## INTRODUCTION

### COMMON REQUIREMENTS

### ENVIRONMENTAL DESIGN AND SUSTAINABILITY

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ENVIRONMENTAL DESIGN AND SUSTAINABILITY

1. GENERAL

This Section establishes common requirements for environmental design and sustainability for the BART system.

1.1 DEFINITION

Sustainability shall be understood to mean: To improve and enjoy today’s quality of life while preserving resources and the environment for future generations, based on an understanding of the past, the knowledge of today, and hope for the future.

1.2 SUSTAINABILITY POLICY

Sustainability in the BART system context is a transit performance based policy. While observing the sustainable design principles applicable to buildings and other development, it will encourage increased system capacity for serving more Bay Area communities; optimize BART facility and operational performance; and enhance its service quality to the riding public. Refer to Appendices/District Policies/Sustainability Policy.

A. BART’s transit performance-based policy will result in the following:
   - More compact land uses in developed areas and less pressure in undeveloped areas;
   - More preservation and less impact to the natural environment and resources; and
   - Safer commutes and healthier communities.

B. BART’s Sustainability Policy emphasizes:
   - Resource efficiency
   - Service quality
   - Environmental preservation
   - Cost effectiveness

1.3 OBJECTIVE

Overall objective of this section is to encourage the integration of sustainable design with facility development and maintenance.
   - Promote sustainable, transit-oriented development in the communities BART serves to maximize the use of BART as the primary mode of transportation.
• Enhance multimodal access to new and existing BART stations and related facilities and use of resource efficient and environmentally friendly access modes (bike, walking, etc.).

• Integrate sustainability principles and practices into the planning, design, construction, and maintenance of new BART stations and related facilities.

• Incorporate proven sustainable materials, methods and technologies into BART Facilities Standards to increase life-cycle value including reduction of energy and resource use, and to enhance the health and comfort of employees and patrons.

• Apply sustainable techniques and procedures into BART maintenance projects and operations in a cost-effective manner.

• Develop procurement strategies that incorporate sustainability criteria compatible with Federal and state non-discrimination requirements.

• Adopt applicable provisions of industry standards and technical manuals of sustainable practices, such as applying the U. S. Green Building Council’s Leadership in Energy and Environmental Design (LEED™) Green Building Rating System guidelines for creating healthier work places for employees by providing a better indoor environment.

• Incorporate local sustainability requirements based on appropriateness.

2. REFERENCE STANDARDS

2.1 GOVERNMENT


B. Environmental Protection Agency’s Environmentally Preferred Purchasing website for the database on products and services with reduced environmental impact. http://www.epa.gov/oppt/epp/database.htm

C. Comprehensive Procurement Guidelines (CPG) website “buy-recycled” products list. The EPA considers several criteria when determining which items it will designate, the potential impact of procurement on the solid waste stream; the economic and technological feasibility of producing the item; and other uses of the recovered materials used to produce the item. http://www.epa.gov/cpg/

D. Federal Transit Administration’s Transit Noise and Vibration Impact Assessment, prepared by Harris, Miller, Miller & Hanson, Inc. Final Report, current version.

E. California Division of the State Architect Environmentally Preferable Products Database at http://www.eppbuildingproducts.org
2.2 INDUSTRY

A. The American Public Transportation Association: Transit Sustainability Guidelines, ©2011


3. SITE OPTIMIZATION

3.1 SITE SELECTION

Select alignment of BART routes and sites for BART stations and other facilities with the following in mind:

A. Optimize transit use and access including inter-modal opportunities and Transit-Oriented Development (TOD) potential.

B. Follow the principles of environmentally sensitive site selection and development (including mitigations typically mandated by Environmental Impact Statement/Report).

- Take into consideration preservation of wetlands, wildlife (including threatened and endangered species), and arable lands; avoidance of flood plains; and preservation of community amenities and assets (including historic structures and open space).

- Look for opportunities to enhance or create community amenities, such as enhancing or creating trail access to BART corridor and stations.

