers
EIA/TIA-526-7	(1994) Optical Power Loss Measurements of Installed Single-mode Fiber Cable Plant
EIA/TIA-526-14	(1990) OFSTP-14 Optical Power Loss Measurements of Installed Multi-mode Fiber Cable Plant
TIA/EIA-568-B.1, B.2	(Fall 2001) Commercial Building Telecommunications Wiring Standard
TIA/EIA-568-B.2-1	(2002) Transmission Performance Specifications for 4-Pair 100 Ohm Category 6 Cabling
TIA/EIA-568-B.2-2	(2001) Commercial Building Telecommunications Cabling Standard - Part 2: Balanced Twisted-Pair Cabling Components - Addendum 2 (ANSI/TIA/EIA-568-B.2-2-2001)
TIA/EIA-568-B.2-3	(2002) Commercial Building Telecommunications Cabling Standard - Part 2: Balanced Twisted-Pair Cabling - Addendum 3 - Additional Considerations for Insertion Loss and Return Loss Pass/Fail Determination (ANSI/TIA/EIA-568-B.2-3-2002)
TIA/EIA-568-B.2-5	(2003) Commercial Building Telecommunications Cabling Standard - Part 2: Balanced Twisted-Pair Cabling Components - Addendum 5 - Corrections to TIA/EIA-568-B.2-5 TIA/EIA-568-B.3 (2000) Optical Fiber Cabling Components Standard (ANSI/TIA/EIA-568-B.3-2000)
TIA/EIA-569-A	(1998) Commercial Building Standard for Telecommunications Pathways and Spaces (ANSI/TIA/EIA-569-A-98)
TIA/EIA-569-A-1	(2000) Commercial Building Standard for Telecommunications Pathways and Spaces, Addendum 1 (ANSI/TIA/EIA-569-A-1-2000) This addendum defines the surface raceways contained in the work area outlets.
TIA/EIA-569-A-2	(2000) Commercial Building Standard for Telecommunications Pathways and Spaces, Addendum 2 (ANSI/TIA/EIA-569-A-2-2000) This addendum defines the furniture pathways and spaces contained in work areas.
TIA/EIA-570-A	(1999) Residential and Light Commercial Telecommunications Wiring Standard TIA/EIA-606-A (2002) Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
TIA/EIA-607-A	(2002) Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications

(ANSI/JSTD—607-A-2002)

FEDERAL COMMUNICATIONS COMMISSION (FCC)

FCC Part 68.5	Establishment of Telephone Premises Wiring Attestation List

INSULATED CABLE ENGINEERS ASSOCIATION (ICEA)

ANSI/ICEA S-80-576	(1994) Communication Wire and Cable for Wiring of Premises

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA WC 63	(1994) Telecommunications Cables

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2002) National Electrical Code

RURAL ELECTRIFICATION ADMINISTRATION (REA)

REA 345-165	(1989) Digital Stored Program Controlled Central Office Equipment (Form 522)
REA TECM 823	(1980) Electrical Protection by Use of Gas Tube Arrestors

UNDERWRITERS LABORATORIES INC. (UL)

UL 444	(1994; R 1995, Bul. 1995 and 1996) Communications Cables
UL 467	(1993; Bul. 1994 and 1996, R 1996) Grounding and Bonding Equipment
UL 497	(1995) Safety Protector for Paired Conductor Communication Circuit
UL 514C	(1988; R 1989, Bul. 1993 and 1994) Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers
UL 910	(1995; R 1995, Bul. 1995 and 1996) Flame-Propagation and Smoke-Density Values for Electrical and Optical-Fiber Cables Used in Spaces Transporting Environmental Air
UL 969	(1995) Marking and Labeling Systems
UL 1286	(1993) Office Furnishings

UL 1581	(1991; Bul. 1993, 1994, 1995, and 1996, R 1996) Electrical Wires, Cables, and Flexible Cords
UL 1666	(1991; Bul. 1995 and 1996) Flame Propagation Height of Electrical and Optical-Fiber Cables Installed in Vertical Shafts
UL 1863	(1995) Communication Circuit Accessories

PUBLIC WORKS STANDARDS, INC.

GREENBOOK Green Book Standard Specifications For Public Works Construction 2000

1.2 DEFINITIONS

1.2.1 Main Distribution Frame (MDF)

A. A physical concentration or central location for terminating backbone cables to interconnect with local exchange carrier (LEC) equipment at the activity minimum point of presence. The MDF generally includes vendor specific components to support voice and data circuits, building surge protector assemblies, main cross connect blocks, equipment support frames, and plywood backboard. Depending upon local site conditions, the MDF and IDF may be identical.

1.2.2 Intermediate Distribution Frame (IDF)

A. An intermediate termination point for horizontal wiring and cross connections normally within another structure separate from the MDF. Ensure that a plywood backboard is installed in the IDFs.

1.3 SYSTEM DESCRIPTION

A. The structured telecommunications cable and pathway distribution and wiring system shall include permanently installed backbone and horizontal cabling, horizontal and backbone pathways, workstation pathways, telecommunications outlet assemblies, conduit, raceway, and hardware for terminating, and interconnecting.

B. The horizontal system includes the cabling and pathway between the IDF and the work area telecommunications outlet.

C. The backbone cabling and pathway system includes the interconnecting cabling, pathway, and terminal hardware to provide connectivity between the MDF's, and IDF's.

D. The backbone system shall be wired in a star topology with the MDF at the center or hub of the star.

E. Hardware and terminating equipment shall consist of UL approved Category 5E patch panels, jacks, and fiber optic terminating equipment at existing City facilities and Cat 6 components in new construction sites.

F. Backbone cable shall consist of Multi-mode fiber optic cable (OFN). Determination for use of 62.5/125µm or 50/125µm will be made on a site-by-site basis.

G. Inter-building backbone pathways will consist of 2" conduits, existing conduits or a combination of both, as per the drawings.

H. Horizontal pathways will consist of 2" conduits, existing conduit and raceway, Panduit LD 5 or LD 10 or equivalent raceway or combination of both, as per the drawings.

I. Structured Telecommunications Cabling and Pathways Systems shall be installed in a "neat and workmanlike manner" as specified by *ANSI/NECA/BICSI 568-2001* and *National Electrical Code,* Sections 110-12 and 800-6.

1.4 SUBMITTALS

A. Contractor is to submit the following prior to construction for City approval:

1.4.1 Manufacturer's Catalog Data

A. Telecommunications cabling (backbone and horizontal)

1. Fiber optic type connectors, ST for multi-mode or SC for single-mode as required
2. Telecommunications outlet/connector assemblies RJ-45 jack
3. Equipment support rack
4. Patch Panels (Copper and Fiber optic)
5. Power Strips and UPS
6. Cable Hangers
7. Floor outlet boxes or modules

8. Firestop material

9. External mounted raceway

10. Cable tray

1.4.2 Drawings

A. Telecommunications Drawings

B. Distribution Frame Elevations

1.4.2.1 Telecommunications Drawings

A. Provide registered communications distribution designer (RCDD) approved drawings complete with wiring diagrams and details required to prove that the distribution system shall properly support connectivity from the MDF to the IDF to the telecommunications work area outlets.

B. Show the layout of cabling and pathway runs, MDF, IDF and ground system. Drawings shall depict final telecommunications cabling configuration, including location, gage, pair assignment and patch panels after telecommunications cable installation.

