

# City of Alameda Smart City Master Plan Needs Assessment & Recommendations



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Prepared for:



## TABLE OF CONTENTS

<b>Acronyms .....</b>	<b>4</b>
<b>1 PROJECT BACKGROUND .....</b>	<b>5</b>
1.1 Smart City Goals & Objectives.....	5
<b>2 STAKEHOLDERS .....</b>	<b>7</b>
2.1 City Departments .....	7
2.2 Local Institutional, Business and Community Organizations .....	7
2.3 Regional Partners .....	8
<b>3 NEEDS IDENTIFICATION .....</b>	<b>8</b>
3.1 Transportation.....	9
3.2 Public Works.....	10
3.3 Information Technology (IT).....	11
3.4 Alameda Municipal Power (AMP) .....	11
3.5 Recreation & Parks.....	12
3.6 Public Safety .....	12
3.7 Economic Development .....	13
3.8 Educational Institutions & Equity Priority Populations .....	14
3.9 Regional Partners .....	15
<b>4 RECOMMENDATIONS.....</b>	<b>15</b>
Recommendation #1: Build Out City Communications Network.....	16
Recommendation #2: Deploy Public Wireless Networks (Wi-Fi) .....	19
Recommendation #3: Deploy Citywide Emergency Vehicle Preemption (EVP).....	21
Recommendation #4: Deploy Transit Signal Priority .....	21
Recommendation #5: Partner with Internet Service Providers.....	22
Recommendation #6: Develop Dig Once & Installation Standards Policies .....	22
Recommendation #7: Implement Centralized Transportation Management .....	24
Recommendation #8: Interconnect Emergency Operations Center & City Facilities .....	25
Recommendation #9: Implement Transportation Data Analytics .....	25
Recommendation #10: Deploy Traffic Monitoring Camera Network.....	26
Recommendation Summary .....	28



## TABLES

Table 1: Smart City Goals & Objectives.....	6
Table 2: Transportation Needs Summary .....	9
Table 3: Public Works Needs Summary .....	10
Table 3: Information Technology (IT) Needs Summary .....	11
Table 4: Alameda Municipal Power (AMP) Needs Summary.....	11
Table 5: Recreation & Parks Needs Summary.....	12
Table 6: Public Safety Needs Summary.....	12
Table 7: Economic Development Needs Summary.....	13
Table 8: Educational Institutions & Equity Priority Populations Needs Summary.....	14
Table 9: Regional Partners Needs Summary.....	15
Table 10: Recommendations Summary .....	29

## FIGURES

Figure 1: Recommended Communication Network Infrastructure .....	18
Figure 2: Recommended Public Wi-Fi Access .....	20
Figure 3: Recommended Transit Priority Corridors .....	23
Figure 4: Recommended Closed Circuit Television System .....	27



## ACRONYMS

AMP	Alameda Municipal Power
ATMS	Advanced Traffic Management System
AUSD	Alameda Unified School District
AVL	Automated Vehicle Location
CCTV	Closed Circuit Television
DMZ	Demilitarized Zone (network security term)
DOJ	Department of Justice
DRT	Digital Realty Trust
EOC	Emergency Operations Center
EVP	Emergency Vehicle Preemption
HVAC	Heating, Ventilation, and Air Conditioning
ISP	Internet Service Provider
IP	Industrial Protocol (Ethernet)
IT	Information Technology
LPR	License Plate Recognition
ROW	Right-of-Way
SCADA	Supervisory Control and Data Acquisition
TSP	Transit Signal Priority



# 1 PROJECT BACKGROUND

The City of Alameda (City) has initiated this Smart City Master Plan project (Project) to provide a roadmap for improving the City's Smart City infrastructure to better serve the City's growing technology needs. The Project will assist the City in utilizing new technologies to improve community member's lives. This document includes a summary of the City's needs with respect to Smart City technologies and recommendations for achieving the City's technology-related goals. The Project's intent is to provide a comprehensive plan that leverages the existing infrastructure while introducing new technologies for the purpose of improving air quality, vehicular, pedestrian, bicycle, and transit access and safety, accommodating emerging micro mobility and autonomous vehicles, and improving the City's communications infrastructure. This project involves the following tasks:

- Task 1: Existing Conditions Assessment
- **Task 2: Needs Assessment and Recommendations**
- Task 3: Master Plan Development

This document represents the Needs Assessment and Recommendations memorandum resulting from Task 2. The intent of this memorandum is to document the City's needs that were identified through stakeholder meetings and provide an initial set of recommendations for addressing those needs via the City's existing Smart City goals and objectives. The memorandum is intended to serve as an interim step towards the final master plan development.

## 1.1 Smart City Goals & Objectives

The City of Alameda is poised to expand its use of technology to improve community members' lives. As technology needs in the City have evolved greatly, the City has developed a list of Smart City Master Plan Goals and Objectives, which are summarized in **Table 1**.

**Table 1: Smart City Goals & Objectives**

Goal	Objectives
Equitable Internet	<ul style="list-style-type: none"> <li>• Provide free public Wi-Fi at key City locations</li> <li>• Provide equitable internet access options for all community members including training opportunities</li> <li>• Enhance communications to support expanded bandwidth throughout the City of Alameda facilities</li> </ul>
Government Operations	<ul style="list-style-type: none"> <li>• Provide more services to residents and staff digitally to enhance City productivity, transparency and engagement with community members</li> <li>• Enhance cyber security measures to protect City and Community information</li> </ul>
Transportation Operations	<ul style="list-style-type: none"> <li>• Improve the transportation efficiencies and safety such as with interconnected traffic signals, real-time public transit information, multimodal detection and data collection, smart parking, streetlights and maintenance</li> <li>• Prepare for the future of transportation technology deployments, i.e., connected and autonomous vehicles</li> <li>• Reduce delay citywide, resulting in more effective traffic flow with improved safety and fewer emissions</li> </ul>
Safety	<ul style="list-style-type: none"> <li>• Provide emergency response optimization, disaster early-warning signals, and crash avoidance system capabilities</li> <li>• Enhance security from cyber attacks</li> </ul>
Economic Vitality	<ul style="list-style-type: none"> <li>• Enhance technology and internet access as well as training opportunities via City programs</li> <li>• Facilitate improved internet service options and improve reliability, speeds, and bandwidth availability</li> </ul>
Climate Goals	<ul style="list-style-type: none"> <li>• Facilitate telecommuting, tele-school and telehealth to reduce vehicle trips</li> <li>• Enhance transportation systems and operations to reduce idling and greenhouse gas emissions</li> <li>• Deploy new technologies to improve energy and water efficiencies</li> <li>• Deploy technologies and infrastructure to support monitoring of environmental indicators (e.g., air quality)</li> <li>• Partner with science communities and educational institutions to support climate-specific initiatives</li> </ul>

## 2 STAKEHOLDERS

This section provides a summary of the various stakeholders involved in the development of the Smart City Master Plan document. As part of the needs assessment process, City staff and Iteris conducted a number of outreach meetings with key city departments, educational institutions, neighboring agencies, and local community and business organizations. The key stakeholder focus group meetings helped the City staff and Iteris better understand the needs of these members and how technology and communications solutions could potentially help address these needs.

### 2.1 City Departments

The City of Alameda is comprised of many different departments which serve multiple functions for City business and resident services. For this plan, the following City departments were consulted to review their existing infrastructure and operations, as well as assess their current and projected needs as it relates to the City's Smart City goals.

- Public Works
- Information Technology
- Transportation Planning
- Alameda Municipal Power
- Recreation & Parks
- Public Safety
- Economic Development

### 2.2 Local Institutional, Business and Community Organizations

In addition to the City's key department stakeholders, various institutional, business, and community-based organizations were also included. These groups also contributed to shaping the overall vision of the City's Smart City goals, which aim to address widespread equitable access issues in Alameda and to serve the City's growing business needs. The following groups were included in the needs assessment:

- Key Business Groups
  - Alameda Chamber of Commerce
  - West Alameda Business Association
  - Downtown Alameda Business Association
- Key Institutional Groups
  - College of Alameda
  - Alameda Unified School District
  - Community science: CENIC and community volunteers
- Equity Priority Community Service Groups
  - Alameda Educational Foundation
  - City Paratransit

- Alameda Family Services
- Mastick Senior Center (via Recreation & Parks)
- Alameda Point Collaborative
- Alameda Housing Authority

## 2.3 Regional Partners

Finally, to continue to partner well with the City’s neighbors, several regional public agency partners were introduced to the City’s Smart City initiatives and asked for their feedback. Partnering with other public agencies operating within and adjacent to Alameda will offer a more seamless regional technology experience, and also offers Alameda a chance to learn about similar initiatives neighboring agencies may be implementing. The following regional partners were also invited to contribute to this Master Plan:

- AC Transit
- City of San Leandro
- City of Oakland
- Telecommunications providers

## 3 NEEDS IDENTIFICATION

The needs assessment presented in this section includes discussions with the stakeholders identified in Section 2. Meetings with stakeholders were primarily conducted during January and February 2021, with a follow-up meeting with Public Works conducted in June 2021.