- Look for opportunities to enhance natural systems within project areas, especially sensitive areas such as creeks and wetlands. ¹

- Consider Brownfield Redevelopment: Brownfield Redevelopment is rehabilitation of abandoned, idled, or under-used industrial and commercial facilities or sites where development is complicated by real or perceived environmental contamination. Such Brownfield Redevelopment reduces pressure on undeveloped land, implements remediation measures, and returns the Brownfield site to economic and community usefulness instead of liability. Brownfield Redevelopment also permits use of uncontaminated sites for housing or recreation where containment of contaminants or other remediation or mitigation might be less practical.

¹ Or as LEED SS c5.1 puts it: Conserve existing natural areas and restore damaged areas to provide habitat and promote biodiversity.
• Take into account environmental justice: Avoid disproportionately high and adverse impacts on minority and low-income populations. Minimize and/or mitigate unavoidable impacts by identifying concerns early in the planning phase and providing offsetting initiatives and enhancement measures to benefit affected communities and neighborhoods.

3.2 TRANSIT-ORIENTED DEVELOPMENT

Transit-Oriented Developments or Designs (TODs) are mixed-use, walkable communities developed around transit stops. They are designed to significantly reduce auto dependency. They also have proven to be an economic boon, revitalizing downtowns and main streets and offering a new model for managing growth.\(^2\) Refer to Appendices, District Programs and Guidelines, TOD Guidelines, and District Policies, Station Area Development Implementation Policy.

• Look for opportunities to encourage or develop transit-oriented development at existing or proposed BART stations and preserve their viability as such in accordance with BART’s TOD Guidelines.

• Consider modifications to the design and function of BART facilities as may be necessary to support the construction and operation of transit-oriented development on and adjacent to BART property.

3.3 REDUCE IMPACT OF PROJECT SITE

3.3.1 EROSION AND SEDIMENTATION CONTROL DURING CONSTRUCTION AND IN PERMANENT FACILITIES

Temporary and permanent erosion and sediment control measures shall control erosion to reduce negative impacts on water and air quality. Refer to BART Standard Specifications 01 57 00, Temporary Controls, Articles on Erosion and Sediment Control and Dust Control.

A. Measures shall achieve the following objectives:

• Prevent loss of soil during construction by storm water runoff and/or wind erosion, including protecting topsoil by stockpiling for reuse.

• Prevent sedimentation of storm sewer or receiving streams.

• Prevent polluting the air with dust and particulate matter.

B. Measures shall include a sediment and erosion control plan (and its implementation) that conforms to United States Environmental Protection Agency (EPA) Document No. EPA 832/R-92-005 (September 1992), Storm Water Management for Construction Activities, Chapter 3 or local erosion and sedimentation control standards and codes, whichever is more stringent.

\(^2\) From US Department of Energy website.
3.3.2 STORM WATER MANAGEMENT

Limit disruption and pollution of natural water flows by managing stormwater runoff.\(^3\)

A. Provide oil/water separator system to intercept runoff from parking facilities, including surface parking and parking structures. Separator shall be designed to separate out contaminants from runoff and prevent them from entering the storm water system. Refer to Facility Design /Criteria/CIVIL/Drainage, 11. Oil and Water Separator.

B. Design the project site to maintain natural stormwater flows by promoting infiltration.

C. Site development may include storm water detention areas to promote infiltration.

D. Consider additional measures such as the following to limit disruption and pollution of natural stormwater flows:\(^4\)
   - Pervious paving to minimize impervious surfaces.
   - Garden roofs (specially designed vegetated roof treatment).
   - Collect storm water and use for non-potable uses such as landscape irrigation, toilet and urinal flushing, and custodial uses.

3.3.3 REDUCE NON-ROOF HEAT ISLAND

Reduce heat islands to minimize impact on microclimate and human and wildlife habitat. Heat island is the thermal gradient differences between developed and undeveloped areas.