C. Provide a plastic laminated schematic of telecommunications cable system showing cabling, IDF's, MDF's, and equipment rooms keyed to floor plans by room number.

D. Provide two (2) electronic copies of As-Builds to City.

1.4.2.2 Distribution Frames

A. Provide shop drawing showing layout of applicable equipment including incoming IDF racks, patch panels and LAN equipment.

1.4.3 Statements

A. Installer qualifications

B. Test plan

C. Professional References

D. Labeling Scheme

1.4.3.1 Installer Qualifications

A. Prior to installation, submit data of installer's experience and qualifications, which shall include 3 years on projects of similar complexity. Include names and locations of two projects successfully completed using fiber optic and copper communications cabling systems in similar environments.

B. Installers shall be Panduit certified or City approved equivalent. Include written certification from users that systems have performed satisfactorily for not less than 18 months.

C. Include specific experience in installing and testing structured telecommunications distribution systems using fiber optic and Category 5E or higher, cabling systems.

1.4.3.2 Test Plan

A. Provide a complete and detailed test plan for the telecommunications cabling system including a complete list of test equipment for the UTP and OFN components and accessories. Include procedures for certification, validation, and testing.

B. Furnish factory reel tests for fiber optic cables.

1.4.3.3 Professional References

A. Provide a list of at least five professional references for similar projects. Include Company names, Contacts, phone numbers and a description of project.

1.4.3 Factory Test Reports

A. Factory reel tests

1. Furnish factory reel tests for fiber optic cables.

1.4.4 Field Test Reports

A. Telecommunications cabling testing

1.4.6 Operation and Maintenance Manuals

A. Telecommunication's cabling and pathway system

1.4.7 Schedules

A. MS Project Construction Schedules are required for each project

1.5 DELIVERY AND STORAGE

A. Provide protection from weather, moisture, dirt, dust and other contaminants for telecommunications cabling and pathway equipment placed in secured storage.

PART 2 PRODUCTS

2.1 COMPONENTS

A. UL or third party certified. Provide a complete system of telecommunications cabling and pathway components using star topology and support structures, pathways, and spaces complete with conduits, pull wires, raceways, pull boxes, outlets, cables, ground boxes, as per the drawings. Fixed cables and pathway systems for telecommunications systems shall be UL listed or third party independent testing laboratory certified, and shall comply with NFPA 70. Horizontal cable and termination equipment shall be of a manufacture, installed and certified so as to provide a 15-year warranty:

2.2 PATHWAYS (BACKBONE AND HORIZONTAL)

A. TIA/EIA-569-A. Pathway shall be conduit, and raceway installations. Provide grounding and bonding as required by TIA/EIA-607-A.

B. Pathways shall be installed in accordance with NEC Article 314 and Article 800.51 (J), (K), or (L), as applicable, and installed in accordance with Articles 362.24 through 362.56, where the requirements applicable to electrical nonmetallic tubing apply.

2.3 TELECOMMUNICATIONS CABLING

A. Cabling shall be UL listed for the application and shall comply with EIA TSB-67, TIA/EIA-568-B.1, B.2 and NFPA 70. Cabling shall consist of Category 5E, or 6 UTP as required and OFNP/FT6. Plenum cables shall comply with UL 910. Provide a labeling system for cabling as required by TIA/EIA-606-A and UL 969. Cabling manufactured more than 12 months prior to date of installation shall not be used. OFN shall comply with UL 1581 vertical tray flame test. OFNP may be substituted for OFNR. OFNG, OFN may be substituted for OFNP, OFNR.

2.3.1 Backbone Cabling

A. Shall be a minimum of indoor/outdoor rated, tight-buffered 12 strand 62.5/125 multi-mode or 12-strand 50/125 multi-mode fiber optic cable.

2.3.2 Horizontal Cabling

A. Comply with NFPA 70, NEMA WC 63, ANSI/ICEA S-80-576 and performance characteristics in TIA/EIA-568-B.1 and B.2 UTP, four-pair 100 ohm.

B. Provide four each individually twisted pair, 24 AWG or 22 AWG conductors enclosed by an overall plenum-rated jacket.

C. Individual pairs shall be constructed to contain minimum two twists per foot per each pair.

D. Overall diameter of four pair cable shall not exceed 0.25 inches.

E. Ultimate breaking strength shall be minimum 90 pounds.

F. Four pair cable shall withstand a bend radius of one-inch minimum at a temperature of minus 20 degrees C maximum without jacket or insulation cracking.

G. Conductors shall be color coded and polarized in accordance with TIA/EIA-568-B.1 and B.2.

H. Enhanced performance Category 5E UTP plenum cable for local area networks shall exceed TIA/EIA-568-B.1 and B.2 standards.

I. Conductor shall be a 24 AWG solid annealed copper wire.

J. Primary insulation shall be FEP fluoropolymer resin for each pair.

K. Cable shall be plenum rated and shall comply with NFPA 70, UL 444, and UL 910.

L. Manufacture: Panduit or City approved equivalent Enhanced Category 5E.

2.3.2.2 Category 5E Patch Cables

A. UTP Patch Cables. Patch cables for unshielded twisted pair cable shall be Category 5E rated and shall be equipped with factory-attached connectors

to interconnect equipment mounted on the racks of the distribution frame and to connect computer stations to outlet locations.

B. Patch cords may also be used for patching applications not to exceed 20 feet. Quantity required for 100% port population with 10% spare.

C. Manufacture: Panduit, AllenTel or City approved equivalent.

2.3.2.3 Fiber Optic Patch Cables.

A. Fiber Optic Patch Cables shall be multi-mode or single-mode (to conform to desired plant) patch cords pre-made to connect fiber optic equipment with fiber optic cross connects, interconnects and outlets. Patch cables shall be duplex and conform to properly connect to equipment.

B. The patch cords (jumpers) shall be impact-resistant multi fiber cables, SC or ST connectors as required, of the same performance characteristics as the multi-mode fiber backbone being connected (62.5/125µm or 50/125µm).

C. These fiber optic patch panel connections shall provide 0.4 dB or less insertion loss and provide connection between the Active LAN devices and the Fiber Optic patch panel. Quantities for 100% population plus 10% Spares.

2.4 DISTRIBUTION FRAMES

A. Provide intermediate distribution frames (IDF's), per each project site walk for terminating and cross connecting permanent cabling.

2.4.1 Equipment Support Cabinet

A. Fully enclosed, lockable, modular type steel construction and treated to resist corrosion.

B. IDF cabinets shall be wall mount/swing out type and provide 19" rack mounting.

C. Rack shall be designed to allow for left or right-hand swing. Minimal dimensions shall be approximately 24"H X 22" W X 24" D.

D. Cabinet shall be mounted on plywood backboard in location to be determined.

E. In selected cases, a 48" high cabinet will be used. Larger cabinet size or 7' open rack will be determined on a project-by-project basis.

2.4.2 Copper Patch Panels

A. UTP patch panels shall be rack mounted, rated to exceed EIA/TIA Category 5E modular (8 position) patch panels each wired to terminate modular jacks per the EIA/TIA T568A standard.

B. Quantities of jacks are based on the number of UTP cables originating at wall outlets and terminating at the patch panel.

