

# BART Adaptation Strategy for Sea-Level Rise in the San Francisco Bay Area

FTA Project CA-26-6006-00

with support of

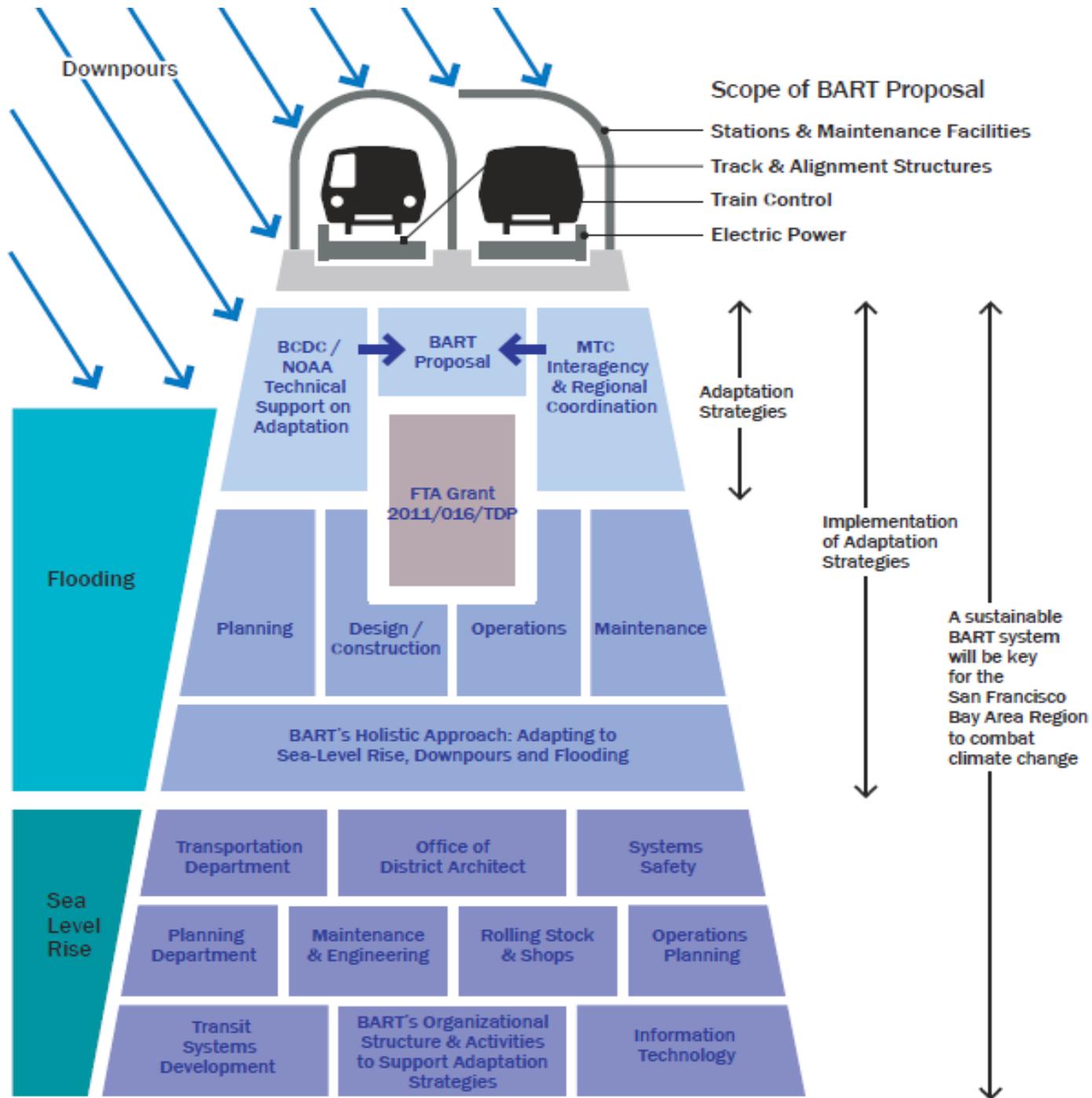
National Oceanic & Atmospheric Administration