The following sections summarize the specific needs from the various stakeholders provided during each of the needs assessment meetings. For each stakeholder, a table is provided that summarizes their needs and the related Smart City objective(s) to be achieved.

## 3.1 Transportation

**Table 2: Transportation Needs Summary**

Need	Objective
Robust communications network that interconnects signalized intersections in Alameda, including future planned signals	Improve operational efficiencies for managing traffic signal infrastructure and provide mechanism for Public Works to manage signal infrastructure remotely
Centralized traffic signal control and monitoring	Improve operational and maintenance efficiencies within the City and provide mechanism for Public Works and City Traffic Engineer to manage and monitor traffic signal infrastructure remotely
Continue to implement advanced traffic management strategies and technologies (e.g., adaptive signal control, TSP, EVP, etc.)	Reduce signal maintenance and incident management workload, improves public safety, improves transit service and reliability
Provision for enhanced multi-modal data collection at all City intersections (i.e., vehicle counts, speed data, pedestrian and bicycle counters, origin-destination surveys, congestion management tools)	Enable City Transportation Planning and Public Works staff to make well-informed decisions to develop and improve the city's transportation network, including facilitating system performance measurement and an open data portal so that the public and partners can access data and develop "civic tech" applications and engagement
Support technology deployment for City parking facilities (e.g., mobile payment solutions, wayfinding)	Automate parking management and payment services to reduce workload needs for parking services
License Plate Reader (LPR) system for parking enforcement	Enhance automated parking enforcement
Support future Connected Vehicle/Automated Vehicle (CV/AV) technologies	Prepare the City for the expanding CV/AV needs in the region
Deploy roadway CCTV monitoring system	Enhance remote transportation network monitoring and incident management capabilities while protecting privacy in that it will not be used as a surveillance or tracking system



## 3.2 Public Works

**Table 3: Public Works Needs Summary**

Need	Objective
Shift more City services online and continue to digitize documents	Improves public access to services without need to visit City offices
Institute methods like micro-trenching for development underground installations	Reduce impact on existing infrastructure during construction
Develop policies and standards that ensure development projects contribute to communications network buildout	Ensure development in the City is consistent with City infrastructure goals and objectives
Support City's infrastructure asset management system needs	Enable improved remote asset management and aid in protecting and maintaining City's various infrastructure and fleet assets
Support City's planned fleet telematics (AVL) deployment	Enable improved remote fleet management and aid in protecting and maintaining City's fleet assets
Improve coordination with utility agencies for joint trenching/boring opportunities	Reduce impact on existing City infrastructure and enhance relationship for future improvement opportunities
Enhance City building operations and maintenance with automation and monitoring systems (HVAC, access, mechanical systems, etc.)	Provide remote monitoring and management capabilities to reduce staff workload to maintain various building systems
Continue to improve remote capabilities of City's SCADA system to allow for improved remote lagoon and pump station management	Provide remote monitoring and management capabilities to reduce staff workload for pump station and lagoon management
Develop or acquire utility monitoring dashboard technology to engage smart infrastructure for monitoring utility use (power, water, etc.)	Inform City financing of utility systems and provide real-time status monitoring of all utility usage citywide
Continue to enhance air quality monitoring capabilities (indoors and outdoors)	Improve air quality reporting capabilities to better inform City partners and residents, especially during California Wildfire season

### 3.3 Information Technology (IT)

**Table 4: Information Technology (IT) Needs Summary**

Need	Objective
Independent municipal network managed by City IT	Allow IT to manage and scale network to meet City needs without restrictive limits currently imposed by utility regulations.
Connect all of City's existing communications facilities on City-owned communications network	Enable seamless management and scalability of bandwidth of City's facilities to meet ever changing needs
Establish EOC as the hub of communications in the City	Provide City with a centralized management point for all systems to enhance management and maintenance, including during emergencies
Firewall management to separate City and AMP infrastructure, as well as intra-City and public access to City network	Protect City network assets and systems from malicious entities, provide secure and separate system solely for City administrative use, as well as a separate secure public network to enhance digital equity
Establish a secured network perimeter for City's internal network connection	Protect City network assets and systems from malicious entities
Consider interconnection to Digital Realty Trust (DRT) data center in Oakland (Tier 1 data center)	Expand City's access to global resources and cloud services
Sensitivity to public privacy (compliance with City's Privacy Policy)	Maintain City's commitment to protect privacy for all users, especially residents
Establish robust cyber security protocols and policies	Protect City network assets and systems from malicious entities

### 3.4 Alameda Municipal Power (AMP)

**Table 5: Alameda Municipal Power (AMP) Needs Summary**

Need	Objective
Clear separation between AMP and City's communications infrastructure to ensure compliance with previous agreements	Provide greater autonomy, enhanced service features, and enable City IT to manage their own infrastructure
Separate out the proposed City communications fiber network from AMP electricity network	Split the network since AMP has stricter telecommunications regulations for equipment controls and network security for the electricity grid

## 3.5 Recreation & Parks

**Table 6: Recreation & Parks Needs Summary**

Need	Objective
Remote management systems for lighting, facility security, and irrigation	Improve efficiencies within the Recreation & Parks and provide mechanism for city staff to manage Rec & Park infrastructure remotely, reducing workload on existing staff
Internet access at park facilities, such as the Gym	Provides broadband internet service for city staff and users at facilities that lack this service

## 3.6 Public Safety

**Table 7: Public Safety Needs Summary**

Need	Objective
Infrastructure to support Zone Haven efforts for evacuations	Improve City's and Public Safety's ability to communicate to its residents during emergencies, and especially during evacuations
Emergency Vehicle Preemption (EVP) city-wide and on Public Safety vehicles	Enhance Public Safety response time to emergencies by providing safe, clear travel routes for first responders
Establish notification system that alerts Fire Department of bridge raisings that may impact response routes in real-time	Inform fire department of real-time traffic impacts to emergency vehicle routing
Revised emergency response routing coordination as a result of street narrowing projects or construction activity	Continue to provide sufficient emergency response coverage in conjunction with other City efforts to build safer streets
Continue to provide public safety communications network that are compliant with Department of Justice requirements	Maintain compliant systems to supplement Public Safety goals and objectives

### 3.7 Economic Development

**Table 8: Economic Development Needs Summary**

Need	Objective
Reliable internet options in the Business Districts	Attract diverse businesses and industries to Alameda to enhance economic vitality
Public Wi-Fi in incentive areas such as downtown areas	Attract consumers and business to these areas to enhance economic vitality
Redundant internet infrastructure, perhaps with added nodes on public property (i.e., 5G nodes at intersections on City poles)	Partner with ISPs to support growing bandwidth need, including cellular needs of visitors, businesses, and residents
Enhanced cyber security measures on public networks	Protect City network assets and systems from malicious entities