In regard to BART Stations and miscellaneous sites such as traction power substations and cash handling facilities, this requirement shall include one of the following provisions (or a combination):\(^5\)

A. At least 30 percent of a site’s non-roof impervious surfaces including parking lots, walkways, plazas, etc.:
   - Provide shade (within 5 years), or
   - Use light-colored/high-albedo materials (reflectance of at least 0.3 when tested in accordance with ASTM E903 at minimum six weeks after placement), or
   - Open grid pavement

B. Place a minimum of 50 percent of parking spaces underground or covered by parking structure.

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\(^3\) LEED SS6.1.
\(^4\) Refer to LEED SS6.1, Potential Technologies & Strategies.
\(^5\) Based on LEED SS7.1.
3.3.4 **MINIMIZE LIGHT POLLUTION**

Eliminate to the extent possible light trespass from the buildings and site thereby improving night sky access and reducing development impact on nocturnal environments.\(^6\) Refer to Facility Design/Criteria/ELECTRICAL.

3.3.5 **REDUCE IMPACT OF NOISE AND VIBRATION**

Refer to Facility Design/Criteria/ARCHITECTURE, Passenger Stations, under Noise and Reverberation Control.

A. Reduce impact of noise and vibration on neighboring open spaces and structures and their occupants. Refer to FTA’s Transit Noise and Vibration Impact Assessment.

B. Require noise and vibration studies specific to alignment when warranted, i.e. cut-and-cover subway segment of BART to SFO and comply with recommendations.

4. **WATER CONSERVATION**

4.1 **LANDSCAPE IRRIGATION SYSTEMS**

Design and operate water efficient irrigation system. Refer to BART Standard Specifications Section 34 84 00, Planting Irrigation, and Facilities Design/Criteria and Guidelines/ARCHITECTURE/Landscape and Vegetation Control, for provisions for remote-controlled monitoring system which prevents water waste by monitoring moisture levels.

4.2 **PLANT SELECTION**

Make plant selections in accordance with water conservation principles. Refer to Facilities Design/Criteria and Guidelines/ARCHITECTURE/Landscape and Vegetation Control.

4.3 **PLUMBING FIXTURES**

Utilize water efficient plumbing fixtures. Refer to Facility Design/Guidelines/MECHANICAL/General.

4.4 **VEHICLE WASHER**

Minimize vehicle washer water usage. Refer to Facility Design/Criteria/ARCHITECTURE/Yards and Shops.

5. **ENERGY EFFICIENCY**

5.1 **BUILDING CONFIGURATION AND PLACEMENT**

Place and configure buildings to optimize energy efficiency through minimizing artificial ventilation; maximizing natural lighting; reducing heating, ventilating, and air conditioning

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\(^6\) Based on LEED SSc8.
energy use, and optimizing solar energy utilization. Take into account solar orientation, wind direction, and natural features.

5.2 BUILDING ENVELOPE

Design building envelope to optimize energy efficiency including the following elements:

A. Provide adequate insulation
B. Utilize cool roofing to both decrease heat gain through roof and to reduce heat island effect.
C. Place windows and skylights to provide natural lighting while using glazing types (low-e, insulated, and similar types), shading, and orientation to reduce heating and air conditioning energy use.
D. Optimize natural ventilation through use of operable windows, vents, and other devices.

5.3 BUILDING MECHANICAL SYSTEMS

Optimize building mechanical systems’ energy use through maximizing systems performance and using energy efficient appliances and equipment.

A. Maximizing systems performance shall include
   - Designing systems to meet and exceed Title 24 requirements
   - Commissioning and operations and maintenance programs to ensure energy efficient performance throughout the life of systems.
B. Selecting energy efficient appliances and equipment: I.e. Energy Star products, Environmentally Preferred Purchasing.

5.4 LIGHTING

Maximize lighting system performance through

A. Selecting energy efficient equipment and controls: I.e. Energy Star products.
B. Incorporating natural lighting to the extent practical.
5.5 TOTAL BUILDING PERFORMANCE

5.5.1 INTEGRATE BUILDING SYSTEMS TO REDUCE TOTAL ENERGY USE

A. Provide for ongoing accountability and optimization of building energy and water consumption performance over time.  

1. Install continuous metering equipment for the following end-uses:
   - Lighting systems and controls
   - Constant and variable motor loads
   - Variable frequency drive (VFD) operation
   - Chiller efficiency at variable loads (kW/ton)
   - Cooling load
   - Air and water economizer and heat recovery cycles
   - Air distribution static pressures and ventilation air volumes
   - Boiler efficiencies
   - Building-related process energy systems and equipment
   - Indoor water risers and outdoor irrigation systems. Refer to Facility Design/Criteria/ARCHITECTURE/Landscaping and Vegetation Control for requirements for landscape irrigation control system.

2. Develop a Measurement and Verification Plan that compares predicted energy and water savings to those actually achieved. Plan shall incorporate the monitoring information from the end-uses and be consistent with the International Performance Measurement & Verification Protocol (IPMVP) Volume I: Concepts and Options for Determining Energy and Water Savings (Option B, C, or D) 2001 edition. Apply Plan to facility operation.

B. Incorporate advanced control technology to regulate power for lighting and other electrical systems decreasing overall energy use. Refer to Facility Design/Criteria/ELECTRICAL.

5.5.2 EXCEED TITLE 24 ENERGY BUDGET

Achieve a level of energy performance above the prerequisite standard (Title 24) by reducing energy costs compared to the energy cost budget for energy systems as demonstrated by a whole building simulation using the Energy Cost Budget Method described in Section 11 of ASHRAE/IESNA Standard 90.1 (1999). Reduction of energy costs for systems such as HVAC, hot water, and interior lighting shall be analyzed and level of reduction selected such as 15 percent to 50 percent reduction.

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7 LEED EAc5.
8 Based on LEED Eac5.
9 Based on LEED EAc1.
6. CONSTRUCTION MATERIALS

6.1 LIFE-CYCLE VALUE OF FACILITY

The life-cycle value of a facility shall be taken into account when analyzing construction materials and systems. Life-cycle value of a facility equals initial investment, operability, maintainability, longevity, and life-cycle operational cost, as well as its reusability and convertibility. Life-cycle value considers the total performance of materials and assemblies in an objective, balanced approach.

6.2 EVALUATION OF MAJOR BUILDING MATERIALS AND ASSEMBLIES

Evaluate major building materials and assemblies to reduce consumption of natural resources and reduce the impact on the natural environment using BEES or equivalent method acceptable to the District.

A. BEES software implements a rational systemic technique for selecting environmentally and economically balanced building products. BEES uses an environmental life-cycle assessment approach specified in ISO 14040 standards. BEES model is implemented in publicly available decision-support software which includes actual environmental and economic performance data for a number of building products.

B. BEES software or equivalent method shall be used to analyze selection of all major building material and assemblies. Major materials and assemblies shall include the following:

- Structural system
- Exterior wall finishes
- Building insulation
- Wall framing
- Roofing
- Interior finishes
- Flooring
- Parking lot and driveway paving

C. The Designer may propose, for acceptance by the District, that certain major materials and assemblies be exempted from this analysis on the basis that the particular material or assembly choice depends on the other project requirements, i.e. building code or seismic design.

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6.3 EVALUATE AND SPECIFY MATERIALS AND CONSTRUCTION PRACTICES

Evaluate materials and assemblies (in addition to major building materials and assemblies) and configure construction contract requirements to reduce consumption of natural resources and reduce the impact on the natural environment.

A. Utilize existing resources in selection of materials and assemblies as well as conduct product research. Designers shall, at minimum, implement to the following:
   - EPA’s Environmentally Preferred Purchasing and Comprehensive Procurement Guidelines.

B. Reduce waste through practicing reuse and recycling including construction and demolition waste management.
   - In regard to reuse, consider reuse of equipment, facilities, and miscellaneous items. Examples of reuse is refurbishing office cubical partitions in lieu of purchase of new partitions.
   - In regard to construction and demolition waste management, District policy is to conform to local requirements. Specifications shall require that at least 50 percent of construction, demolition and land clearing waste be recycled or salvaged. Specifications shall require that each construction contractor develop plan which helps ensure compliance with waste requirements. Refer to Standard Specifications Section01 74 21, Waste Management.

C. Use local materials and products to the extent practical.

6.4 SUSTAINABLE DESIGN MATERIALS LIST

This is a list of sustainable design materials for use in the BART facilities.

A. Concrete Mix Designs:
   - Concrete specified under BART Standard Specifications Section 03 05 15, Portland Cement Concrete: Utilize fly ash as a replacement for a portion of the Portland cement in concrete. Utilize High Volume Fly Ash Concrete (HVFAC) in cast-in-place concrete to the greatest extent practical,
   - Concrete Mix Designs for Precast and Other Elements: Utilize fly ash and ground slag to the greatest extent practical in concrete mixes for precast items (i.e. precast concrete piles and precast concrete ties) and other work not covered by BART Standard Specifications Section 03 05 15, Portland Cement Concrete.

B. Roofing: Select EnergyStar compliant and high emissivity roofing (emissivity of at least 0.9 when tested in accordance with ASTM E408). \[11\]

C. Heating, Ventilating, and Air Conditioning (HVAC) Equipment: Select equipment which utilizes no CFC-and no HCFC-based refrigerants. When appropriate, phase-out CFCs in existing building HVAC equipment. \[12\]

\[11\] Based on LEED SS c7.2.
D. Fire Suppression Systems: Select systems that do not contain HCFCs or Halons. When appropriate, phase out HCFCs and Halons in existing fire suppression systems. Refer to Standard Specifications Section 21 22 00, Clean Agent Fire Extinguishing System.

E. Adhesives and Sealants for Interior: Specify adhesives and sealants with VOC content less than the current limits of South Coast Air Quality Management District Rule #1168, and all sealants used as fillers must meet or exceed the requirements of the Bay Area Air quality Management District Regulation 8, Rule 51.

F. Paints: Specify paints and coatings with VOC emission less than or equal to the VOC and chemical component limits of Green Seal’s Standard GS-11 requirements. Consider use of consolidated and reprocessed latex paint.

G. Flooring:
   - Carpeting: Where carpeting is used, select carpeting meeting or exceeding the requirements of the Carpet and Rug Institute’s Green Label Indoor Air Quality Test Program.
   - Resilient Sheet Flooring: Consider use of linoleum where resilient flooring is required.

F. Toilet Partitions: Consider plastic toilet partitions with recycled content.

7. INDOOR ENVIRONMENTAL QUALITY

7.1 INDOOR AIR QUALITY

Design and operate facility to ensure indoor air quality.

A. Ventilation Requirements: Meet the minimum requirements of ASHRAE 62, Ventilation for Acceptable Indoor Air Quality, and approved addenda, using the Ventilation Rate Procedure.

   - Comply with the following additional requirements for ventilation effectiveness: For mechanically ventilated spaces, design ventilation systems that result in an air change effectiveness (Eac) greater than or equal to 0.9 as determined by ASHRAE 129. For naturally ventilated spaces demonstrate a distribution and laminar flow pattern that involves not less than 90 percent of the room or zone area in the direction of air flow for at least 95 percent of hours of occupancy.

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12 Based on LEED EA Prerequisite 3 and c4.
13 Based on LEED EA c4.
14 Based on LEED EQ c4.1.
15 Based on LEED EQ c4.2.
16 Based on LEED EQ c4.3.
17 Based on LEED EQ Prerequisite 1.
18 Based on LEED EQ c2.
B. CO₂ Monitoring: Install permanent carbon dioxide monitoring systems that provide feedback on space ventilation performance in a form that affords operational adjustments. Refer to the CO₂ differential for types of occupancy in ASHRAE 62, Appendix C.¹⁹

C. Construction IAQ Management Plan: Develop and implement an Indoor Air Quality (IAQ) Management Plan for the construction and pre-occupancy phases of buildings to prevent indoor air quality problems resulting from construction.²⁰

- During construction meet or exceed the recommended Design Approaches of the Sheet Metal and Air Conditioning National Contractors Association (SMACNA) IAQ Guideline for Occupied Buildings under Construction, 1995, Chapter 3.

- Protect stored on-site or installed absorptive materials from moisture damage.

- If air handlers must be used during construction, filtration media with a Minimum Efficiency Reporting Value (MERV) of 8 must be used at each return air grill, as determined by ASHRAE 52.2-1999.

- Replace all filtration media immediately prior to occupancy. Filtration media shall have a Minimum Efficiency Reporting Value (MERV) of 13, as determined by ASHRAE 52.2-1999 for media installed at the end of construction.

D. Low-Emitting Materials: Select construction products to minimize indoor air pollution: Refer to requirements under Construction Materials, Sustainable Design Materials List, for requirements for adhesives and sealants, paints, and carpeting.

E. Low-Emitting Products: Select operations and maintenance products to minimize indoor air pollution.

F. Environmental Tobacco Smoke (ETS) Control: In addition to State law prohibiting smoking in public buildings and offices, prohibit smoking near building entries and operable windows.

G. Thermal Comfort:

- Comply with HVAC System Indoor Design Conditions (Refer to Facility Design/Criteria/MECHANICAL /Stations and Station Sites) and insulate building envelope to help ensure indoor thermal comfort.

- Integrate natural ventilation with heating, ventilating, and air conditioning system.

7.2 LIGHTING AND VIEWS

Design spaces and provide openings to visually connect the indoor environment and outdoor spaces, particularly the natural environment.

A. Consider daylighting regularly occupied spaces.

¹⁹ Based on LEED EQ c1.
²⁰ Based on LEED EQ c3.1.
B. Provide quality lighting to maximize productivity and safety.

7.3 **ACOUSTICAL AND VIBRATION CONTROL**

Refer to Facility Design/Criteria/ARCHITECTURE, Passenger Stations, under Noise and Reverberation Control.

8. **OPERATION AND MAINTENANCE**

8.1 **ENERGY AND ENVIRONMENTAL CONTROL DEVICES AND PROCEDURES**

Incorporate and optimize energy and environmental control devices and procedures.

A. Incorporate, commission, and maintain control and monitoring devices including CO₂ monitoring sensors; energy monitoring/optimization devices; and temperature, ventilation, and humidity control devices. Add control devices to existing facilities for optimum energy and environmental performance.

B. Establish and perform procedures including calibration and validation of control devices and sampling for air quality. (Perform such sampling routinely if conditions warrant, i.e. possible presence of mold or asbestos.)

C. Establish and follow routine maintenance procedures to maintain and optimize HVAC equipment itself as well as of control devices.

8.2 **OPERATION AND MAINTENANCE**

Minimize pollution resulting from operation and maintenance.

A. Utilize Environmentally Preferred Purchasing (see website) for lubricants, cleaning agents, and paint.

B. Utilize methods that reduce pollution including the following:
   - Methods that extend life of lubricants

8.3 **REDUCE, RE-USE, AND RECYCLE**

Examples of BART reduction of resource use and recycling include the following:

A. Vehicle washer water use reduction through system design for recycling.

B. Station and office waste recycling.

C. Operational waste reduction and recycling programs, such as recycling of railroad ties, electronic devices, lamps, and ballasts.
D. Recycle magnetic ballasts and older fluorescent lamps containing poly-chlorinated biphenyls (PCBs) and other toxic chemicals in such a manner that potentially dangerous chemicals are safely reprocessed. Recycle HID lamps.

8.4 PERFORMANCE AND LONGEVITY

Enhance facility performance and longevity.

A. Implement operation and maintenance programs and procedures.

B. Keep operation and maintenance procedures and manuals up-to-date.

C. Perform post-occupancy evaluation and make any modifications necessary to enhance safety, worker productivity, occupants’ health and comfort, and building energy performance.

9. INTEGRATION OF SUSTAINABLE DESIGN AND FACILITY DEVELOPMENT

BART encourages the incorporation of sustainable design early in the project development process, throughout project design and implementation, and in operation and maintenance. Design for sustainability should not be considered as separate from conventional design process and considerations, and it should not be considered as introducing requirements which are totally new. Ideally, design for sustainability and conventional design should form a harmonious process. Design for sustainability should be an integrated, organic, holistic, seamless part of design. Design for sustainability should enhance the classical design approach forming a synergistic process.

END