San Francisco Bay Conservation & Development Commission

Metropolitan Transportation Commission

March 22, 2012  
Arlington, VA

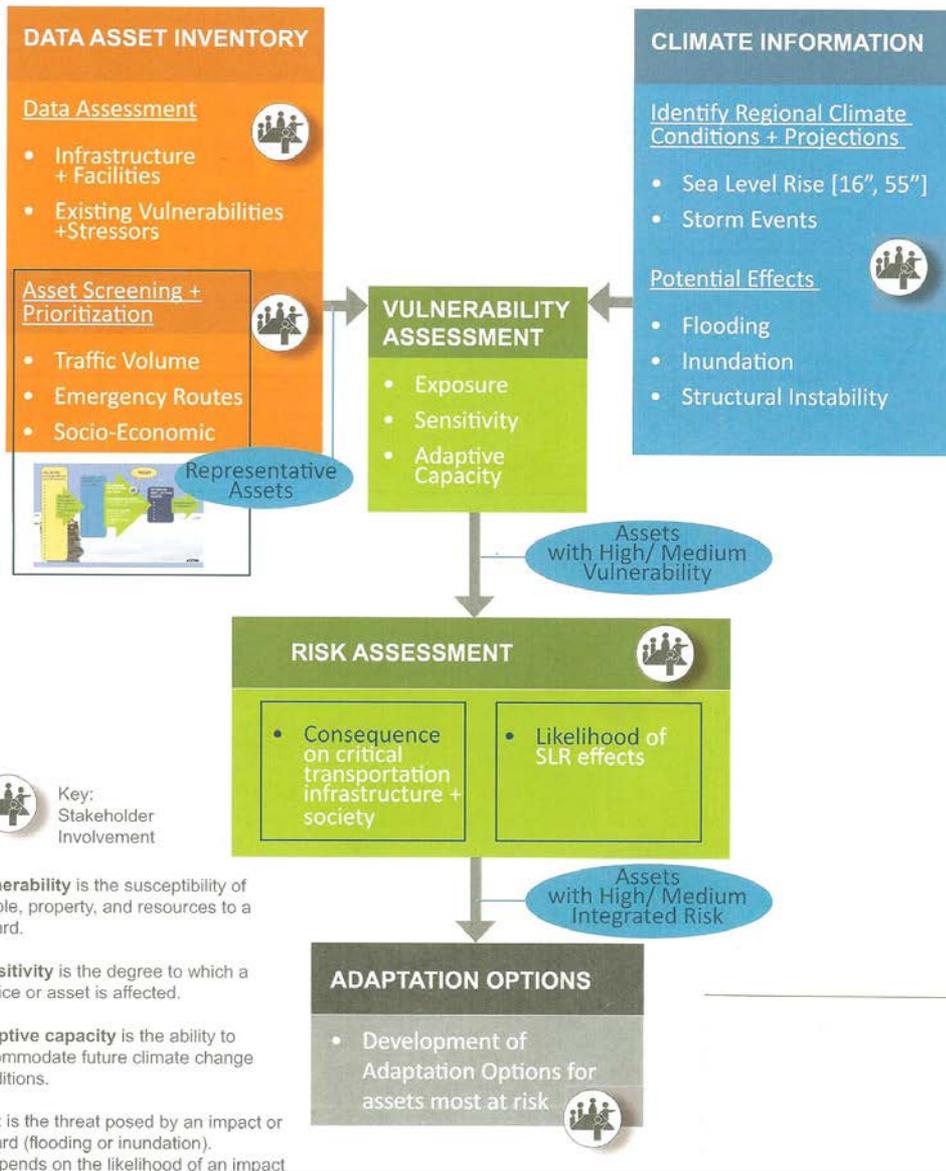
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**50 year**  
 – 16 inch  
 &  
**100 year**  
 – 55 inch