C. All voice cables to be terminated on 110 blocks on backboard.

D. All patch panels shall be grounded.

E. Manufacture: Panduit or City approved equivalent Enhanced Category 5E.

F. Wire Managers

2.4.3 Fiber Optic Patch Panel

A. Provide panel for maintenance and cross connecting of fiber optic cables.

B. Panel shall be constructed of 0.125-inch minimum aluminum and shall have connectors which interface the inside plant fiber optic jumper cable with the outside plant fiber optic cable.

C. Panels shall be equipped with engraved laminated plastic nameplates above each connector.

D. Rack-mounted fiber patch panels shall be equipped to terminate or splice the incoming inter-building fiber and any required backbone or interconnect cables.

E. Each cable must be properly dressed.

F. These units will terminate the fiber optic cables, provide a place for jumper cables and will provide room to terminate additional optics.

G. All connectors will be types SC for single-mode or ST for multi-mode pursuant to circumstance.

H. The fiber optic patch panel connections shall provide 0.4 dB or less insertion loss.

I. All patch panels shall be grounded.

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2.5 TELECOMMUNICATIONS OUTLET/CONNECTOR ASSEMBLIES

A. Jacks shall comply with FCC Part 68.5, and TIA/EIA-568-B.1 and B.2.

B. Jacks shall accommodate UTP or OFN and work in concert with Panduit LD 5 or LD 10 or City approved equivalent raceway.

C. UTP jacks shall be RJ-45 designation T568A type, UL 1863 listed, eight position, constructed of high impact rated thermoplastic housing rated for Category 5E service.

D. UTP jacks for data shall be Category 5E hardware and shall comply with the attenuation requirements contained in TIA/EIA-568-B.1 and B.2.

E. UTP jacks for voice shall be (two) RJ-11 designation type, UL 1863 listed, four position, constructed of high impact rated thermoplastic housing rated for Category 3 service.

F. Telecommunications cover plates shall comply with UL 514C, and TIA/EIA-568-B.1 and B.2; flush design constructed of high impact thermoplastic material.

G. Stenciled lettering for voice and data circuits shall be provided using thermal ink transfer process.

H. Manufacture: Panduit or City approved equivalent Enhanced Category 5E.

2.6 RACEWAY

A. Conceal cable pathways within walls whenever possible.

B. Unless otherwise indicate, raceway shall be three channel, Panduit LD 5 or LD 10 with all necessary hardware and equipment to install Panduit or City approved equivalent certified UTP cable system as described above.

C. Raceway shall be ivory in color, or to match electrical outlets on new/remodel construction.

D. Notching or modifications of raceway will not be permitted.

2.7 BACKBOARDS

A. Provide fire rated plywood ¾ inch thick 8'H X 4' W for mounting of IDF cabinet.

B. Backboards shall be painted with a white, nonconductive fire-resistant overcoat.

2.8 GROUNDING AND BONDING PRODUCTS

A. Comply with UL 467, TIA/EIA-607-A, and NFPA 70. Components shall be identified as required by TIA/EIA-606-A.

2.9 FIRESTOPPING MATERIAL

A. Contractor shall provide all necessary fire stopping of openings through which cable is installed under this specification, in accordance with NFPA 70 and all local codes. This includes installation in conduits, raceways, or bare penetrations. Provide and install UL 1479 approved (Fire Barrier Caulk) firestop material.

2.10 POWER STRIP (Power Distribution Unit) AND UPS

A. Install Perma Power #JT06BOB, Geist SP120-10 Surge Protector, or City approved equal. This shall be connected to an APC Smart-UPS 2200 when Network Equipment will be connected. A Network Management Card (APC9617) must be included and properly configured to provide City staff alerts if there are issues associated with the UPS.

PART 3 EXECUTION

3.1 INSTALLATION

A. Telecommunications cabling and pathway systems, including the horizontal and backbone cable, pathway systems, telecommunications outlet/connector assemblies, and associated hardware shall be installed in accordance with TIA/EIA-568-B.1, B.2, B.3, TIA/EIA-569-A, NFPA 70, and UL standards as applicable.

B. Cabling shall be connected in a star topology network.

C. Contractor shall provide all necessary tools and materials not specified, (tie wraps, "D" rings, screws, consumables, hardware, etc.) and equipment, (ladders, hydraulic lifts, storage containers, etc.) necessary to provide a complete and operating system.

D. Installation methodologies shall adhere to manufacturer installation procedures so as to not violate certifications (i.e. UL).

E. All work shall be performed in a workmanship-like manner leaving each location in the same or better condition as at the start of each project.

F. The designated City representative shall be provided progress reports.

G. Periodic on-site inspections will be done during the course of installation.

H. The City reserves the right of "local jurisdiction" for final approval.

3.1.1 Cabling

A. Install Category 5E UTP and OFN telecommunications cabling and pathway system in accordance with TIA/EIA-568-B.1, B.2 and the drawings.

B. Cabling installation shall comply with EIA TSB40-A and EIA TSB-36.

C. Screw terminals shall not be used except where specifically indicated on plans.

D. Do not untwist Category 5E UTP cables more than ¼ inch from the point of termination to maintain cable geometry.

E. Do not exceed manufacturers' cable pull tensions for copper and fiber optic cables. Provide a device to monitor cable pull tensions. Do not exceed 25 pounds pull tension for four pair copper cables.

F. Do not chafe or damage outer jacket materials.

G. Use only lubricants approved by cable manufacturer.

H. Do not over cinch cables with tie wraps or crush cables with staples.

I. For UTP cable bend radii shall not be less than four times the cable diameter.

3.1.1.1 Open Cable

A. Use only where specifically indicated on plans or determined during site surveys.

B. When not run in surface mounted raceway or conduit, utilize cable hooks above suspended ceilings and in all ceiling spaces.

C. Comply with TIA/EIA-568-B.1 and B.2.

D. Install cabling above suspended ceilings 6 to 12 inches above ceiling T-bar using cable hooks spaced on 12 to 24 inch centers and securely attached to structural ceiling.

E. Do not exceed cable pull tensions recommended by the manufacturer.

1. Plenum cable shall be used in all where applicable per code. Plenum cables shall comply with flammability plenum requirements of NFPA 70 and shall comply with UL 910.

2. Avoid routing copper cable in areas where there may be high levels of electromagnetic interference (EMI). EMI is caused by AC power lines, broadcast signals, X-ray equipment, motors, generators, and fluorescent lights. UTP cables shall be routed at least 5 inches away from fluorescent lighting fixtures.

3. Cables shall be placed in the support device, J-hooks located every 4 feet, as long as they are separately bundled and tie-wrapped using Velcro ties.

4. Cabling shall be organized and identified so as to facilitate locating and handling individual sheaths for maintenance functions.

5. Each bundle shall be neatly tied without over cinching or stressing cable.

6. Bundles shall be clearly marked identifying the IDF and room to which routed, the station numbers served by the bundle, and any other information that may assist in administration.

7. Great care shall be taken to protect all cabling from physical damage.

8. A 10' service loop shall be installed on each cable installation where possible.

3.1.1.2 Backbone Cable

A. Fiber Optic Backbone Cable. Install backbone OFN in pathways.

B. Do not exceed manufacturer's recommended bending radii and pull tension.

C. Prepare cable for pulling by cutting outer jacket 10 inches leaving strength members exposed for approximately 10 inches. Twist strength members

together and attach to pulling eye.