### 3.8 Educational Institutions & Equity Priority Populations

**Table 9: Educational Institutions & Equity Priority Populations Needs Summary**

Need	Objective
System capable of facilitating an anticipated need for continued distance learning, telecommuting, and telemedicine in the future	Ensure networks are sufficient for expanding bandwidth needs including coordination with private ISPs
All homes with access to the internet, including multi-family	Expand high speed and reliable internet access availability to bridge digital divide
Establish policies and provisions for current prohibitive internet installations, such as within leased/rented multi-unit buildings	Encourage digital equity citywide
Robust technological support for all users	Encourage digital equity citywide, especially for equity priority populations (e.g., seniors, unhoused, low-income, etc.)
Access to power for charging devices for unhoused and equity priority populations	Enable equitable access to technology for all
Wi-Fi on AUSD campuses and off-campus at public gathering centers (i.e., Boys and Girls Club, Alameda Point Collaborative Learning Center, and Recreation & Parks facilities)	Expand reliable internet access availability to bridge digital divide
Provision for technology and internet literacy training, including multi-lingual offerings, in person and online	Support equity priority populations (e.g., seniors, unhoused, low-income, etc.) in use of available digital equity tools and develop “Service Learning Credits” in partnership with our educational community and other training programs
Access to internet via equipment/hardware for seniors, low-income and unhoused population	Expand internet access availability and support with programs such as Service Learning Credits to bridge digital divide
Continued connection and partnership with the scientific community	Enhance City’s contribution to reaching environmental goals
Affordable broadband internet subsidized by the City	Enhance internet availability in the City by coordinating with private ISPs to expand available affordable options
Legislation to prevent predatory tactics used by ISPs to escalate prices	Protect equity priority populations from tactics that expand digital divide
Publicity/marketing plan to advertise City resources available to the public, including non-digital notifications (newspapers, mailers, etc.)	Enable access to City resources for all residents, visitors, and businesses



### 3.9 Regional Partners

**Table 10: Regional Partners Needs Summary**

Need	Objective
Traffic signal coordination between jurisdictions	Enhance regional coordination and provide seamless traffic operations across jurisdictional borders, particularly at entry/exit points to the city and in case of an evacuation
Traffic signal coordination with transit queue jumps on key transit routes	Enhance transit reliability, which in turn encourages transit use; support roadway equity
Improved transit amenities, including real-time bus arrival/departure infrastructure, as City owns bus stop amenities	Encourage transit use; support roadway equity
Provide Transit Signal Priority (TSP) on key transit routes	Enhance transit reliability, which in turn encourages transit use; support roadway equity
Consider connection with Lit San Leandro, a public private partnership that provides broadband internet service focused on the business community in San Leandro	Enhance regional internet availability
Shared GIS fiber network map among regional partners	Boost regional coordination for better regional planning for enhancements to communications network architecture
Lane enforcement system for bus only lanes	Enhance transit reliability, which in turn encourages transit use; support roadway equity

## 4 RECOMMENDATIONS

Smart City is a fairly loosely defined term and thus can encompass a large number of initiatives. The National League of Cities (NLC) describes a smart city is one “that has developed some technological infrastructure that enables it to collect, aggregate, and analyze real-time data and has made a concerted effort to use that data to improve the lives of its residents.” The US Department of Transportation (USDOT) has described a smart city is one that “uses advanced data and Intelligent Transportation Systems (ITS) technologies and applications to reduce congestion, keep travelers safe, protect the environment, respond to climate change, connect underserved communities, and support economic vitality.” However, there is a general consensus that a smart city is comprised of the following main components:

- Devices and applications that collect data;
- A communications network to support the collection and dissemination of data;
- Applications and tools to analyze and interpret the data to provide actionable insight; and
- An organizational structure that utilizes this intelligence as predictive analytics to improve services for and engage with community members.

In essence, a smart city initiative is multi-layered, starting with a communications infrastructure, with connect networked devices, and the data from these devices used to improve daily operations and services to the public. Based on the needs and objectives expressed by the various project stakeholders, a number of recommendations have been developed to address these needs. Note that many of the needs expressed by various stakeholders overlap and thus a number of the recommendations address multiple needs.

It should also be noted that the implementation of Smart City initiatives may also require additional personnel support to fully utilize and benefit from the systems, as noted in the fourth bullet point above. The proposed Smart City infrastructure are merely tools, and the value of these tools are only realized if there are adequate and trained personnel to use these tools. This may include expanded staffing for roles such as network analysts, field staff for Underground Service Alert (USA) support, or other operations and maintenance staff. As City systems and operations grow, so will the need to acquire additional support for day-to-day management, operation, and maintenance.

The following recommendations are intended to guide the City in the strategic investment and deployment of Smart City infrastructure and applications to achieve its Smart City goals and objectives by improving city services, mobility, safety, and the environment, thus enhancing the quality of life for its residents.

## Recommendation #1: Build Out City Communications Network

The foundation of a Smart City is the network on which the Smart City elements are able to interconnect. According to the USDOT's recent Putting People First: Smart Cities and Communities, "Undergirding these technologies is an integrated information and communications system. Strong information technology architecture and standards are the backbone of Smart Cities & Communities – allowing smooth data connections; creating opportunities for partnerships and public engagement; and enabling innovative cross-cutting, data-driven solutions." Establishing a municipal broadband communications network will provide the foundation for which various smart city initiatives and applications such as public safety, mobility, economic development can be built upon.

The recommended communications network would consist primarily of a fiber optic network that would interconnect the majority of the City's existing facilities and infrastructure and would serve as the communications infrastructure backbone. The fiber optic communications network would be supplemented using wireless communications as a "last-mile" solution to connect remote or lower priority infrastructure, enabling the City to reduce the amount of undergrounded infrastructure. Remote or lower priority infrastructure may include an isolated traffic signal or non-critical city facility.

**Figure 1** depicts the proposed network layout for the recommended communications network. The fiber optic network has been designed to interconnect all key city facilities (both City Halls, Emergency Operations Center, Police Department, Maintenance Service Center, and all fire stations) and most signalized intersections. The network is designed for resiliency and provides multiple redundant paths to interconnected facilities in the event of a localized failure or accidental fiber cut. The network has also been designed to support other potential Smart City applications and devices such as a public Wi-Fi deployment and traffic monitoring cameras by functioning as a communications back-haul for these devices.

The proposed communications network would provide infrastructure to support the majority of the City's Smart City goals, as well as most of the involved stakeholders. The network will enable the City to reduce its dependency on AMP infrastructure, providing the City with infrastructure managed internally. It will enable many of the remote operational needs discussed previously, providing reliable City-owned infrastructure on which to build those systems (e.g., signals, facilities, lighting, irrigation, pump station management, parking, etc.). The network will also support the continued digitization of City services,

again providing a dedicated network to be able to interconnect all City service facilities to provide cohesive services.

The network will support the City's need for more robust transportation-related data collection, providing a way to remotely access that information and improve system management, including across jurisdictions. It will also empower the City to support the future of transportation technologies like connected and autonomous vehicles. These systems require roadside equipment and communications to work effectively.

In addition to infrastructure, the build-out of the system also provides the opportunity for the development of additional soft skill resources. With support from robust communications, programs like the Alameda Adult School technology courses would be able to expand. The opportunity for other City-sponsored programs like Senior technology support and student community service credits would also expand when supported by the network. The introduction to the network will increase technological literacy throughout Alameda as a result.

Management and maintenance of this network will likely require additional City staff support for the long term. Though fiber optics and wireless communications are relatively low maintenance, software and hardware management is a key element to a well-functioning communication system. This task would likely fall jointly to IT and Public Works to ensure all communications links are operating satisfactorily both in the field and within facilities.

Investment in a large-scale communications network comes with a substantial cost. The cost of installation of hardwired fiber optic cables can be high and varies with the construction market; the cost of wireless solutions are less, but come with a shortened equipment life expectancy. The network depicted as part of this recommendation will likely cost several millions of dollars and will likely need to be implemented in a phased manner. Phasing of communications implementation should balance the operational need for the communications link in the greater physical network with the available funding. In general, a core central communications ring should be built out first with phased expansions identified down the road. For that reason, the time frame of this recommendation ranges from short- to long-term depending on the priority and available funding for the improvements.



### Figure 1: Recommended Communication Network Infrastructure



## Recommendation #2: Deploy Public Wireless Networks (Wi-Fi)

Internet access is considered an essential service and is recognized as a human right in some countries. Wireless connection to the internet has become almost ubiquitous in our society as more and more common everyday devices, such as kitchen appliances, are now “on-line.” Wireless networks (Wi-Fi), and the resulting access to the internet, has become commonplace throughout our work environment and at home. Public agencies and organizations initially deployed Wi-Fi at their facilities to support municipal operations but have expanded the use to provide a public benefit such as digital inclusion, economic development, and services to an underserved population who do not have internet access at home. The recent pandemic has required students to transition to on-line schooling, workers to work from home, and has even meant that seeing a doctor was done on-line via telehealth/telemedicine.