**FHWA PILOT MODEL  
 ADAPTING TO RISING TIDES  
 PROJECT PROCESS**  
 Draft 5/18/2011



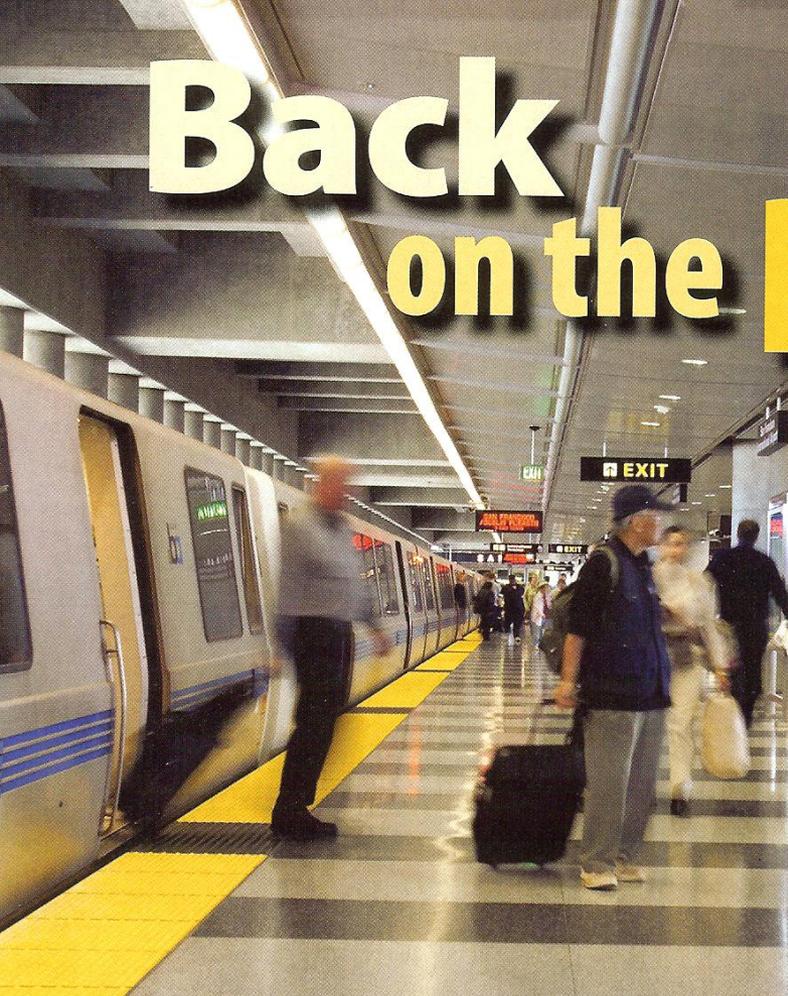
**BART pilot is building on the findings but adding "heavy down pour and flood"**

# Scope & Methodology

**A component(s) of each type of SYSTEMS and ASSET (a location specific facility) will be studied against sea level, heavy down pouring, and flooding in scenarios of 50/100 years for 4 aspects: hazard, risk, adaptation strategies, and implementation strategies**

Proposed Scope and associated Tasks and Budget	ELEMENT 1	ELEMENT 2	ELEMENT 3	ELEMENT 4	ELEMENT 5
STATIONS AND MAINTENANCE FACILITIES	Sea-level rising, down pouring, and flood - vulnerability defined by Adapting to Rising Tides (ART) Project funded by FHWA.	Lake Merritt Station (subway), West Oakland Station (aerial), Coliseum/Airport Station (aerial), and Oakland Shop (at grade)	BART has developed relevant strategies in the Water Intrusion Program (IRP).	IRP has mainstreamed strategies, increased institutional awareness and ensured that adaption is addressed in responsible departments.	IRP documentation and related BART Facilities Standards will be included in the final report. See side bars in this proposal for samples.
TRACK / ALIGNMENT STRUCTURES	Sea-level rising, down pouring, and flood - vulnerability defined by Adapting to Rising Tides (ART) Project funded by FHWA.	Oakland WYE, Transbay tube, Aerial structures, at grade ballast track, Drainage systems, and Retaining systems	Summarize maintenance records. Selective field inspection. Research for best practices. Identify planning, remediation and maintenance options.	Draft an action plan. Workshop with stakeholders. Define roles and responsibilities. Solidify intra- and inter-agency partnerships. Update standards.	Final report will document changes to EMS, Emergency Plan, Facilities Standards, maintenance manuals and organizational roles.
ELECTRIC POWER	Sea-level rising, down pouring, and flood - vulnerability defined by Adapting to Rising Tides (ART) Project funded by FHWA.	Traction contact rail Transformer-rectifier AC and DC switchgear Cross bonding Raceway	Summarize maintenance records. Selective field inspection. Research for best practices. Identify planning, remediation and maintenance options.	Draft an action plan. Workshop with stakeholders. Define roles and responsibilities. Solidify intra- and inter-agency partnerships. Update standards.	Final report will document changes to EMS, Emergency Plan, Facilities Standards, maintenance manuals and organizational roles.
TRAIN CONTROL	Sea-level rising, down pouring, and flood - vulnerability defined by Adapting to Rising Tides (ART) Project funded by FHWA.	Train control room Equipment room Trackside equipment Track switch Signal system	Summarize maintenance records. Selective field inspection. Research for best practices. Identify planning, remediation and maintenance options.	Draft an action plan. Workshop with stakeholders. Define roles and responsibilities. Solidify intra- and inter-agency partnerships. Update standards.	Final report will document changes to EMS, Emergency Plan, Facilities Standards, maintenance manuals and organizational roles.