D. Terminate individual strands into fiber optic type connectors, SC for single-mode or ST for multi-mode as specified.

3.1.1.3 Horizontal Cabling

A. Install horizontal cabling and pathway as shown on drawings or as determined at site survey, between IDF and telecommunications outlet assemblies at workstations, in accordance with TIA/EIA-568-B.1, B.2 and 569-A. This must be determined for each project to ensure compliance. Vendor must obtain this direction in writing (from the City) before wire is terminated.

3.1.2 Work Area Outlets

A. Terminate UTP cable in accordance with TIA/EIA-568-B.1, B.2 and wiring configuration T568A. This must be determined for each project to ensure compliance. Vendor must obtain this direction in writing (from the City) before wire is terminated.

B. Shall have four jacks, Data A, Data B, Voice A and Voice B.

3.2 TESTING

3.2.1 Telecommunications Cabling Testing

A. Perform telecommunications cabling inspection, verification, and performance tests in accordance with TIA/EIA-568-B.1 and B.2.

B. All testing personnel shall be trained on testing equipment tools to assure that complete and accurate testing results are obtained/provided.

3.2.1.1 Inspection

A. Visually inspect UTP and OFN jacket materials for UL or third party certification markings.

B. Inspect cabling terminations in telecommunications rooms and at workstations to confirm color code for tip and ring pin assignments, and inspect cabling connections to confirm compliance with TIA/EIA-568-B.1 and B.2.

C. Visually confirm appropriate Category marking of outlets, cover plates, jacks, and patch panels.

3.2.1.2 Verification Tests

A. Perform 100 MHz near end cross talk (NEXT) and attenuation tests for Category 5E systems installations.

B. Perform OFN end-to-end attenuation tests using an optical time domain reflectometer (OTDR) and manufacturer's recommended test procedures. Perform tests in accordance with EIA/TIA-526-14, Method B for horizontal, multi-mode OFN. Perform verification acceptance tests and factory reel tests.

3.2.1.3 Performance Tests

A. Category 5E Links. Perform UTP link tests in accordance with TIA/EIA-568-B.1, B.2 and manufactures guidelines.

B. Tests shall include wire map, length, attenuation, NEXT, FEXT and propagation delay.

C. OFN Links. Perform OFN end-to-end attenuation tests and reel tests at job site.

3.2.1.4 Final Verification Tests

A. Perform verification tests for UTP and OFN systems after the complete telecommunications cabling and workstation jacks are installed.

B. Provide City representative with written final tests verification within 1 week of completion of installation.

C. Final test results shall include summary pages for each IDF/MDF as required.

D. Test results shall be provided in both hard and soft copy.

4.0 PATHWAY INSTALLATIONS

A. Comply with TIA/EIA-569-A, NEC and CEC.

B. Shall be installed in accordance with NEC Article 314 and Article 800.51 (J), (K), or (L), as applicable, and installed in accordance with Articles 362.24 through 362.56, where the requirements applicable to electrical nonmetallic tubing apply.

C. Conceal interior conduit under floor slabs and within finished walls, ceilings, and floors where possible.

D. Keep conduit minimum 6 inches away from parallel runs of electrical power equipment, flues, steam, and hot water pipes.

E. Install conduit parallel with or at right angles to ceilings, walls, and structural members where located above accessible ceilings and where conduit is visible after completion of project.

F. Run conduits in crawl spaces and under floor slabs as if exposed.

G. Install no more than two 90-degree bends for a single horizontal cable run.

H. Run raceway as determined by site survey.

I. Provide Pull boxes with "Sealtight" flex conduit only where flexible connections are required. City approval required prior to all "Sealtight " flex conduit installations.

J. Provide all coring, patching and painting as needed for Intra-Building and Inter-Building pathways. Caulking is not an acceptable patching method for conduit penetrations into exterior walls. Coordinate with City for acceptable patching methods.

4.1 Ground Boxes and Pullboxes

A. Ground boxes shall be made of concrete and the minimum size shall be 35 ½" x 17 ½" x 12".

B. Ground box covers shall be rated for traffic (type T.05) and shall be marked communications.

C. Metal covers shall be used in all location subject to vehicle traffic.

D. Gravel shall be installed below all ground boxes for drainage.

E. Ground boxes and pull boxes shall not be placed in areas subject to flooding.

F. Establish drainage to meet Public Works Construction Standards (Green Book).

G. Unless otherwise noted, exterior pull boxes shall have minimum dimensions of 20" x 20"6".

1. Interior pull boxes shall consist of 16 gauge steel minimum, unless otherwise noted on plans.

2. Indoor enclosures shall conform to NEMA Type 4, unless otherwise noted.

3. Size pull boxes to not less than minimum Code requirements. Increase size above Code requirements where necessary to provide space for pulling, racking or splicing enclosed conductors, or where specified or indicated dimensions exceed Code requirements.

4. Exterior metal pull boxes exposed to weather (and not installed in or below grade) shall be equipped with rain-tight or weatherproof-hinged doors.

5. Exterior pull boxes shall have 16 gauge steel bodies and 14 gauge steel doors.

6. Exterior pull boxes shall be equipped with external mounting feet.
7. Exterior pull boxes shall be equipped with stainless steel door clamps on three sides and a removable stainless steel continuous hinge pin.

8. Exterior pull boxes shall be equipped with a hasp and staple for padlocking

9. Enclosures installed on vertical exterior walls shall conform to NEMA Type 3R.

10. Enclosures installed on exterior horizontal surfaces such as rooftops or breezeways shall conform to NEMA Type 4 unless otherwise noted.

11. Rain tight or weatherproof boxes shall use threaded watertight hubs for top or side entry and may use knockout for bottom entry only.

12. Exterior pull boxes shall conform to these industry standards:

    a. UL 508 Type 4

    b. NEMA/EEMAC Type 3, Type 4, Type 12, Type 13

    c. JIC standard EGP-1-1967

    d. CSA Type 4

    e. IEC 529, IP66

13. Tamper resistant screws shall be used on all exterior, aboveground junction/pull boxes that are exposed to public areas.

4.2 Communication Duct-Banks and Conduits

4.2.1 Trenches

A. All underground trenches shall be 24" wide by 30" deep.

B. Trenches shall be back-filled at 95% compaction.

C. Contractor shall restore surface to same or better condition.

D. Contractor shall contact Underground Service Alert (800.227.2600 or www.usanorth.org) a minimum of 48 hours prior to excavation to verify the location of existing underground utilities.

E. Modifications to pathway design may be dictated by field conditions subject to approval by City.

F. Compaction testing notification must be provided to the City 48 hours prior to testing so that a City inspector may be present.

G. Slurry fill trenches to within three inches (3") of finished grade whenever crossing paved areas. "Two Sack" slurry shall be used.

H. Pavement removal and patching shall conform to specifications and standards listed in the Public Works Standards (Green Book 2000).

4.2.2 Conduit

A. Underground conduit shall consist of Schedule 40 PVC - 2 inch inside diameter or type C telephone conduit - 2 inch inside diameter (if concrete encased)

1. Innerduct, where specified, corrugated or splined (inside and outside) flexible orange innerduct, 1 inch in diameter, riser rated, will be placed for fiber optic cable protection.

2. One (1) innerduct shall be placed in a 2-inch conduit. Innerducts are to be equipped with 1/4" pull ropes.

3. Conduit shall have a factory formed bell on one end for interconnecting segments.

4. Conduit located under heavy use highways or railroad rights-of-ways shall be encased in steel casing consistent with the AASHTO or AREA specifications. The thickness of the steel casing shall be engineered for each specific application. This may vary based on local codes.

5. Spacers: High impact spacers shall be used in all multi-duct systems, for both solely owned or joint telecommunications/power construction. They shall conform to NEMA TC-2, TC-6, TC-8, and ASTM F 512 dimensions.

6. All fittings shall be designed specifically for use with the type of conduit placed.

7. All conduits shall be equipped with seal plugs in all ground boxes and expansion rubber seal plugs within all buildings.

8. A horizontal and vertical separation of 1 inch between the ducts shall be maintained by installing high impact spacers with horizontal and vertical locking intervals of ten feet.

B. All communications conduits shall be placed in a uniform manner between ground boxes and pull boxes. Conduit in position #1 at one ground box or pull box shall maintain its position within the duct run and terminate in the #1 position at the next box. The position of all conduits between ground boxes and pull boxes shall be maintained.

C. Long radius bends (over 30 feet) shall be used whenever possible to make changes in direction. If it is found to be necessary to place a 90-degree bend in the conduit run, a factory-made sweep of no less than 60-inch radius shall be used.

D. No conduit run shall exceed a total of 180 degrees of bend between any two points (such as manholes or buildings) considering both vertical and horizontal sweeps.

E. Cold-formed trench bends shall have a radius of not less than 60 inches and shall pass mandrel integrity. Bend radius criterion for 2" conduit, or less, is 6 times the diameter of the conduit and any conduit larger than 2" is 10 times the diameter of that conduit.

F. The length and destination of all conduits shall be identified in each ground box, pull box and building. Embossed metal or heavy plastic tags strapped to each conduit shall be used.

G. After installation of communications conduits, the contractor shall prove all conduits by pulling a mandrel with a diameter ¼ inch smaller than the conduit and 6 inches long through each conduit end-to-end. An inspector designated by the contractor and City shall be notified 24 hours before this procedure. Each conduit shall be cleaned with a bristle brush to remove any debris.

H. Utility marking tape (see 4.2.2.3) shall be buried 12 inches below the surface directly above the conduit.

I. Where communications and power conduits occupy the same trench, all conduit structures shall be built with the telecommunications conduits placed above the power conduits and separated by a minimum of 12" of compact earth or 3" of concrete encasement, unless otherwise called out on the construction drawings and approved by City. If this type of construction is required, it shall receive the prior approval of the contractor and City.

J. Contractor shall install new ¼" pull rope in all newly placed conduits.

4.2.2.1 Overhead Conduit

A. Where overhead conduit is required between or within buildings, Contractor shall utilize EMT conduit with an inside diameter of 2", unless otherwise specified.

B. All fittings shall be compression type connectors and couplers designed specifically for use with the type of conduit placed.

C. All fittings shall be watertight. Fitting types shall be pre-approved by the designated City representative. Unless pre-approved by the designated City representative, a qualified electrical contractor who has at least five years experience in similar installations within the Northern California area shall install all conduits.

D. Contractor shall install conduit at roof locations utilizing the current City approved methodology and process. City must approve all conduit pathways and locations prior to installation.

E. All roof penetrations must be approved by City prior to installation.

F. Contractor shall install new ¼" pull rope in all conduits placed.

4.2.2.2 Communications Entrance Conduit

A. To prevent shear, all inter-building conduit (either underground or aerial) shall transition from PVC or metal to Sealtite flex conduit when attaching to a permanent structure. The contractor and City shall determine the placement of all entrance conduits. All applicable standards shall be adhered to, i.e., City, NEC, BICSI or G.O. 128.

B. Size of entrance conduit to de determined by the service Provider (AT&T), usually a minimum of 4" diameter.

C. Sealtight flex conduit lengths shall not exceed 24", unless approved by City.

D. Sealtight flex conduit may be used between adjacent buildings within 24" of one another using City approved connectors and methods. Use of Seal Tite flex conduit between building locations beyond the 24" distance shall require written authorization (email) from City.

E. Contractor shall install new ¼" pull rope in all conduits placed.

4.2.2.3 Duct-bank locating cable (electronically detectable warning tape)

A. Warning tape shall be a minimum of 3" wide, orange in color, and shall have a non-degradable imprint as follows:

1. "Caution fiber optic cable buried below"

2. The tape shall be electronically detectable.

4.2.2.4 Pull Rope

A. Pull rope shall be new ¼" polypropylene over polyester rope with a minimum 1700 lb. Tensile strength.

B. Pull rope shall be new material that is free of knots, kinks, and abrasions and shall be placed as a single continuous length in every new conduit.

C. Pull rope shall be secured at each end.

5.0 BONDING AND GROUNDING

5.1 MDF

A. All MDF Racks shall be installed with a Telecommunications Grounding Busbar (TGB)

B. The TGB shall be installed in accordance with TIA/EIA-607-A.

C. The TGB shall be grounded to the nearest access to the building ground with a #6 AWG insulated conductor.

1. Building ground is identified as cold water pipe, building structural steel, or ground rod. Gas pipes and electrical conduits are not acceptable ground attachment points.

2. Ground conductors are not to exceed 40'. If building ground connection is beyond 40', contractor is to install a new ground at the nearest outside location. City shall approve ground rod location prior to installation.

3. Provide ohms testing for ground. Ground connections shall not exceed 5 ohms.

D. Materials shall consist of:

1. Fargo clamp: shall be cast from copper, silver-plated, and furnished with copper bolt. Ground rod: shall be manufactured of high strength high carbon steel, with electrolytically bonded jacket of copper on surface, and meet UL spec. 467 and ANSI C-33.8-1072.

5.2 IDF Racks

A. IDF racks shall be installed with a telecommunications grounding busbar (TGB) the TGB shall be installed in accordance with TIA/EIA-607-A. The TGB shall be grounded to the nearest building ground with a #6 AWG insulated conductor.

1. Building ground is identified as cold water pipe, building structural steel, or ground rod. Gas pipes and electrical conduits are not acceptable ground attachment points.

2. Ground conductors are not to exceed 40'. If building ground connection is beyond 40', contractor is to install a new ground round at the nearest outside location. City shall approve ground rod location prior to installation.

3. Provide ohms testing for ground. Ground connections shall not exceed 5 ohms.

B. Materials shall consist of:

1. Fargo clamp: shall be cast from copper, silver-plated, and furnished with copper bolt. Ground rod: shall be manufactured of

high strength high carbon steel, with electrolytically bonded jacket of copper on surface, and meet UL spec. 467 and ANSI C-33.8-1072.

6.0 DATA SYSTEMS LABELING PROCEDURES

A. The labeling shall be in accordance with the TIA/EIA-606-A standards for data.

B. The labeling shall be computer software generated and printed with readable fonts and black ink.

C. The ink and label shall be water and smear-proof for both indoor and outdoor use.

D. Samples of each type of media showing label type, labeling format, font size and ink shall be submitted for City approval.

6.1 Data Systems Labeling

A. The data systems labeling shall include all related equipment, cables, racks and RJ-45 outlets.

B. Label all cables at each end of the cable designating the rack and room number.

C. The labeling shall be delineated on any riser diagrams, floor plans and test reports.

D. The labeling shall be computer software generated and printed with readable fonts and black ink.

6.1.1 Patch Panels

A. Patch Panels will be provided with factory lettering located above the ports with port number and factory installed field labels installed below the ports.

B. The field labels will identify the room address.

6.1.2 Outlets

A. Outlets will be provided with factory installed field labels identifying IDF and its room number and related patch panel port number. City Data Cabling Standards and Specifications will be adhered to.

DATA COMMUNICATIONS ACTIVE INFRASTRUCTURE

PART 1 GENERAL

In general, each City facility will be built out in a single phase. Multiple facilities may be implemented simultaneously. The project owner will specify an implementation schedule shortly after contract award.

1.1 SUMMARY

A. General: This section describes the data communications network infrastructure including electronics and software needed to support Local Area Networks and network management.

B. Related Work

1. Related Documents: Drawings and Specifications, including General and Supplementary Conditions and Cabling specifications apply to the Work in this Section.

2 Products Installed but not Furnished Under this Section:

a. Manholes, Hand-holes, Conduits, Electrical Work, Pull-strings, Sleeves, Cores, Raceways, Cable Tray, Plywood and associated supporting hardware.

b. The provisioning of telephone equipment, its' mainframe cross-connects and placement of telephone instruments.

c. Cabling systems including station copper cabling and backbone fiber optic multi-mode cabling.

C. Products Installed Under this Section: Only new equipment and material, produced by manufacturers that are recognized nationally by the telecommunications industry and approved by Underwriters Laboratory shall be used as specified in this Section or on the Drawings.

1. All mounting hardware.

2. All mounting brackets.

D. Quality Assurance:

1. Use adequate numbers of skilled workers thoroughly trained and experienced in the necessary crafts and completely familiar with the specified requirements and methods needed for the proper performance of the work of this Section.

2. Contractor is required to provide references of three similar installations completed in the last 12 months in the Northern California Area.

3. Contractor must provide a project manager who has demonstrated the ability to supervise a project of this magnitude. The project manager must be available to be interviewed, and must be deemed acceptable by the City. The Project Manager must be available to attend meetings as required. Acceptance will not be unreasonably withheld.

E. References: Comply with the provisions and recommendations of the following documents, except where more stringent documents are indicated.

1. IEEE and ANSI standards for Ethernet (10BaseTX), Fast Ethernet (100BaseTX/FX) and Gigabit Ethernet (1000BaseSX/LX).

2. Cisco or Enterasys installation and configuration manuals for specified products.

F. Submittals.

1 Submit the following in accordance with the approved submittal Schedule.

a. Materials list of items proposed to be provided under the Section;

b. Manufacturer's specifications and other data needed to prove compliance with the drawings and specifications as needed to depict the space required for these items, and their interface with the work of other trades;

c. Manufacturer's recommended installation procedures which, when approved by the Owner, will become the basis for accepting or rejecting actual installation procedures used on the work.

G. Delivery, Storage and Handling.

1. Delivery of Materials: Deliver materials (except bulk materials) in manufacturer's unopened containers fully identified with manufacturer's name, trade name, type, class, grade, size and color.

2 Storage of Materials: Store materials in unopened containers. Store off ground and under cover, secure and protected from damage.

2.0 PRODUCTS

2.01 LAN Electronics

A. Material - Must be rack mountable in the equipment racks specified in the structured telecommunications cabling and pathway system standard.

3.0 EXECUTION
3.01 SURFACE CONDITIONS

A. Examine the areas and conditions under which the work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected. Request for Information (RFIs) shall be submitted to a designated City Representative for direction as required.

3.02 INSTALLATION

A. Ceiling tiles broken or defaced by the contractor during the installation and testing process shall be replaced at no cost to the Owner.

B. Contractor will be responsible for all mounting kits and brackets for the LAN electronics.

C. Contractor will be responsible for patching ALL fiber and copper data cables into LAN electronics per Owner's specifications.

3.02 LOCATIONS

A. Coordinate with other trades to assure proper and adequate provision for the work of those trades to interface with the work of this Section.

B. Install the work of this Section in strict accordance with the original design, the approved drawings, pertinent requirements of governmental agencies having jurisdiction, and the manufacturer's recommended installation procedures as approved by the owner representative, anchoring

all components firmly into position for long life under hard use.

3.04 LAN ELECTRONICS

A. General.

1. The Target System Configuration at all facilities will be a collapsed backbone topology. A high capacity Gigabit Ethernet (1000BaseTX/FX) switch located in the MDF of each core site will be the focal point of the backbone.

2. The switch will connect client workstations with servers throughout the campus as well as to applications available through the WAN. For all City departments, this switch will be an Enterasys C2-P (C2H124-48P), Enterasys V2H-P (V2H124-24P) both with power over Ethernet and associated module(s) for connectivity to the City's backbone, , Cisco model 4006 equipped with a 4306-GB Gigabit, and a 4148-RJ, quantity as required. Cisco WS-X4232 may be utilized as required.

3. For all core sites (or where specified) the core switch shall be a Enterasys Matrix N-Series (1, 3, 5 or 7) with associated module(s) for connectivity to the City's backbone or Cisco 6009 equipped with a 6416-GBIC and 6348 –RJ, quantities as required.

4. All core switches shall be configured with all necessary control and management modules for a complete and operational system.

5. Each MDF Enterasys Matrix N-Series (1, 3, 5 or 7) , Cisco 4006 or 6009 switch will be configured with redundant load sharing power supplies.

6. Each MDF Enterasys Matrix N-Series (1, 3, 5 or 7) , 4006 or 6009 switch will be supported by an in-line UPS capable of supplying 15 minutes of power to the MDF switch at full load.

7. The UPS will also be equipped with an SNMP agent so that a management station is notified if the UPS is operating in battery mode.

8. MDF UPS power supply shall be capable of interfacing with the Enterasys Matrix N-Series (1, 3, 5 or 7) , 4006 or 6009 management port.

9. Provide patch cord(s) and connection(s) from switch to UPS.

10. Smaller facilities (or portable cluster) will have one Intermediate Distribution Frame (IDF) that will serve as wiring closets/technology room.

11. A chart describing the distribution of each device type per wiring closet is contained in part C of this section.

12. Ethernet (10/100/1000BaseTX) Switches will be located in each closet supporting interfaces to station devices.

13. Unshielded Category 5E Twisted Pair (UTP) wiring will connect the switches to the station devices (PC's, printers, etc.) All 10/100/1000BaseTX interfaces will be 8-pin modular (RJ-45) type.

14. All Gigabit interfaces connectors will be determined on a per project basis.

15. This switch will be a Cisco 3500 series, with 1000Base SX or LX GBIC (as required) and C3550 stacking GBIC (as required), modules or an Enterasys C2-P (C2H124-48P), Enterasys V2H-P (V2H124-24P) both with power over Ethernet and associated module(s) for connectivity to the City's backbone. Quantities as required.

16. Multi-mode fiber optic cable (62.5/125µm or 50/125µm) will connect the IDF LAN Electronics to the high capacity Ethernet switch.

17. The goal of the network is to allow any workstation (PC) access to any application that the user is authorized to on the LAN or WAN.

18. All MDF and IDF switch components must be manageable by the existing City's Cisco Works 2000 or Enterasys NetSight Atlas management platform.

19. City will provide IP addresses. The vendor will be responsible for configuring each switch with the appropriate IP address and City's configuration. The console and management software is currently installed at City offices.

3.05 ACCEPTANCE TESTING

A. All LAN electronics specified in this document must meet manufacturers' standard tests. Testing must include the ability to successfully "ping" from one device to another and to and from PC end stations and servers. PC's must be able to connect to their appropriate servers.

B. The City's project manager will issue an acceptance certificate upon successful completion of all network tests. Issuance of the certificate will not be unreasonably withheld.

3.06 PROJECT RECORD DOCUMENTATION

A. Prepare and submit as-builds and logical network diagrams updated to reflect the new work completed for each campus project (i.e. site plans, cable, pathways, MDF/IDF cabinet elevations, equipment configuration spreadsheets, etc.)

B. These documents must be delivered to the City 10 working days after a project is completed.

3.07 INSTALLATION REQUIREMENTS

A. City requires the successful contractor to provide a full suite of installation services. A turnkey solution is expected. Specifically, this includes:

1. The project shall be executed under the direction of the City project team.
2. Each contractor will be responsible to coordinate activities with other contractors on site under the overall direction of the project team.
3. The successful contractor will appoint their own project manager who will be responsible for the implementation of the system hardware and software components.
4. The contractor shall provide the name and resume of their project manager in their response to this RFP.
5. The successful contractor is expected to have their personnel perform in a professional manner. At the end of each workday, the contractor personnel will clean the work area. This includes removal of all garbage, trash, food, and installation debris.
6. The contractor will submit a written report on a weekly basis to the City Project Team. This report should contain the following information:
    a. Summary of work completed for that week.
    b. Summary of work anticipated for the following week.
    c. Any questions the contractor has that may materially affect the project.
    d. Any action items requested of City personnel.

e. Any deviations from the implementation schedule.

7. The contractor will be responsible for attending coordination meetings (weekly or biweekly as needed) until the system has reached final acceptance.

8. The contractor will be responsible for all phases of the equipment delivery process.

9. The contractor will be responsible for all insurance, security, delivery and staging of equipment.

10. The contractor will be responsible for installation of all equipment and software identified in this RFP to insure a functional, attractive and quality installation.

11. The contractor will coordinate installation schedules with the City Project Team so as to minimize the impact on day-to-day operation for each site project.

12. Turnkey installation is defined as having all networking components including cabling, LAN electronics and LAN servers working as individual components as well as a homogenous system.

3.08 DOCUMENTATION REQUIREMENTS

A. Initial set-up and configuration

B. Configuration management for adds and changes. (Including emergency board replacement.)

C. Problem solving and resolution procedures

D. A custom operations manual in support of the day-to-day operations which are unique to City's Network.

E. The contractor shall provide all products standard documentation in printed and electronic format. Two copies of the printed documentation are required for all equipment and software products proposed in this section.

3.09 MAINTENANCE REQUIREMENTS

A. Warranty - The contractor shall provide one-year Smart net maintenance or similar Enterasys maintenance on all equipment and software provided during the course of this contract. In addition, the contractor shall provide a limited lifetime hardware and software warranty on all products supplied. The contractor will warrant the system to perform in the intended use as indicated in this section.

B. The system is expected to operate 24 hours/day, 7 days/week. At a minimum, City expects an uptime of 99 percent for any single switch component during the hours of 7:00 a.m. to 7:00 p.m. (and 98 percent uptime when calculated over a 24-hour day). The contractor should state Mean Time Between Failure (MTBF) statistics in their response for the equipment bid.

C. The contractor shall commit that major component failures will be replaced within a four-hour period. A major component shall be considered any hub or switch component that affects fifty or more user devices. The contractor should state Mean Time To Repair (MTTR) statistics in their response for the equipment bid.

D. The contractor must provide a four-hour response time to problem calls during the Prime Period of Maintenance (PPM). For problems reported outside of PPM, response time can occur no later than the beginning of PPM for the next day. Response time is defined as on-site presence of authorized maintenance personnel equipped with appropriate spare parts and diagnostic tools.

E. Once work has begun on repair of a critical problem, a technician shall remain on-site until the problem has been repaired. The contractor shall be allowed to change technicians at shift changes, however, the first technician shall not leave the site until the second has arrived and has been briefed on the problem.

F. The contractor shall provide its published escalation and priority handling procedures. This shall include the names and phone numbers, in organizational chart format, of the technicians and management (up to the CEO of the company) responsible for supporting the City.

G. The contractor shall describe its policies and plans to assist the City in the event of a catastrophic disaster to the facilities mentioned in this section.

H. The contractor shall provide a toll-free hotline and support center to assist City personnel in the installation, tuning, maintenance and updating of the systems hardware and software for the term of this contract.

I. Maintenance Charges for all equipment and software purchased from the contractor shall rise at a rate no greater than two-thirds the annual increase in the Consumer Price Index (CPI).

J. The contractor shall maintain an inventory of critical spare parts that shall be available locally, in a location approved by City, so as to ensure the repair response times required in this section.

K. If parts are required to fix a critical problem and are not available locally, they shall be shipped by the fastest possible means at no cost to City.

L. The contractor shall keep on-site detailed maintenance records of all maintenance calls made to the facility.

Technical Specifications for the Installation of Fiber Optic Cable
(Campus, Core Facilities)

1.1 Introduction

The Information Technology Division (ITD) currently specifies the installation of 62.5/125-micron multi-mode and 8.3/125 micron Single-mode fiber optic cables to support data communication services in and between Core Facilities. For the purposes of this document, the Frank Ogawa Plaza Campus (Plaza) will be referred to.

The following ITD specifications for the selection and installation of fiber optic cable and associated hardware are intended to ensure a reliable and consistent fiber optic media infrastructure for the this campus.

2.1 Fiber Cable Specifications

Fiber installed on the Plaza must meet or exceed the following specifications.

2.1.1 Multi-mode Fiber

Installed cable shall be 62.5/125micron core/cladding, enhanced grade, multi-mode, and graded index glass fiber. All materials in the cable shall be dielectric.

2.1.1.1 Performance

Installed fiber must meet or exceed the following performance specifications.

Wavelength (nm)	Max. Attn.(dB/Km)	Min. Bandwidth (Mhz*Km)
850	3.0	200
1,300	0.9	500

2.1.1.2 Cable Construction

Installed cable must be manufactured to meet or exceed the following specifications:

2.1.1.3 Plenum Cable (Inside Cable)

Plenum rated cable shall be used for all interior installations. Installed cable shall meet or exceed the following specifications:

a. Tight buffered 900 um, mechanical strippable Teflon (for plenum applications).

b. EIA/TIA -598 color coding for fiber optic cable.
c. Aramid yarn strength member, capable of supporting a short-term tensile load of 400 lb. without stretching.
d. Capable of bend radii as small as 20 x outside cable diameter (under installation load) and 10 x outside cable diameter (long term load).
e. Capable of a minimum crush resistance of 850 lb./in.

2.1.1.4 Outside Plant Cable

Outside plant cable shall be used for all applications where cable is to be run in underground conduits. Outside plant cable may not be used for interior applications and shall meet the following specifications:

a. Gel filled buffer tube, 250 um, acrylate.
b. EIA/TIA-598 color-coding for fiber optic cable.
c. Flooded core
d. Capable of bend radii as small as 20 x outside cable diameter (under installation load) and 10 x outside cable diameter (long term load).
e. Capable of a minimum crush resistance of 850 lb/in.

2.1.1.5 Recommended Suppliers

Corning and Mohawk fiber are currently recommended for installation on campus. Cable from other manufacturers will be considered. All cable installed must be cleared by ITD prior to installation.

2.1.2 Single-mode Fiber

Installed cable shall be 8.3/125micron core/cladding, Single-mode, and graded index glass fiber. All materials in the cable are to be dielectric.

2.1.2.1 Performance

Installed fiber must meet or exceed the following performance specifications.

Fiber cable types	Wavelength (nm)	Max. Attn. (dB/Km)
Single-mode, Inside plant	1,310	1.0
	1,550	1.0

Single-mode, Outside plant	1,310	0.35
	1,550	0.2

2.1.2.2 Cable Construction
Riser or plenum rated cable shall be used for all interior installations. Installed cable shall meet or exceed the following specifications:

2.1.2.3 Riser or Plenum (Inside Cable)
Riser cable shall be used for all interior installations and shall meet the following specifications:

a. Tight buffered 900 um, mechanical strippable Teflon.
b. EIA/TIA -598 color coding for fiber optic cable.
c. Aramid yarn strength member, capable of supporting a short-term tensile load of 400 lb. without stretching.
d. Capable of bend radii as small as 20 x outside cable diameter (under installation load) and 10 x outside cable diameter (long term load).
e. Capable of a minimum crush resistance of 850 lb/in.

2.1.2.4 Outside Plant Cable
Outside plant cable shall be used for all applications where cable is to be run in underground conduits. Outside plant cable may not be used for interior applications and shall meet the following specifications:

a. Gel filled buffer tube, 250 um, acrylate.
b. EIA/TIA -598 color coding for fiber optic cable.
c. Flooded core
d. Capable of bend radii as small as 20 x outside cable diameter (under installation load) and 10 x outside cable diameter (long term load).
e. Capable of a minimum crush resistance of 850 lb/in.

2.1.2.5 Recommended Suppliers
Corning and Mohawk fiber are currently recommended for installation on campus. Cable from other manufacturers will be considered. All cable installed must be cleared by ITD prior to

installation.

3.1 Installation Standards

3.1.1 Underground Inter-Building Cable

All fiber cable is to be protected with inner duct. After installation, inner ducts are to be permanently labeled as containing fiber optic cable. Instruction for labeling will be provided by ITD.

All cable and inner duct are to be fully supported throughout its entire run.

At no time shall more than 400 pounds of tension be placed on any fiber cable while it is being pulled through tray or conduit. It is preferred that all fiber cable be pulled with hand power only. If power winches or mechanical advantage devices are used to pull cable, a tension meter must be used to insure that maximum tension is not exceeded. Alternatively, a "mechanical fuse" rated at 350 pounds may be included in the linkage. Torsion shall be avoided by the use of a swivel at the cable end. While under tension, a minimum bend radius of 20 times the outside cable diameter will be maintained through the use of pulleys and sheaves where required. After pulling, no bend may have a radius, at rest, of less than 10 times the outside cable diameter.

3.1.2 Labeling

Each cable and inner duct is to be permanently labeled at each end with a unique cable number. In addition, labels shall be affixed to the cable/inner duct at every transition of a vault, hand hole, riser closet, or major pull box. Labels will be in the form of “ITD-Location one-Location two- sequence number”. For example, cable number 123 from Wilson to Dalziel would be labeled as "ITD-Wil-Dal-123.

Each fiber optic strand shall be labeled with a unique identifier at the ST/SC coupler in the LIU. Connectors shall be labeled on the identifying sheets on the front of the LIU.

Each fiber shall be labeled where it enters the back of the coupler panels. The identifier shall be in the format Cable # - tube- strand. For tight-buffered cables the "tube identifier" shall be "xx".

3.1.3 Conduit Assignments

The Berkeley Campus has a conduit management system in force. Scopes of Work for cable installation, supplied by ITD for each project, will specify which conduits are to be used for cable installation.

4.1 Termination Standards

The terminal ends of all fibers cable strands shall be field connectorized. The connectors shall be mounted on bulkheads and installed in enclosures called Light guide

Interconnect Unit (LIU). It is ITD's practice to terminate both ends of all fibers within a fiber cable with ST for multi-mode or SC for single-mode, epoxy and polish style connectors. Termination of older cables may be of several types including mechanical or fusion spliced pigtails. The choice of termination method must be cleared with ITD prior to termination.

4.1.1 Fiber Organizers

Fiber cables are to be terminated in one of two types of enclosures. ITD may specify either wall-mounted or rack-mountable stand-alone units for installation. Rack mounted units made by ADC, Panduit, or an equivalent, will be acceptable. The final choice of fiber organizer shall be cleared with ITD prior to installation.

Each enclosure shall be labeled with a machine made label with permanent black ink on a white background. Labels shall be in the format "LIU_NN", with the numbers, "NN", supplied by ITD. In addition, each LIU shall be labeled on the faceplate with the identifiers of the cables it contains.

Each fiber optic strand shall be labeled with a unique identifier at the ST/SC coupler in the LIU. Connectors shall be labeled on the identifying sheets on the front of the LIU. Each fiber shall be labeled where it enters the back of the coupler panels. The identifier shall be in the format Cable #-tube- fiber strand #. For tight-buffered cables the "tube identifier" shall be "xx".

4.1.2 Connectors and Splices

Fiber ends are to be terminated in ST for multi-mode or SC for single-mode, type connectors with composite ferrules. They must be of the "epoxy and polish". Exceptions may occur when an older City of Oakland installation is being expanded or a new site is being developed. In all cases, ITD will specify connector requirements.

If it is necessary to splice pigtails onto an existing, partially terminated fiber cable, the splice type utilized must conform to whatever is already in use at that location. Clearance from ITD must be obtained before installing any type of splice.

4.1.3 Miscellaneous

At each end of the cable, sufficient slack (10 – 20') shall be left to facilitate reasonable future relocation of the LIU. Slack shall be mounted on walls or upper ladder racks according to ITD direction.

5.1 Testing

5.1.1 Before Installation

It is expected that each individual fiber in a cable be tested with an OTDR for length and transmission anomalies while on the reel before installation.

5.1.2 After Installation and termination

5.1.2.1. All single-mode and multi-mode fiber strands shall be

tested end-to-end for bi-directional attenuation, 850-nm/1300 nm for multi-mode and 1310 nm/1550 nm for Single-mode fibers. Tests should be conducted in compliance with EIA/TIA-526-14 or OFSTP 14, Method B, according to the manufacturer's instructions for the test set being utilized.

5.1.2.2. Tests must ensure that the measured link loss for each strand does not exceed the "worst case" allowable loss defined as the sum of the connector loss (based on the number of mated connector pairs at the EIA/TIA-568 B maximum allowable loss of 0.75 dB per mated pair) and the optical loss (based on the performance standard above, 2.1.1 and 2.2.1).

5.1.2.3. After the cable is in place it shall be tested in the following manner:

a. After termination, each fiber shall be tested with an ODTR for length, transmission anomalies, and end-to-end attenuation. Results are to be recorded and supplied to ITD in the form of hard-copy printouts or photographs of screen traces.
b. After termination and bulkhead mounting, each terminated fiber is to be tested for end-to-end loss with a power meter/light source. As above, results are to be recorded and supplied to ITD.
c. The maximum allowable attenuation for any splice or termination is 0.3 dB.