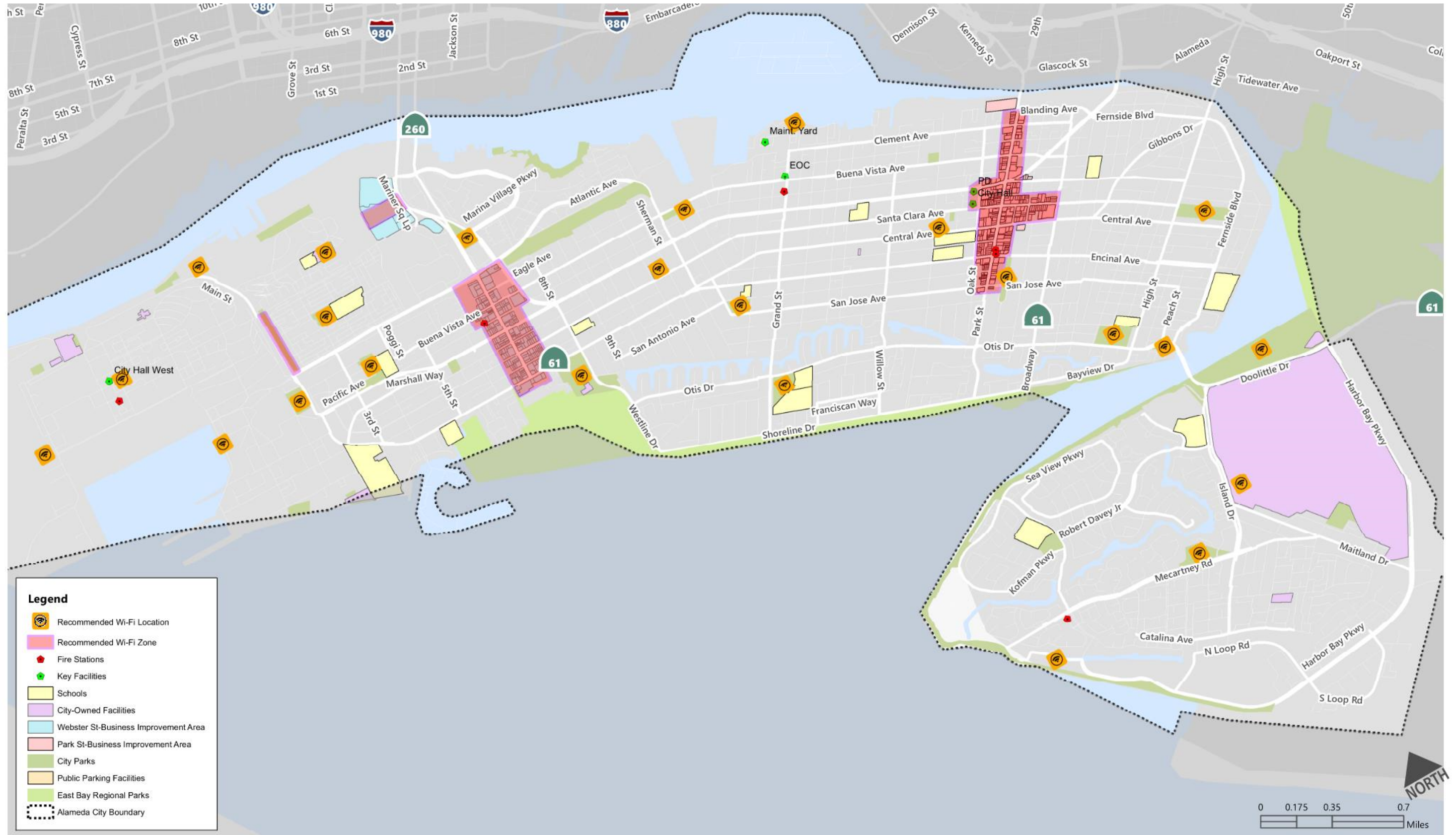
As a first phase, it is recommended that the City deploy a public Wi-Fi service starting with city buildings and city-owned outdoor spaces. For city buildings, this would include both City Hall buildings, Police Department, Emergency Operations Center, Maintenance Service Center, and recreation centers. For outdoors spaces, this would include most city parks, the three ferry terminal lots, key corridors including Park Street and Webster Street and priority equity neighborhoods such as Alameda Point. For later implementation phases, City staff will conduct further input to ensure that the public Wi-Fi is deployed at high priority locations for community members beyond the locations mentioned above, such as at bus stops or other gathering places. Operations and maintenance of these networks will likely fall to IT and depending on the extent of deployment may require additional staffing to support the system. Deployment of this system will largely depend on the deployment of the supporting communication network which would affect deployment timeframe.

Proposed locations for public Wi-Fi services are depicted in **Figure 2**. These locations are mainly centered around City gathering spaces, like public services facilities, parks, and commercial and business districts as mentioned previously. The Wi-Fi locations are supported by the recommended fiber optic communications network to serve as backhaul for this service. Backhaul will be especially necessary for sufficient bandwidth availability and internet connection. For outdoor and public spaces, it is recommended to utilize the traffic signal infrastructure as that provides a convenient location to access power, an established connection to the recommended fiber optic network for backhaul, and signal poles that provide height and secure mounting locations for wireless access points.

The capital investment associated with this technology is moderate and implementation will likely also follow a phased approach. It is recommended that City observe a prioritization of deployments such that they deploy services to the areas where it is most needed first. These priority areas may have implementation within a few short years (i.e., short term), while lower priority locations may take longer. Thus, the deployment of this recommendation is expected to be a short to long term timeline to balance the needs of the City and areas that will be served by the public wireless network.



Figure 2: Recommended Public Wi-Fi Access



### Recommendation #3: Deploy Citywide Emergency Vehicle Preemption (EVP)

As part of the public safety goal, it is recommended that emergency vehicle preemption (EVP) be deployed at all signalized intersections in Alameda to improve emergency incident response time and safety at intersections during an emergency. This preemption will assist in reducing emergency response time by granting priority to emergency vehicles at traffic signals. The preemption system would detect an approaching emergency vehicle and provide a green light to flush out any queued vehicles along the approach and/or hold the light green until the emergency vehicle has made it past the intersection. Thus, emergency vehicles would no longer have to run a red light, making it safer for everyone while also increasing the response time. This recommendation would entail installation of fleet equipment in conjunction with intersection equipment. Prioritization of these deployments would ideally follow emergency responder's data regarding most used routes and along heavily congested corridors. Signalized intersections in more remote or isolated areas may be lower in priority in terms of deployment.

The implementation of this measure can be combined with Recommendation #4 to deploy transit signal priority (TSP) to reduce travel times while riding the bus in Alameda. The City currently has TSP deployed at signalized intersections along the AC Transit Line 51 route along Webster Street. The TSP system used along the Line 51 deployment is Global Traffic Technologies' (GTT) GPS-based system. It utilizes a combination of GPS-based tracking and wireless radio communications equipment installed at traffic signals to detect approaching transit vehicles and provides them with priority treatment such as triggering an early green light or holding an already green light to maximize the opportunity for the vehicle to pass the signal without having to stop and wait at a red light.

This same system is capable of doing double-duty and can support both TSP and EVP operations. Thus, the same equipment that would be installed at a signalized intersection can be utilized for EVP and TSP. For EVP functionality, the City's emergency vehicle fleet would have to be equipped with the corresponding GTT equipment, which is the same equipment that is installed in AC Transit buses for TSP.

Deployment of EVP and/or TSP can be a short-term implementation that would entail deployment along existing emergency routes. Deployment to all City intersections and City emergency fleet could be implemented within a short-term timeframe due to standardization of the system equipment. In addition, the capital investment is moderate.

### Recommendation #4: Deploy Transit Signal Priority

In coordination with AC Transit, deployment of transit signal priority (TSP) along key transit routes in Alameda would improve transit service. TSP offers priority to transit vehicles ensuring that transit routes operate on schedule. Providing this additional functionality will reduce travel times for bus operations around the City, which in turn would enhance transportation options for residents and others accessing Alameda, and ultimately contribute to transportation equity. This investment may also allow AC Transit to improve service frequency or consider new routes, further providing additional transportation options within and to Alameda, contributing to the city's various economic and climate goals. Installation of TSP would also require close coordination with AC Transit, as they have specific system requirements as noted in Recommendation #3.

Proposed locations for TSP deployment are depicted in **Figure 3** which follows most of the current AC Transit routes that serve the City. Also similar to Recommendation #3, deployment of TSP at any signalized intersection also means that EVP functionality will also be provided at that location.

Similar to EVP, implementation of TSP may be achieved within a short-term timeframe. Capital costs

can be combined with the EVP deployment and implementation may be done faster than EVP since TSP would only need to be deployed along key AC Transit routes in Alameda.

## Recommendation #5: Partner with Internet Service Providers

As a means to improve internet availability and options, the City should partner and coordinate with internet service providers (ISPs). Partnerships with ISPs could include collocation on City infrastructure for 5G equipment, which would expand cellular service in Alameda. It could include joint trench opportunities for conduit and/or fiber installations building out Recommendation #1. It could also include development of City incentives to attract more ISPs to Alameda to provide more options for home and business internet service in Alameda. The City may also consider development of policies in conjunction with these efforts that would work to prevent or reduce predatory practices regarding internet pricing in Alameda. These partnerships and conversations with ISPs are timely as most ISPs are also offering Smart City programs and could be a short-term action to improve internet equity with relatively low cost impact.

## Recommendation #6: Develop Dig Once & Installation Standards Policies

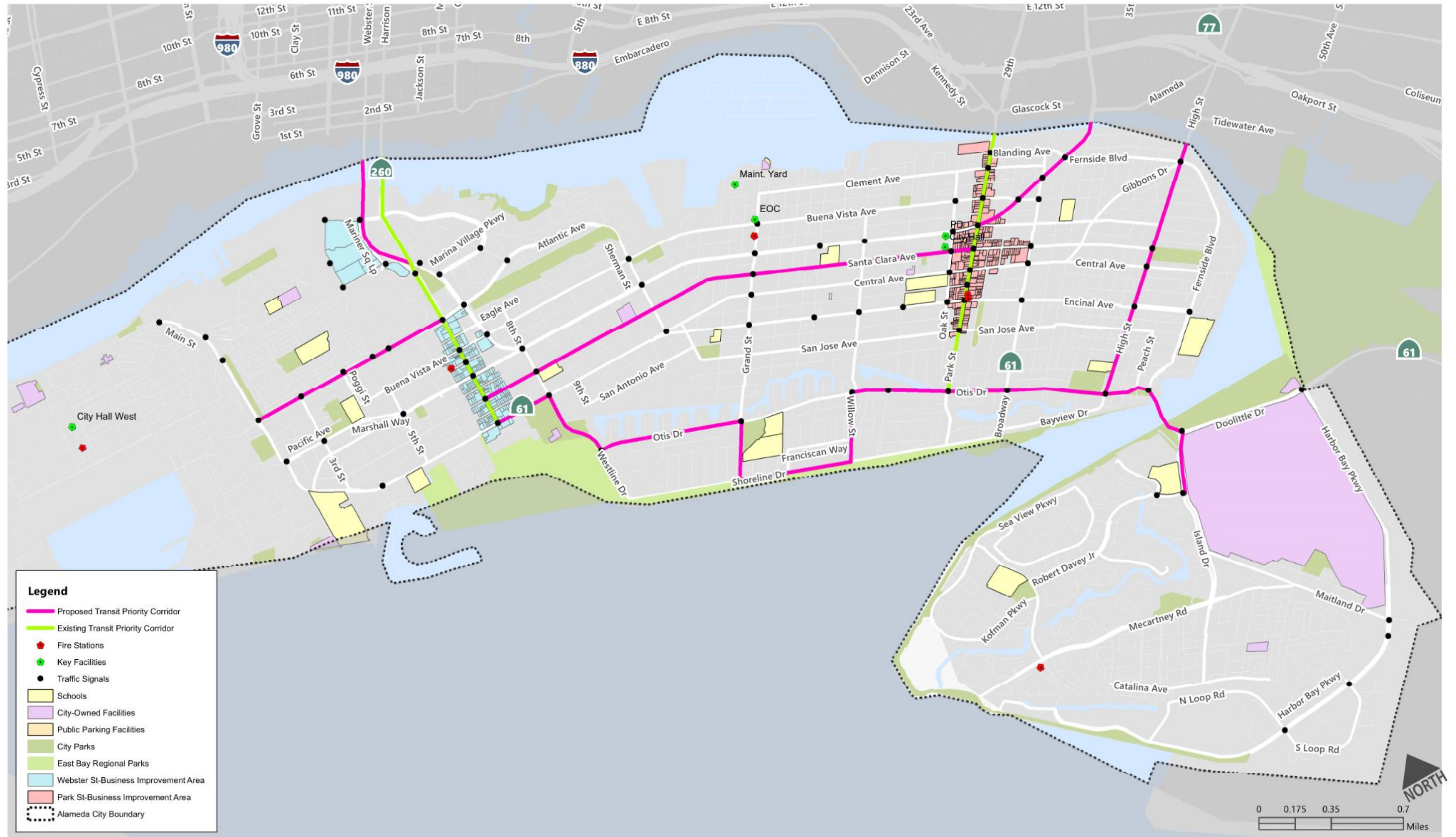
A Dig Once policy would establish a guideline that would not only protect existing infrastructure but would also proactively build out the City's upcoming infrastructure needs. The Dig Once policy would also provide a mechanism by which developments would be required to contribute to public right-of-way improvements in Alameda, including those which are discussed in this plan. This policy would also likely improve coordination with the various non-City utility companies and provide more joint trenching opportunities which will in turn minimize impact on existing facilities.

In addition to Dig Once policies, the City should also develop installation standards policies which will dictate standards for all City infrastructure installations. Examples of this would include standardization of signal equipment, new or modified roadway standards, or public street frontage requirements. These types of policies ensure that new installations are easily operated and maintained and are consistent with existing infrastructure and assets. Preparation of these types of policies could be completed in a relatively short-term timeframe.

To support these policies and standards, the City may find that additional personnel resources may be required. It's expected that checks and balances on the Dig Once policy may be required to ensure that all planned infrastructure is accounted for with each Dig Once inquiry. Further, maintenance of City standards will also be required, as industry standards and City equipment and hardware preferences may evolve over time. This person would also act as the single point of contact for implementing the Dig Once policy and the City's standards. Policy development is likely a lower cost effort and may be implemented by existing City staff, and thus has been assigned a short-term timeframe.



Figure 3: Recommended Transit Priority Corridors



## Recommendation #7: Implement Centralized Transportation Management

To better manage traffic and the traffic signal system around the City, establishment of centralized traffic management functionality would be ideal. This would offer a central location for real-time traffic incident monitoring, including during emergencies, and remote-control capabilities of all interconnected traffic signals. This would also enable a central location for CCTV monitoring of key traffic corridors, allowing for improved coordination with public safety and improved maintenance response times as well. While some of these needs are not currently urgent, the deployment of this kind of functionality would require communication capabilities with all of the managed equipment to first be established.

Centralized transportation management has traditionally meant a physical room or dedicated space where traffic management operations, management and monitoring has taken place. This was the case when most communications and underlying technologies were analog and typically could only be routed to one central location. With greater bandwidth capabilities and the switch to digital and networked communications (Ethernet), centralized transportation management today can be anywhere from the traditional dedicated physical room to a workstation on someone's desk, or a laptop in the field. As long as the physical infrastructure and software applications are in place to support it, centralized transportation management can be established in any or multiple locations.

For day-to-day operation, it is recommended that centralized transportation management be established at the Maintenance Service Center for use by traffic signal maintenance staff to monitor, detect, and assist in the troubleshooting of any maintenance or operational issues related to the traffic signal infrastructure. This functionality should also be established at City Hall West for Public Works engineering staff to monitor, manage, and operate the traffic signal infrastructure. In the case of emergency operations where the EOC is activated, this functionality should also be established in the EOC to coordinate transportation related activities to support emergency response activities. Ultimately, these three facilities should be interconnected to provide the ability for seamless system management at any of the three locations.

As part of establishing centralized transportation management functionality, it would also be necessary to update the system that will manage the signal equipment. The City currently has a basic Econolite Centrac's advanced traffic management system (ATMS) license but should consider expanding the use of this tool. The use of an ATMS like Centrac's would enable City staff and the City traffic engineer to manage and monitor traffic operations in real-time and remotely. ATMS systems provide a centralized dashboard to view and manage signal system performance and are a key tool in incident and emergency response. ATMS systems will also provide a reduction in maintenance monitoring staff time with automated tools that notify when equipment may need attention, allowing the City to have a proactive maintenance response. Acquiring the ATMS tool is likely not a high priority until most of the communications network is built out, so a mid-term timeframe would be expected.

Management of an ATMS system can be performed by existing City personnel. It's envisioned that the City's transportation staff, such as a traffic engineer, would take on this role, ultimately performing most system planning, upgrades, and maintenance of the ATMS system. Since implementing centralized transportation management requires other improvements, such as communications, to be implemented first, a mid-term timeline is appropriate. The capital investment is moderate for associated system licensing, software, hardware, and support services.



## Recommendation #8: Interconnect Emergency Operations Center & City Facilities

An important element of a Smart City is a central location where City staff may manage systems and emergency response. The City has recently established an Emergency Operations Center (EOC), which will serve as that central location for managing City services. As discussed in previous recommendations, in order to effectively provide that service, the EOC should be interconnected to the rest of the City's many facilities and service centers. This would be supported by Recommendation #1, which would ultimately reduce City dependency on AMP communications infrastructure. The interconnection of the EOC would also provide a secondary management location for Public Works assets.

This interconnection of the EOC would support the needs of various City departments, including Public Works, Public Safety, and IT. Implementation of this recommendation would likely occur once sufficient supporting infrastructure from Recommendation #1 is in place and would likely involve last-mile connections to the EOC building itself.

Interconnection of the rest of the City's various facilities to the EOC would provide the ability to enhance IT support and maintenance across the City's various offices and services, allowing for a more unified system. This approach would empower the City to manage its own network needs, including as it relates to cybersecurity. Being that the City has a multitude of facilities spread throughout the City, this would be a longer-term recommendation and would require prioritization of facilities to connect. The main work under this recommendation would be last mile installations to the facilities, which may increase cost being that they are to existing facilities and would require building modification.

## Recommendation #9: Implement Transportation Data Analytics

As traffic signal safety standards continue to evolve, it is important that signal systems are as close to current standards as possible. The City has a mixture of older equipment and new equipment. To achieve some of the other Smart City goals like automation, signal performance monitoring, or adaptive signal timing, signal equipment will need to be updated to best practice standards, which includes upgrades to the signal controllers, traffic detection technologies, and other auxiliary signal cabinet equipment. These upgrades will enable the City to begin collecting high-resolution multi-modal data, which will inform where transportation network deficiencies exist, which key corridors or areas are most utilized, and thus can help inform where transportation investments should be targeted. This technology is also potentially capable of collecting speed data, pedestrian volumes, bicycle volumes, and transit data, which would also be extremely useful to City planning efforts such as transit-oriented development, complete streets, and other multi-modal solutions.

Upgrade of equipment will also bring the technology up to best practice standards to be able to utilize the planned communications infrastructure (e.g., Ethernet). The City has already begun this process with the current use of Econolite's Cobalt traffic signal controllers and AutoScope video detection systems. These devices, in addition to serving its main function of operating a traffic signal and detecting vehicles, are able to collect data that can be analyzed to provide insight into roadway performance and utilization. The Cobalt controller is capable of logging signalized intersection activity in high resolution which when combined with an automated traffic signal performance monitoring system (ATSPM) can be used to understand and improve signal operations. The video detection system is capable of collecting intersection traffic counts that can provide insight into overall utilization, when the intersection is most used, how long that occurs, and which specific movement(s) are the most utilized and when. At the moment, this capability is not being utilized as there is not the existing communications infrastructure in place to retrieve the data from these devices in the field and there is

no central repository and application platform to store and analyze this data.

Overall, having up to date equipment will aid in improving intersection safety and will contribute to enhancing transportation operations citywide for all modes, allowing the City to manage and reduce delay and emissions while also making it easier to walk, bicycle and take the bus.

Implementation of this recommendation is tied to investments for equipment at City intersections and other supporting infrastructure. For this reason, the timeline for implementation will be longer term as it likely will depend on supporting infrastructure to be implemented first. Installation of all of these improvements would also need to be phased and may be subject to available funding for this type of work. This would likely push the time frames out to be more mid- to long-term.

In addition to data that would be generated by the City's own infrastructure, the City can also consider the use of third-party data sources, such as INRIX, Here, Streetlight, and Wejo, to serve its data needs for decision making. For example, the City has access to INRIX data through the Metropolitan Transportation Commission. One of the limitations to using these third-party data sources is that the data is based on a sampling of a sub-set of the overall data population as a way to represent the entire data population. So the use of third-party data is very good for determining measures such as travel speed, travel time, and origin-destination since a sub-set data pool can be fairly accurate in representing the behavior of the entire data population, but not very accurate in representing total demand or usage such as traffic volumes. Data from these sources are usually available via a subscription model and may aid the City in implementing the use of detailed data in the nearer term.

It should also be noted that the City has already embarked on several other science-related data collection efforts in partnership with the California for Education Network Initiatives in California (CENIC) via the Berkeley Labs. The CENIC data collection deployment for monitoring seals offshore at Alameda Point is serving as a pilot project for the City to partner with the science community and meet some of its environmental goals.

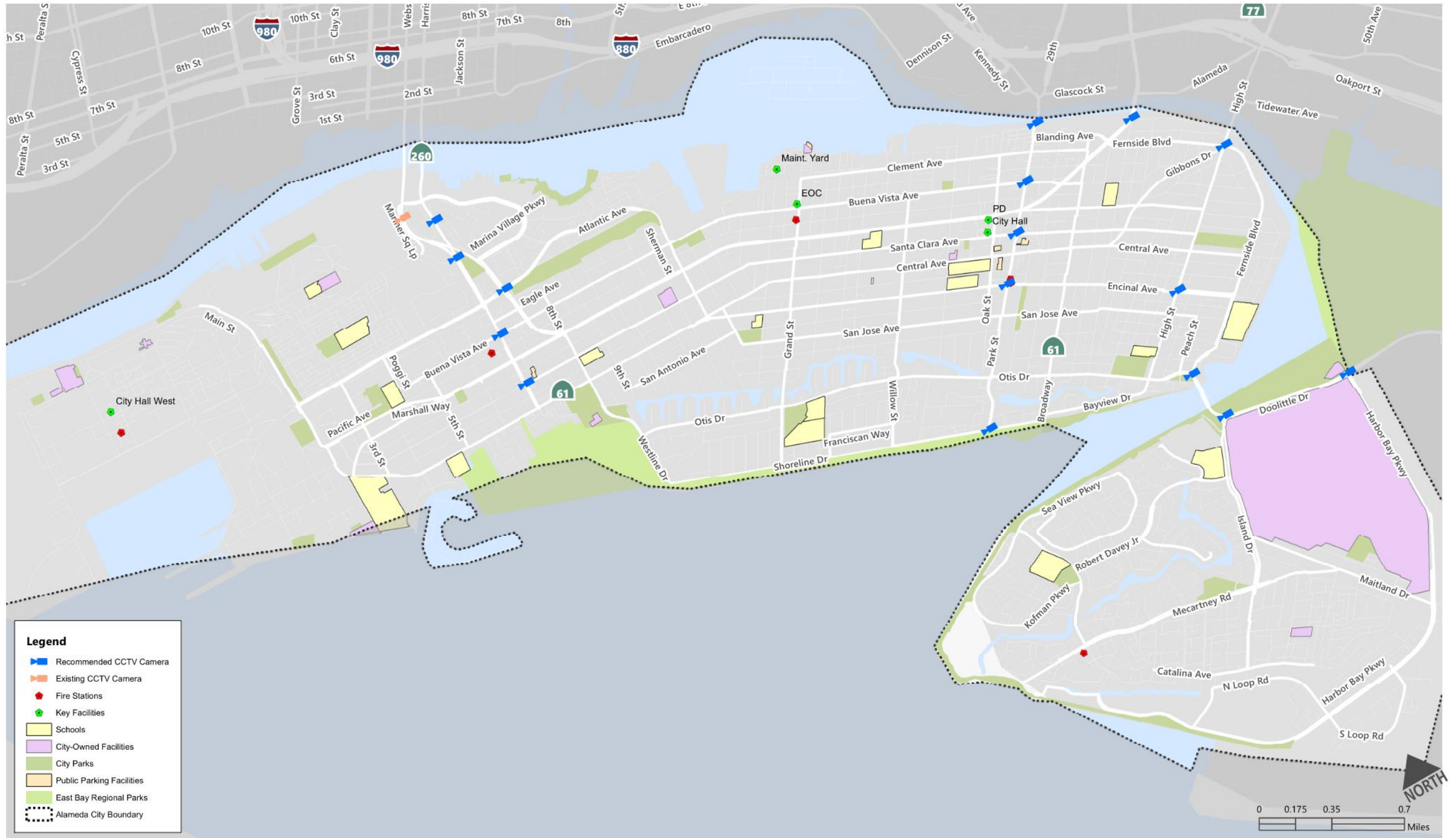
## Recommendation #10: Deploy Traffic Monitoring Camera Network

To enhance traffic and incident management in Alameda, a network of CCTV cameras is recommended. CCTV cameras would be strategically placed on city streets around the City to monitor areas that are key to circulation or areas that frequently experience issues requiring mitigation. This capability would enable City staff to monitor these areas remotely, thus improving incident detection and emergency response. It could also be especially useful at gateway traffic bottlenecks, like the tubes and bridges on and off the island. The use of these CCTV cameras would be for live viewing only, and images would not be recorded or used for surveillance or tracking. The CCTV cameras would essentially function as a substitute for a staff person standing on the street and making observations. It should be clearly noted that the intent of this system is not for security or policing and would only function as non-recording observational tools for transportation network monitoring.

Proposed locations for CCTV deployment are depicted in **Figure 4**. Given the importance of privacy and privacy concerns, the recommendation for CCTV camera deployments have been limited to key commercial corridors such as Webster Street and Park Street and the five access points to/from the City. Care was taken not to locate any CCTV cameras in areas that are primarily residential.

Since traffic monitoring is a lower priority within the City but would offer numerous benefits, this recommendation has been assigned a long-term timeframe. Further, CCTV cameras and the associated management systems would require the communications network infrastructure to first be in place. It's recommended that this system be established following the deployment of the communications network in locations where CCTV cameras are planned, thus ensuring that the maximum benefit of the system will be able to be realized following deployment.

Figure 4: Recommended Closed Circuit Television System





## Recommendation Summary

The following table (**Table 10**) offers a summary of the technical recommendations to meet the goals and objectives, as well as needs of the Stakeholders stated in the previous section. Each recommendation is also accompanied by an approximate timeframe for deployment as it relates to the primary goals of this plan, as well as a rough order of magnitude expected investment level for each recommendation.



Table 10: Recommendations Summary

No.	Technical Recommendation	Associated Smart City Goals♦	Benefits/Outcomes	Associated Stakeholders	Complementary City Plan(s)	Timeframe*			Cost Level*	Priority Level
						Short-term	Mid-Term	Long-Term		
1	<b>Build-out City Communications Network</b>	<ul style="list-style-type: none"> <li>Equitable Internet</li> <li>Government Transparency &amp; Cyber Security</li> <li>Transportation Operations</li> <li>Safety</li> <li>Economic Vitality</li> <li>Climate Goals</li> </ul>	<ul style="list-style-type: none"> <li>Reduce City dependency on Alameda Municipal Power communications infrastructure</li> <li>Enable remote operations of City-owned assets (signals, facilities, lighting, irrigation, pump stations, etc.)</li> <li>Enable network connection at all City facilities to support a public Wi-Fi network</li> <li>Enable improved digital City services by establishing access to City assets and data citywide</li> <li>Increase City's readiness for future technology advances related to connected/autonomous vehicles</li> <li>Empower more robust data collection effort, including environmental data</li> <li>Enable improved coordination, and interconnection with regional partners</li> <li>Support City parking management strategies</li> </ul>	<ul style="list-style-type: none"> <li>Public Works</li> <li>IT</li> <li>AMP</li> <li>Recreation &amp; Parks</li> <li>Public Safety</li> <li>Economic Development</li> <li>Educational Institutions</li> <li>Equity Priority Populations</li> <li>Regional Partners (all)</li> <li>Community Science</li> </ul>	<ul style="list-style-type: none"> <li>Emergency Operations Plan</li> <li>Alameda General Plan</li> <li>Information Technology Strategic Plan</li> <li>Economic Development Strategic Plan</li> <li>Transportation Choices Plan</li> <li>Climate Action and Resiliency Plan</li> </ul>	✓	✓	✓	\$\$\$\$	High
2	<b>Deploy Public Wireless Networks (Wi-Fi)</b>	<ul style="list-style-type: none"> <li>Equitable Internet</li> <li>Economic Vitality</li> </ul>	<ul style="list-style-type: none"> <li>Enhance internet availability in public places, and decrease the digital divide</li> <li>Attract businesses and commerce in Alameda</li> </ul>	<ul style="list-style-type: none"> <li>Public Works</li> <li>IT</li> <li>AMP</li> <li>Recreation &amp; Parks</li> <li>Economic Development</li> <li>Educational Institutions</li> <li>Equity Priority Populations</li> </ul>	<ul style="list-style-type: none"> <li>Alameda General Plan</li> <li>Information Technology Strategic Plan</li> <li>Economic Development Strategic Plan</li> </ul>	✓	✓	✓	\$\$\$	Medium
3	<b>Deploy Citywide Emergency Vehicle Preemption (EVP)</b>	<ul style="list-style-type: none"> <li>Transportation Operations</li> <li>Safety</li> </ul>	<ul style="list-style-type: none"> <li>Reduce emergency response times by lessening delay at signals</li> </ul>	<ul style="list-style-type: none"> <li>Public Works</li> <li>Public Safety</li> </ul>	<ul style="list-style-type: none"> <li>Emergency Operations Plan</li> <li>Alameda General Plan</li> <li>Hazard Mitigation Plan</li> </ul>	✓			\$\$	High

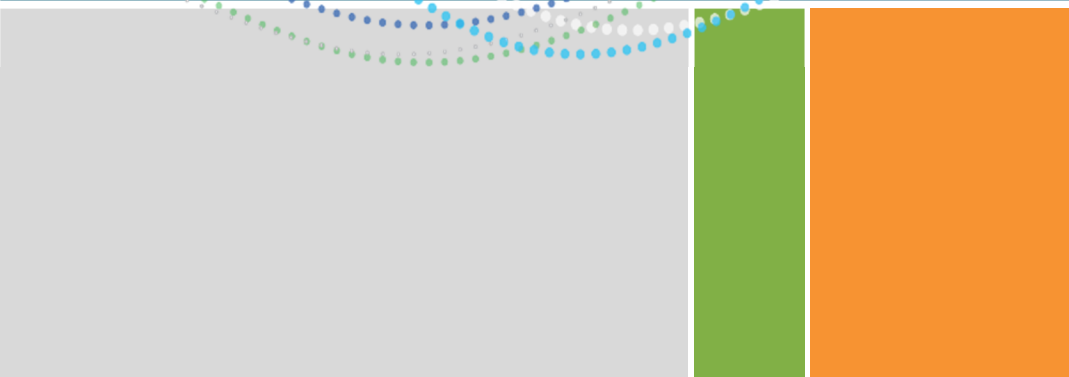
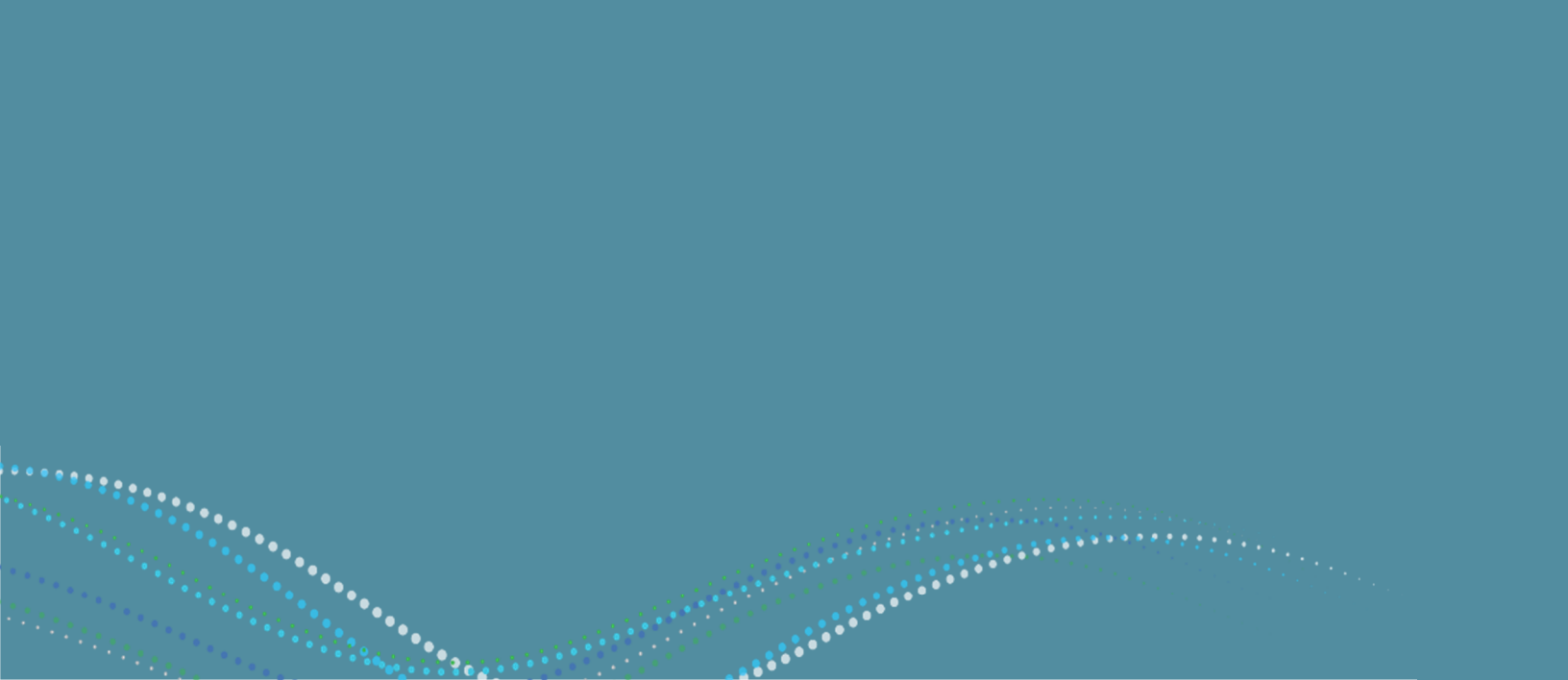
Table 10: Recommendations Summary  
(Continued)

No.	Technical Recommendation	Associated Smart City Goals♦	Benefits/Outcomes	Associated Stakeholders	Complementary City Plan(s)	Timeframe*			Cost Level*	Priority Level
						Short-term	Mid-Term	Long-Term		
4	<b>Deploy Transit Signal Priority</b>	<ul style="list-style-type: none"> <li>Transportation Operations</li> <li>Economic Vitality</li> <li>Climate Goals</li> </ul>	<ul style="list-style-type: none"> <li>Reduce travel times for bus travel by providing priority</li> <li>Enhance transportation equity citywide</li> <li>Enable AC Transit to consider expansion of service</li> </ul>	<ul style="list-style-type: none"> <li>Public Works</li> <li>Economic Development</li> <li>Equity Priority Populations</li> <li>Regional Partners (AC Transit)</li> </ul>	<ul style="list-style-type: none"> <li>Climate Action and Resiliency Plan</li> <li>Economic Development Strategic Plan</li> <li>Transportation Choices Plan</li> </ul>	✓			\$\$	Medium
5	<b>Partner with Internet Service Providers</b>	<ul style="list-style-type: none"> <li>Equitable Internet</li> <li>Economic Vitality</li> <li>Climate Goals</li> </ul>	<ul style="list-style-type: none"> <li>Enhance internet availability and bandwidth for all</li> <li>Lower costs for improved internet services</li> <li>Mitigate predatory tactics on pricing escalations</li> </ul>	<ul style="list-style-type: none"> <li>IT</li> <li>Economic Development</li> <li>Educational Institutions</li> <li>Equity Priority Populations</li> </ul>	<ul style="list-style-type: none"> <li>Alameda General Plan</li> <li>Economic Development Strategic Plan</li> <li>Climate Action and Resiliency Plan</li> </ul>	✓			\$	Medium
6	<b>Develop Dig Once and Installation Standards Policies</b>	<ul style="list-style-type: none"> <li>Transportation Operations</li> <li>Safety</li> <li>Equitable Internet</li> <li>Economic Vitality</li> <li>Climate Goals</li> <li>Government Transparency &amp; Cyber Security</li> </ul>	<ul style="list-style-type: none"> <li>Reduce impact on City's infrastructure</li> <li>Proactively build-out City's communications network infrastructure needs</li> <li>Require developments to build public right-of-way infrastructure defined within this Plan and others</li> <li>Improve coordination with utility companies for joint trenching opportunities</li> </ul>	<ul style="list-style-type: none"> <li>Public Works</li> <li>Transportation Planning</li> <li>IT</li> <li>AMP</li> </ul>	<ul style="list-style-type: none"> <li>Alameda General Plan</li> <li>Zero Waste Implementation Plan</li> <li>Climate Action and Resiliency Plan</li> </ul>	✓			\$	High
7	<b>Implement Centralized Transportation Management</b>	<ul style="list-style-type: none"> <li>Transportation Operations</li> <li>Safety</li> </ul>	<ul style="list-style-type: none"> <li>Manage traffic operations in real-time, remotely</li> <li>Provide a dashboard for signal performance measurement and management</li> <li>Contribute to emergency response</li> <li>Reduce field time needed to maintain and monitor signal system</li> </ul>	<ul style="list-style-type: none"> <li>Public Works</li> <li>Regional Partners (AC Transit)</li> <li>Transportation Planning</li> <li>Public Safety</li> </ul>	<ul style="list-style-type: none"> <li>Alameda General Plan</li> <li>Transportation Choices Plan</li> </ul>		✓		\$\$	Medium to low

Table 10: Recommendations Summary  
(Continued)

No.	Technical Recommendation	Associated Smart City Goals◆	Benefits/Outcomes	Associated Stakeholders	Complementary City Plan(s)	Timeframe*			Cost Level*	Priority Level
						Short-term	Mid-Term	Long-Term		
8	Interconnect Emergency Operations Center & City Facilities	<ul style="list-style-type: none"><li>Government Transparency &amp; Cyber Security</li><li>Safety</li></ul>	<ul style="list-style-type: none"><li>Establish a central location for management of City services during an emergency</li><li>Provide a secondary location for Public Works management of assets</li><li>Enhance IT support and maintenance across the City</li><li>Reduce City dependency on AMP communications infrastructure</li><li>Empower IT management of cyber security citywide</li></ul>	<ul style="list-style-type: none"><li>Public Works</li><li>IT</li><li>AMP</li><li>Recreation &amp; Parks</li><li>Public Safety</li><li>Educational Institutions</li></ul>	<ul style="list-style-type: none"><li>Emergency Operations Plan</li><li>Alameda General Plan</li><li>Information Technology Strategic Plan</li><li>Hazard Mitigation Plan</li></ul>		✓	✓	\$\$\$\$	High
9	Implement Transportation Data Analytics	<ul style="list-style-type: none"><li>Transportation Operations</li><li>Safety</li><li>Climate Goals</li></ul>	<ul style="list-style-type: none"><li>Enable high-resolution multi-modal data collection</li><li>Enable deployment of signal performance measurement</li><li>Bring current hardware up to current communication standards</li><li>Contribute to operations management to increase safety and reduce delay and emissions citywide</li></ul>	<ul style="list-style-type: none"><li>Public Works</li><li>Transportation Planning</li><li>Public Safety</li></ul>	<ul style="list-style-type: none"><li>Climate Action and Resiliency Plan</li><li>Alameda General Plan</li><li>Transportation Choices Plan</li></ul>		✓	✓	\$\$\$\$	Medium
10	Deploy Traffic Monitoring Camera Network	<ul style="list-style-type: none"><li>Transportation Operations</li><li>Safety</li></ul>	<ul style="list-style-type: none"><li>Improve real-time traffic management and incident response</li><li>Provide incident detection and emergency response</li><li>Monitor bridges for emergency route planning in real-time</li></ul>	<ul style="list-style-type: none"><li>Public Works</li><li>Public Safety</li><li>Transportation Planning</li></ul>	<ul style="list-style-type: none"><li>Emergency Operations Plan</li><li>Alameda General Plan</li><li>Transportation Choices Plan</li></ul>			✓	\$\$\$	Low
	<div><div>*Cost Level Key: \$ - Less than \$100,000 \$\$ - \$100,000-\$500,000 \$\$\$ - \$500,000-\$1M \$\$\$\$ - \$1M+</div><div>*Timeframe Key: Short-term: &lt;3 years Mid-term: 3-8 years Long-term: 8+ years</div><div>◆ Smart City Goals and associated Objectives are described in Table 1.</div></div>									





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