# Back on the Rails



by Tian Feng, FAIA, FCSI,

Infrastructure is society's responsible for sustaining and political stability. The creating new infrastructure magnitude of their initial understood. However, strategies (and the scale of) are not common knowledge transportation infrastructure than a quarter of its 80,500 highway lanes in disrepair.<sup>1</sup>

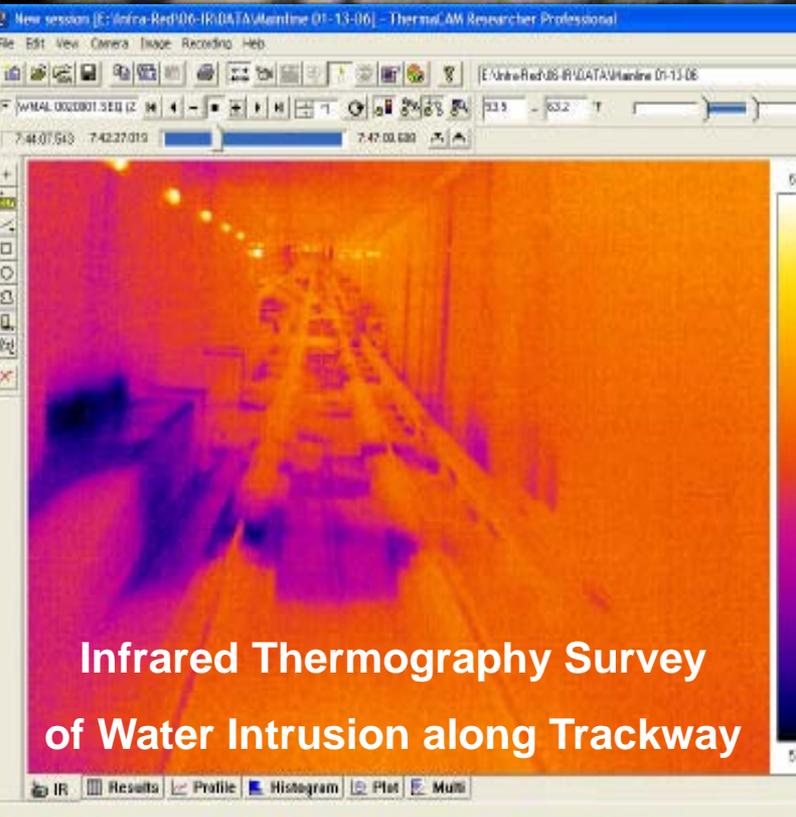
The American Society of (ASCE) estimates \$1.6 trillion

**BART pilot is following the model for BART Water Intrusion Remediation Program: Study – Strategy – Program – Implementation**

**Programming and specifying for transit infrastructure rehabilitation**

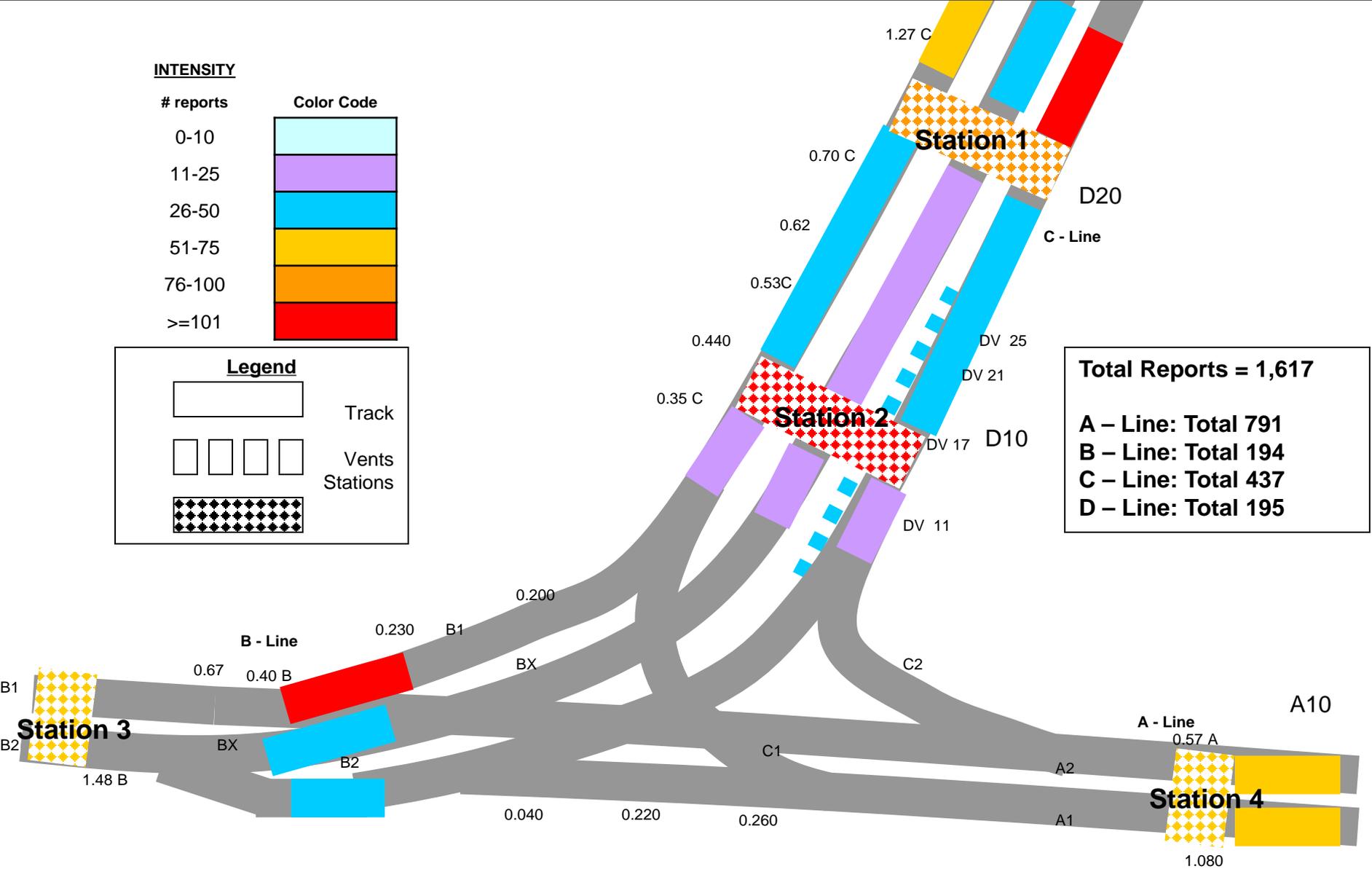
constructed with durable materials with long service life expectancy it is subjected to constant factors including:

- structural capacity by fatigue
- environmental impacts;

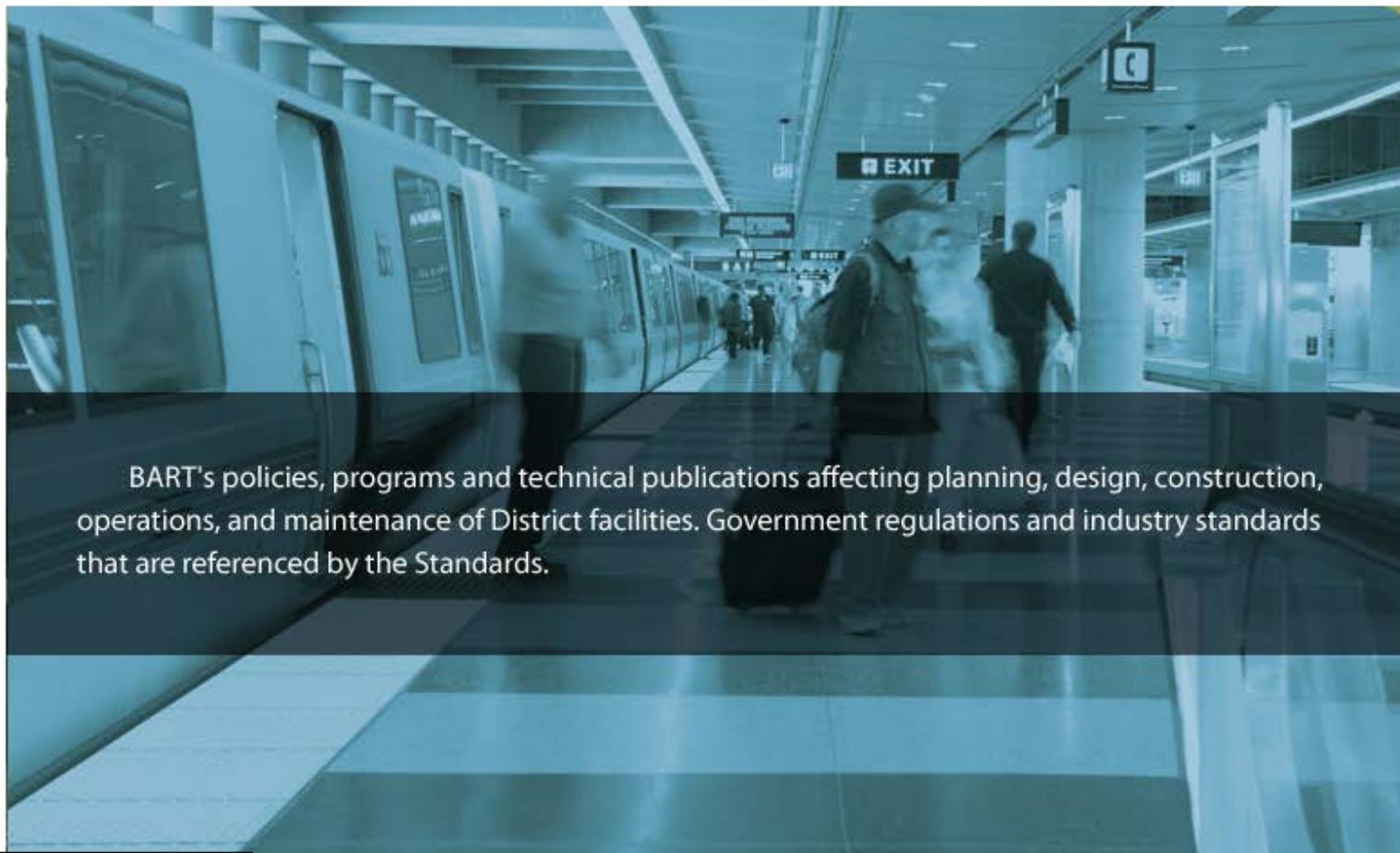


**Infrared Thermography Survey of Water Intrusion along Trackway**

# Water intrusion related maintenance reports color coded water by intensity, superimposed over the transit operating system diagram.



**BART Water Intrusion Program mainstreamed into design, construction, maintenance, and operations**



BART's policies, programs and technical publications affecting planning, design, construction, operations, and maintenance of District facilities. Government regulations and industry standards that are referenced by the Standards.

**Introduction**

**Facility Design Criteria**

**Standard Drawings**

**Standard Specifications**

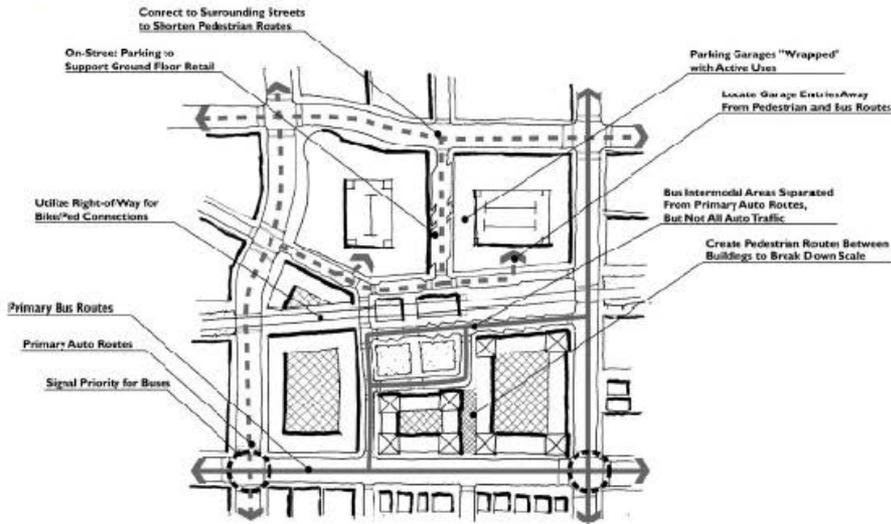
**Appendices**



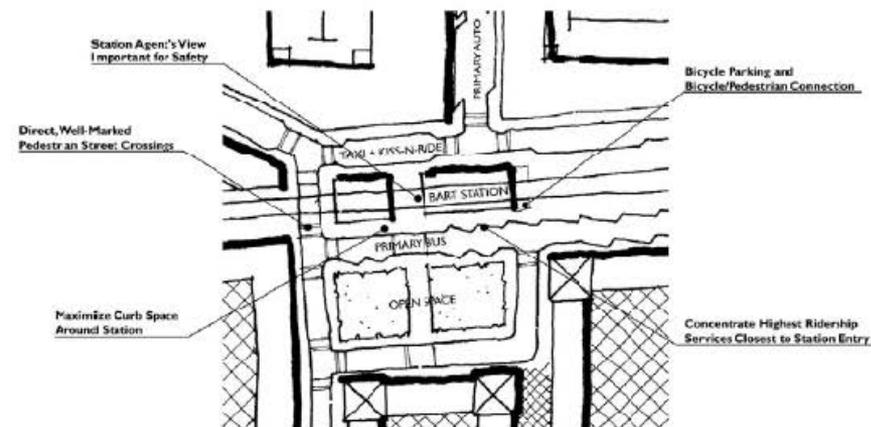
BART' Facilities Standards guide design and construction of assets against natural hazards, such as water intrusions: for example, street level vent is not permitted (10 ft riser is required)

## BART Station Access Guidelines

**Figure 4-1 Station Area Access Priorities**



**Figure 4-2 Faregate Area Access Priorities**



## Appendices

BART's policies, programs and technical publications address construction, operations, and maintenance of District facilities and industry standards that are referenced by the Standards.

### DISTRICT POLICIES

### DISTRICT PROGRAMS & GUIDELINES

BART Bicycle Access and Parking Plan  
 BART Station Access Guidelines  
 DART Transit-Oriented Development Code  
 Public Art Performance Standards  
 Sample Artist Assignment Agreement  
 Wayfinding and Signage Design Video

### DISTRICT TECHNICAL MANUALS

### GOVERNMENT CODES & REGULATIONS

### INDUSTRY CODES & STANDARDS

Standard Drawings  
Standard Specifications

**CHAPTER 13 - RULES COMPLIANCE/ PROCEDURES REVIEW** ..... 13-1

1301 Overview.....13-1

1302 Review and Revision of Rules and Procedures ..... 13-1

1303 Process for Ensuring Rules Compliance .....

1304 Train Operator Evaluations Program.....

1305 Operations Safety Compliance Program.....

**CHAPTER 14 – FACILITIES and EQUIPMENT INSPECTIONS**.....

1401 Facilities and Equipment Subject to Inspection.....

1402 Regular Inspection and Testing.....

1403 Checklists.....

1404 Coordination with Hazard Management Process.....

**CHAPTER 15 - MAINTENANCE AUDITS / INSPECTIONS**.....

1501 Systems and Facilities Subject to Maintenance Program.....

1502 Resolution of Audit/Inspection Findings.....

1503 Checklists.....

**CHAPTER 16 - TRAINING AND CERTIFICATION REVIEW/AUDIT**.....

1601 Overview.....

1602 Employee Safety.....

1603 Contractor Safety.....

1604 Record Keeping.....

1605 Compliance with Training Requirements.....

**CHAPTER 17 - CONFIGURATION MANAGEMENT**.....

1701 Overview.....

1702 Process for Changes.....

1703 Authority for Change.....

**CHAPTER 18 – COMPLIANCE WITH LOCAL, STATE AND FEDERAL REQUIREMENTS**

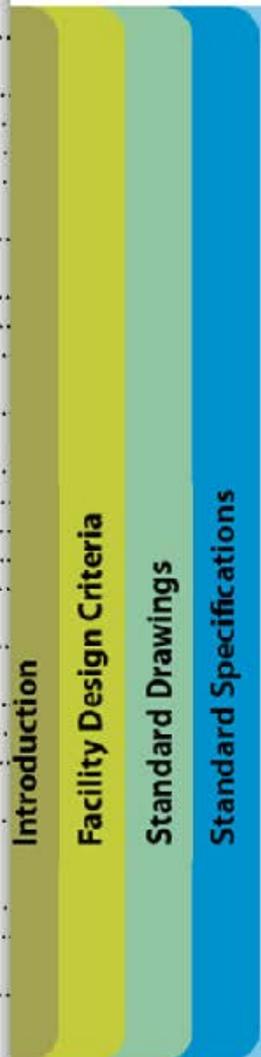
1801 Employee Safety Program.....

1802 Working on or near Rail.....

Transit Controlled Property

1803 Compliance with Required Safety Programs .....

# BART Facilities Standards



## Appendices

BART's policies, programs and technical publications construction, operations, and maintenance of District and industry standards that are referenced by the Standards

### DISTRICT POLICIES

### DISTRICT PROGRAMS & GUIDELINES

### DISTRICT TECHNICAL MANUALS

### GOVERNMENT CODES & REGULATIONS

### INDUSTRY CODES & STANDARDS

- Access Management & Improvement
- BART Policy Framework for System
- BART Strategic Plan
- Financial Stability Policy
- Policy Framework for Station Area Plan
- Sustainability Policy
- System Safety Program Plan
- System Reactivation Safety Inspection
- Transit-Oriented Development (TOD)
- Welfare to Work to Career Policy Framework

## Facility Design Criteria

Principles and recommendations for design practices and BART's experience. Mandatory attributes required for facility safety, usability

### ARCHITECTURE

### CIVIL

### ELECTRICAL

### ELECTRONICS

### MECHANICAL

### STRUCTURAL

Basic Design Policies

Drainage

Miscellaneous Standards

Streets and Surface Park

Trackway

Utilities

1. **GENERAL**
  - 1.1 **Basic Design Policies**
  - 1.2 **Design Responsibilities**
2. **HYDROLOGY**
  - 2.1 **Storm Frequency**
  - 2.2 **Intensity-Duration**
  - 2.3 **Runoff**
3. **HYDRAULIC DESIGN**
  - 3.1 **Open Channels and Culverts**
  - 3.2 **Storm Drains and Closed Conduits**
  - 3.3 **Curbs, Gutters, and Inlets**
  - 3.4 **Debris Control**
  - 3.5 **Permissible Velocities**
  - 3.6 **Energy Dissipation**
4. **PUMPING STATIONS**
  - 4.1 **Justification**
  - 4.2 **Available Natural Storage**
  - 4.3 **Constructed Storage**
  - 4.4 **Runoff Diversion**
  - 4.5 **Pumps**

**PHASES****TIMELINE****BUSINESS  
AREAS**

[Home](#) > [About](#) > [Business Areas](#) > Maintenance



## Maintenance

The Maximo and Optram suite of modules will be implemented to the following business areas as mapped out below:

