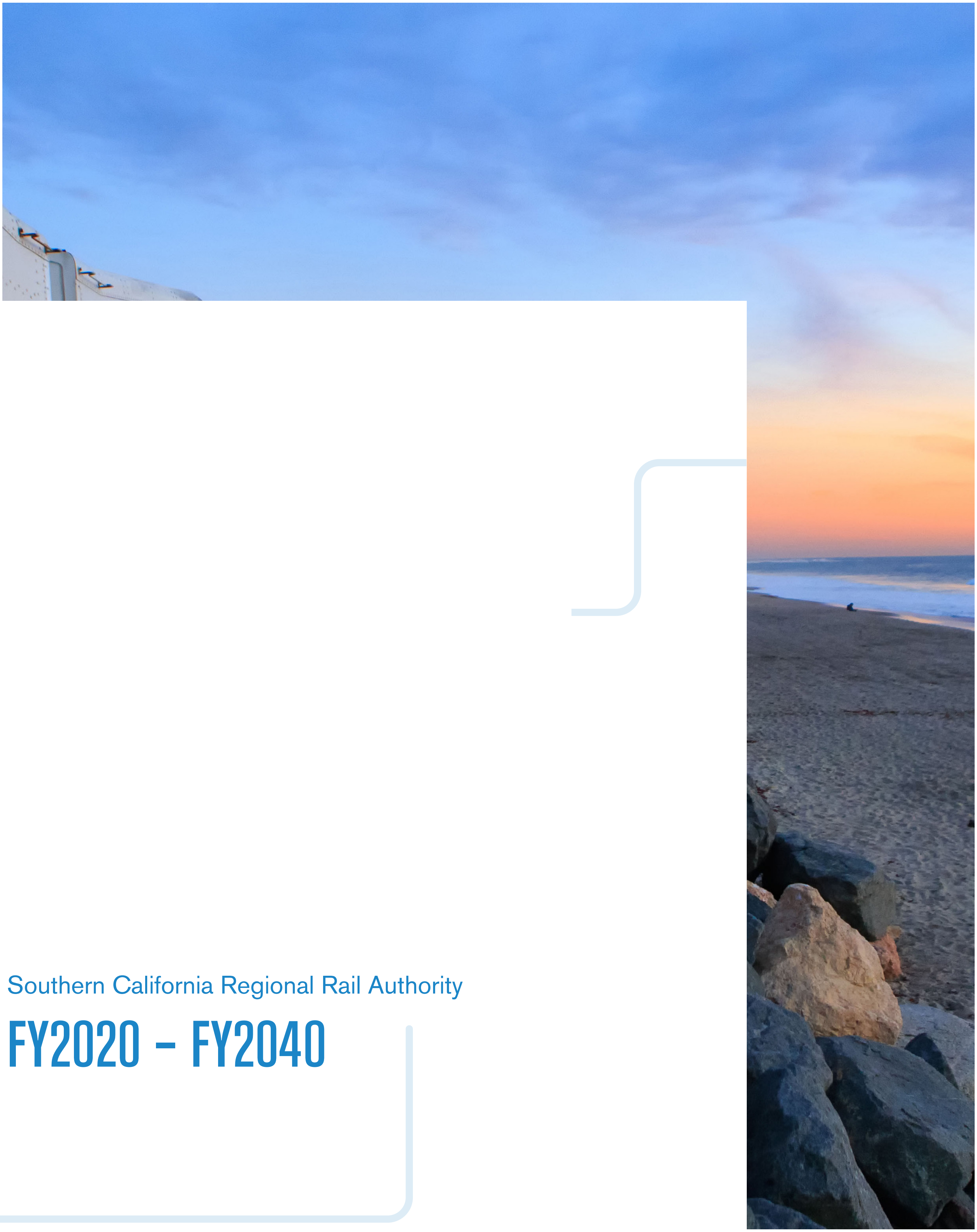


Southern California Regional Rail Authority

FY2020 – FY2040

TABLES

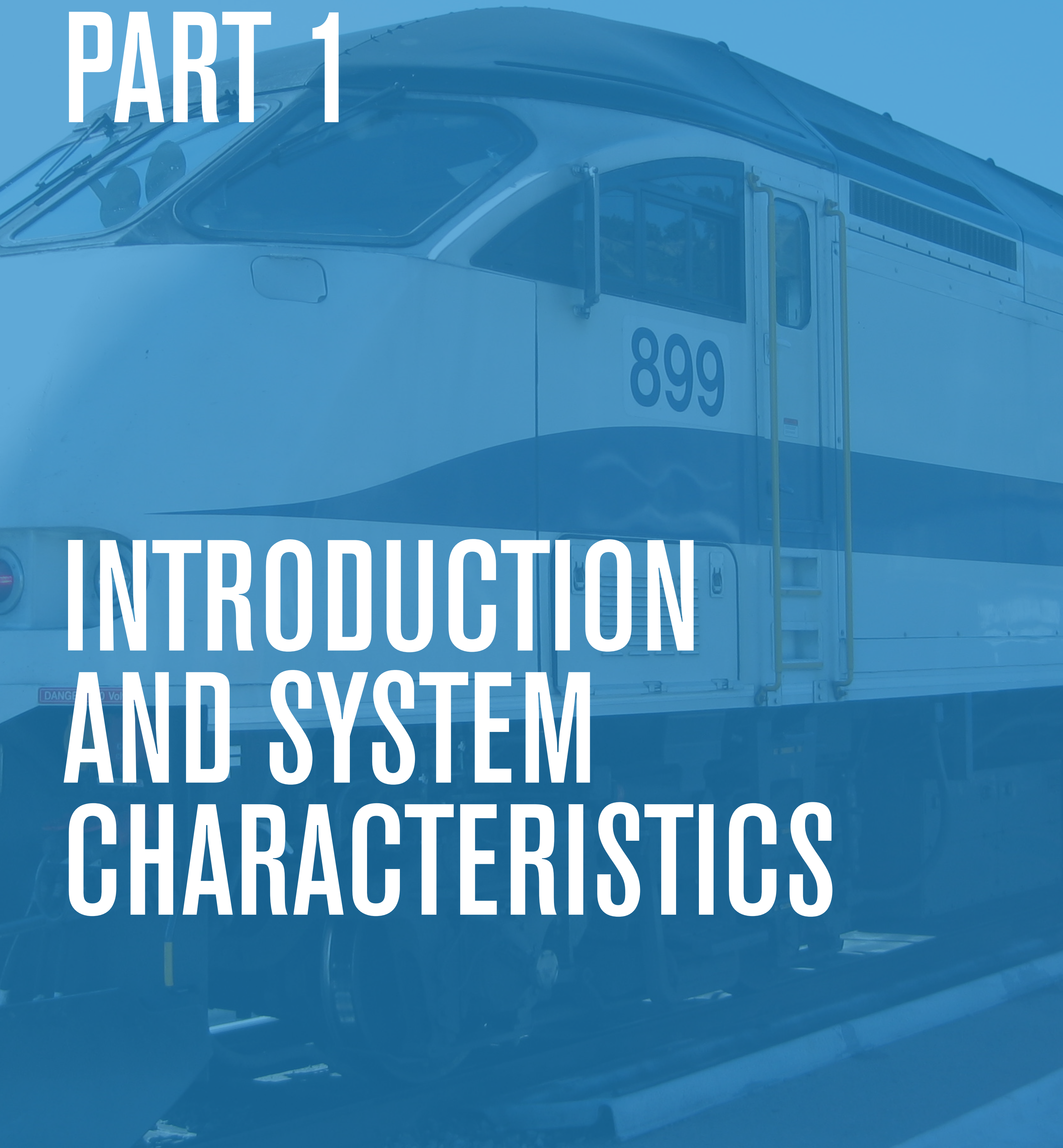
FIGURES

ABBREVIATIONS & ACRONYMS

AESS	Auto-Engine Start/Stop
CEM	Crash Energy Management
CMF	Central Maintenance Facility
DMU	Diesel Multiple Unit
EMD	Electro Motive Division
EMF	Eastern Maintenance Facility
EPA	United States Environmental Protection Agency
FMP	Fleet Management Plan
FRA	Federal Railroad Administration
FTA	Federal Transit Administration
HEP	Head End Power
LCM	Life Cycle Maintenance
LOSSAN	Los Angeles-San Diego-San Luis Obispo Rail Corridor
Metro	Los Angeles County Metropolitan Transportation Authority
MMBF	Mean Miles Between Failures
MPI	Motive Power Industries
OCTA	Orange County Transportation Authority
OEM	Original Equipment Manufacturers
PTC	Positive Train Control
RCTC	Riverside County Transportation Commission
SBCTA	San Bernardino County Transportation Authority
SCORE	Southern California Optimized Rail Expansion
SCRRA	Southern California Regional Rail Authority
TAM	Transit Asset Management
TIRCP	Transit Intercity Rail Capital Program
VCTC	Ventura County Transportation Commission

PART 1

INTRODUCTION AND SYSTEM CHARACTERISTICS



1 RAIL FLEET MANAGEMENT PLAN UPDATE INTRODUCTION & SYSTEM CHARACTERISTICS

1.1 Introduction

Metrolink, the regional rail service in Southern California, is operated by the Southern California Regional Rail Authority (SCRRA), a Joint Powers Authority with member agencies representing the counties of Los Angeles, Orange, Riverside, San Bernardino and Ventura. Metrolink strives to be a leader in the regional rail industry by providing safe, efficient, quality service to its customers through the modernization of technology and business practices and the pursuit of sustainable solutions.

This Rail Fleet Management Plan (RFMP) will be maintained as a live document which will be ever changing with the life and growth of the fleet, including changes in technology, and contains Metrolink's strategy for achieving and maintaining its vehicle assets in a state of good repairs, maintaining its status as an industry leader and, most importantly, providing its passengers with an outstanding customer experience on every ride with safe, clean, dependable and on-time operations.

1.2 Fleet Management Plan Update Objectives

The objectives of the Metrolink Fleet Management Plan Update (FY2020 – FY2040) are:

- Plan for the replacement of the older fleet

- Plan for rolling stock maintenance activities such as midlife and/or progressive overhauls to facilitate operational and budget planning;

- Identify fleet needs to accommodate planned service growth as articulated in the Strategic Business Plan;

- Inform long-term storage and maintenance facility needs, including support for new zero-emission technologies and overall cleaner operations;

- Identify potential opportunities to partner with agencies on procurements to reduce unit costs and production times, and to create a shared demand for future parts and rolling stock;

- Align procurements to ensure major maintenance investments are not needed simultaneously.

- Support the intended benefits of the Southern California Optimized Rail Expansion (SCORE) Program and the project improvements to achieve the intended outcomes of the 2018 Transit and Intercity Rail Capital Program (TIRCP) award;

- Identify an approach for a pilot implementation plan to achieve the intended outcomes of the 2020 TIRCP award to fund operations of zero emissions technology on the system;

- Ensure Plan addresses Federal Transit Administration (FTA) and Federal Railroad Administration (FRA) requirements for Fleet Management Plans.

1.3 Understanding the Federal Framework

Federal regulations require agencies receiving federal funding to develop a Transit Asset Management (TAM) Plan. This is one component of the FTA's strategy for helping the nation's transit providers bring their capital assets into a State of Good Repair (SOGR).

1.3.1 Compliance with FTA Requirements

The following are the primary FTA requirements for transit operators to develop their FMP:

- The plan should reflect a 10 to 15-year time frame.
- The plan should address vehicle and service types in operation and anticipated to be in operation, including paratransit, as well as factors that are relevant to determine current and future equipment needs.
- The plan should also address in detail the composition of the fleet, operating conditions, facilities, etc.
- Future demand should be estimated based on (a) vehicle life expectancy, (b) the requirements for peak and spare vehicles, (c) strategies for acquisition of new vehicles, and (d) strategies for maintenance and operations.
- The plan must address operating policies (level of service requirements, vehicle failure definitions and actions); peak vehicle requirements; maintenance program

(scheduled, unscheduled, and overhaul); system and service expansions; vehicle procurements and related schedules; and spare ratio justification.

Metrolink has determined that it complies with the above-mentioned FTA requirements.

1.3.2 State of Good Repair

A State of Good Repair (SOGR) is achieved when all capital assets are functioning at their ideal capacity within their designed life expectancy and no backlog of needs or maintenance exists. One of the goals of FTA policies is for agencies using FTA funds to follow investment and maintenance strategies that will keep federally funded transit assets in a SOGR. The result should be maximized availability and operation of those assets to the end of their useful economic life, thus optimizing the use of available FTA funds. An RFMP is a first step towards achieving and maintaining a SOGR. The information contained in this RFMP will be integrated with information about Metrolink's other transit assets as part of a larger TAM Plan.

1.3.3 Transit Asset Management Plan

The TAM Plan includes the development of a comprehensive transit asset inventory (this applies to fixed, linear and rolling stock assets) along with a detailed plan for regularly assessing the condition of transit assets. It also contains a description of the means and methods by which those assets are brought to and kept in a SOGR and how investment in those assets is prioritized. All transit agencies are currently required to develop and implement a TAM Plan in order to qualify for federal funding. Beyond that, agencies will be required to report annually on the condition of its system assets and any changes since the last report.

1.3.4 Previous Fleet Management Plan

In 2015, Metrolink developed a Fleet Management Plan to guide rolling stock investment decisions and considered projected service increases and expansions and the needs of planned capital programs (such as overhauls) to determine the timelines for procurement and retirement of vehicles. The Fleet Management Plan was adopted by the Board of Directors in February 2016 and spanned a ten-year period from 2015 through 2025. The Plan introduced a strategic maintenance approach referred to as a Lifecycle Maintenance Program (LCM). Metrolink currently utilizes elements of this program and will implement additional aspects to improve the reliability and availability of rolling stock and enhance efficiencies at its maintenance facilities. Metrolink also included the plan to replace older locomotives with new Tier 4 F125 locomotives to reduce issues with reliability due to the aging fleet at the time.

1.4 Planning Process

In planning for future needs of Metrolink's regional rail fleet, several reports have been performed related to the facilities and rolling stock – including the Strategic Business Plan (five and 10 years), SCORE, CMF Modernization & EMF Build Out and the Fleet Modernization Study. To further progress the fleet planning process, it is necessary to first perform a comprehensive review of vehicle needs with regard to intended service, as well as capital projects in the years being planned. Some of the main steps in this process include:

1. Identify Required Capacity: Fleet size is largely dependent on the projected passenger capacity for the intended service. Rather than direct passenger

counting, planning for future capacity requirements must be based on current ridership and projections of passenger demand. Factors that affect future ridership include the distribution of jobs and residences, the strength of the local economy, changes in connectivity to other services (e.g., California High-Speed Rail) and operational changes that may impact travel times and connectivity, trip origins, travel modes and destinations. Ridership has been severely impacted by the COVID-19 crisis that started in March 2020. The declaration of COVID-19 as a pandemic on March 11 and the Governor issuing a stay at home order on March 19 resulted in an unprecedented decline in Metrolink ridership. In response to the lower demand, Metrolink reduced service by 30%. On November 16, 2020 Metrolink optimized train schedules to better reflect new travel patterns. These new travel patterns reflect the trend of many riders staying at home or finding alternative ways to get to work to avoid potential contact with other riders. Metrolink will continue to closely monitor ridership trends especially as some riders may continue to work from home or utilize alternative transportation modes for the foreseeable future.

2. Develop Asset Inventory: To accurately plan for vehicle needs, a very basic and important step is clearly identifying the types and quantities of vehicles available, noting any limitations of the various types or specific vehicles, including seating capacity and passenger accessibility.

3. Identify Required Number of Vehicles and Train Sets: Future assumptions about the number of vehicles and train sets rely on current service needs and plans for service expansion as well as projected changes in ridership. It is based on the expected number of riders, which is tied to the service frequency and destinations provided. Some projections may also be linked to policy decisions, such as providing a minimum level of service.

   Projections of Metrolink's future vehicle and train set requirements were developed separately as part of the SCORE program and are the basis of future assumptions in this RFMP.

4. Perform Fleet Condition Assessment: In addition to understanding the types and quantities of vehicles available, the condition of those assets must be understood and documented. This allows for planning to address deferred maintenance, unexpected repairs and any modifications needed to bring the vehicles into a State of Good Repair. An objective, detailed method of asset condition evaluation must be developed and implemented with a baseline condition assessment established for each vehicle in the fleet.

5. Identify Vehicle Maintenance Needs and Capital Projects: In addition to the vehicle needs for passenger service, an adequate quantity of vehicles must be available to account for vehicles that will be out of service for maintenance and unplanned repairs.

   Additionally, vehicles will be taken out of service for certain periods of time to support major capital overhauls or modification activities, which must also be accounted for in long-term planning of fleet requirements.

6. Identify Vehicles Available in the Planning Year: Based on expected vehicle retirements, ongoing vehicle procurements, vehicles out of service for capital overhauls and modification projects, the expected composition of the fleet in each year being planned must be identified.

7. Develop Conceptual Train Sets: A comprehensive review of fleet requirements includes the development of conceptual train sets to satisfy the ridership demand, restrictions of the infrastructure, operational requirements, agency policies and public commitments.

8. Develop Resolution to Expected Vehicle Shortage or Surplus: Based on the results of these analyses, if a vehicle shortage is expected, a determination is made as to whether the life of some vehicles need to be extended beyond the planned retirement date or if additional vehicles need to be purchased or leased. This decision is based on several factors, including the timespan of the expected vehicle shortage, the condition of the vehicles whose life may be extended, the availability of funding and the cost effectiveness of extending the life of certain vehicles versus purchasing or leasing vehicles.

   If it is concluded that a significant surplus of vehicles is expected, a review is initiated to determine whether that surplus will be needed in subsequent years or if arrangements should be made to determine an alternative purpose for those extra vehicles or reduce the fleet size.

1.5 Related Studies

This Fleet Management Plan references the following plans and documents:

- Climate Action Plan, March 2021
- Draft Final Cost-Benefit and Operations Analysis – Southern California Optimized Rail Expansion Program, March 2021
- Rolling Stock Management & Maintenance Plan 2020-2021, March 2020
- Metrolink Strategic Business Plan, January 2021
- Metrolink Locomotive Fleet Modernization – Alternate Propulsion Study Draft, December 2020
- 2020 Metrolink Rehabilitation Plan, October 2020
- SCRRA MP36 Locomotive, Modernization Report Draft, September 2020
- CMF Modernization and EMF Build-Out Study, Existing Conditions and Needs, July 2020
- 2019 Metrolink Rehabilitation Plan Implementation, July 2019
- SCRRA/SBCTA Shared Facility Proposal – Modifications to SCRRA's Eastern Maintenance Facility, March 2019

- Project Study Report for the Orange County Maintenance Facility, January 2019
- Hybrid Rail Study, San Bernardino County Transportation Authority, November 2018
- Zero Emissions Multiple Unit Project, San Bernardino County Transportation Authority, December 2017 – present
- Transit Asset Management Plan, October 2020

2 METROLINK AGENCY ORGANIZATION

2.1 Metrolink Overview

Metrolink is operated by SCRRA and serves Los Angeles, Orange, Riverside, San Bernardino, Ventura and North San Diego counties. SCRRA is a joint powers authority made up of an 11-member board representing the transportation commissions of Los Angeles (Los Angeles County Metropolitan Transportation Authority), Orange (Orange County Transportation Authority), Riverside (Riverside County Transportation Commission), San Bernardino (San Bernardino County Transportation Authority) and Ventura (Ventura County Transportation Commission) counties that govern the service. Metrolink is the largest regional rail operation in California based on route miles, and the eighth largest in the United States in terms of ridership. It is also one among a newer generation of regional railroads, having started operations in October 1992. Since then, Metrolink's network has grown from three routes to seven, providing service to 62 stations in six counties. Metrolink service operates on tracks owned both by its member agencies and North County Transit District, Union Pacific Railroad and the Burlington Northern Santa Fe Railway.

Over the FY14-FY18 period, Metrolink's network grew by 26 route miles with the initiation of service in the Perris Valley Corridor and San Bernardino – Downtown extension, Metrolink's first service expansion since 2002. In May 2018, the new Burbank Airport-North station on the Antelope Valley Line was opened, which expanded Metrolink's train-to-plane connectivity by providing additional access to the Burbank Airport from northern Los Angeles County and from Los Angeles Union Station.

3 EXISTING METROLINK SYSTEM

3.1 Service Area and Routes

Metrolink serves 62 stations in six counties on seven lines totaling 538 route miles of service (Figure 3.1). Of the seven lines, six terminate at Los Angeles Union Station (LAUS). LAUS is a stub-end, 13-track station with six low-level platforms that can accommodate trains up to sixteen cars long. The station is used for Metrolink and Amtrak trains. The station also includes stops for Metro's Red and Purple Line subways, the Gold Line light rail, Silver Line Bus Rapid Transit, numerous local bus routes, LAX Flyaway service and Amtrak Thruway Buses. On a typical weekday, 149 Metrolink trains use LAUS in addition to approximately 30 Amtrak trains, making it the twelfth busiest train station in the country based on annual rail passenger volumes.

Figure 3.1 - Metrolink System Map

3.2 Metrolink Lines

With the announcement of Safer-at-Home orders across Southern California, passenger rail service was temporarily reduced in March 2020 by 30 percent. In November 2020, schedules were updated to better match existing ridership needs – still at reduced levels – and included the reintroduction of San Bernardino Line Express service. This section reflects pre-COVID service levels from October 2019 and are indicative of normal, regular service provided by Metrolink outside of the reductions implemented as a result of the pandemic.

3.2.1 Ventura County Line

The Ventura County Line operates between Los Angeles Union Station and East Ventura. Service on the Ventura County Line includes shuttle trains between Los Angeles and Hollywood Burbank Airport.

Table 3.1 - Ventura County Line Profile

COUNTIES SERVED	Los Angeles and Ventura
ROUTE MILES	70.9
NUMBER OF STATIONS	12
WEEKDAY SERVICE	3 Los Angeles – East Ventura round trips 4 Los Angeles – Moorpark round trips 3 Los Angeles – Chatsworth round trips 7 Westbound, 6 Eastbound Burbank Airport Shuttles
WEEKEND SERVICE	No Service
AVERAGE WEEKDAY RIDERSHIP (FY19)	4,416

3.2.2 Antelope Valley Line

The Antelope Valley Line operates between Los Angeles Union Station and Lancaster. Most trains operate to and from Lancaster, with additional midday service provided to the city of Santa Clarita.

Table 3.2 - Antelope Valley Line Profile

COUNTIES SERVED	Los Angeles
ROUTE MILES	76.6
NUMBER OF STATIONS	12
WEEKDAY SERVICE	9 Los Angeles – Lancaster round trips 1 Los Angeles – Palmdale round trip 4 Los Angeles – Via Princessa round trips 1 Los Angeles – Santa Clarita roun trip
WEEKEND SERVICE	6 Los Angeles – Lancaster round trips
AVERAGE WEEKDAY RIDERSHIP (FY19)	6,588

3.2.3 San Bernardino Line

The San Bernardino Line operates between Los Angeles Union Station and the San Bernardino - Downtown station, part of the San Bernardino Transit Center complex. The San Bernardino Line was extended to the San Bernardino - Downtown station in 2017.

Table 3.3 - San Bernardino Line Profile

COUNTIES SERVED	Los Angeles and San Bernardino
ROUTE MILES	57.6
NUMBER OF STATIONS	14
WEEKDAY SERVICE	19 Los Angeles – San Bernardino round trips (1 additional round trip on Fridays)
WEEKEND SERVICE	10 Los Angeles – San Bernardino round trips on Saturday 7 Los Angeles – San Bernardino round trips on Sunday
AVERAGE WEEKDAY RIDERSHIP (FY19)	6,588

3.2.4 Riverside Line

The Riverside Line operates between Los Angeles Union Station and the Riverside-Downtown station on weekdays only.

Table 3.4 - Riverside Line Profile

COUNTIES SERVED	Los Angeles, San Bernardino, and Riverside
ROUTE MILES	59.1
NUMBER OF STATIONS	7
WEEKDAY SERVICE	6 Los Angeles – Riverside-Downtown round trips
WEEKEND SERVICE	No Service
AVERAGE WEEKDAY RIDERSHIP (FY19)	3,868

3.2.5 91/Perris Valley Line

The 91/Perris Valley Line operates between Los Angeles Union Station, Riverside and Perris. The line was extended 24 miles from downtown Riverside to Perris in 2016.

Table 3.5 - 91/Perris Valley Line Profile

COUNTIES SERVED	Los Angeles, Orange, and Riverside
ROUTE MILES	84.8
NUMBER OF STATIONS	12
WEEKDAY SERVICE	4 Los Angeles – Perris-South round trip 1 Los Angeles – Riverside-Downtown round trip
WEEKEND SERVICE	2 Los Angeles – Perris-South round trips
AVERAGE WEEKDAY RIDERSHIP (FY19)	3,293

3.2.6 Orange County Line

The Orange County Line operates between Los Angeles Union Station and Oceanside in San Diego County. Service consists of direct trains between Los Angeles and Oceanside, Laguna Niguel/Mission Viejo, or Irvine, as well as shuttle trains between Fullerton and Oceanside or Laguna Niguel/Mission Viejo. At Oceanside, Metrolink passengers can transfer to North County Transit District (NCTD) Coaster regional rail trains to San Diego or Sprinter hybrid rail trains to Escondido.

Table 3.6 - Orange County Line Profile

COUNTIES SERVED	Los Angeles, Orange, and San Diego
ROUTE MILES	86.9
NUMBER OF STATIONS	15
WEEKDAY SERVICE	3 Los Angeles – Oceanside round trips 5 Los Angeles – Laguna Niguel/Mission Viejo round trips 1 southbound Los Angeles – Irvine trip 2 northbound Irvine – Los Angeles trips 1 Oceanside – Fullerton round trip 1 Laguna Niguel/Mission Viejo – Fullerton round trip
WEEKEND SERVICE	4 Los Angeles – Oceanside round trips
AVERAGE WEEKDAY RIDERSHIP (FY19)	10,600

3.2.7 Inland Empire-Orange County Line

The Inland Empire-Orange County Line operates between the communities of San Bernardino, Riverside, southern Orange County and Oceanside in San Diego County. As the only Metrolink line that does not serve Los Angeles Union Station, the Inland Empire-Orange County Line is one of the only regional rail lines in the nation providing suburban passenger rail service that does not serve an anchor big-city passenger rail station.

Table 3.7 - Inland Empire-Orange County Line Profile

COUNTIES SERVED	San Bernardino, Roverside, Orange, and San Diego
ROUTE MILES	101.1
NUMBER OF STATIONS	16
WEEKDAY SERVICE	2 San Bernardino – Oceanside southbound trips 1 Oceanside - San Bernardino northbound trip 1 Oceanside - Riverside northbound trip 3 Riverside - Laguna Niguel/Mission Viejo round trips 1 Riverside - Laguna Niguel/Mission Viejo southbound trip 1 San Bernardino - Laguna Niguel/Mission Viejo southbound trip 3 Laguna Niguel/Mission Viejo - San Bernardino northbound trips 1 San Bernardino - Irvine southbound trip
WEEKEND SERVICE	2 San Bernardino – Oceanside round trips
AVERAGE WEEKDAY RIDERSHIP (FY19)	4,656

3.2.8 Arrow Service

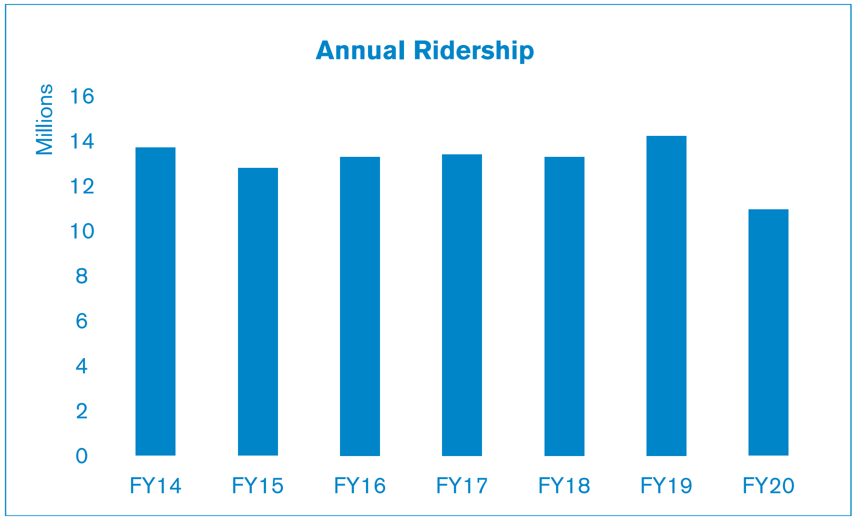
Arrow is scheduled to begin service in early 2022 and will run over nine miles with five stations between the San Bernardino Transit Center and terminate at the University of Redlands. The service will operate with three Diesel Multiple Units (DMUs) and a local passenger service using a Metrolink locomotive hauled train to provide express service from Redlands onwards to Los Angeles. A separate DMU maintenance facility is planned near the San Bernardino Depot: The Arrow Maintenance Facility (AMF).

3.3 Ridership

Since its inception in 1992, Metrolink has seen an overall growth in ridership supported by a proportional growth in service, with the exception of FY10 due to the economic recession. Between Fiscal Years 2014 and 2019, Metrolink saw a steady increase in ridership, culminating with a record 11.9 million boardings in FY19. Ridership was on pace to grow approximately 5 percent above that through February 2020, prior to the declines precipitated by the COVID-19 pandemic and resulting stay at home orders. Metrolink anticipates it may take up to three years to see ridership return to pre-COVID levels.

In March 2020, Metrolink temporarily reduced service levels by 30% due to a ridership decrease related to COVID-19 and the State of California's stay at home orders. By the end of April 2020, ridership had dropped by 90 percent compared with the previous year and has since seen slight increases. Service schedules have been and will continue to be modified based upon ridership demand and patterns related to the COVID-19 pandemic and its associated impacts to the service region.

Figure 3.2 - Annual Ridership



3.4 Amenities

All existing Metrolink passenger cars have restrooms, hand sanitizer dispensers, seating for those with disabilities, timetable holders, two outward-facing destination signs on the side, and storage for some bicycles or strollers. Most passenger cars have tables – typically eight per car with four seats each – which are very popular and often fill early. Newer cars also have standard electrical outlets. Currently they do not have Automatic Passenger Counters (APC) or passenger wi-fi, although both are desired. The upcoming vehicles for the Redlands Passenger Rail Project will have APCs and wi-fi but will not have restrooms, due to the short trip length.

A typical Metrolink train consist includes a locomotive, two to four 'normal' trailer cars, a bicycle car, and a cab car – for a total of four to six passenger cars. A cab car can substitute for the trailer car adjacent to the locomotive. A newer-generation "Guardian" car is always used for the car adjacent to the locomotive (a Metrolink practice, not a government regulation) and as the cab car. All Metrolink bicycle cars are the older generation "Sentinel" cars, so a typical train consist includes both old and new cars.

Locomotives typically operate on the side of the train facing away from LAUS, but there are exceptions due to the triangle-shape of Metrolink's 91/PV, IEOC and OC Lines.

3.5 Operation and Maintenance Services

The Metrolink fleet is comprised of bi-level passenger cars (built as either trailer cars or cab cars with an operator compartment at one end) and locomotives, the majority of which are newly delivered locomotives that use leading edge innovative clean technology. The equipment is arranged into sets of four, five, or six passenger cars and configured for push-pull operation, with a locomotive at one end and a cab car at the other.

As a key step in its drive to a zero emissions future, SCRRA was the first regional railroad in the United States to use diesel-electric locomotives with "Tier 4" clean engine technology. Tier 4 locomotives are compliant with the latest U.S. Environmental Protection Agency (EPA) emissions standards and reduce particulate matter and nitrogen oxide emissions by up to 85 percent compared to older passenger rail locomotives. SCRRA placed the first of its 40 new "F125" model Tier 4 locomotives into revenue service in 2017. The Tier 4 locomotives are the cleanest diesel locomotives in the nation, providing wide-ranging environmental benefits for the Southern California region. In addition, SCRRA's new locomotives are also equipped with the latest rail safety features, such as Positive Train Control (PTC) and Crash Energy Management technology. The new locomotives have up to 46 percent more horsepower than older models, which will enable Metrolink to transport more people reliably and efficiently. The new locomotives also feature enhanced on-board engine diagnostics and are expected to reduce delays caused by mechanical issues on trains. SCRRA's order of 40 Tier 4 locomotives replace 37 older locomotives that otherwise would have required a midlife overhaul to maintain service reliability, and to increase the total in-service fleet by three locomotives to allow for service expansion.

SCRRA employees administer the Metrolink system, while many of the service and maintenance functions that support Metrolink's day-to-day operations and maintenance activities are provided by external parties as contracted services. These services are based upon formal contracts or purchase orders. Contractors provide their own staff to carry out the functions they have agreed to provide. The four major contracted services for operations and maintenance include:

- Train operations. SCRRA's operator services will continue to be provided by the National Railroad Passenger Corporation (Amtrak) with a new contract effective January 1, 2021 with a 4.5-year base term ending June 30, 2025.

- Train equipment maintenance. SCRRA's rolling stock is maintained through the use of an equipment maintenance agreement with Alstom. The contract is performance based and includes incentives and penalties, determined by performance factors such as average fleet availability. The eight-year agreement expires on June 30, 2025.

- **Track and Signal Infrastructure Maintenance.** SCRRA's rail infrastructure including track, bridge, right-of-way (ROW), signal, communications, train control systems, specialized maintenance equipment and maintenance support facilities. This contract was recently awarded to Herzog Contracting Corp., starting July 1, 2021.

In 2023, SCRRA anticipates initiating the procurement process for a new fully bundled Operations and Maintenance Services contract that would take effect on July 1, 2025, superseding the current separate contracts for train operations, and inspection and maintenance activities related to revenue equipment, track, structures and right-of-way and signal, train control and communications systems. These actions align with the following SCRRA Strategic Business Plan (SBP) commitments:

- **Modernizing Business Practices:** We will improve our operational efficiency, through transparency, objective metrics, and streamlined governance, reducing over-reliance on subsidy while bringing our system into a state of good repair and investing in the development of our fellow employees.

- **Advancing Key Regional Goals:** We will grow the role of regional rail in addressing climate change, air quality, and other pressing issues by advancing toward zero emissions, making rail a compelling alternative to single-occupant automobiles, and advancing equity-focused opportunities for all communities through Southern California.

3.6 Current Schedule Requirements and Levels of Service

The following section describes the current schedule requirements and levels of service for pre-COVID operations and the current environment (COVID-19) where service was temporarily reduced on March 26, 2020.

3.6.1 Pre-COVID Environment

SCRRA weekday operations in March 2020 required 40 daily cycles of equipment sets, requiring 40 locomotives, 40 cab cars, and 155 trailer cars. Consist sizes are determined by the passenger demand on the trips served by each equipment cycle. Under current operational practices, equipment sets are generally limited to no more than six coaches. At the lower end, trains must be a minimum of two cars long to ensure adequate braking ability; the current operating schedule exceeds this limit and uses equipment cycles with a minimum of four cars. SCRRA's policy stipulates a maximum 90 percent load factor on all trains, meaning train sets are sized to ensure estimated average passenger loads fill no more than 90 percent of seats available on a train. This load factor is intended to ensure efficient use of SCRRA equipment, while providing adequate capacity for day-to-day fluctuations in actual passenger loads. SCRRA's current revenue service fleet consists of 57 active locomotives and 218 passenger cars that support current cycle requirements and provide spare equipment to maintain day-to-day reliability when cars and locomotives are removed from regular service for preventive maintenance, periodic inspections, or unscheduled repairs. In addition, the spare equipment has been deployed for special services and provides resiliency in the event of unplanned service disruptions.

The total Metrolink equipment fleet also contains several pieces of equipment that are out of service. There are several reasons that equipment may be identified as out of service in the SCRRA fleet inventory. For example, 12 passenger cars designated "out of service" (one cab car and 11 trailer cars) are currently being deployed on a PTC test train, while five additional trailer cars are temporarily unavailable while they undergo overhauls. One locomotive and nine passenger cars have been set aside for long-term repair, and 10 additional trailer cars have been stored in serviceable condition with plans for reactivation. Also remaining on the property awaiting determination of disposition are three former New Jersey Transit Comet-I cars, 38 decommissioned locomotives awaiting disposal or re-use for low emissions prototype testing, and three leased locomotives being prepared to return to the lessor.

3.6.2 Current Environment (COVID-19)

Service was temporarily reduced in March 2020 by 30 percent with the announcement of Safer-at-Home orders across Southern California. Since then, a passenger survey was distributed to gather customer feedback on changing travel needs and cleanliness requirements. Metrolink launched an online tool, "How Full is My Train," to help customers gauge the ability to social distance on their train before boarding. Additionally, cleaning protocols were ramped up to curb the spread of COVID-19 onboard trains and included an increase in cleaning staff and nightly deep cleaning of all trains at minimum. In November 2020, schedules were updated to better match existing ridership needs and included the reintroduction of San Bernardino Line Express service.

3.7 Peak Vehicle Requirements

3.7.1 Special Services

In addition to its regularly scheduled weekday and weekend operations, Metrolink also operates special trains throughout the year to bring travelers to and from special events in the region. Special trains are defined as revenue operating trains that are not included in Metrolink's regularly scheduled timetable. Special trains present an opportunity to attract new riders and fulfill Metrolink's responsibility to serve communities. Special trains historically had been handled as third-party transactions, but last year Metrolink began including Special Trains as a distinct budget item, beginning with the FY2019-20 Budget. Special trains can be operated as additional frequencies supplementing regularly scheduled service on one or more lines, or they can be operated as unique services with their own schedules and originating and terminating locations.

In recent years, Metrolink has operated special trains for the following events:

- Women's March in Downtown Los Angeles: Special weekend roundtrips operated on the Antelope Valley, San Bernardino, and Ventura County lines.

- Lunar New Year Celebration in Downtown Los Angeles: Two additional weekend departures on the Orange County Line from Laguna Niguel/ Mission Viejo to Los Angeles. Free transfer to the Gold Line for all Metrolink passengers at Los Angeles Union Station (LAUS).

- Auto Club 400 NASCAR Cup Series race at the Auto Club Speedway in Fontana: On race day, Metrolink operates one special roundtrip train from Oxnard (Ventura County Line), one from Oceanside (Orange County Line), and one from Lancaster (Antelope Valley Line), each making selected stops across the region, and arriving at a specially constructed platform near the back straightaway of the racetrack. Trains depart one hour after the end of the race.

- Angels baseball games at Angel Stadium in Anaheim: Metrolink operates Angeles Express Train Service to and from Angels home games. Special trains operate on the Orange County Line for all weekday evening home games. Additional Friday only trains operate on the Orange County and 91/Perris Valley Line for home games played on Friday evenings.

- Los Angeles Dodgers weekend evening baseball games at Dodger Stadium in Los Angeles: In 2018, Metrolink operated special trains on the Antelope Valley and San Bernardino lines providing late-evening departures from LAUS for fans attending Friday and select Saturday Dodgers home games.

- Los Angeles County Fair at Fairplex in Pomona: Regularly scheduled San Bernardino Line trains make an additional stop at the Fairplex Station platform during Labor Day weekend for riders attending the Los Angeles County Fair. The station adjoins a Fairplex parking lot, and a free shuttle takes Fairgoers directly to the front gates. Metrolink also operates a special evening weekend departure from the Fairplex Station to LAUS.

- Los Angeles Rams football games in Los Angeles: Metrolink operated special trains to and from LAUS for passengers attending Rams home games at the Los Angeles Coliseum. Special trains operate on the Antelope Valley, Orange County, San Bernardino, and 91/Perris Valley lines as an enhancement to the regular weekend service.

- Festival of Lights at the Mission Inn in Riverside: Special roundtrip trains operate on consecutive Fridays and Saturdays between Thanksgiving and Christmas from L AUS (91/Perris Valley Line), Laguna Niguel/Mission Viejo (Inland Empire-Orange County), and Perris (91/Perris Valley Line) to the Riverside-Downtown Station. Riders can transfer to a complimentary shuttle from the Riverside-Downtown Station to reach the festival, located at the Mission Inn Hotel & Spa.

- Holiday Express Train Pilot: Over three consecutive Sundays in December 2019, Metrolink operated Holiday Express Trains offering an interactive special train experience for families featuring carolers, holiday characters, and a visit from Santa Claus. During the season, Metrolink operated one Holiday Express Train on the Orange County Line boarding at Laguna Niguel/Mission Viejo, one train on the Ventura County Line boarding at Simi Valley, one train on the Antelope Valley Line boarding at Burbank-Downtown, and one on the San Bernardino Line boarding at Rancho Cucamonga. Tickets were priced at $20 to cover the costs of Holiday Express Trains.

3.8 Spare Ratios

To allow for preventive and corrective maintenance, it is necessary for the fleet to contain more vehicles than required for use in daily passenger service. The spare ratio is comprised of maintenance spares, which are necessary to allow a percentage of the fleet to be out of service for routine maintenance, and contingency spares. Contingency spares are typically not in regular operation but may be pressed into service with minimal work to backfill equipment that is out of service for overhaul or damage that will take an extended period to repair, such as from mechanical breakdowns or grade crossing collisions. This equipment may also be used to support unplanned additional services for civil emergencies or other unexpected needs.

The “spare” vehicles are quantified by a spare ratio, which is equal to the number of spare vehicles divided by the number of vehicles operated in peak period service and is expressed in percentages. The FTA does not specify a rail car spare ratio, but operators are required to justify spare ratio calculations. A separate spare ratio is calculated for each type of vehicle (locomotives, cab cars and trailer cars). Metrolink currently has more vehicles than are required for current operations; however, the additional vehicles are expected to be needed in the next several years for anticipated service increases. In particular, Metrolink has a high percentage of Guardian cars due to being previously purchased to allow for future expansion and service increase. This decision reflected the fact that the added complexity of cab cars made them difficult and prohibitively expensive to purchase in small quantities. It was decided to purchase a sufficient quantity to prevent the need to purchase additional cab cars before another large procurement.

Metrolink currently uses some of its extra vehicles as operating spares. The vehicles are ready to run in the case of a failure, but are not assembled into trainsets and do not have a sperate designated crew; therefore, per FTA requirements, those vehicles are counted as spares, not as part of the peak passenger service requirement. Metrolink's current goal is to maintain a spare ratio of 15% for locomotives and passenger cars. The future goal is to maintain a spare ratio of 15 percent for locomotives and cab cars and 10 percent for trailer cars. Calculations for Metrolink's spare ratio are shown in Figure 3.3.

Figure 3.3 - Actual Spare Ratios

	LOCOMOTIVES		CAB CARS		TRAILER CARS		ALL COACHES	
	CURRENT		ESTIMATED CURRENT		ESTIMATED CURRENT		ESTIMATED CURRENT	
	VEHICLES	SPARE CALCULATION	VEHICLES	SPARE CALCULATION	VEHICLES	SPARE CALCULATION	VEHICLES	SPARE CALCULATION
PEAK REQUIREMENT	40		40		155		195	
PM/PERIODIC INSPECTION/LCM	4	10.0%	3	7.5%	5	3.2%	8	4.1%
UNSCHEDULED REPAIRS	8	20.0%	2	5.0%	8	5.2%	10	5.1%
MODIFICATION/TESTS/CAPITAL PROGRAM	3	7.5%	6	17.5%	7	4.5%	25	12.8%
MAINTENANCE SPARES	15	38%	11	30%	20	12.9%	43	22.1%
OPERATING SPARES (NO CREW) (LAUS & EMF)	2	5.0%	5	12.5%	5	3.2%	10	5.1%
ALL SPARES (MAINTENANCE + OPS)	17	43%	16	40%	25	16.1%	53	27.2%
TOTAL AVAILABLE FLEET	57		56		180		248	
SPARE RATIO	42.2%		40%		16.1%		27.2%	
STORED SERVICEABLE/CONTINGENCY FLEET	3		8		2		10	
ALTERNATIVE FUEL TESTING PROGRAM	0		0		0		0	
PTC TEST TRAINS	0		1		11		0	
TOTAL FLEET - AVAILABLE/STORED/SPECIAL PURPOSE	60		65		193		258	

3.9 Rail Vehicle Useful Life

At the onset of regional rail service, Metrolink established a typical useful life goal of 30 years for locomotives and rail cars based on regional rail industry standards and associated funding requirements. Up to 30 years of useful life is assumed for all vehicles in the Metrolink fleet, except for the F59PH locomotives, which are reaching the end of their useful life between 22 and 24 years due to stress fractures in the crankshafts, and engine mounts. The type of engine installed in Metrolink's F59PH locomotives is a reverse firing order engine which experiences more pronounced vibration with resulting structural stress.

PART 2

EXISTING FLEET AND FACILITIES

4 EXISTING FLEET

4.1 Locomotives and Locomotive-Hauled Coaches

The Metrolink fleet contains 59 locomotives including:

- 39 Electro-Motive Diesel/Progress Rail F-125,
- 15 Motive Power, Inc. MP36PH-3C, and
- 5 Electro-Motive Diesel F59PHR locomotives rebuilt to FRA Tier 2 specifications.

Metrolink has one additional EMD F-125 locomotives ordered with expected delivery in early Summer 2021. As the last remaining EMD F-125 is delivered, tested, and commissioned, the remaining EMD F-59PHR locomotives will be phased out of revenue service and stored as part of the contingency fleet.

A summary of the locomotive fleet is included in Table 4.1

Table 4.1 - Locomotive Fleet Summary

Builder	Model	Built	Horsepower	Engine	Active/ Pending	Contingency	Retired	Road #	HEP Type	HEP (KW)	Disposition	Contract #
Active Locomotives												
EMD	**+F40**	1985	1985	16-cylinder EMD 645			1	800	Direct Drive	800	Retired 2019	Amtrak MOU
EMD	**F59PH**	1992 - 93	1992 - 93	12-cylinder EMD 710		1	14	853, 854, 857-860, 862-867, 869, 871, 872	Caterpillar 3406	600	Retired 2018-2019 except #866, which remains in contingency fleet	R60-CR-002
EMD	**F59PHR**	2009	2009	12-cylinder EMD 710 (T2)	5	2		851, 852, 856, 861, 868, 870, 873	Caterpillar C27 Diesel	600	Repowered w/EPA Tier 2 compliant 710 diesel engines, new electrical cabinets, EM2000 microprocessor control, AESS. Assigned to contingency fleet	SP247-07
EMD	**F59PHI**	1995	1995	12-cylinder EMD 710			8	874-881	Caterpillar C27Q	600	Retired 2018-2020	MOU0140
EMD	**F59PHI**	1998	1998	12-cylinder EMD 710			2	882-883	Caterpillar C27Q or 3406	600	Retired 2019-2020	Philip-Morris
EMD	**F59PHI**	2001	2001	12-cylinder EMD 710			4	884-887	Caterpillar 3412	600	Retired 2020	EP 102
MPI	**MP36P H-3C**	2008	2008	16-cylinder EMD 645 (T2)	15			888-902	Caterpillar C27	600	In service; fitted w/EPA Tier 2 compliant 16-645 diesel engines, Q-Tron microprocessor control, AESS	EP 161-06
EMD	**F59PH**	1988	1988	12-cylinder EMD 710		3		18520, 18522, 18533			Leased	LE 114-16
EMD	**F125**	2015 - 16	2015 - 16	20-cylinder Caterpillar C175 (T4)	40			903-942	Inverter	600	1 unit pending/due for delivery by Summer 2021	EP 181-13
Total Active / Pending and Contingency Locomotives					60	6						

Notes:
1) 5 retired F59 PHIs replaced by F125 locomotives (base order) and will be used for alternate fuel research.
2) 14 F59s and 1 F40 replaced by F125s in base order and retired.
3) 1 F59PH, 9 F59PHIs & 7 PHRs replaced by F125s in option order. F59PH and F59PHIs retired. 7 PHRs assigned to contingency fleet.
4) Locomotive 855 was scrapped prior to the last Fleet Plan

4.1.1 MP36PH-3C

In 2008 and 2009 SCRRA took delivery of 15 MP36PH-3C locomotives built by Motive Power Industries (MPI) in Boise, Idaho. These are part of MPI's popular MP Express series of locomotives that operate on over a dozen different regional railroads in North America. Each locomotive in the MP36PH-3C fleet is comprised of a high percentage of remanufactured parts including diesel engines, major electrical components, rotating equipment, trucks, and frames. The high portion of remanufactured components made the MP Express series popular because it kept the price down while providing like-new components with "new part" warranty protection.

The cabs, carbody, fuel tanks, control apparatus, electronics, HEP package, and other replaceable parts such as wheels, couplers, and draft gear were new when delivered. The engine is a modified EMD 3600hp 16-cylinder 645 EPA Tier 2-compliant diesel driving a remanufactured EMD AR15 main alternator. The units feature operating cabs configured to meet current federal crashworthiness requirements, Automatic Engine Start/Stop apparatus, exhaust silencers, diesel oxidation catalysts and other characteristics allowing the units run cleaner and more efficiently than older locomotives.

Table 4.2 - MP36PH-3C

MP36PH-3C	
MAKE/MODEL	Motive Power Industries
YEAR BUILT/IN-SERVICE	2008
YEAR OF LAST OVERHAUL	N/A
PROPULSION/TECHNOLOGY	EPA Tier 2 Diesel
QUANTITY	15
GENERAL CONDITION	Good
EST. USEFUL LIFE	30 years

Metrolink currently has a renewable diesel demonstration underway on a Metrolink MP36 locomotive to reduce emissions in the near-term.

This fleet will be due for mid-life overhaul in less than four years from the date of this fleet plan, with the current plan to either procure new Tier 4 locomotives or replace the main engine with a Tier 4 compliant diesel, permitting cleaner, more efficient combustion – funding permitting. This initiative may be combined with a propulsion retrofit from traditional DC propulsion equipment to AC propulsion similar to the F125 locomotives. Conversion to AC propulsion will enable a retrofit of the HEP package from the current traditional stand-alone diesel-powered HEP package to an inverter HEP system powered by the main generator that would create further similarity to the F125 configuration and render the MP36 fleet as efficient and clean-burning as the F125 units. The alternative to AC propulsion would be an in-kind overhaul of the DC propulsion equipment and installation of a Tier 4 stand-alone HEP package.

The final scope of this upgrade will ultimately be determined by the availability of adequate funding. This could reasonably be included in the future overhaul and upgrade program described above and handled on an ad hoc basis until that program is implemented.

4.1.2 F-125PH

Metrolink is currently operating 39 F-125PH locomotives built by Progress Rail/Electro-Motive Diesel. These 39 units are part of a 40-vehicle order that began delivery in 2016. Metrolink has had a steady stream of deliveries, with the bulk of the order delivered in 2018. These are brand new, state-of-the-art vehicles and have a service life of approximately 30 years. As they are new vehicles, the only modifications made have been field modifications completed by the Original Equipment Manufacturer (OEM). The remaining one locomotive is slated to be delivered in June 2021.

Figure 4.1 - F-125PH

Table 4.3 - F-125PH

F-125PH	
MAKE/MODEL	Progress Rail/EMD
YEAR BUILT/IN-SERVICE	2016 - 2020
YEAR OF LAST OVERHAUL	N/A
PROPULSION/TECHNOLOGY	EPA Tier 4 Diesel CEM technology
QUANTITY	40 *1 of 40 pending delivery
GENERAL CONDITION	Excellent
EST. USEFUL LIFE	30 years

4.2 Contingency and Retired Locomotives

4.2.1 F40PH

Metrolink operated only one unit of this model, which was obtained from Amtrak. This unit was replaced by the F-125PH locomotives, retired, and decommissioned.

4.2.2 F59PH

Metrolink operated a total of 22 F59PH locomotives built by EMD in 1992 and 1993. There were originally 23 units in the fleet, but one unit (#855) was retired and scrapped. Fifteen of them operated in their as-built configuration until retirement. The remaining seven units were modified and updated with EPA Tier 2-compliant diesel engines and other upgrades; they are designated as F59PHR locomotives, with “R” indicating that they have been repowered. All but one of the remaining F59 units were replaced by F-125 locomotives and were retired and decommissioned. One locomotive (#866) remains in Metrolink’s contingency fleet, but without an engine.

4.2.3 F59PH-R

The F59PH was the first locomotive procured by Metrolink from General Motors’ Electro-Motive Division (EMD). The original order consisted of 23 locomotives, out of which 16 have been phased out of service. The remaining seven locomotives underwent a significant retrofit program performed by Motive Power Industries in Boise, Idaho in 2009 that included replacing the as-built 12-cylinder EMD 710 3000hp diesel with an upgraded EPA Tier 2-compliant 3000hp EMD 710 engine and remanufactured AR15 alternator along with a new high voltage cabinet and electrical components and microprocessor control apparatus. A new, cleaner and more efficient

Head-End Power (HEP) package was also retrofitted that included a Caterpillar C27 diesel engine driving a Kato alternator that produces up to 600 kilowatts of 480vAC HEP. The Integrated Automatic Engine Start/Stop (AESS) apparatus was also part of the upgrade program, providing improved fuel efficiency and lower exhaust and noise emissions. The upgraded locomotives were designated F59PH-R.

These units are used to support daily service and exhibit improved reliability compared to the units they were derived from (F59PH) and provide benefits related to the cleaner burning, more efficient diesel engine and HEP package. However, the systems aboard this fleet that were not upgraded or retrofitted as part of the 2009 program work – such as the dynamic brake grids, cabling and interior wiring – have continued to age.

Two of these units have been decommissioned at this time with the remainder five units stored serviceable. These units were replaced by the F-125 locomotives and have been reassigned to Metrolink's contingency fleet.

Table 4.2 - F59PH-R

F59PH-R	
MAKE/MODEL	EMD
YEAR BUILT/IN-SERVICE	1991 - 1993
YEAR OF LAST OVERHAUL	2009
PROPULSION/TECHNOLOGY	EPA Tier 2 Diesel
QUANTITY	5
GENERAL CONDITION	Adequate
EST. USEFUL LIFE	21 - 25 years

4.2.4 F59PHI

There were 14 F59PHI locomotives in the Metrolink fleet that were built and delivered in three separate lots over the course of 1995-2001.

This fleet never underwent any significant overhaul work and were replaced by the F-125 locomotives. All of these units have been retired and are either decommissioned or pending decommissioning.

4.3 Push-Pull Cab and Trailer Coaches

Metrolink's passenger car fleet, summarized in Table 4.4 consists of two types of passenger rail cars: Bombardier-built "Sentinel" cars, and Hyundai-Rotem "Guardian" cars. All cars are bi-level, with two double-sliding doors per side, on the lower level of the cars. This allows easy boarding at the low-level platforms found throughout Metrolink's operating territory. All cars contain a restroom and are ADA-compliant with a bridge plate stored onboard; however, wheelchair ramps are only located at the end of each station platform potentially requiring multiple station stops to allow for wheelchair boardings.

Within the classes of passenger rail cars, there are two additional designations: cab cars and trailer cars. Cab cars are placed at the end of a train consist, opposite the locomotive; they include an operating cab with the controls necessary to control the locomotive at the opposite end of the train in push mode.

The fleet currently contains 33 Sentinel cab cars, which are used exclusively as trailer cars. All of these cab cars in active use have had their cab controls disabled. Metrolink uses Guardian cab cars on the end of all consists opposite the locomotive since they contain enhanced safety features for passengers and crew in the event of a collision.

Metrolink's oldest cars date from the service's creation in 1992, while the newest cars were delivered in 2013. Seating is 2+2 throughout the fleet, providing generous hip room and giving Metrolink's customers greater comfort than that afforded to passengers at many other agencies, especially in the eastern United States. The cars are configured for multi-level seating on the upper and lower levels with modest seating capacity on the intermediate levels at the ends of the cars. All cars are fitted with a pair of roof-mounted, unitized HVAC units to provide continuous climate control regardless of ambient conditions and a significant level of redundancy, should one HVAC unit be inoperable or delivering subpar cooling. This feature is reinforced by the dual bus HEP trainline configuration of Metrolink's vehicle fleet. The HVAC units are each powered by different trainlines, which enhances overall reliability and provides a good measure of redundancy. The air filtration systems were upgraded in 2020 to improve health and safety during the pandemic.

Table 4.4 - METROLINK Passenger Railcar Revenue Fleet Summary

BUILDER	MODEL	BUILT	TYPE	ACTIVE	STORED	ROAD #	SEATS	DISPOSITION	CONTRACT #
BTNA	Sentinel - Generation 1	1992-93	Trailer Car	60	0	101 - 163	149	24 cars re-configured to accommodate bicycles w/slight reduction in seating; all stored cars need O/H before re-use. Active Cab Cars in test trains only. 1 car is out of service – wrecked	EP R60-CR-001
			Cab Control Car (used as trailers)	22	6	601 - 631	142	Total of 7 still in METROLINK's fleet. Active Cab Cars in test trains only	
BTNA	Sentinel - Generation 2	1997-98	Trailer Car	0	2	166, 168	140		PO150
			Cab Control Car (used as trailers)	3	2	632 - 637	135		
BTNA	Sentinel - Generation 3	2002	Trailer Car	26	0	183 - 210	141	1 car out of service – wrecked.	EP100
Hyundai-Rotem	Guardian	2011-12	Trailer Car	80	0	211 - 290	132	All consists run w/Guardian cab cars and Guardian cab cars or trailers against locomotive; 5 cabs & 3 trailers out of service - wrecked.	EP142-06
			Cab Control Car	57	0	638 - 695	121		
Total Passenger Railcars by Type			Trailer Car	166	2				
			Cab Control Car (used as trailers)	25	8				
			Cab Control Car	57	0				
Total Passenger Railcars Fleet				**248**	**10**				
				258					

Note 1: All Guardian cab cars include Crash Energy Management (CEM) characteristics

Note 2: Bombardier Sentinel Generation 1 and 3 cars in service; all Generation 2 trailer and cab cars stored; no Sentinel cab cars in service except test trains; 16 Generation 2 cars sold as surplus to Caltrain

Note 3: All cars fitted with a lavatory

Note 4: All stored cars need overhaul work before re-use in revenue service. All stored cars are at EMF and Keller Yard.

Note 5: 24 Sentinel Generation 1 cars have been reconfigured to accommodate bicycles: #102, 104, 110, 112, 114, 116, 120, 121, 124, 130, 131, 137, 138, 139, 140, 141, 144, 146, 147, 149, 151, 153, 154, 157

Note 6: Final Guardian car out of warranty in June 2015.

Note 7: Retired cars: 113, 133, 148, 174, 185, 608, 623, 625, 634. Car 184 destroyed during delivery

4.3.1 Bombardier Sentinel – Generation 1

Features

This fleet of 88 cars was delivered to Metrolink in 1992 and 1993 to initiate regional rail service and is an adaption of a design originally developed for GO Transit in Toronto, Ontario by Hawker-Sideley in the 1970s. This fleet originally consisted of 94 cars, however six have been retired. Bombardier continues to supply cars built to an updated version of this design to regional rail agencies in North America. The car bodies are fabricated from a low-alloy high tensile steel underframe structure with a riveted aluminum upper car body structure and aluminum "skin." They are fitted with tight-lock couplers and disc as well as tread braking to provide maximum stopping capability and facilitate long wheel life. This fleet, as built, included trailer cars seating 149 passengers and cab cars seating 142.

Condition

Following the delivery of the Rotem Guardian fleet, the Sentinel Generation 1 cab control cars were pulled from service as cab cars. A portion of the fleet had their cab controls disabled, while some have served on PTC test trains and as passenger-carrying trailer cars. Additionally, several have been stored out of service pending repairs. The Sentinel Generation 1 cars have provided close to 30 years of continuous service and were in significant need of overhaul. They are currently being overhauled as a part of Metrolink's ongoing car overhaul program, details of which can be found in Section 5.2.

There are currently 60 Generation 1 cars in revenue passenger service plus the seven currently used for PTC testing. Details of the planned overhaul program are in Section 5.2.1.

Twenty-four Sentinel Generation 1 trailer cars have been converted to bicycle cars, which can hold up to 18 bicycles on the lower level. They are deployed throughout the Metrolink system and used interchangeably with the rest of the fleet.

4.3.2 Bombardier Sentinel – Generation 2

Features

This fleet of 18 trailer cars and five cab control cars were delivered to Metrolink by Bombardier in 1997 and 1998 to augment the original regional railcar fleet. The Sentinel Generation-2 fleet originally consisted of 25 cars. One trailer and one cab car have been retired. Sixteen more were sold to Caltrain in the San Francisco Bay area in 2015, following the arrival of the Guardian cars. They are similarly configured to the Sentinel Generation 1 fleet. There are slight variations in seating that result in trailer cars seating 140 and cab control cars seating 135. Cars from this fleet were sold in lieu of cars from the Sentinel Generation 1 fleet due to more flexible lease terms that enabled the sale of surplus cars.

Condition

Metrolink retains five trailer cars and two former cab cars from Generation 2, all of which are included in the ongoing overhaul program. Once overhauled they will be available for revenue service.

4.3.3 Bombardier Sentinel – Generation 3

Features

This fleet of third generation Sentinel cars was ordered in trailer car configuration only. The Generation-3 fleet originally consisted of 27 cars with one car now retired - leaving 26 cars. They were purchased from Bombardier and delivered in 2002 to support service and ridership expansion. They are also configured similarly to the two previous orders, seating 140 customers per car.

Condition

The Sentinel Generation 3 cars are currently used in daily service with one car out of service. This fleet will need overhaul work to be done within the next five years and are included as an option in the overhaul program.

4.3.4 Hyundai-Rotem Guardian

Features

The newest cars in the Metrolink fleet were built by Hyundai Rotem and delivered and accepted between 2010 and 2013. These cars feature Crash Energy Management (CEM) technology at the ends to improve protection of customers and crew in the event of a collision. Modifications are being pursued to enhance safety features of these cab cars. The Guardian passenger seating configuration consists of 132 in the trailer cars and 121 in the cab control cars.

Condition

This fleet is in good condition and will not likely require overhaul work in the next five years. There are, however, currently eight cab cars out of service long-term awaiting replacement parts or repairs because of damage incurred in grade crossing collisions.

Metrolink will explore pilot projects to test alternative fleet types and alternative propulsion technologies.

Unlike the older Bombardier cars, there are few agencies operating these Rotem cars – making it difficult to source some parts.

Due to the young age of this fleet and the fact it incorporates a number of micro-processor-controlled systems, housed in a carbody of stainless steel construction, make the cars a very good candidate for lifecycle maintenance or progressive overhaul of selected systems, which was started in 2019.

4.4 Multiple Units

4.4.1 Stadler Rail FLIRT

Features

Metrolink will operate Diesel Multiple Units (DMU) on the Redlands Passenger Rail Project (Arrow). The DMUs are powered by an on-board low-emission, clean diesel engine which are smaller, quieter, more efficient than standard locomotive hauled coaches. The three new Stadler Rail FLIRT vehicles will be two-car consists that will operate between the San Bernardino Transit Center to the University of Redlands Station. The vehicles are expected to be delivered in 2021. In 2024, Zero Emission Multiple Units (ZEMU) that will be powered using hydrogen fuel cell-battery hybrid technology will operate on the Arrow corridor. The ZEMU trains will use hydrogen as a primary fuel source, providing capacity for 108 passengers while providing clean air by eliminating rail emissions and air pollutants.

4.5 Maintenance of Way Fleet

In addition to the locomotives and railcars previously mentioned in this section, Metrolink owns, maintains and operates a fleet of Maintenance of Way equipment. These typically see a very light duty cycle, and therefore are overhauled on an as-needed basis. Table 4.5 provides a summary of this equipment.

Table 4.5 - Maintenance of Way Fleet Summary

VEHICLE TYPE	VEHICLE TYPE	YEAR BUILT
FLAT CAR	2	1980
FLAT CAR	2	1977
CABOOSE	1	1950
BALLAST HOPPER CAR	5	1998
AIR DUMP GONDOLA CARS	2	1990

5 VEHICLE CAPITAL PROJECTS

5.1 Targeted Component Upgrades

SCRRA's rolling stock equipment and rehabilitation component upgrades are based on safety, condition, upfront replacement costs, maintenance costs, ongoing costs, on-time performance, return on investment, OEM recommendations and economies of scale for the individual programs.

Metrolink's older vehicles have reached or exceeded the mid-point of their service lives and are due or overdue for a comprehensive mid-life overhaul. To date, they have undergone a variety of targeted programs to address immediate major maintenance needs, as funding allows. This includes:

- Repowering of seven F59PHR locomotives with Tier 2 main engines, the installation of microprocessor control apparatus and Tier 2 HEP engine/generator packages as well as partial overhaul of those locomotives in 2009
- Replacement of locomotive air compressors
- Replacement of locomotive HVAC units
- Replacement of locomotive traction motors
- Upgrade older HEP engine/generator packages with Tier 2 HEP engine/generator packages on 10 locomotives
- Addition of Automatic Engine Start/Stop to 10 F59PHI/PH locomotives

Once the vehicles are in a State of Good Repair, the goal is to bring the older vehicles that remain in the fleet into a Life Cycle Maintenance (LCM) program. Although Metrolink has not yet begun a full progressive/lifecycle maintenance program on its entire fleet, elements of an LCM program have been started. These programs have been applied to specific systems on vehicles and have been generally project-based.

With the new vehicle maintenance contract, a full LCM approach is to be applied to the Sentinel passenger cars and the EMD F-125 locomotives. The remainder of the railcar fleet is currently undergoing or expected to undergo overhauls in the next several years and could then be considered for inclusion in the lifecycle maintenance program.

5.2 Traditional Overhauls

A vehicle overhaul is major maintenance work intended to return vehicles to a State of Good Repair after a significant period of operation. Traditionally, this has meant mid-life overhauls for passenger railcars and locomotives, plus interim top-deck overhauls for locomotives. This type of work is not necessarily intended to extend the service life of a vehicle, but to ensure it is able to perform reliably and reach its intended service life. Planned and anticipated overhaul programs are discussed in the following sections.

Table 5.1 provides the State of Good Repair needs in 2017 dollars without escalation. This data is from SCRRA's MRP Section 6 Rolling Stock Rehabilitation Plan, dated October 2020.

5.2.1 Overhauls to Sustain Existing Service

5.2.1.1 Locomotives

Following the delivery and commissioning of Metrolink's new F125 locomotives, all F59 locomotives (F59PH, F59PHI, and F59PHR) will be retired or placed in the contingency fleet; with five designated for alternative fuel research. As the majority of Metrolink's locomotive fleet is replaced by the new F125 locomotives, it is expected unplanned maintenance will decrease, and a comprehensive LCM program will be followed.

Locomotive overhaul/rehabilitation work anticipated for the remaining locomotive fleet includes:

Table 5.1 - State of Good Repair Needs Summary

TOTAL	Backlog (Immediate Need)	State of Good Repair (Annualized over 25 Years)	State of Good Repair (Annualized 25 Year Total)	State of Good Repair (Special Projects)	State of Good Repair (25 Year Total)
Locomotives	$.000M	$15.620M	$390.510M	$72.000M	$462.510M
Passenger Cars	$87.666M	$8.407M	$210.168M	$345.350M	$643.184M
Total	**$86.666M**	**$24.027M**	**$600.678M**	**$417.350M**	**$1,105.694M**

[2] The market for Tier 4 passenger locomotives is currently dominated by one supplier, with another being the supplier of the Metrolink F125 locomotive, a model produced exclusively for Metrolink. Motive Power (GE) has provided one protype Tier 4 unit with an additional 10 on order to GO Transit in Ontario, Canada. The passenger locomotive rebuild and remanufacture supplier base has been steadily shrinking over the past decade

- Completing the overhaul or replacement of all MP36PH-3C Locomotives (15 units), to make these Tier 4 emissions compliant.
- Impacting the replacement/rebuild decision will be passenger locomotive market conditions at the time the overhaul comes due[2].
- Performing annual preventive maintenance and repair.
- Performing four-year cycle maintenance including main engine (top end) overhaul and HVAC coil cleaning.
- Performing six-year cycle maintenance including air compressor overhaul and wheel/axle assembly replacement.
- Performing eight-year cycle maintenance including main engine (major) overhaul, alternator heavy repairs, rotating electrical overhaul (cooling fans, DB Brake Blower, and Aux generator), cab equipment (replace PTC/Cab signal battery and overhaul master controller), battery replacement, and HVAC unit overhaul.
- Performing 10-year cycle maintenance including non-engine system overhaul such as event recorder replacement, electrical replacements (power contactors, motor/brake contactors, and reversing contactors), and trucks/suspension replacement (yaw damper, vertical/lateral shocks).
- Performing 12-year cycle maintenance including coupler overhaul, draft gear overhaul/paint, alternator overhaul, HVAC coil cleaning, and truck frame overhaul.
- Performing16-year cycle maintenance including car body overhaul/paint, journal spring replacement, and traction motor replacement.

5.2.1.2 Passenger Railcars

Rail car component overhauls such as air conditioning, door operators, emergency windows, and car batteries have been performed. Railcars historically have had fairly low levels of investment beyond key components, regulatory requirements, and normal preventive maintenance.

Bombardier Railcar:

The current Rail Car Overhaul Program (started in FY19) includes the overhaul and rebuild of all 121 Bombardier vehicles in a base order of 50 cars with an option order for the remaining 71 cars. All 50 cars in the base order will be Generation 1, regardless of being a trailer car or (decommissioned) cab car. SCRRA will request further funding to support the remaining railcar option orders, which include 33 Generation 1, seven Generation 2 and 26 Generation 3. This sequencing of overhauls is based on the lifespan of each generation type.

The goal is to bring the Bombardier passenger cars into an LCM program, but their current conditions make it critical they undergo a more comprehensive overhaul to bring the fleet into a State of Good Repair prior to the program's conversion. Therefore, SCRRA has planned a one-time traditional overhaul for the Sentinel rolling stock.

Hyundai-Rotem Railcar:

SCRRA also plans a mid-life overhaul and rebuild of the Hyundai Rotem fleet to improve service reliability. The majority of this work will likely be performed under the LCM program. The priority sequence of the systems and current status is noted below:

- HVAC - in progress (FY20)
- Doors - in progress (FY20)
- Couplers - in progress (FY20)
- Restrooms - planned (FY22)
- Battery - planned (FY22)
- Seats - planned (FY22)

- Floor and Interior - planned (FY22)
- Exterior - planned (FY25)
- Cab Control Equipment - planned (FY25)
- Truck/Suspension - planned (FY27)
- Lights - planned (FY27)

This sequence is based on cross-references among service issue history, service convenience impact and the Hyundai-Rotem maintenance manual.

Capital Program:

The SCRRA Equipment Team also plans capital projects to advance various onboard systems with high technology devices for customer convenience, maintainability, and operational enhancement.

- Convenience electrical outlets: The Bombardier railcars will have an approximately 70 outlet modules (center of every seat-pair).
  - The Hyundai-Rotem fleet - increase the number of convenient outlet modules for more reliable ridership. The same design as the Bombardier cars will be introduced and provide passengers with approximately 65 outlet modules accessible throughout the railcar.

- Metrolink Smart Train (MST) Project – includes the implementation of smart features using the following wireless technology:
  - Monitoring Diagnostic System (MDS) - wireless maintainability and predictive maintenance algorithm
  - Security Surveillance Camera
  - Commercial Wi-Fi
  - Broadcasting TV

- Procurement of new cab cars to support service capacity increases

5.2.2 Overhauls for Service Increases or Expansions

Metrolink service expansion and growth scenarios require the commitment of Member Agencies and additional resources (capital and operating). The key strategies for service increases and/or expansions are further outlined in Metrolink's Strategic Business Plan and the Southern California Optimized Rail Expansion (SCORE) Service Plan.

5.2.2.1 Locomotives

Currently no overhauls are planned for service increases or expansions of the locomotive fleet, due to the procurement of 40 new F-125s. However, as a leader in moving towards a zero emissions standard, SCRRA is exploring the use of alternative locomotive propulsion technology. Refer to the Vehicle Technology Assessment Section 9 for additional details.

5.2.2.2 Passenger Railcars

When completed with options exercised, the overhaul program for the Bombardier Generation 1, 2 and 3 fleets will provide SCRRA with greater reliability and availability, including reactivating the Contingency Fleet to support service growth.

5.3 Lifecycle Maintenance Program

Metrolink has started the process of moving towards an LCM program to improve the reliability and safety of its fleets. The Guardian cars and the F125 locomotives are currently being maintained within this program. Once the legacy vehicles have completed the one-time major overhauls, it is planned they will also be shifted to an LCM maintenance program for the remainder of their service lives.

Metrolink's LCM covers all major reliability and safety critical systems that would be overhauled or replaced every certain number of years, specific to each system, to best match the needs of the system and the operational demands of Metrolink's service. The number of years between each iteration of an overhaul/replacement activity for a certain system is called the LCM cycle length.

Since it would not be possible to perform maintenance activities on all vehicles at the same time, the LCM activities need to be staggered, and may be performed over several years to complete on the whole fleet. The first cycle length requires performing some overhaul/replacements early, but once all activities have been performed on the staggered schedule, the remaining cycles will be naturally staggered without needing further adjustments. This allows for improved planning and preparation of maintenance activities and reduces the likelihood of multiple failures occurring within a short timeframe for the same system. Additionally, costs are stabilized, and long-term funding needs to support the fleet are normalized.

5.3.1 Locomotives

Per the general configuration of the F125 locomotives and the anticipated miles operated per year, the LCM activities identified in the table below would need to be performed to keep them in a State of Good Repair throughout their service lives. This information should be reviewed and revised based on OEM (Original Equipment Manufacturer) maintenance documentation and in-service operational data.

For efficiency and planning, activities can be grouped together into several LCM overhaul groups. Activities with a similar cycle can be performed at the same time to gain economies of scale, thus reducing the number of times each locomotive is out of service for LCM work, offering cost savings through the gained efficiencies.

Based on the cycle length, the LCM overhaul groups identified in Table 5.3 would be recommended. Any refinements made to the overhaul activities and cycle lengths would also need to be modified in these LCM overhaul groups. Since the completion of these overhaul activities would take several years to complete on the entire fleet, it is anticipated they would be scheduled such that the end of each program coincides with the ideal vehicle/component age for the selected overhaul activity.

A generalized summary of a potential LCM program for locomotives is shown in Figure 5.1. In the process of developing the lifecycle maintenance plan, additional factors must be considered, including the available shop space, staffing levels and skillsets, and the funding necessary. Depicted in Figure 5.2 is an overview of total locomotives that might undergo an LCM overhaul each year.

Planning in advance allows for leveling of the total overhauls performed each year and related funding requirements. It also allows for planning not to commit to more overhauls than maintenance personnel and shop space can accommodate. Shown in Figure 5.3, is a sample of the total shop space days (available shop spaces for LCM maintenance X annual days worked by maintenance crews) that might be required to complete the work included in the LCM plan. As all vehicles move from traditional overhauls to LCM work, fewer shop spaces should be required for unscheduled repairs, thus allowing other shop space to be dedicated to LCM work.

Table 5.2 - Lifecycle Maintenance Activities - F125 Locomotive Components

Main System	System Component	Replacement Interval (Years)
Cab Controls and Equipment	Drive Controls	7
Carbody and Structure	Automatic Equipment Identification Tag	2
	Brakes	2
	Carbody Exterior Equipment	21
	Carbody Interior Equipment	8
	Coupler	5
	Coupler and Draft Gear	5
	Primary Suspension Damper Bushing	2
	Primary Suspension Resilient Joint	3
	Suspension	16
Compressed Air	Air Brake	8
	Air Compressor	6
	Air Dryer	3
	Air Treatment and Reservoir	5
	Auxiliary	5
	CCBill Air Rack	12
	Compressed Air	3
	Disc Brake Unit	13
	Parking Brake	4
	Tread Brake Unit	10
High Voltage and Propulsion	Battery	5
	Blower Motor	4
	Inertial Filter Blower Motor	4
	Terminal Board	2
	Traction Alternator	4
	Traction Motor	2
	Traction Moter Blower	2
	Traction Moter Gearbox	11
	Traction Motor Gearbox Breather	5
	Traction Motor Gearbox Coupling	5
	Traction Motor Gearbox Reaction Rod	5

Table 5.2 - Lifecycle Maintenance Activities - F125 Locomotive Components

	Traction Power Alternator	5
	Traction Power Generation	4
Lighting	Lighting	3
Locomotive General	Locomotive General	23
Main Engine	Coolant	4
	Cooling Fan	4
	Exhaust	5
	Fuel	5
	Fuel Pump	3
	Fuel Tank	4
	Main Engine	4
	Water Cooling	13
Microprocessor	Accelerometer	4
	Automatic Train Stop	11
	Communication	4
	Event Recorder	7
	ITS Coil	3
	Locomotive Control Computer	12
	Positive Train Control	38
	PTC IETMS	3
	PTC Recorder	5

Table 5.3 - Lifecycle Maintenance Activities - F125 Locomotive Overhaul Groups

Vehicle Age	System Component		Program
4 years	Main Engine		Top End Overhaul
	HVAC	Coils	Clean Coils
6 years	Air Compressor	Air Compressor	Overhaul
	Trucks / Suspensions	Wheel Axle Assembly	Replace
8 years	Main Engine		Major Overhaul
	Alternator	Insulation Resistance & Hi-Pol	Heavy Repair
		Inspect & Clean Rectifier	Heavy Repair
		SCR, Luse & Diode Replacement	Heavy Repair
	Rotating Electrical	Colling Fans, DB Blower, Aux Generator	Overhaul
	Cab Equipment	PTC/Cab Signal - Data Logger Battery	Replace
		Master Controller	Overhaul
	Electrical	Battery	Overhaul
	HVAC	A/C Units	Replace
10 years	Cab Equipment	Event Recorder - CHMM & Battery	Replace
	Electrical	Power Contactors	Replace
		Motor Brake Contactors	Replace
		Reversing Contactor	Replace
10 - 12 years	Trucks/Suspension	Trucks - Yaw Damper	Replace
		Trucks - Vertical Lateral Shocks	Replace
12 years	Main Engine		Top End Overhaul
	Air Compressor		Overhaul
	Coupler		Overhaul
	Draft Gear		Overhaul
	Alternator		Overhaul
	HVAC		Clean Coils
	Truck Suspensions	Truck Frame	Overhaul
		Wheel Axle Assembly	Replace
	Carbody		Overhaul Paint
	Main Engines		Replace / Remanufacture
	Truck Suspensions	Journal Springs	Replace
	Electrical	Battery	Replace
	Alternator	Insulation Resistance & Hi-Pol	Heavy Repair

Table 5.3 - Lifecycle Maintenance Activities - F125 Locomotive Overhaul Groups

15 -16 years		Inspect & Clean Rectifier	Heavy Repair
		SCR, Fuse & Diode Replacement	Heavy Repair
	Rotating Electrical	Traction Motors	Replace
		Cooling Fans, DB Blower, Aux Generator	Overhaul
	Cab Equipment	PCT Cab Signal - Data Logger Battery	Replace
		Master Controller	Overhaul
	HVAC	AC Units	Overhaul
16 years	Air Compressor		Overhaul
	Trucks Suspension	Wheel Alex Assembly	Replace
20 years	Main Engine		Top End Overhaul
	Cab Equipment	Event Recorder - CHMM & Battery	Replace
	Electrical	Motor Brake Contactors	Replace
		Reversing Contactor	Replace
		Reversing Contactor	Replace
	HVAC	Coils	Clean Coils
20 or 24 years	Trucks / Suspension	Trucks - Yaw Damper	Replace
		Trucks - Vertical Lateral Shocks	Replace
24 years	Main Engine		Major Overhaul
	Air Compressor		Overhaul
	Coupler		Overhaul
	Draft Gear		Overhaul / Paint
	Trucks / Suspension	Truck Frames	Overhaul
		Wheel / Axle Assembly	Replace
	Alternator	Insulation Resistance & Hi - Pot, inspected & Clean Rectifier, SCR, Fuse & Diode Replacement	Heavy Overhaul
	Rotating Electical	Cooling Fan, DB Blower, Aux Generator	Overhaul
	Cab Equipment	PTC Cab Signal - Data Logger Battery	Replace
		Master Controller	Overhaul
	Electrical	Battery	Replace
	HVAC	Coils	Clean Coils
		AC Units	Overhaul
26 years	Main Engine		Top End Overhaul
	HVAC	Coils	Clean Coils

Figure 5.1 - LCM Plan - Locomotive Overhaul Activities by Year

		Qty		FY 94-95	FY 95-96	FY 96-97	FY 97-98	FY 98-99	FY 99-00	FY 00-01	FY 01-02	FY 02-03	FY 03-04	FY 04-05	FY 05-06	FY 06-07	FY 07-08	FY 08-09	FY 09-10	FY 10-11	FY 11-12	FY 12-13	FY 13-14	FY 14-15	FY 15-16	FY 16-17	FY 17-18	FY 18-19	FY 19-20	FY 20-21	FY 21-22	FY 22-23	FY 23-24	FY 24-25	FY 25-26	FY 26-27	FY 27-28	FY 28-29	FY 29-30	FY 30-31	FY 31-32	FY 32-33	FY 33-34	FY 34-35	FY 35-36	FY 36-37	FY 37-38	FY 38-39	FY 39-40
	MP36PH - 3C LOCOMOTIVES	15	Overhaul & Remanufacture to Tier IV:																												7	8																Exter	
			4/12/18/24/29-year LCM work:																														7	8							7	8					7	8
			6/14/21/27-year LCM work:																																8	7							7	8				
			8/15/24-year LCM work:																																		8	7						7	8			
			10/21-year LCM work:																																				7	8								
			Engine OH & Replace Tract. Motor:																																										7	8			
			Vehicle Age:														0	1	2	3	4	5	6	7	8	9	#	11	#	#	#	15	#	17	#	#	#	#	#	#	#	#	#	#	#	#	#	#	#
			Vehicle Age (after remanufacture):														-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	1	2	3	4	5	6	7	8	9	#	11	#	#	#	15	#	17	#
FUTURE LOCOMOTIVES	F125 LOCOMOTIVES	40	4/12/18/24/29-year LCM work:																							10	10	10	10					10	10	10	10			10	10	10	10			10	10	10	10
			6/14/21/27-year LCM work:																									10	10	10	10					10	10	10	10				10	10	10	10			10
			8/15/24-year LCM work:																											10	10	10	10				10	10	10	10						10	10	10	10
			10/21-year LCM work:																													10	10	10	10								10	10	10	10			
			Engine OH & Replace Tract. Motor:																																		10	10	10	10									
			Vehicle Age:																						0	1	2	3	4	5	6	7	8	9	#	11	#	#	#	15	#	17	#	#	#	#	#	#	#
	FUTURE LOCOMOTIVES 1	9	4/12/18/24/29-year LCM work:																																4	5							4	5					4	5
			6/14/21/27-year LCM work:																																		4	5							4	5				
			8/15/24-year LCM work:																																					4	5							9		
			10/21-year LCM work:																																						4	5								
			Engine OH & Replace Tract. Motor:																																												4	5			
			Vehicle Age:																												0	1	2	3	4	5	6	7	8	9	#	11	#	#	#	15	#	17	#

= vehicles completing LCM work each year

- # (red) LCM work at: 4, 12, 18, 24 and 29 yrs
- # (orange) LCM work at: 6, 14, 21 and 27 yrs
- # (yellow) LCM work at: 8, 15 and 24 yrs
- # (light yellow) LCM work at 10 and 21 yrs
- # (blue) Engine Mid-life Overhaul
- (green) Retirement

Figure 5.2 - Sample LCM Plan – Locomotive LCM Overhauls per Year

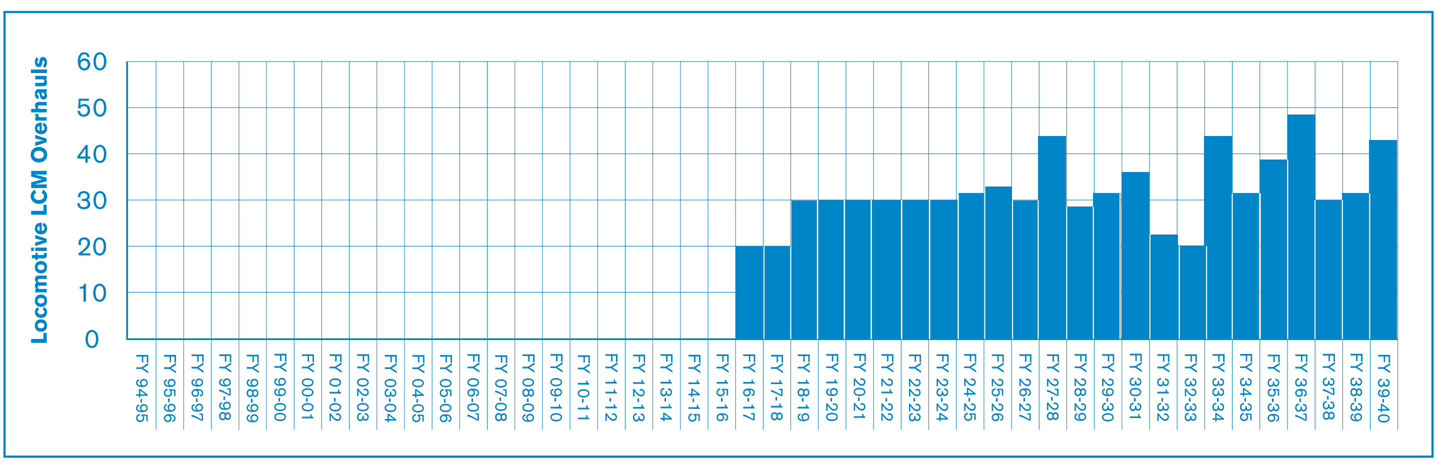
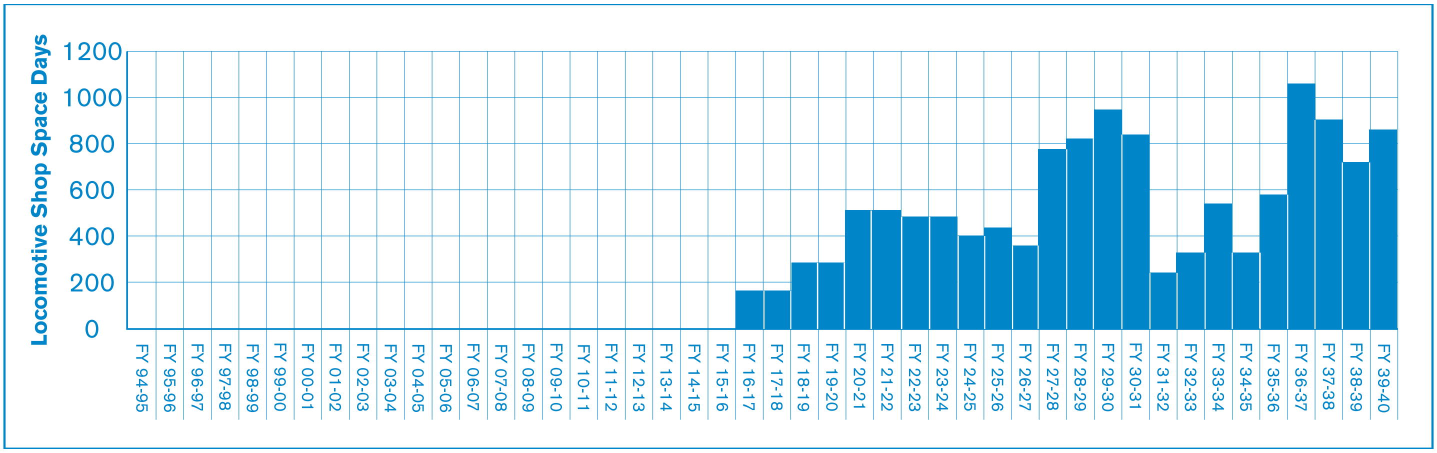
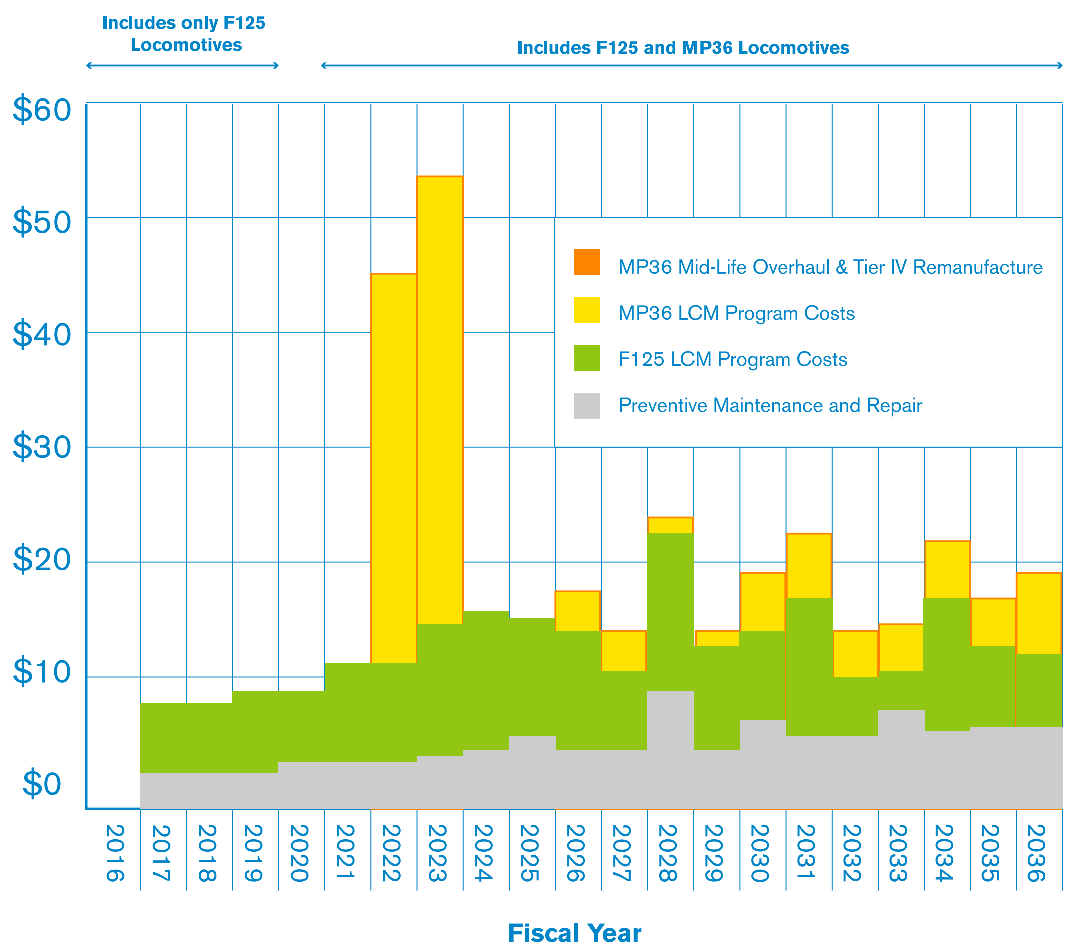


Figure 5.3 - Sample LCM Plan - Annual Shop Space Days for Locomotive LCM Overhauls



A generalized summary of a potential lifecycle maintenance program for the locomotive fleet is shown in Figure 5.4.

Figure 5.4 - Lifecycle Maintenance Activities by System – Locomotives



5.3.2 Passenger Railcars

Based on the general configuration of the Guardian cars and the annual miles operated, general recommendations for LCM activities are identified on Table 5.4. This list should be refined through a review of OEM recommendations and a more in-depth review of actual vehicle conditions and maintenance history.

Table 5.4 - LCM Overhaul Groups – Guardian Cars

Lifecycle Maintenance Activities - Guardian Cars

Approximate Service Cycel	System & Component		Maintenance Activity
15 years	Door System	Door Guides	Replace
		Hangers	Replace
	HVAC	Protective Heaters	Replace
		Floor Heaters	Replace
	Interior	LLEPM Decals	Replace
16 years	Cab Equipment	Windshield Wiper	Overhaul
		Master Controller	Overhaul
	Electrical	Battery Set	Replace
		LVPS	Overhaul Replace Capacitors Electrolytic
	Floor	Floor Covering	Replace
	HVAC	AC Units	Overhaul
		Contactors	Rebuild
	Interior	Passenger Seats	Replace
	Toilet	Regulator	Overhaul
		Retention Tank	Inspect
		Hooper	Overhaul / Replace
		Actuator Valve	Overhaul
		Vacuum Breaker	Replace
	Cab Equipment	Cab Signal	Replace

Table 5.4 - LCM Overhaul Groups – Guardian Cars

18 years		Data Logger Battery	Replace
	Electrical	Light Shades	Replace
	Truck Suspensions	Brake Discs	Replace
		Wheel Axle Assembly	Replace
20 years	Cab Equipment	Event Recorder	Overhaul
		CHMM & Battery	Replace
	Door System	Door Guides	Replace
		Door Seals (Edge)	Replace
	HVAC	AC Units	Replace
		Protective Heaters	Overhaul
	Interior	LLEPM Decals	Replace
24 years	Cab Equipment	Cab Signal	Replace
		Data Logger Battery	Replace
		Whindshield Wiper	Replace
		Master Controller	Overhaul
	Coupler	Coupler	Evaluate
		Draft Gear	Replace
		Coupler Carrier	Replace
	Door System	Operator	Replace
		Limit Switches & Solenoids	Overhaul
	Electrical	Battery Set	Overhaul
		LVPS	Overhaul
		Trainline Jumper Receptacles	Overhaul
		Decelostat	Replace
	HVAC	AC Units	Rebuild
		Contactors	Replace
	Interior	Windows	Replace
	Lighting	Light Shades	Overhaul
		Ballast & Sockets	Replace
	Toilet	Regulator	Overhaul
		Retention Tank	Inspect
		Hopper	Overhaul / Replace
		Actuator Valve	Overhaul
		Vacuum Breaker	Replace

Table 5.4 - LCM Overhaul Groups – Guardian Cars

	Truck Suspection	Brake Discs	Replace
		Wheel Axis Assembly	Overhaul
		Anchor Rods & Bushings	Overhaul
		Dampers	Replace
		Air Bags	Replace
		Center Pin	Replace
		Truck Fame	Overhaul
25 years	Door System	Door Guides	Replace
	HVAC	Protective Heater	Evaluate
	Interior	LLEPM Decals	Replace
28 years	HVAC	AC Units	Overhaul
As Needed	Floor		Replace

These activities can be grouped together into several LCM overhaul groups so activities with a similar cycle can be performed at the same time, thus reducing the number of times each vehicle is out of service for LCM activities.

Based on the LCM cycle lengths, the overhaul groups identified in Figure 5.5 would be recommended with refinements made to the overhaul activities and LCM cycle lengths based upon actual operating data. Since the completion of these overhaul activities would take several years to finish on the entire fleet, it is anticipated they would be scheduled so that the midpoint of each program coincides with the ideal vehicle/component age for the selected overhaul activity.

As SCRRA moves the maintenance practices towards a full LCM program, there is an immediate need to overhaul/rebuild certain systems of Guardian cars over the next five years. The items that require attention are noted on Table 5.5.

An overview of the total passenger railcars that might undergo an LCM overhaul each year is shown in Figure 5.5. The work to be completed would need to be matched with the available staff and shop space. The goal is to spread out the work within reasonable timeframes that keep the vehicles in a state of good repair while leveling out the daily and yearly requirements for workforce and shop space. Shown in Figure 5.7, is a sample of the total shop space days (available shop spaces for LCM maintenance x annual days worked by maintenance crews) that might be required to complete the work included in the passenger railcar LCM plan.

Table 5.5 - Guardian Car Overhaul Components

Component	Detial
Door	Door control system improvements and components experiencing a high failure rate.
HVAC	Controller and HVAC units.
Toilet	Toilet module, piping, controller, toilet door and other components experiencing high failure rates.
Battery	Overhaul
Seats & Floor	All vinyl for viral ontrol and improved maintainability.

Figure 5.5 - Sample LCM Plan – Passenger Railcar Overhaul Activities Per Year

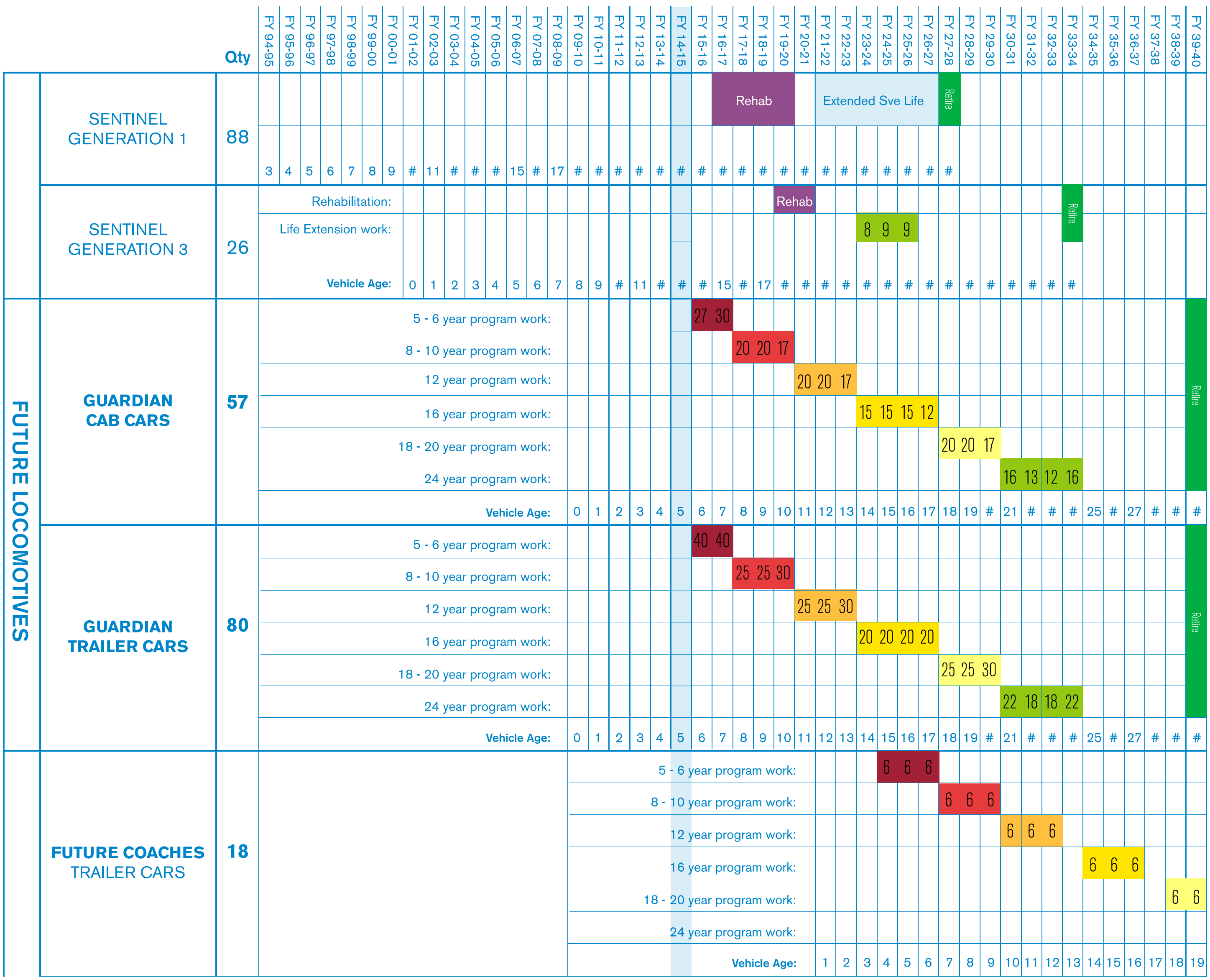


Figure 5.5 - Sample LCM Plan – Passenger Railcar Overhaul Activities Per Year

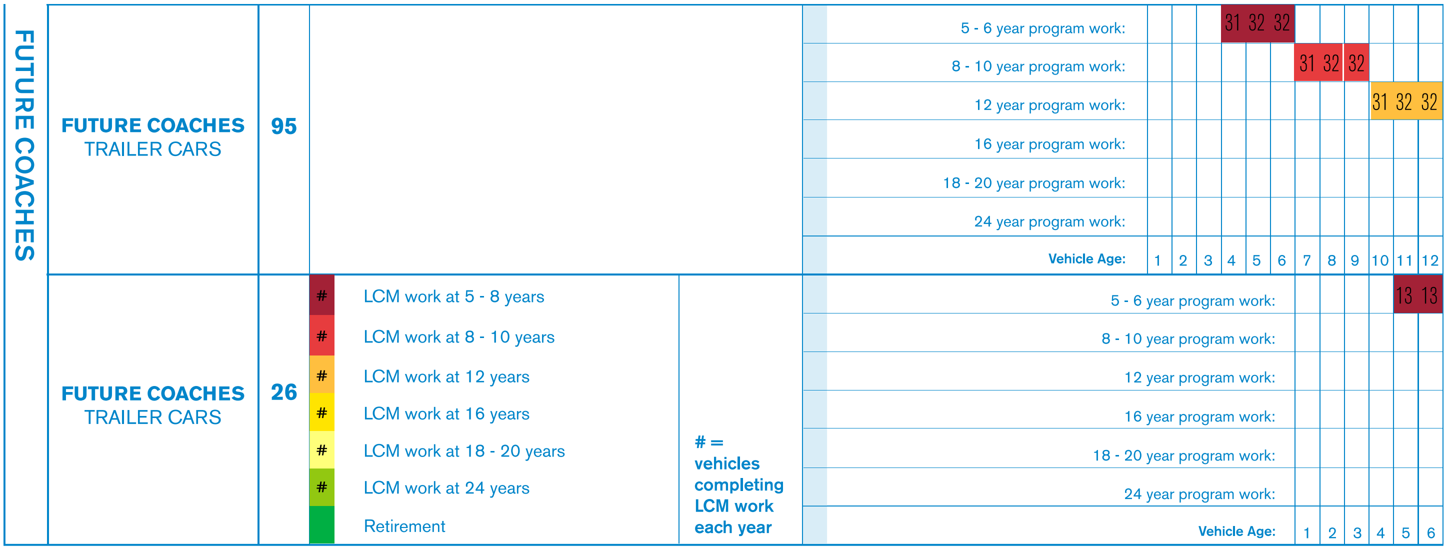


Figure 5.6 - Sample LCM Plan – Passenger Railcar LCM Overhauls per Year

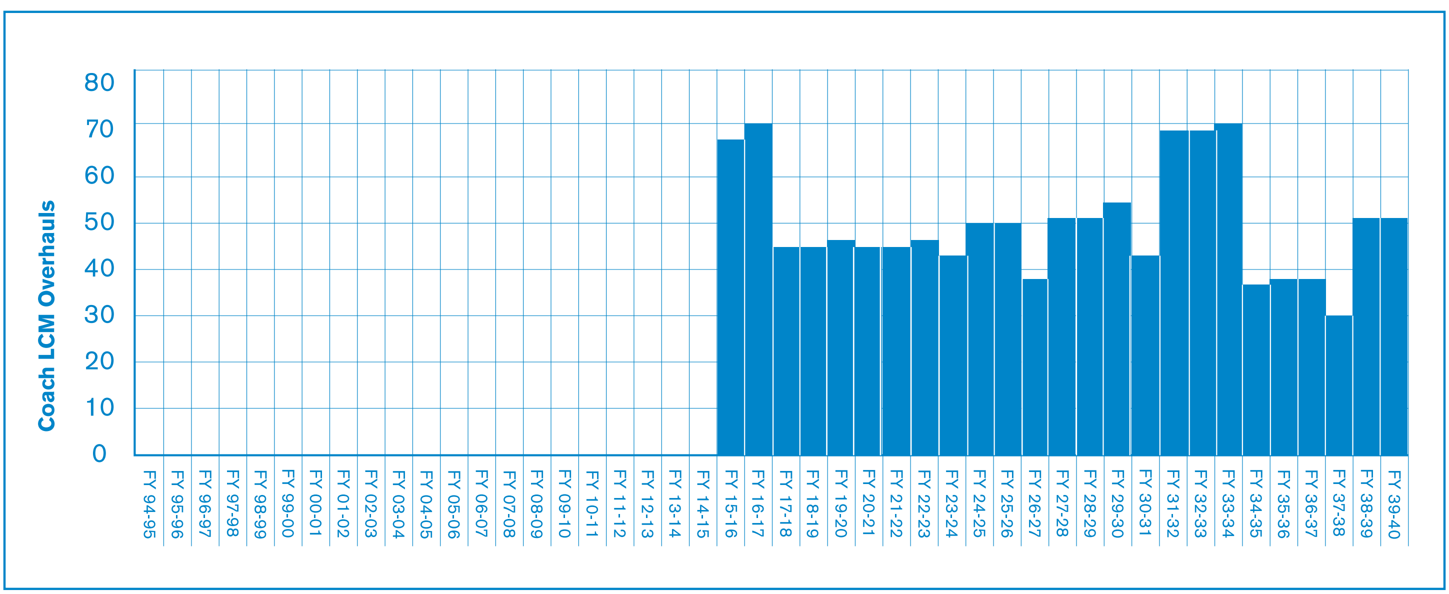
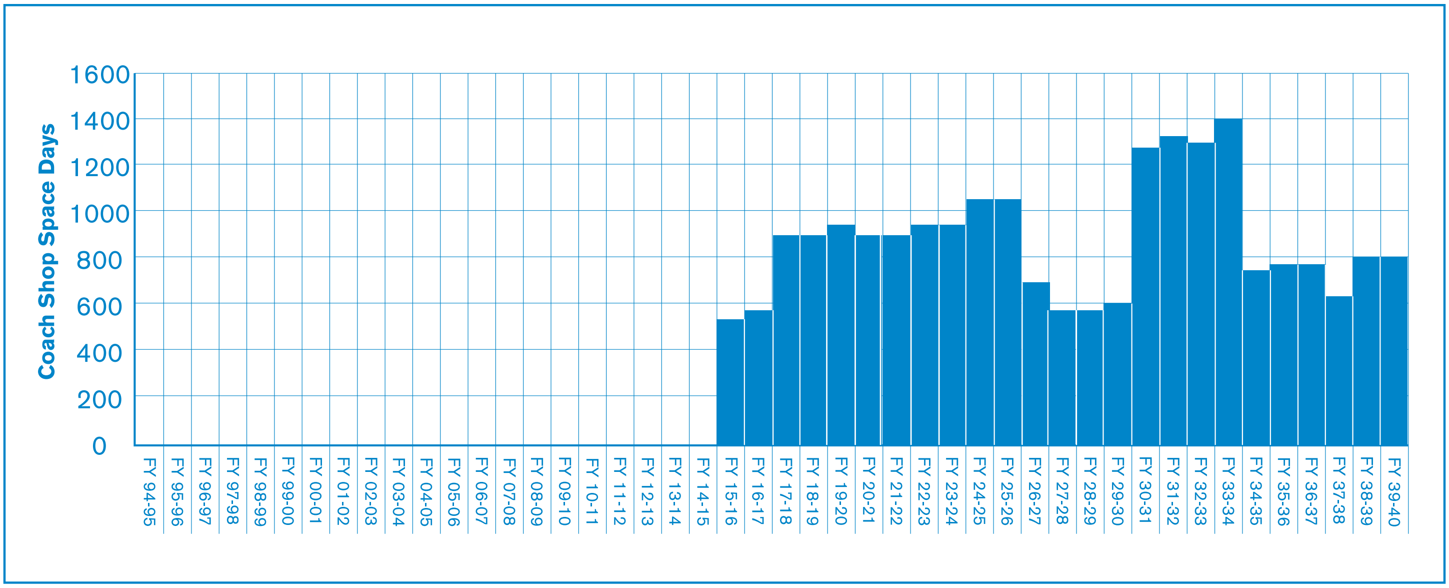


Figure 5.7 - Sample LCM Plan - Annual Shop Space Days Required for Passenger Railcar LCM Overhauls



5.4 Environmental Projects

Metrolink is an environmentally conscious service provider and is always at the fore-front of this area within the transit industry. Metrolink's Climate Action Plan (CAP) is its blueprint to grow the role of regional rail in addressing climate change, air quality, and other sustainability and economic issues by advancing toward zero emissions, making rail a compelling alternative to single-occupant automobiles and advancing equity-focused opportunities for all communities. This commitment is exemplified through the recent procurement of Tier 4 compliant locomotives, which reduce emissions and noise impacts on the local neighborhoods. Metrolink has also undertaken the following environmental programs:

- 2012 Plug-in program for wayside power to reduce emissions and noise while plugged into the shore supply
- Automatic Engine Stop-Start (AESS) to reduce noise and fuel consumption since 2012
- Alternative Fuel Research and Prototyping for several retired F59PH and F59PHI locomotives for alternative fuel research
- Seven of Metrolink's F59 locomotives were fitted with updated EPA Tier 2-compliant diesel engines.

A six-month pilot test demonstration of renewable diesel fuel on one Tier 2 MP36 locomotive is planned to commence in Spring 2021. Should the initial phase of the pilot test prove successful, the testing would be expanded to assess performance on one Tier 4 F-125 locomotive. Providing both phases of the pilot test prove to be successful and the existing fleet could be transitioned to renewable diesel fuel. Metrolink will concurrently develop the next diesel fuel procurement to provide for the potential use of renewable diesel in its locomotives.

6 EXISTING FACILITIES AND FUNDED IMPROVEMENTS

Metrolink operates or rents space at a total of nine service and support facilities, divided into maintenance, layover, and storage facilities as follows:

Maintenance Facilities

- Central Maintenance Facility (CMF)
- Eastern Maintenance Facility (EMF)
- Orange County Maintenance Facility (OCMF) (Planned / Partially Funded)

Layover Facilities

- Montalvo, East Ventura County (EVC)
- Lancaster (LCS)
- Moorpark (MPK)
- Riverside – Downtown (RVS):
  - Riverside – North layover facility
  - Riverside – South layover facility
- South Perris (SPS)
- Stuart Mesa Maintenance Facility, Oceanside (OSD) – operated by NCTD

Storage Facility

- Keller Yard

The locations of these facilities within the Metrolink system is included in Figure 6.1.

Figure 6.1 - Metrolink Facility Map

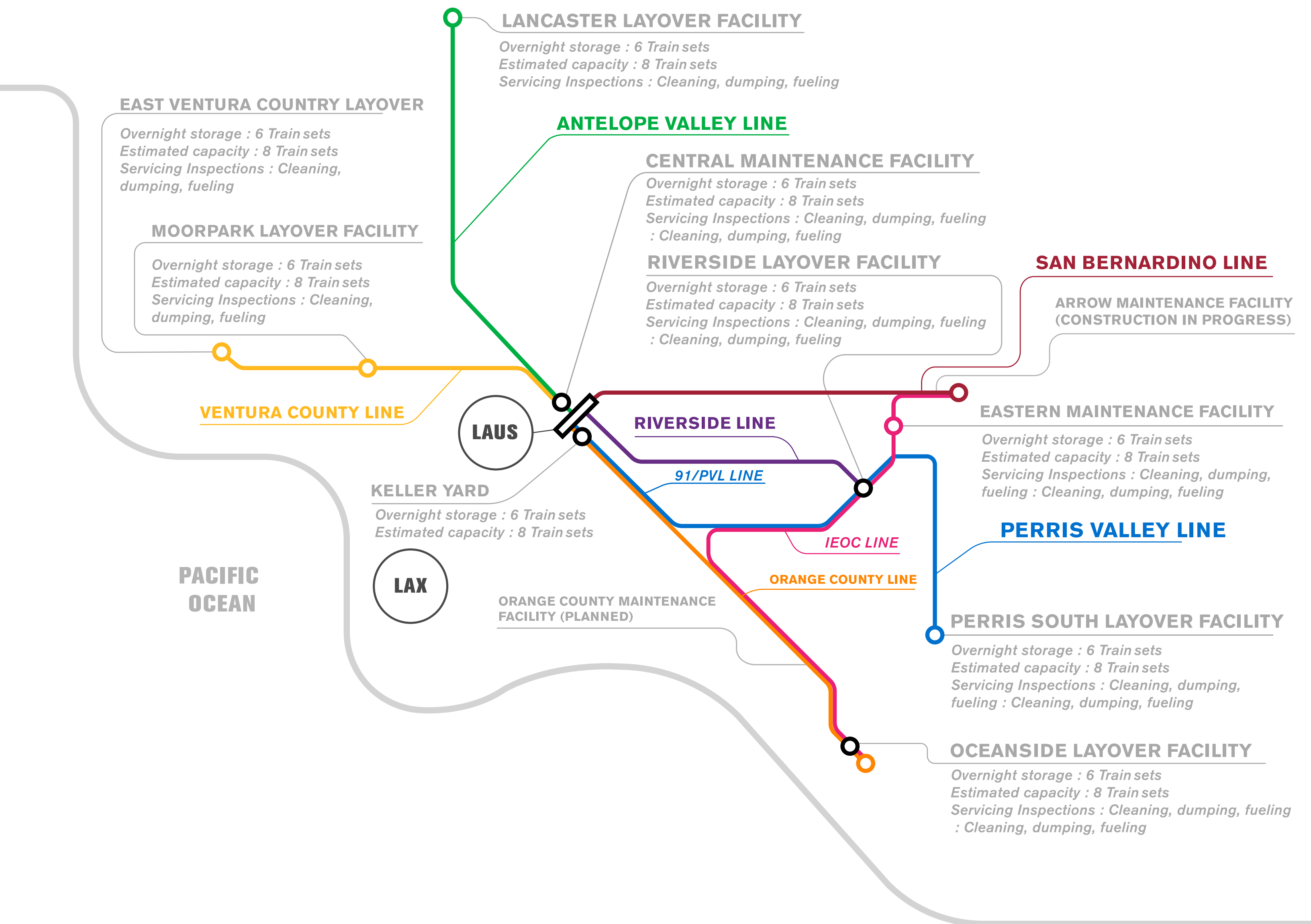


Table 6.1 - Services and support available at Metrolink's facilities

Service and Support Facilities	CMF	EMF	EVC	LCS	MPK	RVS	SPS	OSD	KY
Wheel Truing Machine	X								
Rolling Stock Fixed Jack System	X								
Rolling Stock Portable Jack System	X								
Drop Tables	X								
Overhead Cranes	X								
Oil / Water Separator	X								
Shop Compressed Air Supply	X	X					X		
Yerd Compressed Air Supply	X								X
Shop 480VAC Power Supply	X	X	X	X	X	X	X		

Table 6.1 - Services and support available at Metrolink's facilities

Service and Support Facilities	CMF	EMF	EVC	LCS	MPK	RVS	SPS	OSD	KY
Yard / Wayside 480 VAC Power Supply	X	X	X	X	X	X	X		X
Potable Water Supply System	X	X	X	X		X	X	X	X
Load Test System	X								
Forklift Truck	X	X							
Biocide Truck	X	X							
Mobile Seat Cleaner	X	X							
Car Wash	X	X							
Sanding System	X	X							
Fueling System	X	X							
Fueling from Truck			X	X	X	X	X		

* Limited access to fueling system (Approx. 1 train/day)

Figure 6.2 - Central Maintenance Facility / Taylor Yard

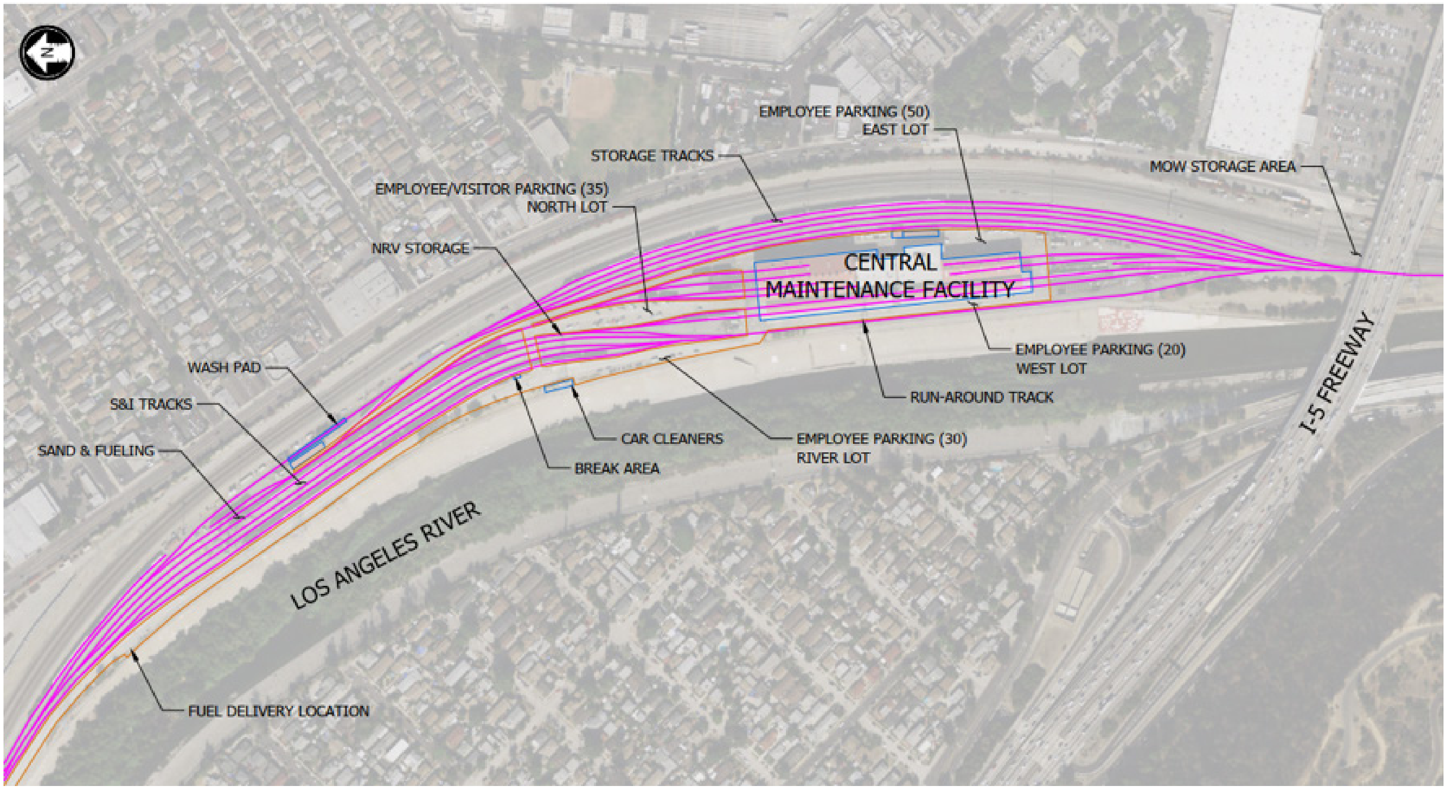
6.1 Central Maintenance Facility

Metrolink's Central Maintenance Facility (CMF) is in Los Angeles north of LAUS on a 29.3-acre site between the Los Angeles River and San Fernando Road, north of the Golden State Freeway (Figure 6.3). It was opened in 1991 on the site of Taylor Yard, a former Southern Pacific Railroad freight yard that had been in service since the 1920s. The CMF is a heavy maintenance facility with a coach shop, locomotive shop, progressive maintenance shop, a Service and Inspection (S&I) facility, and an adjacent train storage yard.

The Metrolink maintenance of equipment is currently operated under contract by a third-party service provider. Over 25 train sets are serviced daily (pre-COVID) at the CMF and the Service & Inspection (S&I) station is equipped with sand, water and sewage dump, and fuel and oil stations. The S&I station also has ground power stations to power train sets.

The CMF is Metrolink's primary location for rolling stock maintenance, fueling, materials management and serves as a crew base. The facility is limited in space, not ideally suited for overnight storage, but requires storage for midday layovers. After the morning peak runs, most Metrolink trains arrive at the CMF for daily service and to be prepared for the afternoon departures. The CMF is equipped to provide the following services:

Figure 6.3 - CMF Aerial View



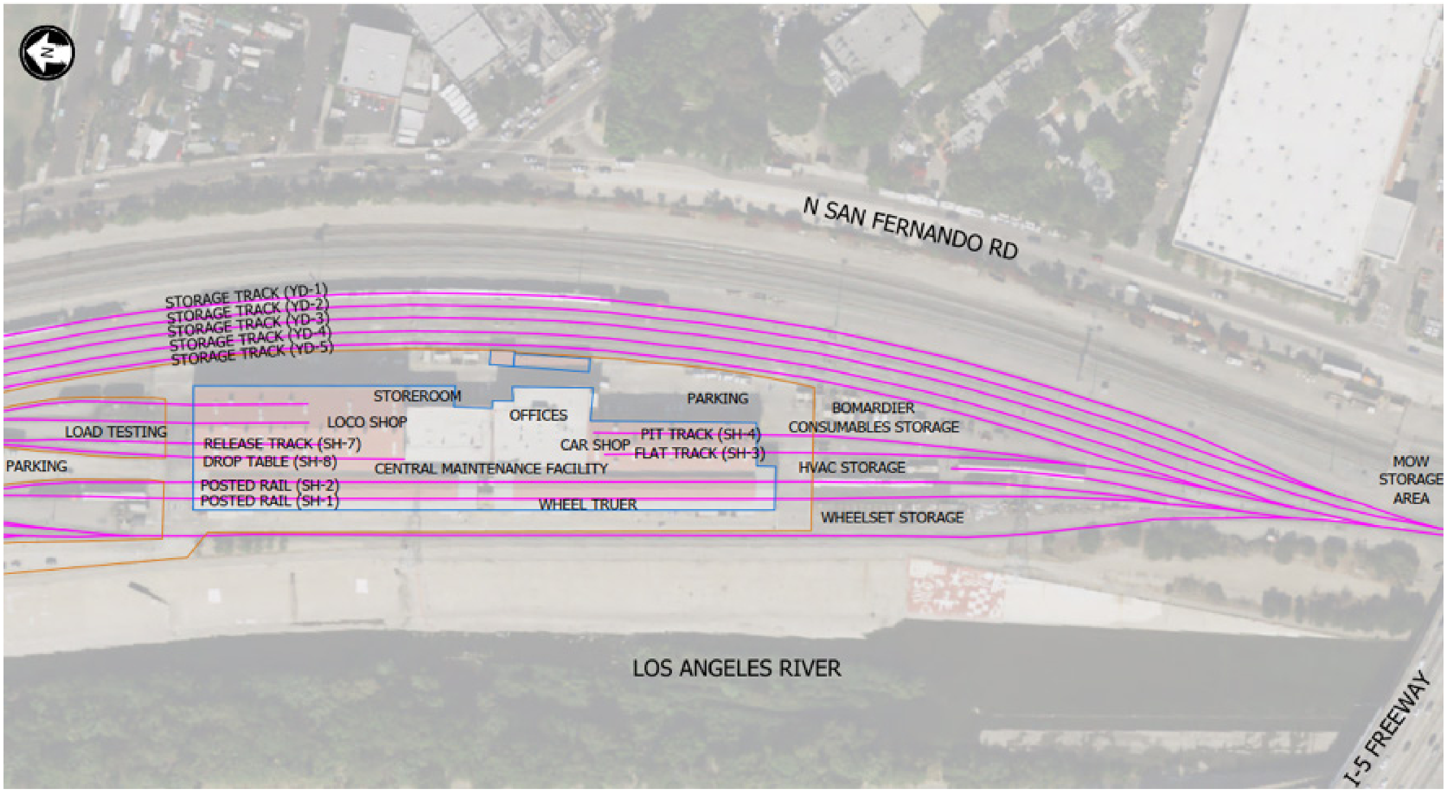
- Replenishment of locomotive fuel and fluids
- Inspection of locomotive
- Inspection of Equipment Exterior
- Inspection of Equipment Interior
- Class I Air Brake Test
- Cleaning of passenger car interior
- Emptying of waste system and replenishing potable water
- Performing repairs
- Equipment run through train wash
- Coach and Cab car 90-day periodic maintenance is performed in-line

The CMF is also the only facility equipped to perform heavy repairs within the Metrolink system. Major maintenance and overhaul/ rebuild work is identified in the Capital Plan where then work is prioritized and performed based on need and availability of funding under separate contracts.

6.1.1 Main Building

The shop facility covers approximately 100,000 square feet and is configured with a locomotive shop on the northern end, a coach shop on the southern end, and space for administration, storeroom and welfare space between them on the eastern side (Figure 6.4). A two-track progressive maintenance/service and inspection facility runs along the length of the west side of the building, and train storage tracks are on the opposite side.

Figure 6.4 - CMF Main Building Aerial View



6.1.1.1 Locomotive Shop

The locomotive shop is at the northern end of the CMF building and can only be accessed from that side (Figure 6.5.) There are three shop tracks designated L1, L2, and L3. Tracks L1 & L2 can each accommodate two locomotives and are fitted with a pedestal rail and inspection pits. Both tracks have running board level platform access to facilitate maintenance. L1 has platforms on both sides while L2 only has a platform on the eastern side. The eastern side of L1 is configured with a roof level platform that enables roof work to be performed in both spots.

Track L3 is located west of L2 and is equipped with a drop table configured to change-out complete trucks or just single traction motor/wheelset/gear case "combos." L3 is separated from L2 by the release track for the drop table. Traction motor "combos" are stored at the southern end of the shop. The shop is fitted with a 25-ton bridge crane spanning the width of the building and a five-ton jib crane that is used for building traction motor/wheelset/gear case combos. The shop is also fitted with a 30-ton bridge crane with a 10-ton jib crane to accommodate Tier 4 engine skids that are part of the F125 locomotive fleet.

Figure 6.5 - CMF Locomotive Shop - Tracks L1, L2, and L3

The fall protection system at the locomotive shop allows for little mechanic mobility and does not allow for two mechanics on the roof at the same time. This system would be upgraded as part of the CMF Modernization projects.

6.1.1.2 Coach Shop

The coach shop (Figure 6.6) is on the opposite side of the locomotive shop within the main building and includes tracks C1 and C2. These tracks can be accessed from the southern end only. Each track can accommodate two railcars. C1 is equipped with jacking stations for two railcars. The jacks currently in use are portable jacks placed on reinforced sections of concrete slab floor. One car spot on C2 is fitted with a scaffold-like structure (also called "window racks") on both sides at two levels to facilitate rail car roof access and replacement of broken car windows, see Figure 6.7. This structure was not engineered for its current use and therefore should be replaced to comply with safety regulations. This replacement has been included as part of the scope of the CMF Modernization projects.

There is inspection pit access on C1 but not on C2 and there is no drop-table. Both tracks are spanned by a traveling 10-ton capacity bridge crane used primarily for the replacement of roof-top mounted HVAC units.

Figure 6.6 - Coach Shop Structure

Figure 6.7 - Roof Access

6.1.1.3 Progressive Facility

The Progressive Facility runs the length of the CMF building, alongside the west side of the locomotive and coach shops. The two progressive maintenance tracks, designated as P1 and P2, are used primarily for interior cleaning and periodic inspection and minor repair. The west side exterior wall of the Progressive track, adjacent to P2, is equipped with movable louvers that swing open to facilitate good ventilation throughout the progressive tracks. Each track can accommodate 10 cars. Tracks P1 and P2 are outfitted with pedestal rail and inspection pits for their full length to enable unobstructed access to railcar undercarriages (Figure 6.8.) P2 is equipped with a Simmons-Stanray milling-type wheel truing machine near the east end of the shop. The machine is used as needed for all railcar and locomotive wheel truing. The machine was recently overhauled and is currently operating sufficiently, but its location blocks movements onto the progressive maintenance track and prevents use of the progressive track for consist maintenance activities. A bridge crane is not provided on the progressive tracks for vehicle maintenance; only a jib crane which is reserved for wheel truer maintenance. The CMF Modernization-EMF Buildout Study is proposing the addition of a 3-ton bridge crane, split rails, roof access platforms, and fall protection. This would allow for enhanced abilities to perform consist maintenance.

Figure 6.8 - Progressive Maintenance Tracks at CMF

6.1.2 Yard Tracks

Yard tracks at the CMF include four distinct areas: S&I tracks, storage tracks, load testing, and the train wash.

6.1.2.1 Service and Inspection Tracks

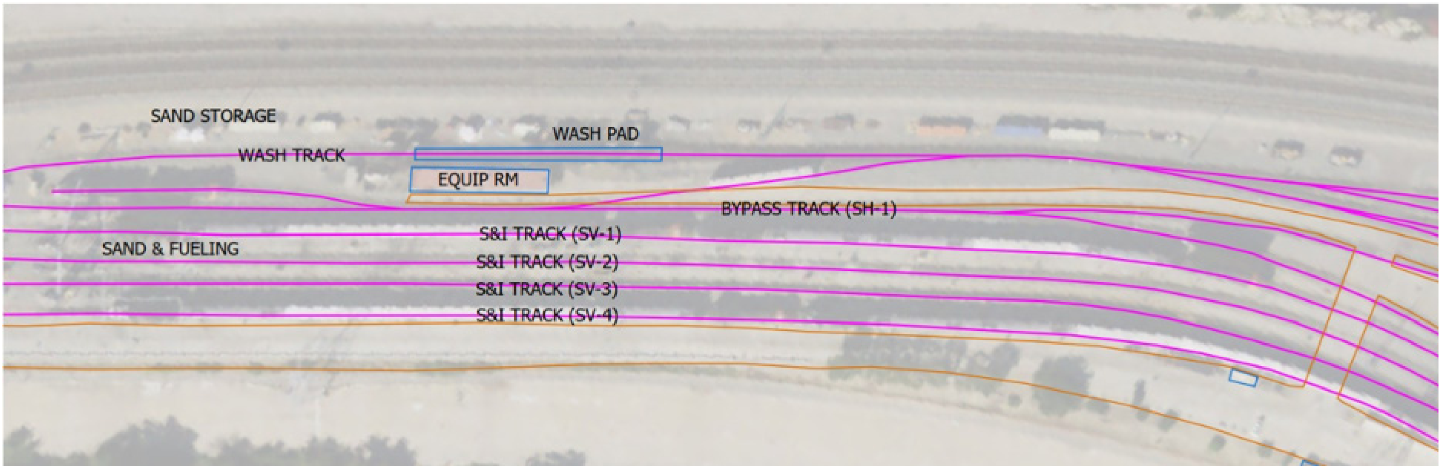
There are four (4) locomotive servicing spots located north of the main CMF building (see Figure 6.9.) The S&I tracks include required safety system testing and inspections along with facilities for fueling, sanding, lubrication, dumping, watering, cleaning, minor repairs and troubleshooting. Troubleshooting may include load testing. These tracks have the following characteristics:

- Accommodates two four-car trainsets on each track, but only the forward position on each track can fuel, sand and lubricate.
- Two tracks have full length pits to cover a four-car trainset, and two tracks have pits for the length of a single locomotive only.
- Service and inspections completed on 25 trainsets daily (based on pre-COVID-19 service):
    - 23 trainsets during the day
    - Two trainsets at night

The CMF infrastructure includes eight Underground Storage Tanks (UST), which are double-walled, are capable of storing 30,000 gallons of diesel fuel in each tank. CMF receives fuel Tuesday through Saturday in double-bottom trucks carrying 7,600 gallons each.

Approximately three-fourths of Metrolink trains receive daily fueling at CMF, in midday between the morning and evening commuter peaks. Trains typically enter from the south end of the property and queue up on the track that runs between the shop and the river, known as the “River Track.” From here they advance forward onto one of the four S&I tracks where they receive their daily service.

Figure 6.9 - CMF S&I Tracks Aerial View



6.1.2.2 Train Wash

The automatic train wash is located east of the S&I tracks and shown in Figure 6.11. Consists are typically cycled through the wash every other day, dependent on their outlying origin/destination points. They are washed after they receive service on the S&I tracks, before moving to the storage tracks. The wash was installed in 1992 and refurbished in 2011. The results of a condition assessment conducted in June 2020 indicate several components of the train wash equipment are in poor condition and require replacement.

Figure 6.10 - CMF Locomotive fueling/sanding area

Figure 6.11 - Train Wash at CMF

6.1.2.3 Storage Tracks

The five storage tracks are located east of the main CMF building (see Figure 6.12) and are used to store trainsets after service and inspection activities. Each track can accommodate three typical Metrolink consists ranging from four to six cars and a locomotive. Some trains run through the S&I tracks to receive fuel, sand and lubrication only, then finish their daily servicing of dumping, watering, and cleaning in the storage yard. Two trainsets are stored at the CMF yard overnight for service commencing the next morning.

6.1.2.4 Load Testing

Periodic locomotive and head end power (HEP) engine load testing is conducted on the load testing tracks, located north of the main CMF building. Locomotive load testing takes 10 to 20 minutes. The ability to change out coach rotors on the PM tracks would help prevent the breaking of trainsets to re-shop coaches. A changeout device would need to be fabricated to assist in the removal of brake rotors from vehicles in consists while in the PM shop.

Figure 6.12 - Storage Tracks Aerial View

6.1.2.5 Staff and Contractor Parking

Staff and Contractor parking is decentralized on site and at times not sufficient to accommodate all employees. Table 6.2 approximates the number of parking spots currently onsite per location. Many parking spots are not available for staff use due to exterior storage of parts, placement of contractor trailers and circulation required by trucks making deliveries.

Table 6.2 - Parking Capacity at CMF

Parking Lot Location	Current Use	Parking Spaces
East Lot	Metrolink Employees	50
North Lot	Contractor Crews	35
West Log	Contractor Crews	20
River Lot	Amtrak	30

6.1.2.6 Maintenance Material Storage Areas

Maintenance parts and materials are stored in various locations throughout the CMF site. Inventory control is not efficient as parts and materials are scattered all over the CMF property, both in the shops and out in the yard, due to the scarcity of storage space. Consequently, parts inventory and location are difficult to control. Additionally, no loading dock is present on-site making part deliveries challenging. The original loading dock was repurposed as storage space.

6.1.3 Community Concerns

Due to its proximity to residential neighborhoods and private businesses, surrounding communities have expressed concerns with noise, vibration and air quality impacts coming from the CMF. Metrolink has made various operational enhancements and modifications to reduce negative impacts on the surrounding community, including the reduction of noise and emissions. Metrolink will continue the commitment to be a good neighbor as it strives to create value and exceed expectations by building and maintaining positive relationships with all the communities where we operate. Community outreach will be integral to any analysis that is conducted because of the initiatives identified in the RFMP and will be incorporated as part of the ongoing work related to the CMF Modernization and EMF Build-Out Study.

Metrolink developed and implemented a fuel conservation program in 2010 that remains in effect and is audited and refined as service levels change. The program requires equipment not in the process of servicing, testing or operating be shut off to reduce the consumption of fuel, thereby eliminating unnecessary locomotive idling. Equipment is re-started 45 minutes to one hour prior to departure for service. This allows the HVAC system to either cool or warm the passenger cars to a comfortable ambient temperature prior to loading passengers at Los Angeles Union Station. In addition to the CMF, the fuel conservation program is also applicable at the following locations: EMF, SPS, RVS, LCS, EVC, and MPK.

Additionally, noise is controlled whereby heavy noise (full operation or possible locomotive testing) is to only occur between the hours of 10 AM to 4 PM Monday through Friday, and 10 AM to 1 PM on Saturday and Sunday. Sand delivery is only to occur on Saturdays between 10 AM to 2 PM. The yard is to be noise free from 12 AM to 3 AM every day; and, additionally from 4 PM to 8 PM and from 11 PM to 12 AM on Saturdays and Sundays.

In May 2019 the CMF Action Plan was adopted as part of the Metrolink "Good Neighbor Program". The Action Plan outlines 11 tasks that are divided into three timeframes: short-term (0-6 months), mid-term (6-18 months) and long-term (18+months), as shown in Table 6.3.

The CMF has been in service since 1992 and is overdue to be modernized to keep up with changes in technology, meet State of Good Repair requirements, improve operational efficiencies, address community concerns, and prepare for future ridership growth and increase of service frequency.

A condition assessment following the Federal Transit Administration (FTA) Transit Asset Management (TAM) regulations was conducted in June 2020. The results of this assessment indicated that some components or equipment within the CMF are in marginal condition (rating= 2 – defective or deteriorated component in need of replacement; exceeded useful life) or in poor condition (rating= 1 – critically damaged component or in need of immediate repair; well past useful life). The equipment and components include:

Table 6.3 - CMF Good Neighbor Program Action Plan

Short-term (0-6 months)	Mid-term (6-18 months)	Long-term (18+ months)
1. Optimize Use of Ground Power Stations 2. Installation of Sound Monitors 3. Internal Audit 4. Independent New Noise Study 5. Expedite 8 Tier 4 Locomotives into Service 6. Change the accoountability Metrics of the Equipment Maintenance Contractor	7. Fleet Moodernization Study 8. CMF Modernization Study 9. Complete Deployment of 40 Tier 4 Locomotives	10. Work Towards a Zero Emissions Future 11. new Contracting Approach System-Wide Goes in Effort with Accountability Metrics

Table 6.4 - CMF equipment and components with marginal or poor condition

Equipment / Components	Condition	Rating	Estimated Cost to Replace
Inspection pits lighting system	Marginal	2	$500,000
Car wash system (several components)	Poor	1	$800,000
Uderground airlines along tracks	Poor	1	$120,000
Switch panel #3 for S&I tracks	Marginal	2	$80,000
Low mast lights	Marginal	2	$100,000
PA System (Yard and Shop)	Poor	1	$180,000
Fire Alarm System	Poor	1	$260,000
Sewer line	Marginal	2	$205,000
Shop restrooms	Marginal	2	$70,000
Shop exhaust fans	Poor	1	$275,000
Mechanical room cinder block walls	Marginal	2	$275,000
Switchgear for building discoonect	Marginal	2	$140,000
Carshop switchgear	Marginal	2	$170,000

Metrolink has identified and prioritized additional studies and designs to correct many of these problems. The design and construction of this work is based on funding availability. In addition, some outside initiatives by Member Agencies, Federal, State, and other agencies may affect the CMF in the future and require additional modifications due to the zero emissions transition of the fleet. These major elements are discussed in the following subsections.

6.1.3.1 Parts Storage and Other Support Spaces (future funding)

Metrolink's storeroom capacity at CMF is undersized to properly service all the needs of the vehicle fleets. The increasing maintenance demands of Metrolink's existing fleets have put significant pressure on CMF's secure storage space.

A recent study was performed to identify improvements to be made for parts storage, to consolidate space, provide dock access, raise the roof for more vertical storage, and install modern inventory control systems such as vertical lift modules (VLM) and pallet retrieval systems. In addition, maintenance locker rooms may be moved from the 2nd floor to the 1st.

Additionally, Metrolink is engaged in preliminary discussions with the City of Los Angeles regarding the acquisition of a parcel at the entrance to the CMF for a future warehouse location to provide much-needed storage for rolling stock parts.

6.1.3.2 Shop Capacity (Future Funding)

With the new Tier-4 Locomotives now in service, the locomotive platforms are not long enough, nor do they allow the proper alignment of maintenance pits. In order to allow a six-car consist to be correctly indexed on the PM Tracks without duck-under interference, it is necessary to relocate the locomotive service positions, install posted-rail, pits, platforms, lubrication reels and waste fluid collection ports. The locomotive maintenance platforms will need to be pushed south approximately 35 feet and they will be extended to span 70 feet. This move will allow the full locomotive to be serviced, while the passenger cars are properly aligned over the pits.

6.1.3.3 Shop Equipment

Equipment in the CMF shops has been in continuous use since 1992 and nearing s the end of its useful life. In addition to rehabilitation and eventual replacement of equipment such as the drop table, overhead cranes, train wash, jacks and lifts, Metrolink is considering improving shop capacity by replacing and relocating the wheel true machine to a standalone facility, which would significantly improve the operational efficiency and allow trainsets to be easily indexed over the machine.

6.1.3.4 Replace Train Wash and Relocate

The train washer is nearing the end of its useful life. A new vehicle wash system is required to effectively clean all Metrolink vehicles, which will provide the opportunity to introduce a system with a working recycle system that will improve site sustainability goals. In connection with the north end connection project, the wash will be replaced and relocated. A new train wash system will be provided with a working recycle system that will improve site sustainability goals.

6.1.3.5 CMF Yard Improvements (Future Funding)

To allow more trainsets to be powered for service and inspection activities, additional wayside power stations can be installed to support night layover trains and relocate some existing stations to position them at the south end of each trainset. Installing additional wayside power will minimize the amount of noise from the locomotives since they will not need to be running idle for the whole process (45-60 minutes). This will help reduce community concerns, while also allowing greater flexibility during service and inspections.

The construction of a second S&I service position behind the existing S&I would increase the locomotive servicing positions at the CMF from four to eight. Crews will no longer need to wait for a trainset to be moved before they begin locomotive servicing, which will significantly improve operational efficiency.

In the future, Metrolink plans to install an automated electronic wheel measurement station on the River Track. This equipment will provide a timelier daily measurement of wheel profiles and brake shoe wear for rail vehicles that operate over the apparatus. This information will allow Metrolink to improve the forecasting of wheel maintenance and replacements.

6.1.3.6 Noise Reduction

Current studies, design, and construction work are being completed to reduce yard noise including:

- Optimize ground electrification (currently being completed)
- Enclose load testing of Locomotives (future funding)
- Improve train movement: Extend north yard tracks and add additional fueling and sanding stations at S&I tracks. (future funding)
- Construct sound barrier on River Track
- Construct sound barriers at Existing S&I

- Landscaping to help screen yard noise (future project)
- Future modification of north yard connection

The current studies are looking at the ability to install additional wayside power stations to support night layover trains and relocate some existing stations to position them at the south end of each trainset. Installing additional wayside power will allow the trainsets to be powered for service and inspection activities. This will minimize the amount of noise from the locomotives since they will not need to run idle for the complete process (45-60 minutes). This will also help reduce community concerns, while also allowing greater flexibility during service and inspection.

Metro conducted a Noise and Vibration Study to evaluate the existing noise and vibration levels at and surrounding the CMF. Several noise monitoring locations were established based on their proximity to common activities that create noise and vibration and community feedback. Noises were recorded 24 hours a day, over a 10-day duration. The study team assessed the noise readings at or above 75 decibels and determined the corresponding sources of noise. Vibration measurements were simultaneously conducted on the ground floor and on the top floor of a multi-story residence to determine if there was any amplification.

- CMF Site 1, Neighborhood Site B (Shoredale Av) – Noise levels at Site B did increase as the activities of the CMF increased. During the 10-day measurement period, noise levels at Site B, during CMF operations, were between 55 and 65 dBA. Noise sources other than the CMF operations were the cause of higher noise levels: firecrackers, motorcycles, flyovers, and maintenance work on the river trail.
- CMF Site 2, Neighborhood Site J (River Edge Road) – Noise levels at Site J are mostly due to freight and Metrolink trains on the through tracks. Noise levels at Site J did not increase as the activities at the CMF increased. During the 10-day measurement period, noise levels at Site J, during CMF operations, were between 65 and 75 dBA.
- CMF Site 3, Neighborhood Site D (Duvall Street) – Noise levels at Site D increased as the activities at the CMF increased. During the 10-day measurement period, noise levels at Site D, during CMF operations, were between 55 and 65 dBA. Noise sources other than CMF operations were firecrackers, motorcycles, aircraft flyovers, and maintenance work on the river trail.
- CMF Site 5, Neighborhood Site F (San Fernando Road) – Traffic Noise from San Fernando Road dominated the noise levels at Site F. Noise levels at Site F did not increase as the activities on the CMF site increased. During the 10-day measurement period, noise levels at Site F from the CMF operations were between 75 and 85dBA.

The sites were monitored for noise and vibration to create a baseline of impacts coming from the facility and provide potential mitigating solutions. Operations at the CMF during the 10-day measurement period included trains arriving and departing as well as fueling and inspection of trains. The highest noise measurements associated with a train horn at a level of 89.8 at Site 1 and 89 dBA at Site 2 (11-02-2020 at 12:00 AM). No other sites recorded a spike in noise levels at that time. The highest noise measurements associated with locomotive load tests were recorded at Site 5 at a level of 95 dBa from two occasions (10-29-2020 between 1 and 5 P.M. and 11-05-2020 between 10 A.M. and 4:30 P.M.). No other site had a spike in noise levels at these times.

If in the future, SCRRA does implement zero emissions technology, then trains would run more quietly and thus help with noise reduction.

6.1.3.7 Improve Drainage

Storm and sanitary drainage improvements are being made and have little to no impact on existing conditions (under construction).

6.1.3.8 Improve Progressive Maintenance Bays (unfunded)

The improvement of the progressive maintenance bays would include:

- Crane: Provide an overhead crane on progressive maintenance tracks.
- Trainset Roof Access: Improve locomotive, coach, and trainset roof access with fixed access platforms.
- Realign progressive maintenance track and provide truck access to wheel truing.

6.1.3.9 General Building Maintenance (partially funded)

Facility repairs for state of good repair projects are ongoing in an attempt to be proactive in facility maintenance

6.1.3.10 North End Connection and Tail Track (Unfunded)

This project replaces an old back entrance to the north end of the CMF yard by way of tail tracks located on previously owned UPRR property adjacent to the Los Angeles River. The tail tracks are being removed by the City of Los Angeles for a future park planned on the former Southern Pacific Taylor Yard Property. The new north entrance is in design by Metrolink and will reconfigure the yard to allow eastbound trains to enter the yard and westbound trains to leave the yard without reverse movements. The existing tail track will be relocated along a 20-foot easement on the City's G2 parcel, adjacent to the Valley Subdivision. The CMF North End Connection and Tail Track project is currently 90 percent designed and when completed it will help solve some of the train access and circulation issues within the yard during servicing and washing.

6.1.3.11 Staff Parking (Future Funding)

Plans to relocate staff parking west of San Fernando Road have been considered to improve site circulation and safety. Construction of a pedestrian bridge from the new parking lot across the mainline to the 2nd floor of the Main Shop would be necessary to allow access to employees and visitors from the nearby Los Angeles County Metropolitan Transportation (Metro) station. The addition of this parking lot will alleviate the already constrained parking on site and replace the spots that were lost during project EX-10 (Construct North Circulation Road).

6.1.3.12 Taylor Yard Project

The City of Los Angeles purchased Parcel G2 in March 2017, the remaining approximately 200 acres of the historic railroad yard, in which a portion was developed as the Metrolink CMF. This large undeveloped parcel on the Los Angeles River provides a strategic location to expand and redevelop Rio de Los Angeles State Park (see Figure 6.13). This project will not directly impact operations at the CMF but has community support that may conversely inflame community opposition to the operations and perceived negative impacts from the CMF.

A small piece of property adjacent to the north end of the yard and south of Kerr Road between the Metrolink main line tracks and the Los Angeles River might be available for acquisition or leasing for additional storage and/or shared parking. This could be done in concert with a community arts and improvement program incorporating local artists' work on newly designed and built structures.

Figure 6.13 - Taylor Yard Project Development

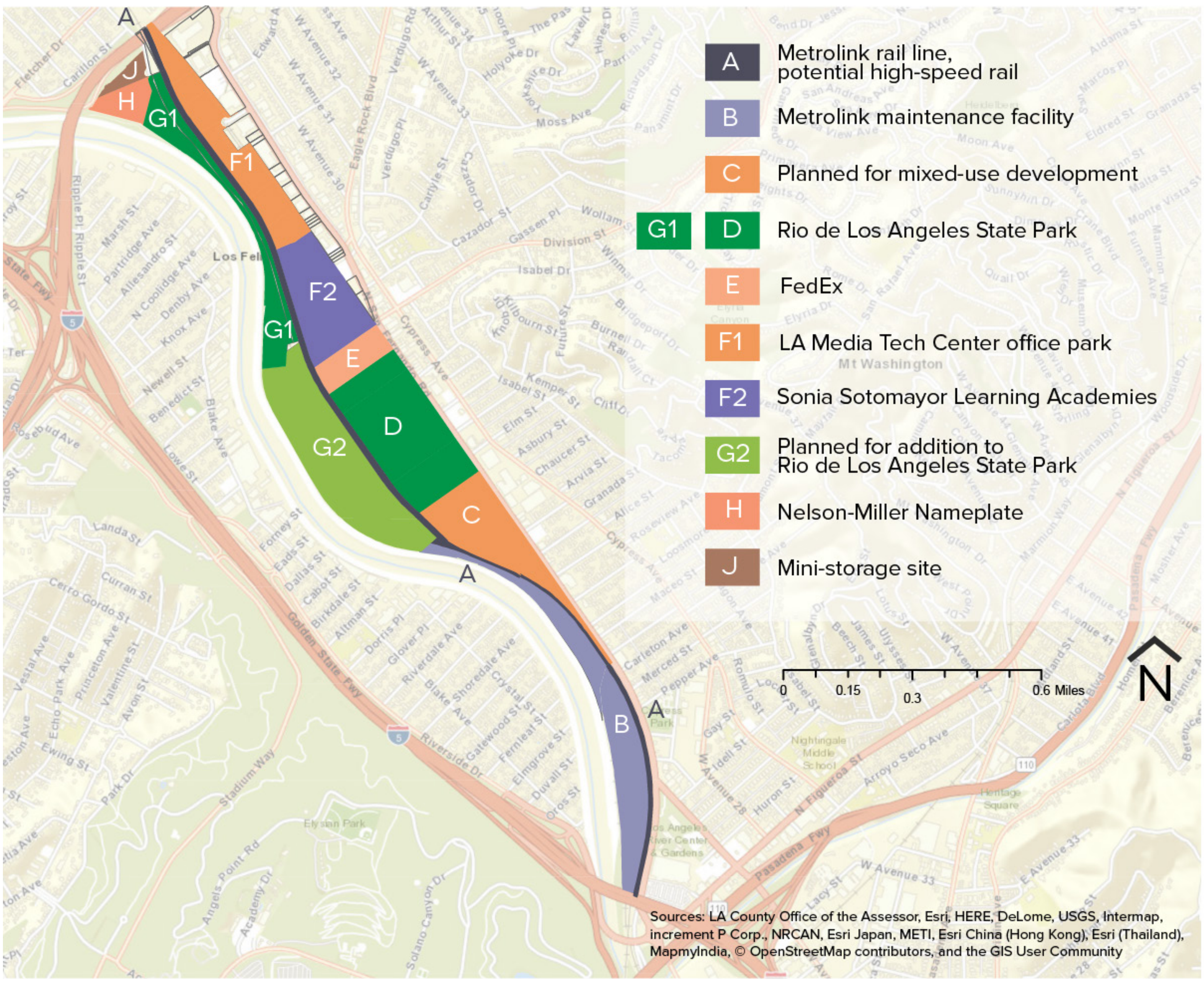


Figure 6.14 - Eastern Maintenance Facility

6.2 Eastern Maintenance Facility

The Eastern Maintenance Facility (EMF) is in Colton, CA, southwest of San Bernardino. The EMF relocated train storage and servicing from the San Bernardino Santa Fe Depot station area, allowing improved efficiencies at CMF. The EMF is a maintenance facility with a train wash system, S&I yard, and an adjacent train storage yard. The facility transportation building is configured with space for administration, training, and offices. Train sets are serviced daily at the EMF, the S&I station is equipped with sand stations, water and sewage dump, and fuel and oil stations.

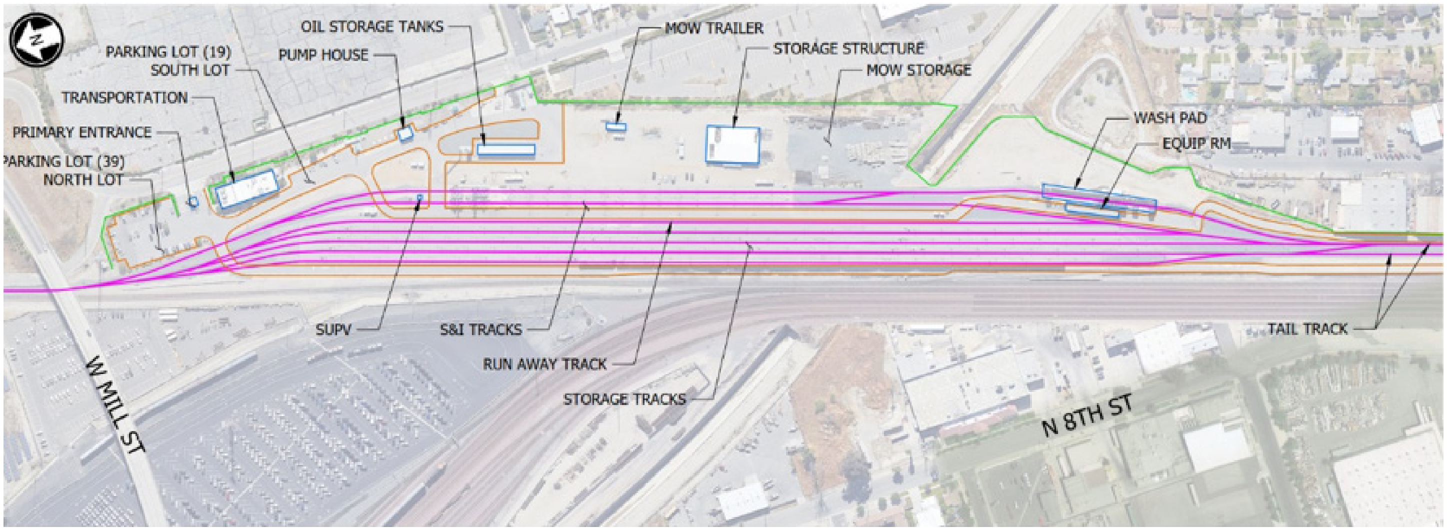
The facility has five storage tracks of an average length of 1,800 feet. Twelve trains are currently stored there overnight, but capacity exists for the storage of approximately 15 trains, if needed. There are currently two S&I tracks, however, the sand and fueling locations were built to accommodate two additional S&I tracks in the future.

The EMF functions include:

- Nightly Service & Inspection
- Light Locomotive Repair
- Light Car Repair
- Train Wash
- Overnight Storage
- Transportation
- MOW (signal and track)

The EMF construction was split into three phases, but only two phases (Phase 1 and Phase 3) have been built to date. The current configuration of the EMF is shown in the track chart overview, see Figure 6.16.

Figure 6.15 - EMF Overview



Phase 1: Phase 1 was designed to allow for improved servicing, cleaning, fueling, and sanding of trains operating on the San Bernardino and IEOC lines. Phase 1 includes the current EMF configuration of four (4) storage tracks with full aisle access on both sides of each track to accommodate inspection and complete servicing of all consists. Each of the storage tracks is equipped with wayside 480vAC power and ground air supply to enable consists to be fully prepared for service even before locomotives are coupled. A runaround track enables continuous access from one end of the yard to the other, allowing moves needed to perform maintenance, and build train consists. There are two (2) S&I tracks that are open air tracks currently but will be covered as part of Phase 2 construction in the future. Phase 1 allowed equipment stored overnight at EMF to receive complete daily servicing overnight instead of at CMF, relieving congestion pressure at CMF. Phase 1 also included the installation of a train wash that is similarly configured to the wash currently in use at CMF. Phase 1 has been completed.

Phase 2: Future construction referred to as “Phase 2” includes building two (2) additional S&I tracks as well as locomotive and car shops equipped with a drop table, overhead cranes, and a wheel truing machine. Future changes in Metrolink’s maintenance requirements may result in shifting other maintenance roles to this facility. Phase 2 construction is currently not funded. Metrolink is currently in the process of updating designs for the Phase 2 shop.

The EMF Modernization study has also recommended the construction of a new Overhaul Shop to be constructed in a separate building from the heavy maintenance shop. This building would be composed of three vehicle positions, two for body/overhaul work and one position for a paint booth.

Phase 3: Phase 3 of the EMF construction includes additional expansion of train storage capacity. Phase 3 has been completed.

Metrolink has recently completed the CMF Modernization and EMF Build-Out Study. This study addresses functionality and efficiency needs for the facility, as well as the CMF community concerns related to noise and emissions from maintenance and operational activities, identifies improvements to the facility to enhance operational efficiency and maintain a State of Good Repair (SOGR), and prepare for future fleet needs that are being identified as part of the Fleet Modernization Plan. Additionally, the study also reviews the EMF Phase 2 original plans which includes construction of a new maintenance and overhaul shop, as well as layover facilities upgrades and modifications to ensure that current and future needs can be met.

A conditions assessment was conducted on the CMF, EMF, and layover facilities. Based on this information, a needs assessment was generated, which was the basis to determine alternatives for improvement and make recommendations for change. Three different project packages were presented:

1. The first one presents a list of primary projects that have high priority for Metrolink in the current operating environment.
2. The second package of projects contains projects with a medium priority, which is added to the primary package.
3. The third package presents the maximum level of investment in an unconstrained package of projects that contains all the projects identified in the study and assumes an unconstrained budget to perform improvements.

Cost estimates and timeframes for completion were also developed, and a final list of recommendations is presented to move forward with projects based on funding possibilities and consideration of environmental needs.

This facility modernization study also takes in consideration other projects that are on-going by Metrolink or its member agencies on the Metrolink system and that will impact the utilization of the maintenance facilities. Some of these projects include among others: SCORE Program, Link US, OCMF, CMF Noise and Vibration Study, Taylor Yard Project, LOSSAN Corridor Optimization Study, Antelope Valley Line Upgrades, and the Riverside Layover Expansion Project. Recommended projects for the CMF in order of priority are shown in the following tables.

Table 10.5 includes the list of High priority projects, Table 10.6 includes a list of Medium priority projects, Table 10.7 includes a list of low priority projects, and Table 10.8 includes a list of Alternative Fueling projects. A rough order of magnitude cost estimate and an assessment of the benefits are also provided for each project. The following categories of benefits were considered in the development of the priority lists:

- Addresses Community Concerns
- Improves level of State of Good Repair
- Improves Operational Efficiency
- Improves safety for employee work environment
- Identifies Sustainability Opportunity with process, material, or reduction of community impacts

For a detailed description of these projects and funding considerations, please refer to the Facility Modernization Study.

Table 10.5 - List of CMF High Priority Project Recommendations

CMF High Priority Project Description	ROM Estimate
Construct Sound Wall on River Track	$225,000
Replace Existing Vehicle Wash in Current Location	$800,000
Install / Relocate Wayside Poswer in Yard	$100,000
Construct North Circulation Road	$50,000
North End Connection	$5,883.972
Construct Sound Walls at Existing S&I with shade treatment	$425,000
Construct Temporary Sound Barrier at Existing S&I (includes design)	$149,000
Upgrade S&I Emer. Power & Switchgear System	$275,000
Reconstruct PM Locomotive Service Positions	$600,000
Install 3T Bridge Crane & Rooftop Platforms on PM Tracks	$5,200,000
Install Split Rail System on PM Tracks	$900,000
Acquire Rotor Changeoout Device for PM Tracks	$120,000
Install Continuous Fall Protection System on SH-5	$50,000
Construct Load Cell Blog Outside SH-5 / SH-6 & Extend Pits	$4,200,000
Mechanic Tablets	$50,000
Reconstruct SH-3 Vehicle Access Scaffolding	$150,000
Reconstruct Warehouse	$13,500,000
Construct Depressed Looading Dock	$150.972
Upgrade Automatic Shop Exhaust System	$50,000
Upgrade Fire Alarm	$260,000
Wi-Fi Access Around Entire Yard	$15,000
Occupancy Sensors for CMF Lighting	$15,000
HIGH PRIORITY PROJECTS SUBTOTAL	**$32,908,052**

Table 10.6 - List of CMF Medium Priority Project Recommendations

CMF Medium Priority Project Description	ROM Estimate
Install Wheel Diagnostic System on River Track	$2,250,000
Install Wayside Cabling Apparatuses in Storage Yard	$1,500,000
Install EV Charging Stations for Staff & Service Vehicles	$80,000
Reconstruct Existing S&I Loco Service Positioon	$1,500,000
Construct 2nd S&I Service Positioon	$3,300.972
Install EC Reels & EC Waste Ports on SH-5 / SH-6	$60,000
Upgrade Fire Alarm System	$260,000
Upgrade / Install Shop Heating Systems	$625,000
Install Shop Spot Cooling System (Evaporative)	$20,000
MEDIUM PRIORITY PROJECTS SUBTOTAL	**$9,595,000**

Table 10.7 - List of CMF Low Priority Project Recommendations

CMF Low Priority Project Description	ROM Estimate
Coonstruct East Parking Lot & Pedestrian Bridge	$1,050,000
Relocate Vehicle Washer to River Track	$1,500,000
Construct WHeel Truing Facility on Old Wash Track	$3,750,000
Construct S&I WelfareBuilding	$750,000
Construct Rooftop Access Platform on SH-6	$300.972
Construct Mechanic Welfare Areas on Shop Floor	$1,000,000
Install Roof Access Platform on SH-3	$200,000
Install PV Panels on Reconstructed Warehouse Roof	$800,000
Renovate 2nd Floor Office / Crew Area	$1,500,000
Renovate 1st Floor Office / Crew Area	$850,000
LOW PRIORITY PROJECT SUBTOTAL	**$11,700,000**

Table 10.8 - List of Alternative Fueling Project Recommendations

CMF Alternative Fueling Project Description	ROM Estimate
Pilot Project for Zero Emission Fueling	$2,100,000
Pilot Project for Battery Charging	&1,800,000
Total Cast (Includes cost of high and intermediate projects)	**$3,900,000**

Table 10.9 - List of EMF Project Recommendations

EMF Project Description	ROM Estimate
High Priority	
Construct a new Maintenance Shop	$27,000,000
Construct a new Overhaul Shop	$6,000,000
Construct Sound Walls at S&I Locomotive Positions	$285,000
Quiet Zones for Crossings on Shortway Sub	$7,700,000
EMF HIGH PRIORITY PROJECTS SUBTOTAL	**$40,985,000**
Medium Priority	
Additional S&I Tracks	$2,300,000
Tail track connection to mainline	$5,000,000
Construct EV Charging Stations	$80,000
EMF HIGH PRIORITY PROJECTS SUBTOTAL	**$7,380,000**
Medium Priority	
Pilot Project for Zero Emission Fueling	$2,100,000

6.2.1 Community Concerns

Similar to the CMF, the EMF is surrounded with residential and commercial properties. Initiatives to improve neighborhood relations relating to noise and vibrations are identical to CMF work and currently not funded.

In planning for the build-out of the EMF concerns of the community must be taken into consideration to minimize impacts to noise, vibration, air quality during construction and in expanded operations.

6.2.2 EMF Needs Assessment

A condition assessment of the EMF was conducted in June 2020 following the Federal Transit Administration (FTA) Transit Asset Management (TAM) regulations. The results of this assessment indicated that major components or equipment within the EMF are in Good or Excellent condition.

Metrolink has identified needs to increase maintenance capabilities at the EMF, and expansion of site buildings and amenities. No design has started but the following needs or expansions have been identified (this list may be modified in scope as other maintenance facilities and projects are developed and built):

- Construction of a new Progressive Maintenance Building with roof and maintenance pits, drop table, parts storage and wheel truing machine.
- Construction of a new Overhaul Shop
- Tail Track connection to Mainline
- Additional S&I tracks services.
- Construct sound barriers at S&I Locomotive Positions and potentially other locations bordering the neighboring residential community.
- Consideration of potential to accommodate maintenance activities for multiple units as well as the ability to accommodate the maintenance of zero emissions equipment.

6.2.2.1 Storeroom Expansion

EMF currently includes a large temporary storage structure that is in very poor condition. The roof has partially collapsed. The Phase 2 shop building would include a permanent storage facility.

The planned implementation of LCM for Metrolink's F125 locomotive fleet as well as other vehicle fleets as they undergo overhaul or remanufacturing will require the agency to keep significantly greater quantities of material on hand in order to ensure the success of LCM. This has been the case at other passenger carriers that have implemented LCM. It is one of the drivers for relatively high up-front costs of LCM programs that, when properly and fully implemented, result in stable and lower lifetime vehicle maintenance costs as compared with traditional maintenance practices, in addition to improved reliability and availability.

6.3 Orange County Maintenance Facility

Metrolink currently has no operational layover facilities in Orange County, and relies on facilities in San Diego, Los Angeles, Riverside, and San Bernardino to support service in Orange County and the southern part of the Metrolink network. To support improved service on the Orange County and Inland Empire-Orange County Lines directly, and the rest of the system indirectly, a new layover facility is needed in Orange County that can store and perform all daily servicing functions – including fueling – overnight. This is planned to occur on railyard land owned by OCTA in Irvine that currently hosts a single set-out track.

Furthermore, existing Metrolink maintenance facilities are at full capacity and there is a need to perform maintenance on locomotives and rail cars to comply with safety and operations standards. Since a significant portion of the fleet will be operating in Orange County, a maintenance facility located along the Metrolink route through Orange County would be an optimal location as it would reduce operating costs by limiting non-revenue moves to the existing SCRRA storage and maintenance facilities in the cities of Los Angeles and San Bernardino (see Figure 10.2.) The proposed maintenance facility, supported by OCTA, and with an initial phase advanced by funding secured by Metrolink's SCORE program, will provide space and equipment to inspect, clean, and maintain cars and locomotives on a regular and efficient basis. Maintenance shops are planned for a later, as yet unfunded, phase.

Figure 10.10 - Orange County Maintenance Facility Location

The OCMF will include train storage tracks, locomotive and car service platforms, pits and platforms for inspection and maintenance, and a service building with overhead cranes. Service platforms will include facilities for inspection, fueling and sanding, toilet service, interior car cleaning, and a train washer. Additional facility components will include office space, welfare spaces for crews and facility staff, parts storage and management, water treatment, parking access roads, and security. Connection tracks between the various service areas, storage locations, and the main tracks will be provided to assure optimal operational flexibility.

The OCMF will be delivered in two phases. Phase 1 focuses on developing facilities needed for the storage and routine cleaning, inspection, and servicing of all anticipated trains. This would include two Service and Inspection (S&I) Tracks capable of dispensing fuel, diesel exhaust fluid (DEF), and sand, a train wash, and a transportation building – all similar to EMF in Colton, CA.

Phase 2 completes the full build out of the yard. It will include development of the maintenance shop building and materials and equipment storage facilities along the eastern part of the site (furthest from the existing railroad ROW). The shop will have capabilities to perform regular three (3) month, six (6) month, one (1) year and four (4) year preventive maintenance cycles for trainsets.

The project is not fully funded at this time. About $58,340,000 in 2018 TIRCP funding has been allocated to partially fund Phase 1 of the OCMF, with completion slated for 2026. The project will pursue federal, state, and local funding needed to complete the facility.

6.4 California High-Speed Rail Authority

The California High-Speed Rail Authority (CHSRA) is planning to construct one light maintenance facility in Lancaster on Avenue M as part of the Bakersfield to Palmdale section. No heavy maintenance facility is planned south of Bakersfield for Phase 1. The CHSRA will be an electrified service operating along segments of the Metrolink AVL and OC corridors. Light maintenance facilities are intended to support terminal station locations by supplying inspected and serviced trainsets at the start of revenue service. There have been preliminary discussions around Metrolink sharing a joint facility with CHSRA in the Antelope Valley and/or Los Angeles.

6.5 Arrow Maintenance Facility

The Arrow's Maintenance Facility (AMF) is being constructed for the 9-mile Redlands Passenger Rail Project. This line will use Rail Multiple Units (diesel to start). Construction recently began on a renovated facility that will repurpose the existing Inland Empire Maintenance Facility located east of the San Bernardino station and west of I-215. SBCTA has owned the property since 2002. This is where Metrolink locomotive-hauled coaches were stored overnight until 2018. The site will initially accommodate a fleet of three and potentially up to six 170-foot long DMUs to support the future Arrow service. The proposed maintenance and operation facility will be 15,000 square feet and includes the following:

- Two maintenance bays with pit and roof access and maintenance shop;
- Parts storage;
- Maintenance staff support areas including lunchroom and locker areas;
- Office and conference space; and
- Exterior S&I tracks fueling and future train wash.

It is anticipated that the fourth multiple unit vehicle being procured as part of the zero emission multiple unit (ZEMU) project will be serviced at the new facility as well. The facility was designed with input from Omnitrans, who was originally planned to be the operator. Recently SCRRA agreed to operate the service under Metrolink and will be called the Arrow Maintenance Facility (AMF) when it becomes operational. The limitations of the site will require some DMU/ZEMU maintenance/overhaul requirements to be carried out off-site, for example wheel truing. Specific upgrades and modifications are required to the AMCF to facilitate hydrogen storage, refueling and required safety enhancements.

6.6 Layover Facilities

Limited daily servicing and cleaning is performed at seven outlying layover facilities with limited mechanical servicing at five of the seven prior to returning to operations. Mechanical servicing includes inspection of the rolling stock in compliance with the requirements of 49 CFR Parts 229 and 238. Keller Yard has potential layover capacity as well but is not currently used for this purpose. Location and capacity information for each layover facility is included in Table 6.5.

Table 6.5 - Layover Facilities Location and Capacity

Layover Facility	Location (Subdivision: Mile Post)	Physical Address	Number of Tracks	Track Length (Feet)	Overnight Storage (# of Transets)	Potential Capacity (# of Transets)
Montalvo / East Ventura County (EVC)	Montalvo MP 403.3	6175 Ventura Blvd. Ventura, CA 93003	1	1,056	3	3 (if all trains have four cars)
Lancaster (LCS)	MP76.6 44812 N.	Sierra Hwy Lancaster, CA 93534	2	1,800 (each)*	6	6 (if all trains have four cars)
Moorpark (MPK)	Ventura MP 426.97	585 Moorpark Ave. Moorpark, CA 93201	4	612 595 583 608	1	4 (with limits on train lengths)
Riverside - North (RVN)	BNSF San Bernardino MP 61.6	4066 Vine St Riverside, CA 92507	2 (platform) 2 (siding)	1,500 (platform)* 550 (siding)	5	7 (with limits on train lengths)
Riverside - South (RVS)	BNSF San Bernardino MP 61.6	4066 Vine St Riverside, CA 92507	2 (platform) 2 (siding)	1,500 (platform)* 550 (siding)	5	7 (with limits on train lengths)
South Perris Station (SPS)	MP 85.4	1304 Case Road Perris Valley, CA 92570	3	Track 2: 1,582 Track 3: 1,580 Track 4: 1,803	4	8 (with limits on train lengths)
Oceanside (OSD)	San Diego MP222.1	810 Mission Ave. Oceanside, CA 92054	4	1,600*	5 (typically 5 locomotives and 30 cars)	n/a (up to 9 locomotives and 34 cars)
Keller Yard River	MP 140	720 Keller Street Los Angeles, CA 90012	5	600 (4 tracks) 900 (1 track)	0 (used for long term storage)	5

* Average Track Strength

6.6.1 Montalvo / East Ventura

The Montalvo / East Ventura (EVC) Layover facility is located at the end of the Ventura County Line and provides servicing for a maximum of three four-car consists or two longer trains each weekday night. There is one storage track for in-line minor maintenance activities. All consists have toilet servicing done at EVC. This layover yard is currently at capacity and cannot accommodate additional rolling stock for overnight storage.

6.6.2 Lancaster

One stub-end layover facility is located at the Lancaster station (LCS) with a maximum capacity for six consists in a two-track yard. This capacity allows for two trains to layover on the mainline track and four trains to layover on the siding track. The Lancaster layover yard is currently at capacity and cannot accommodate additional rolling stock for overnight storage. Planned and funded improvements at LCS are detailed in Section 10.7.2.

As part of the AVL Capacity and Service Improvements Program, Lancaster Station will receive infrastructure improvements to enable 60-minute bi-directional service between LAUS and Lancaster Station. The Lancaster Terminal improvements include construction of a new center platform, the addition of at least two 1,000-foot-long storage tracks, improvements to facilitate efficient fueling, and modifications at the existing Lancaster Boulevard grade crossing to enable quiet zone readiness and facilitate train movements to the storage tracks (see Figure 10.3.) The project is funded by Measure M and a TIRCP grant awarded in April 2020. The project is currently in the environmental and conceptual engineering phase with construction expected to begin in 2024.

[5] Conceptual illustration. Not drawn to scale.

Figure 10.11 - Lancaster Terminal Improvements[5]

6.6.3 Moorpark

The Moorpark layover facility (MPK) is located northwest of LAUS along the Ventura County Line and provides servicing for one consist nightly. It has a four-track yard without toilet dumping facilities or potable water available at the site. Metrolink is currently developing preliminary cost estimates for discussions with funding agencies and stakeholders regarding the addition of future potable water and toilet servicing capabilities at the MPK layover yard. It is located adjacent to the historic Moorpark town center.

6.6.4 Riverside – North and Riverside – South

The Riverside layover facility is comprised of two locations: North Side tracks (RVN) and South Side tracks (RVS). The North Side tracks hold five consists serving the Riverside Line. Daily inspection, testing and cleaning are performed on the North Side tracks, but no potable water or sewer utilities are available. The South Side tracks hold three consists serving the 91-LA and IE/OC Lines. Daily inspection, testing and cleaning are performed, and potable water and sewer utilities are available for two train sets.

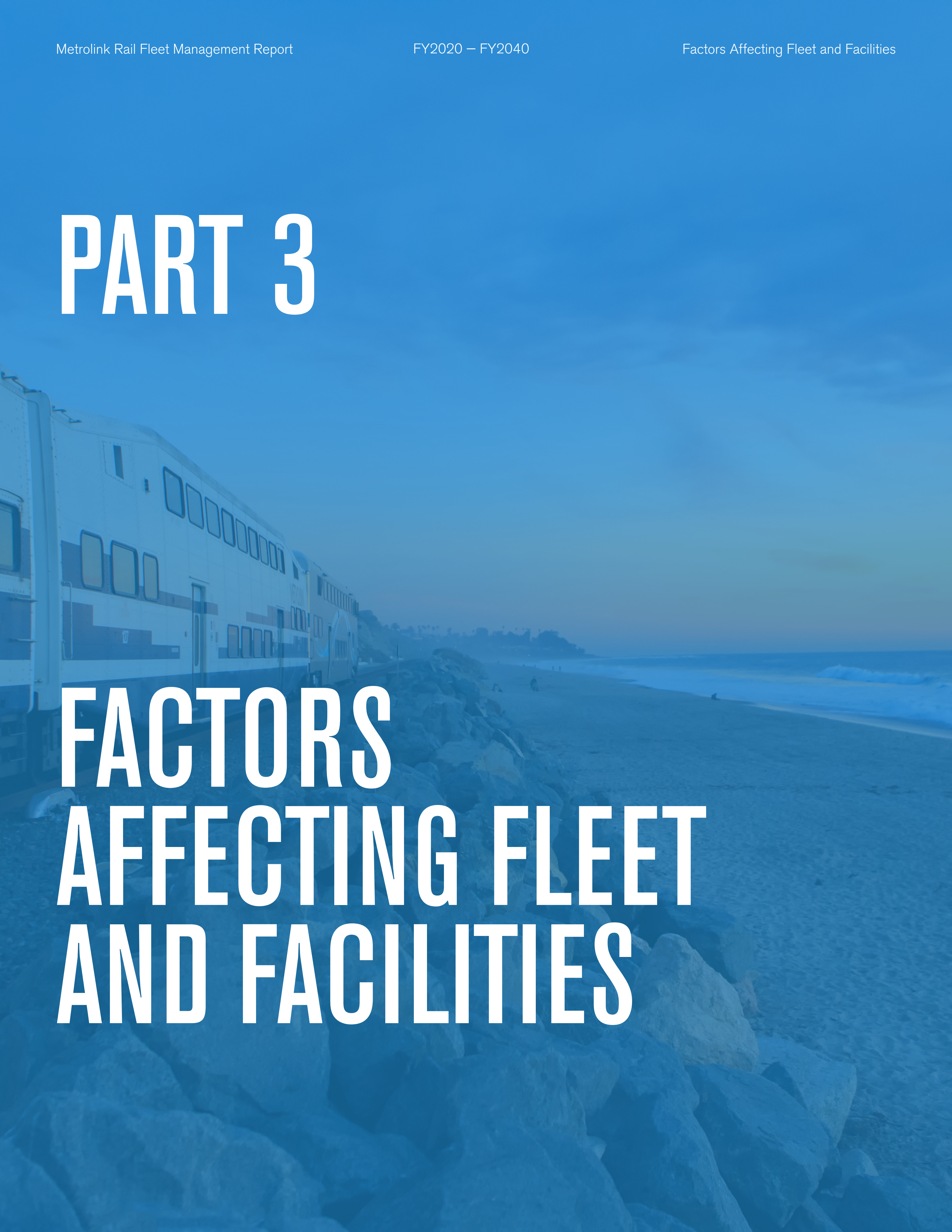
The Riverside County Transportation Commission (RCTC) is leading the Riverside-Downtown Metrolink Station Layover Facility Expansion Project, work began in March 2020 and is expected to last through 2021. This project entails the removal of 261 feet of abandoned track, the removal and salvage of 692 feet of track, and installation of 2,022 feet of new track. The improvements will allow seven trains to be housed overnight at the station; currently five trains are stored there each night. The work also will increase flexibility of the order that trains leave the station each morning and enable light maintenance work and fueling on three trains on the north side by fuel truck to be performed at the Riverside Station, rather than at other maintenance facilities.

6.6.5 South – Perris Station

This facility has three-tracks with ground power, compressed air, potable water, and sewer discharge servicing. It is used by four trainsets currently but could accommodate six trainsets of shorter length. Plans are being developed to expand the Perris-South station and layover facility to add a fourth layover track, but this is an unfunded project.

6.6.6 Stuart Mesa Maintenance Facility (Oceanside) – Operated by NCTD

Inspection and servicing of consists of the Orange County Line are performed at the Stuart Mesa Maintenance Facility (SMMF), located in Camp Pendleton near Oceanside, CA and operated by North County Transit District (NCTD). Its primary function is to provide inspection, cleaning and maintenance for San Diego's COASTER passenger trains. Metrolink consists using this facility are inspected and maintained by NCTD's contracted maintainer. Daily inspections and testing are performed on five consists, as well as interior cleaning and minor repairs. Fueling is typically provided on one Metrolink train daily. There are no expansion capabilities at this facility.



PART 3

FACTORS AFFECTING FLEET AND FACILITIES

7 VEHICLE MAINTENANCE

7.1 Maintenance Philosophy

Metrolink understands the need to implement a robust maintenance regime in order to provide a safe, reliable, on-time, quality service for its customers. As part of this effort and to improve fleet reliability and ensure vehicles are kept in a State of Good Repair, the rolling stock vehicle maintenance contract awarded to Bombardier Transportation (expiring in June 2025) includes the adoption of a Condition Based/ Life Cycle Maintenance (CB/LCM) strategy that will be more proactive in identifying, planning and performing repair or replacement of parts prior to in service failures. This method more closely matches the needs of the vehicles and the associated components. Additionally, to supplement this model due to the age and conditions of portions of the fleet, the classic method of mid-life overhauls will also be performed (e.g., Bombardier Sentinel Generation 1 vehicles).

A key driver to the CB/LCM methodology is to address individual components that make up a vehicle, as they do not all have the same useful life. Some life cycles are much shorter and begin failing prior to a traditional mid-life overhaul, while others with a longer service life would be replaced prematurely. CB/LCM practices acknowledge this characteristic and, instead, provide component replacements and/or overhaul programs that occur throughout the life of the vehicle on repeating cycles tailored to groups of components with similar life expectancy. This keeps all major systems in better working condition throughout the vehicle's service life while reducing reliance on traditional, hard-to-fund and schedule, vehicle mid-life overhauls.

In the short term, maintenance costs tend to increase when CB/LCM is implemented, as some component overhauls or replacements are performed prior to the vehicle's mid-life and ideally, prior to failure. During this stage, inventory and staffing levels are adjusted to support program needs.

When properly implemented, CB/LCM can have a direct positive impact on service by reducing the incidence of vehicle-related service failures. CB/LCM allows long-term maintenance expenses for both labor and materials to be more stable, scheduled and predictable which allows for better budgeting and forward planning especially for such things as long lead time materials and spares. The goal of CB/LCM is to keep the fleet in a State of Good Repair, which is manifested by equipment safety, reliability and availability for improved service delivery.

Dividing a major mid-life overhaul into several smaller component/system overhauls, sometimes referred to as a balanced approach, has added benefits:

- Each overhaul can be performed more quickly and efficiently, reducing the impact to vehicle availability; and
- When properly planned and scheduled, much of the work can be performed concurrently with other regularly scheduled maintenance activities, thus reducing the number of out of service vehicles and downtime.

CB/LCM requires detailed planning of all maintenance activities, supported by operating and failure data, to allow for proper staffing, ordering of necessary parts, and completing contract arrangements for off-site work or other support services.

An industry shift towards CB/LCM has occurred at many agencies across the country, as more and more evidence supports its benefits. The goal of this shift in strategy is to move Metrolink towards:

- Predictable Staffing Needs – Replacing/overhauling parts shortly before they fail may reduce the reliance on overtime expenditures and diversions of crews from scheduled work to repair unplanned failures. The current maintenance contract places the onus of staffing on the contractor to ensure the shops are properly staffed to perform the functions covered within the scope of services.

- Predictable Parts Needs – Replacing parts on a scheduled basis, rather than after an unplanned failure allows the parts to be ordered and available in stock before they are required. This is particularly important for parts and equipment with long lead times. This strategy allows for parts to be purchased in larger quantities, often at lower unit prices. Expedited delivery costs can be significantly reduced by ordering in advance, allowing time for standard delivery timeframes and rates. Efficient ordering quantities can be arranged with suppliers that permit them to set up production runs that result in better prices in balance with the most advantageous storage arrangements for Metrolink. Lastly, and perhaps most critically, knowing and preparing for parts needs in advance can minimize the cannibalization of parts from other units that are out of service awaiting more lengthy repairs. This practice leads to a cycle of unmet parts needs and even lengthier out of service times for vehicles.

- As many fleets are typically purchased and delivered in larger quantities over a short timeframe, vehicles age on the same timeline and are at risk of realizing failures in a short window. When component failures are anticipated and avoided by proactive maintenance, those group failures can be preempted by a planned repair/replacement program allowing for regular staffing levels to repair or replace the parts rather than experiencing a surge in labor overtime or a diversion of resources from preventive maintenance activities.

- Improved Reliability and Consistent Vehicle Availability – Proactively maintaining vehicles allows most failures to be preempted by scheduled repairs or replacements with the number of unplanned failures and long term out of service vehicles reduced. This ensures the fleet is used at a similar rate, thus preventing premature aging of some vehicles while others sit idle waiting for repairs. This also permits a more consistent level of vehicle availability and facilitates planning for revenue service providing more reliable travel experience for the riding customer.

Metrolink's regional rail operations are funded by farebox revenues, other operating revenues, and member agency subsidies. Farebox revenue currently covers about 40.1 cents (FY19) of every dollar spent operating the service. This reliance on customer fares makes it imperative the fleet be kept in a State of Good Repair, ensuring delays do not deter potential customers and maintains the current customer base.

Per the rolling stock maintenance contract effective July 2017, Metrolink's vehicle maintenance contractor is required to:

- Implement Condition Based/Life Cycle Maintenance:
  - Develop a "schedule for monitoring, replacing, repairing and restoring wearing vehicle systems and parts before functional failure occurs without adversely affecting availability and performance of the vehicle"1
  - "…incorporate all Federal Railroad Administration (FRA), Original Equipment Manufacturer (OEM) and Authority inspection, testing and maintenance standards to form a comprehensive preventive maintenance and inspection program."2
  - Balance maintenance to mission critical vehicle systems with cost containment3
  - "…perform the appropriate maintenance activity for components…on a cycle which minimizes the probability of component failure and keeps the vehicle in overall good working condition."4

- “…ensure that all requisite resources (including, but not limited to, shop personnel, shop space, materials, tools and test equipment) are positioned, allocated and in ample supply to implement and sustain the LCM Program.”5
- Update the maintenance plan regularly with improvements identified from analysis of tracked data.
- Perform Engine Risk Assessments to identify and remedy potential causes of poor engine reliability or performance, including oil sampling analysis to determine engine wear of specific components in order to determine maintenance/overhaul intervals.

- Develop a vehicle fleet database to track maintenance and performance data that can be analyzed to identify improvements to the maintenance program.

- Perform root cause analyses to not only repair failed components but identify the cause of the failure and implement programs to address the cause on the failed unit and others at risk.

- Address the highest risk failures:
  - dentify the top 10 major components and failure modes.
  - Make modifications or repairs, as necessary, to correct current conditions and prevent future occurrences.

- Increase Mean Miles Between Failures (MMBF) to:
  - 20,000 for Locomotives
  - 120,000 for Cab and Trailer cars

Refer to Section 7.3 – Fleet Maintenance and Reliability, for more information regarding Metrolink’s MMBF definition and criteria.

The current rolling stock maintenance contract requires LCM methods be applied across all Metrolink fleets. The fleet contains vehicles dating from the service’s inception in the 1990s, as well as new vehicles. A two-pronged approach to maintenance is suggested to address the fleets state: one is targeted for vehicles just beginning their service lives, and another designed to sustain aging vehicles through the end of their service lives. With proper planning and execution of these maintenance regimes, Metrolink will be able to restore and retain reliable operations of its fleet, to deliver a safe, quality service its customers expect.

7.1.1 Maintenance Philosophy for New Fleets

With the delivery of 137 Guardian cars in 2010 and the ongoing delivery and commissioning of 40 F125 locomotives, Metrolink is well positioned to execute the CB/LCM strategy for these vehicles. Newer generations of vehicles are equipped with microprocessor-controlled systems and require shorter/less inspection intervals (based on OEM recommendations) and will not continue to operate well without consistent, timely maintenance. Many agencies, including Metrolink, are now tasked with reorienting their maintenance programs to address the more demanding maintenance requirements, which are typically shorter than the mandatory FRA requirements for inspections that are often based on older technology and legacy equipment. Modern fleets can provide long-term delivery service benefits and customer comfort characteristics that today’s customers expect.

The greater and more frequent maintenance needs of these newer vehicles lay the groundwork for a balanced cycle-based maintenance philosophy. In general, a cycle-based maintenance philosophy is designed to replace all safety and reliability components on a schedule intended to precede the anticipated failure of the component, typically based on the OEM's requirements but in some cases aligned with the specific operating requirements of each application. This practice relies on component-specific information and requires strict adherence to the schedule. Modifications to the replacement schedules are made when empirical data shows it would be beneficial. When performed properly, this type of maintenance minimizes the possibilities of in-service failures, ensuring the rolling stock remains in a State of Good Repair, with only minimal unused component service life. The use of onboard diagnostic apparatus enhances Metrolink's ability to implement progressive maintenance. However, this needs to be supported by a robust maintenance management system to ensure such things as asset maintenance and reliability history, including configuration control is fully controlled throughout the life of the equipment.

Progressive maintenance is more effective when implemented early in a vehicle's service life before many components are overdue for maintenance. Therefore, the start of the new maintenance contract was an ideal time for Metrolink to make the shift in maintenance practices, particularly for the Guardian cars and the F125 locomotives.

A complete lifecycle maintenance plan requires a significant amount of planning, historical data, and organization. A high-level sample of such a program is described in Section 5.3.

Other transit agencies have begun implementation of lifecycle maintenance, some with impressive outcomes. In particular, New York City Transit and Long Island Railroad have been using versions of lifecycle maintenance since the 1980s and the early 2000s, respectively, both with impressive results. Both agencies were fully committed to lifecycle maintenance philosophies and received support at all levels of the agency. As detailed in the following section, there are many critical components of a successful lifecycle maintenance program.

7.1.1.1 Requirements for Lifecycle Maintenance

Lifecycle maintenance must be fully embraced at all levels of the Agency and its contracted maintainer to function properly. It will require the commitment of the whole Agency, from procurement, maintenance personnel, supervisors, and senior administrators to the critical funding members of the Agency.

The most important tool for ensuring the success of LCM is the development, implementation, and adherence to cradle-to-grave maintenance schedules for each fleet based upon solid data inputs (historical/OEM) that account for the needs of service, staffing levels, shop space and material availability.

A fully implemented electronic Maintenance Management System (MMS) will be an integral part of establishing a dependable CB/LCM program that will assist in capturing failure data, maintenance intervals (preventive/corrective), creating work orders, part kits, warranty issues, and assist in the creation of predictive maintenance activities.

CB/LCM changes the funding needs with more funding required as an ongoing expenditure for smaller, more frequent overhaul work and the associated materials. The typical one-time funding spike for mid-life overhauls will eventually flatten, as much of the work will be staggered throughout the vehicles' service lives.

Another key step to implementing the CB/LCM program relies on the ability to work in concert with the Procurement and Materials Management Department to have a steady, stable flow of consumables, parts, components, and systems. This will require a reorganization of the material storage facilities within the CMF and EMF to allow for just-in-time delivery and space to pre-kit parts for more efficient CB/LCM activities. These activities can be tied back to the implementation of the MMS, which will allow for automatic reorder points, hold points for upcoming and planned CB/LCM work orders and kitting, which is inherently more efficient and productive.

To fully commit to this method, it is necessary to ensure consistent availability of maintenance funding at the levels required for an effective program. Long-range planning will also be necessary to safeguard funding needs that are identified early and can be agreed upon by the funding members. The scope of work modifications made to the current maintenance contract will move the maintenance philosophy toward a more mature CB/LCM strategy with the goal of improved service delivery to our passengers.

7.1.2 Maintenance for Older Fleets

The move towards a full cycle-based maintenance strategy is less practical for the older vehicles in the Metrolink fleet, which has many aged components. While the vehicles have been maintained to federal standards, the maintenance required per the Federal Railroad Administration (FRA) is designed to ensure the vehicles are safe for the riding public, not necessarily to optimize availability and reliability. Metrolink's vehicle fleets operate approximately 65,000 miles annually (pre-COVID service level), about on par with other agencies similar in size to Metrolink.

Although the older vehicles in the fleet could benefit from limited cycle-based maintenance, they will need to undergo a full mid-life overhaul to return them to a State of Good Repair prior to implementing most of the cycle-based programs. The Bombardier Sentinel Generation Bi-Level fleet, base order of 28 vehicles (with an option up to 121 vehicles) have started a mid-life overhaul program being performed by Talgo/Systra. This overhaul program will improve reliability and update to current standards and regulations including the remanufacture, refurbishment, renewal, overhaul, replacement and reconditioning of existing hardware, components, equipment, systems and apparatus to extend the useful life of these passenger rail vehicles. This contract includes a Condition Based Maintenance Program at the completion of all overhauls and is intended to add an additional 10 years to the original 30-year service life. See Table 7.1 for work included in the program.

Table 7.1 - Scope of Work for Rebuild

SCOPE OF WORK FOR REBUILD

Item #	Car System	Item #	Car System
1	HVAC Overhaul (Upgrade to R-407C)	14	Install refurbished seating
2	Control voltage conversion 32 to 74v	15	Replace foam & install seat covering
3	Complete electrical systems rewire	16	Replace interior panels with Rotem color match
4	Replace door operator system with next generation	17	Replace toilet module
5	Battery changeout	18	Repair carbody, new paint/exterior graphics
6	Wireless PA installation	19	Replace all glass windows with new
7	Truck overhaul (new air bags and wheels)	20	Install 120v outlets through seating areas
8	PEI system installation	21	New diaphragms
9	Destination sign installation	22	Install Wi-Fi provisions
10	Window gasket replacement	23	Install passenger surveillance provisions
11	Lighting system replacement to LED	24	Replace couplers
12	Install composite subfloors	25	New signage installation
13	Install rubber floors	26	Door Obstruction Detection

For the older railcar fleets, it may be possible to move some components into the LCM program, while leaving others for a more traditional whole-vehicle major overhaul. Any plans for cycle-based maintenance on these older fleets will need to include identification and evaluation of which components can easily be maintained in-house on a separate cycle, and which would duplicate efforts if they were done prior to the overhaul. Table 7.2 shows items that have been identified for inclusion in a CB/LCM program for the Bombardier Bi-Level fleet.

Table 7.2 - System and Component Service Cycles

SYSTEM AND COMPONENT SERVICE CYCLES

Approximate Service Cycle	System & Component		Maintenance Activity
4 Years	HVAC	AC Units	Overhaul
5 years	Door Systems	Door Guides	Replace
	HVAC	Protective Heaters	Evaluate
	Interior	LLEPM Decals	Replace
6 years	Cab Equipment	Cab Signal	Replace
	Lighting	Light Shades	Replace
	Truck/Suspension	Brake Discs	Replace
		Wheel Axle Assembly	Overhaul
8 years	Cab Equipment	Windshield Wiper	Overhaul
		Master Controller	Overhaul
	Electrical	Battery Set	Replace
		LVPS	Overhaul
	HVAC	Contactors	Rebuild
	Toilet	Regulator	Overhaul
		Retention Tank	Inspect
		Hopper	Overhaul/Replace
		Actuator Valve	Overhaul
		Vacuum Breaker	Replace
10 years	Cab Equipment	Event Recorder	Replace
	Door System	CHMM & Battery	Replace
		Door Seals (Sensitive Edge)	Replace
12 years	Coupler	Coupler	Overhaul
		Draft Gear	Overhaul
		Coupler Carrier	Replace
	Door Systems	Operator	Rebuild
		Limit Switches & Solenoids	Replace
	Electrical	Trainline Jumper Receptacles	Replace
		Decelostat	Overhaul
	Interior	Windows	Replace

Table 7.2: System and Component Service Cycles

	Lighting	Ballast & Sockets	Replace
	Trucks/Suspension	Anchor Rods & Bushings	Overhaul
		Dampers	Replace
		Air Bags	Replace
		Center Pin	Replace
		Truck Frame	Overhaul
16 years	Floor	Floor Covering	Replace
	Interior	Passenger Seats	Replace
As Needed	Floor		Replace

The delivery and commissioning of the 40 new EMD F125 locomotives pre-empted the necessity to perform significant overhaul work on the older units, with most of the legacy fleet (F40, F59PH, F59PHI and F59PHR) having already been decommissioned (four remaining) from service.

With investment in the planned overhaul activities (see Section 5.2), followed by cycle-based maintenance through the end of their service life, Metrolink should be able to keep its older vehicles reliably and safely in service through their targeted service lives.

7.2 Current Maintenance Practices

Inspections, maintenance, and cleaning of Metrolink's vehicles are performed by a contractor, and includes daily and periodic inspection and servicing, preventive maintenance, running repair (unscheduled), heavy maintenance and minor overhauls. The maintenance contract is performance based and includes incentives and penalties, determined by performance factors such as average fleet availability. The eight-year agreement was awarded to Bombardier Transportation and expires on June 30, 2025.

7.2.1 Maintenance Management

SCRRA's Equipment Department meets daily with the maintenance contractor to:

- Review previous day incidents and plan for daily operations.
- Review shop status, maintenance, and repair progress.
- Plan and execute service for special events.

SCRRA Mechanical Operations Officers also provide oversight and audit the daily service across the system. Monthly meetings are held with the Maintenance Contractor. SCRRA Equipment Department and SCRRA Chief Operating Officer review monthly incidents, safety record, the efficiency testing program and improvement planning.

- SCRRA has developed and maintains the Preventive Maintenance packets the Maintenance Contractor uses. These packets contain all the federally and contractually mandated items the Maintenance Contractor is required to perform.

- Monitoring will occur quarterly of a 20 percent random sample of Preventive Maintenance Packets. The monitoring will be performed by Mechanical Operations Officers and will be supervised by the Assistant Director.

- Revisions are made to the Preventive Maintenance packet when:
  - New equipment has been introduced into the fleet
  - Federal guidelines have been revised
  - Revisions have been made based on reliability factors

- Evaluations are performed using the PM Packet Audit Sheet.

- Revisions are made to the Preventive Maintenance Packet Audit Sheet when:
  - New equipment has been introduced into the fleet
  - Federal guidelines have been revised
  - Revisions have been made based on reliability factors

7.2.2 Systems and Reporting Analytics

To support data management and decision making, support tools or software are necessary to facilitate record keeping for assets, estimate life-cycle needs, manage ongoing maintenance requirements, capture condition assessment ratings, and prioritize capital reinvestments. Enterprise Asset Management (EAM) systems are a common type of decision support tool for Transit Asset Management (TAM).Metrolink utilizes several asset management systems, reporting and analytic tools throughout the organization. The primary systems used for asset management, specifically for rolling stock, include: AssetWorks RailFocus and Trapeze. Other systems used by Metrolink to manage other assets include: Oracle, Rail Asset Management System (RAMS), and Net Facilities.

AssetWorks RailFocus, is an asset and maintenance management software system for tracking and documenting daily defects, periodic maintenance, repairs, modifications, and capital program work. Daily defects are tracked as "Service Requests / Defects" (SR/Ds) which record defects on equipment found or reported while in service. It is also used to track train set configuration through Consist Management which tracks specific equipment assigned to specific train trips to track individual equipment mileage. Use of this software will need to be enhanced to accommodate the planned LCM approach on the new fleets.

Metrolink also uses Trapeze Enterprise Asset Management, which helps understand the condition of assets to predict their lifecycle and plan capital investments. Trapeze Enterprise Asset Management is an integrated enterprise asset and maintenance software designed for tracking all transit infrastructure, rolling stock and facilities.

The data collected, especially repeated measurements over time, is instrumental in determining the current condition and rate of decline of rolling stock components. Improvements in the data collection methods and systems, including inventory tracking are critical in determining the current condition, State of Good Repair needs and the associated horizon timeline related to the rate of decline. Data tracked should include inventory, cost controls, planning, tracking, rehabilitation schedules and the useful life of components.

Metrolink conducted a State of Asset Management Study in the summer of 2019 to evaluate the current asset management landscape and the agency's readiness to move to singular EAM. The findings from this study pointed out some key characteristics and general functions among the various systems in use today. Efforts are underway to expand upon this study and develop a comprehensive asset management information strategy, which focuses on improving transparency of data information, data integration, and reporting to improve decision-making and to maintain a single source of truth for all asset types.

Currently, the Business Operations Department is partnering with the Information Systems in identifying an asset management strategy moving Metrolink towards a centralized repository and to integrate Trapeze with other software used by the agency to capture and log data from different assets.

7.2.3 Daily Service and Inspection

The daily inspection maintenance plan defines the servicing and inspection tasks to be carried out by Metrolink's contract vehicle maintainer daily in order to meet safety, availability, and reliability requirements set by the FRA, the Agency and the OEMs.An exterior and interior calendar day mechanical inspection of passenger equipment is an FRA regulatory requirement under 49 CFR 238.303 and 49 CFR 238.305. The daily inspections are carried out at the six layover facilities.

The contracted vehicle maintainer inspects the functionality of Metrolink's rolling stock, including the servicing of restrooms and locomotive equipment each calendar day the equipment is in service and remedies defects as an integral part of the inspection process. The equipment must meet all FRA requirements prior to release for daily service. Daily service activities include:

- Replenishment of locomotive fuel and fluids
- Inspection of Locomotive - 49 CFR 229.21
- Inspection of Equipment Exterior - 49 CFR 238.303
- Inspection of Equipment Interior - 49 CFR 238.305
- Class I Air Brake Test - 49 CFR 238.205 and 238.313
- Cleaning of passenger car interior
- Emptying of waste system and replenishment of potable water
- Perform repairs, as required
- Equipment run through train wash

7.2.3.1 CMF Daily Servicing

- Replenishment of locomotive fuel and fluids
- nspection of Locomotive - 49 CFR 229.21
- Inspection of Equipment Exterior - 49 CFR 238.303
- Inspection of Equipment Interior - 49 CFR 238.305
- Class I Air Brake Test - 49 CFR 238.205 and 238.313*
- Cleaning of passenger car interior
- Emptying of waste system and replenishment of potable water
- Perform repairs, as required
- Equipment run through train wash
- Coach and Cab car 90-day periodic maintenance performed in-line

7.2.3.2 Layover Facilities

After the weekday evening trips, the 40 train sets arrive at the seven different outlying points. At five of these locations the Mechanical Contractor services and inspects the rolling stock each day, prior to placing it in service, in compliance with the requirements prescribed in 49 CFR Parts 229 and 238. The trains are cleaned by a sub-contractor to the Mechanical Contractor. All defects and non-conformities that are found are corrected as promptly as practicable and in accordance with all applicable laws, regulations, and standards. Trains arriving in Oceanside (OSD) are serviced by NCTD's Mechanical Contractor. Table 7.3 indicates train distribution, as of January 2020.

Table 7.3 - Train Distribution at Layover Facilities (Pre-COVID)

	Trains	Locomotives	Cars
EVC	3	3	12
CMF	2	2	10
EMF	12	12	64
LCS	6	6	24
MPK	1	1	4
RVS	7	7	34
SPS	4	4	17
OSD	5	5	30

7.2.3.3 Outlying Points Servicing

Table 7.4 - Outlying Points Servicing

Outlying Points Servicing	EVC	CMF	LCS	MPK	RVS	EMF	SPS	SMMF
Inspection of Locomotive - 49 CFR 229.21	X	X	X	X	X	X	X	X
Inspection of Equipment Exterior - 49 CFR 238.303	X	X	X	X	X	X	X	X
Inspection of Equipment Interior - 49 CFR 238.305	X	X	X	X	X	X	X	X
Class I Air Brake Test - 49 CFR 238.205 and 238.313*	X	X	X	X	X	X	X	X
Cleaning of Passenger Car Interior	X	X	X	X	X	X	X	X
Emptying of Waste System & Replenishment of Potable Water	X	X	X		X**	X**	X**	X
Perform Repairs, As Required	X	X	X	X	X	X	X	X
Replenishment of Locomotive Fuel & Fluids		X						X
Car Wash		X						X

Notes:

*Equipment tested from both ends.

**Only on tracks equipped with water and sewage facilities.

7.2.4 Periodic Preventive Maintenance and Inspection

Metrolink's preventive maintenance program is structured to meet the FRA required intervals, progressing in complexity and comprehensiveness through a calendar-driven sequence, up to and including the federally-required change out of air brake components every four years (referred to as COT&S – Clean, Oil, Test & Stencil). This is the base level of maintenance required to legally operate the vehicles. In addition to this work, Metrolink's vehicle maintenance contractor completes other lifecycle-based programs specified by Metrolink (see Section 7.2.5) plus corrective maintenance/running repairs (See Section 7.2.6), as required.

Three-fourths of Metrolink's consists operate through the CMF daily, Monday through Friday, for service and inspections. This ensures toilets are serviced at intervals no greater than three days. It also provides opportunities for vehicles to undergo federally mandated periodic inspections and maintenance. Metrolink trains do not need to visit CMF frequently if activities such as toilet servicing and fueling can occur at outlying points, like they are at EMF where trains can go for a week or two (or even more) before needing to cycle through CMF.

Metrolink vehicles currently undergo scheduled inspection and maintenance at intervals shown in Table 7.5.

At each of these intervals for the federally mandated tests, inspections and repairs are performed, in addition to any other planned work that can be completed in the same time period.

Metrolink performs five locomotive Project Initiatives (PIs) – a term used for the scheduled inspections and maintenance activities – per week to maintain schedule compliance and provide an adequate number of units for service including operating spares. This quantity may vary slightly depending on the number of units out of service long-term or on lead time built into the schedule to allow for holidays or other events that may impact shop throughput.

- The F59 and MP36 fleets follow the standard FRA maintenance intervals and have Periodic Maintenance performed every 92 days, 384 days, and 1472 days.
- The new F125 locomotives have a more stringent Periodic Maintenance cycle. This cycle includes 30-day, 45-day, 92-day, 184-day, 368-day, and 736-day inspections.

Fueling locomotives is almost always completed at CMF, and equipment manipulation cycles are scheduled to avoid wayside fueling except when necessary. Wayside fueling (or "fueling from a truck") is typically much more expensive than fueling from an installed system. However, when it does become necessary to fuel a locomotive at outlying terminals, it can be accomplished using fuel trucks. Typically, such wayside fueling is performed by a different vendor from the one that provides fuel for CMF, but occasionally, the CMF vendor can also provide this service.

Railcars due for federally mandated 184-day periodic maintenance (PM) are worked on in the Progressive tracks P1 or P2. An average of eight to nine 184-day PMs must be performed weekly to maintain proper schedule compliance and avoid cars going "overboard" (past the 184 days between

Table 7.5 - Scheduled Maintenance Intervals

Locomotives	Cabs	Trailers
	Daily	
	30-day (HVAC filters)	
45 - day (HEP)	----------------------------------	
	92-Day	
	184 Day	
	368-Day	
	1,472-Day	

PMs). When consists have been readied for service, they are drilled off the Progressive tracks and moved out to the storage tracks.

7.2.5 Lifecycle Maintenance Initiatives

Beyond the inspection and maintenance intervals required by the FRA, Metrolink is moving towards incorporating most major maintenance activities into a CB/LCM approach that will minimize or eliminate the need for a full mid-life overhaul at half of a vehicle's life. Many of these activities have been begun as part of separate capital programs, but the end goal is to integrate lifecycle maintenance activities in the ongoing maintenance program so that they are carried out as part of ongoing maintenance and are funded as an ongoing capital expense that stretches throughout the vehicles service life. This allows the full cost of state-of-good repair funding to be understood by all funding partners at the start of a vehicle's service life.

Despite being integrated into regular maintenance activities, the LCM program includes tasks that would traditionally be included in a mid-life overhaul and considered a capital expenditure. Potential lifecycle maintenance activities are described in greater detail in Section 5.3.

7.2.6 Corrective Maintenance/Running Repairs

Corrective maintenance/running repairs are corrections of failures or damage and are performed when unforeseen failures occur. These failures are typically due to an isolated component failure, accident, misuse or vandalism, and the repairs are outside of the scheduled daily inspections, federally mandated maintenance, and lifecycle maintenance activities. Corrective maintenance repairs are made as expeditiously as reasonable to allow the vehicle to return to service. This work is completed at the CMF. Lifecycle maintenance activities aim to minimize the incidence of unscheduled component failures.

Since corrective maintenance cannot be scheduled in advance, it has the potential to be disruptive to other scheduled maintenance activities, depending on the severity of the repairs required. Therefore, it is beneficial to try to keep the need for corrective maintenance to a minimum and to carefully manage where and when those repairs are made.

When an inbound consist at LAUS is known to include one or more cars that must be drilled out for repair, the affected consist may be held at LAUS to avoid disrupting the flow of consists across the S&I tracks and blocking the mainline. This is managed closely to also avoid congestion at LAUS.

The move towards LCM is expected to reduce the frequency of unscheduled repairs due to failed components, but cannot fully eliminate all failures, nor can it prevent repairs due to accidents or vandalism. Although efforts are being made to reduce the number of unscheduled repairs, maintenance planning must account for a certain level of corrective maintenance activities, in terms of staff, shop space, spare parts and other materials.

7.2.7 Maintenance Initiatives

7.2.7.1 BTR Support Bearings & Pre-Assembled Combos:

Metrolink currently operates its locomotive fleet with a mix of conventional EMD D77, D78 and D87 plain support bearing (B classification) equipped traction motors as well as motors fitted with roller support bearings (BTR classification) and builds its own combos from individual components (traction motors, wheelsets, gear cases). In the future, purchase orders will require that suppliers deliver combos already built-up and that older B support bearings will be phased out. BTR support bearings require little routine maintenance and are more reliable than the predecessor style. Additionally, there are a mix of D77 and D78 traction motors in service. The two types are the same, but the D78 motors include transposed conductors in the motor windings as well as better, thinner insulation and, as a result, slightly more copper content and marginally greater efficiency. Both types will be phased out over time and replaced with the latest DC motor configuration designated D87. The D87 is more efficient and durable in terms of service than either the D77 or D78 and all 3 types D77, D78 and D87 shall be replaced with D87BTR type as new F125 units are delivered.

7.3 Fleet Maintenance and Reliability

Fleet maintenance and reliability data is tracked and reviewed with a focus on identifying components and systems that cause service delays or impact vehicle availability. This data can also be used to plan maintenance activities so components and systems that are anticipating failure can be remedied prior to failure. Metrolink is beginning to move in this direction and the RAMS (Reliability, Availability, Maintainability and Safety) system is in development.

Mean Miles Between Failures (MMBF) is a measure of reliability that identifies the average number of miles traveled by a vehicle, or fleet, between failures. The terms of Metrolink’s new vehicle maintenance contract require the fleet to achieve increased MMBF levels. Metrolink defines a failure as a vehicle failure that results in the train’s arrival at the terminal station being delayed five or more minutes, a termination or annulment. MMBF is calculated as the number of miles operated in service for a set period (e.g., month or year) divided by the number of failures experienced in that same period and is calculated for each vehicle fleet.

In recent years, Metrolink has struggled with unreliable equipment and is implementing policies and procedures to improve reliability, which should be reflected in the MMBF for the various fleets. The Service Plan requires there shall be no more than 40 total delays from mechanical failures, and on-time performance related to mechanical performance must be 99 percent. Both measures are intended to help the service reach an overall on-time performance goal of 95 percent.

7.3.1 Locomotive Mean Miles Between Failures

Figure 7.1 - MMBF - 3 Months

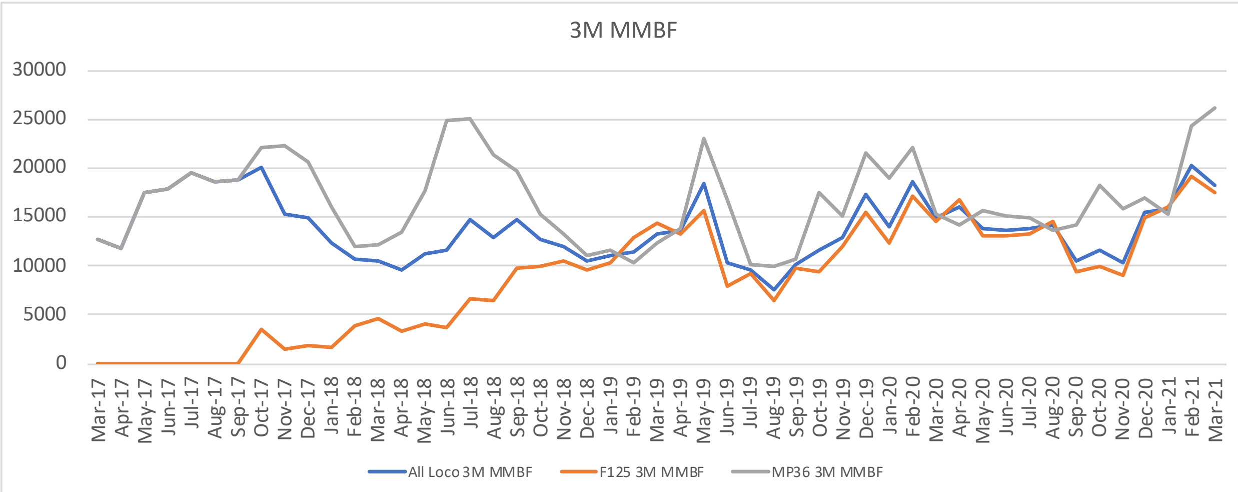


Figure 7.2 - MMBF - 6 Months

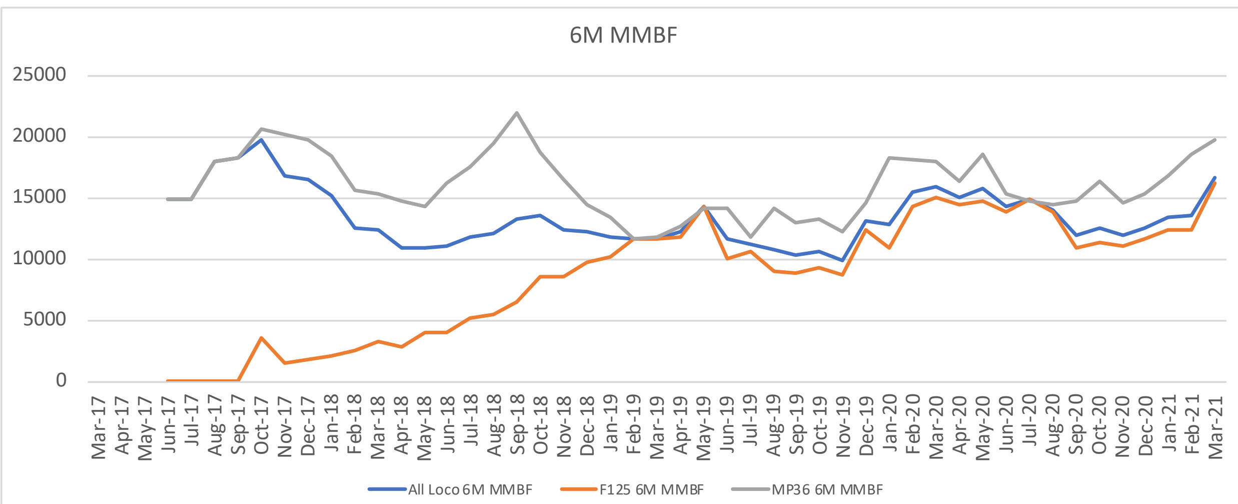


Figure 7.3 - MMBF - 1 Year

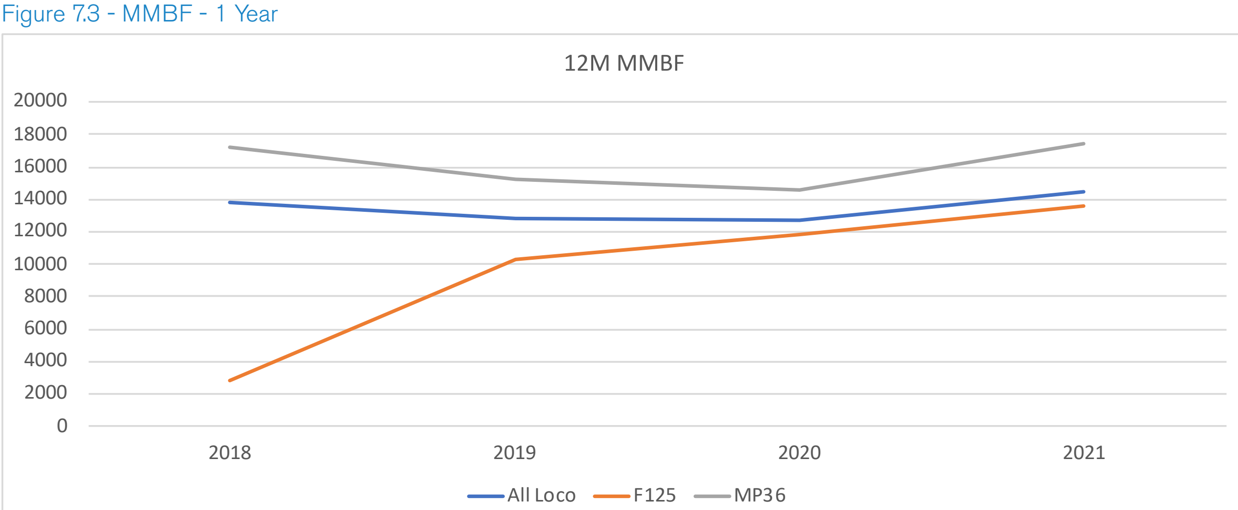
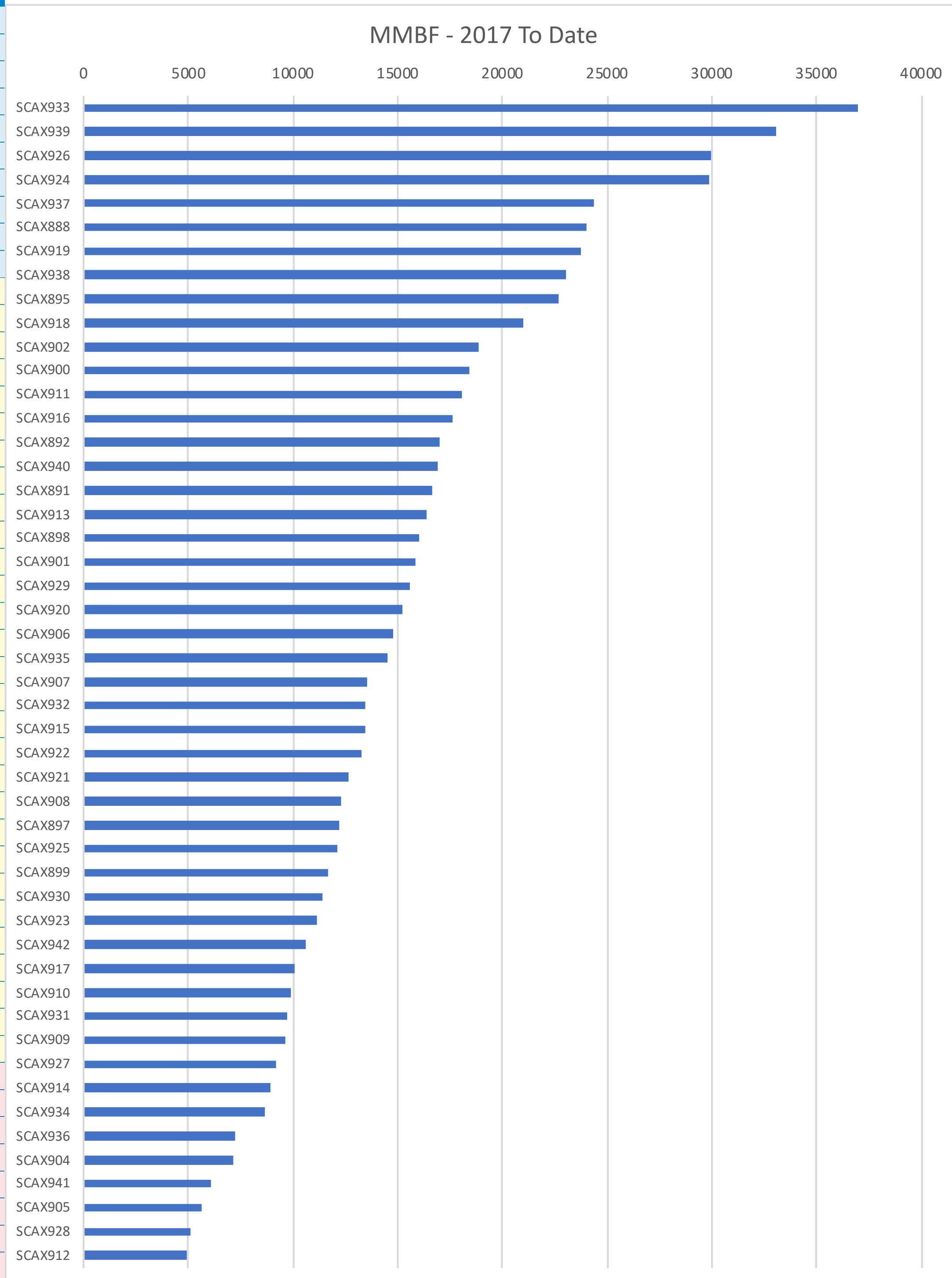


Figure 7.4 - MMBF - All Locomotives

	Unit No.	MMBF
Top 20%	SCAX933	36934
	SCAX939	33063
	SCAX926	29981
	SCAX924	29865
	SCAX937	24360
	SCAX888	23999
	SCAX919	23792
	SCAX938	23009
	SCAX895	22716
	SCAX918	21030
Middle 60%	SCAX902	18887
	SCAX900	18384
	SCAX911	18029
	SCAX916	17623
	SCAX892	16990
	SCAX940	16920
	SCAX891	16618
	SCAX913	16415
	SCAX898	16055
	SCAX901	15863
	SCAX929	15557
	SCAX920	15228
	SCAX906	14804
	SCAX935	14548
	SCAX907	13502
	SCAX932	13454
	SCAX915	13418
	SCAX922	13261
	SCAX921	12656
	SCAX908	12258
	SCAX897	12202
	SCAX925	12114
	SCAX899	11648
	SCAX930	11388
	SCAX923	11141
	SCAX942	10648
	SCAX917	10036
	SCAX910	9913
	SCAX931	9699
Bottom 20%	SCAX909	9595
	SCAX927	9161
	SCAX914	8907
	SCAX934	8653
	SCAX936	7241
	SCAX904	7147
	SCAX941	6076
	SCAX905	5658
	SCAX928	5093
	SCAX912	4956



Formulas used:

MMBF = SF / (IF RF > 0 THEN RF ELSE 1)

SF - Service miles

RF - Road failure during service that resulted in a lost train (delay > 5 min.)

Figure 7.5 - MMBF - F125

	Unit No.	MMBF
Top 20%	SCAX933	36934
	SCAX939	33063
	SCAX926	29981
	SCAX924	29865
	SCAX937	24360
	SCAX919	23792
	SCAX938	23009
	SCAX918	21030
Middle 60%	SCAX911	18029
	SCAX916	17623
	SCAX940	16920
	SCAX913	16415
	SCAX929	15557
	SCAX920	15228
	SCAX906	14804
	SCAX935	14548
	SCAX907	13502
	SCAX932	13454
	SCAX915	13418
	SCAX922	13261
	SCAX921	12656
	SCAX908	12258
	SCAX925	12114
	SCAX930	11388
	SCAX923	11141
	SCAX942	10648
	SCAX917	10036
	SCAX910	9913
	SCAX931	9699
	SCAX909	9595
	SCAX927	9161
Bottom 20%	SCAX914	8907
	SCAX934	8653
	SCAX936	7241
	SCAX904	7147
	SCAX941	6076
	SCAX905	5658
	SCAX928	5093
	SCAX912	4956

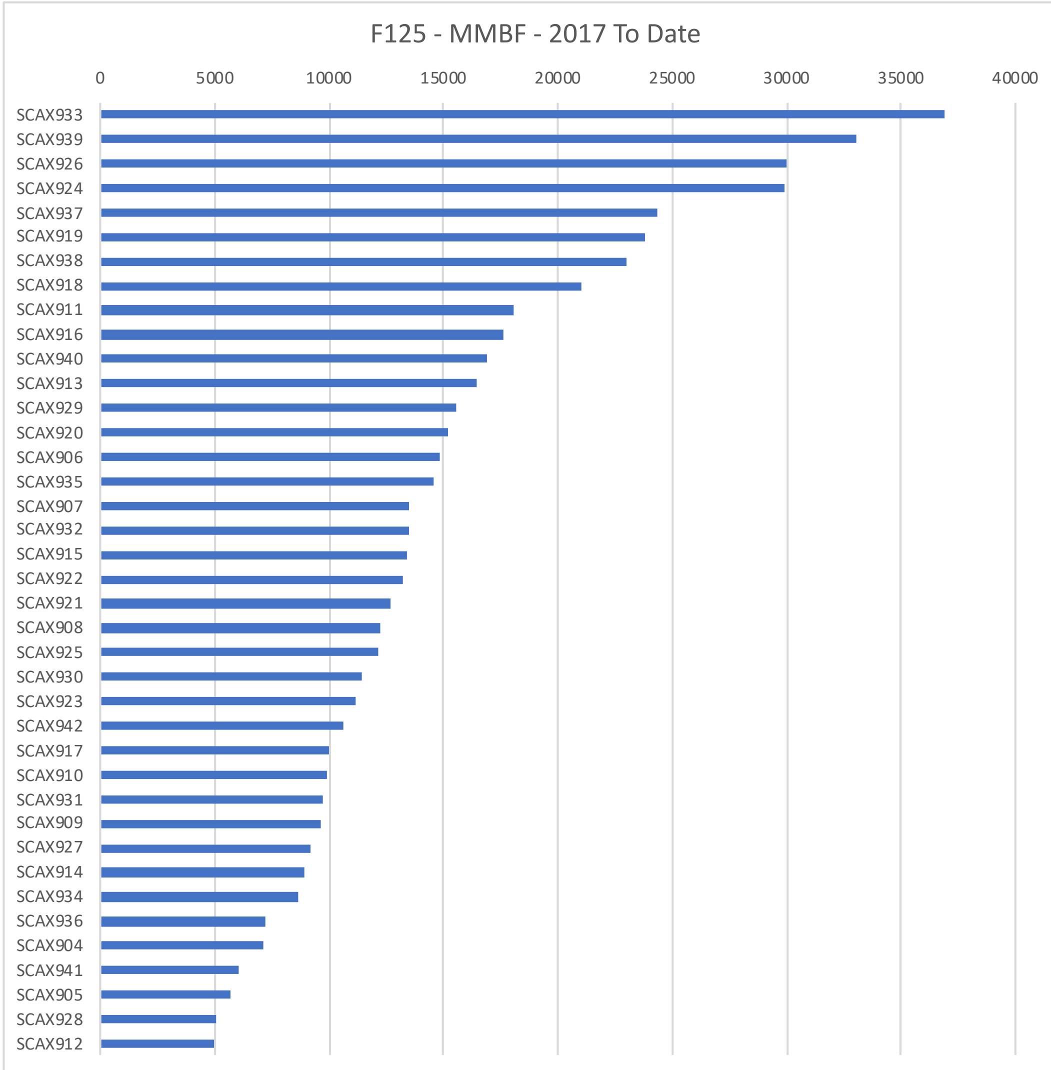
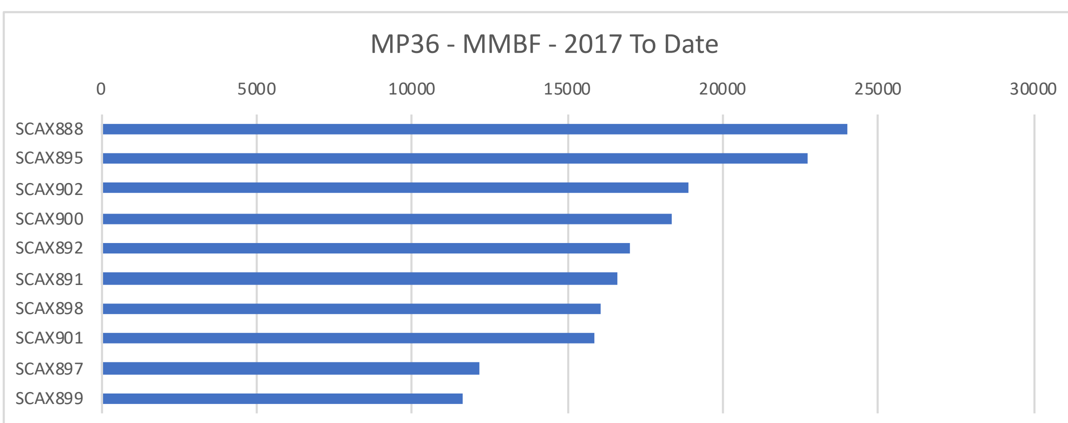


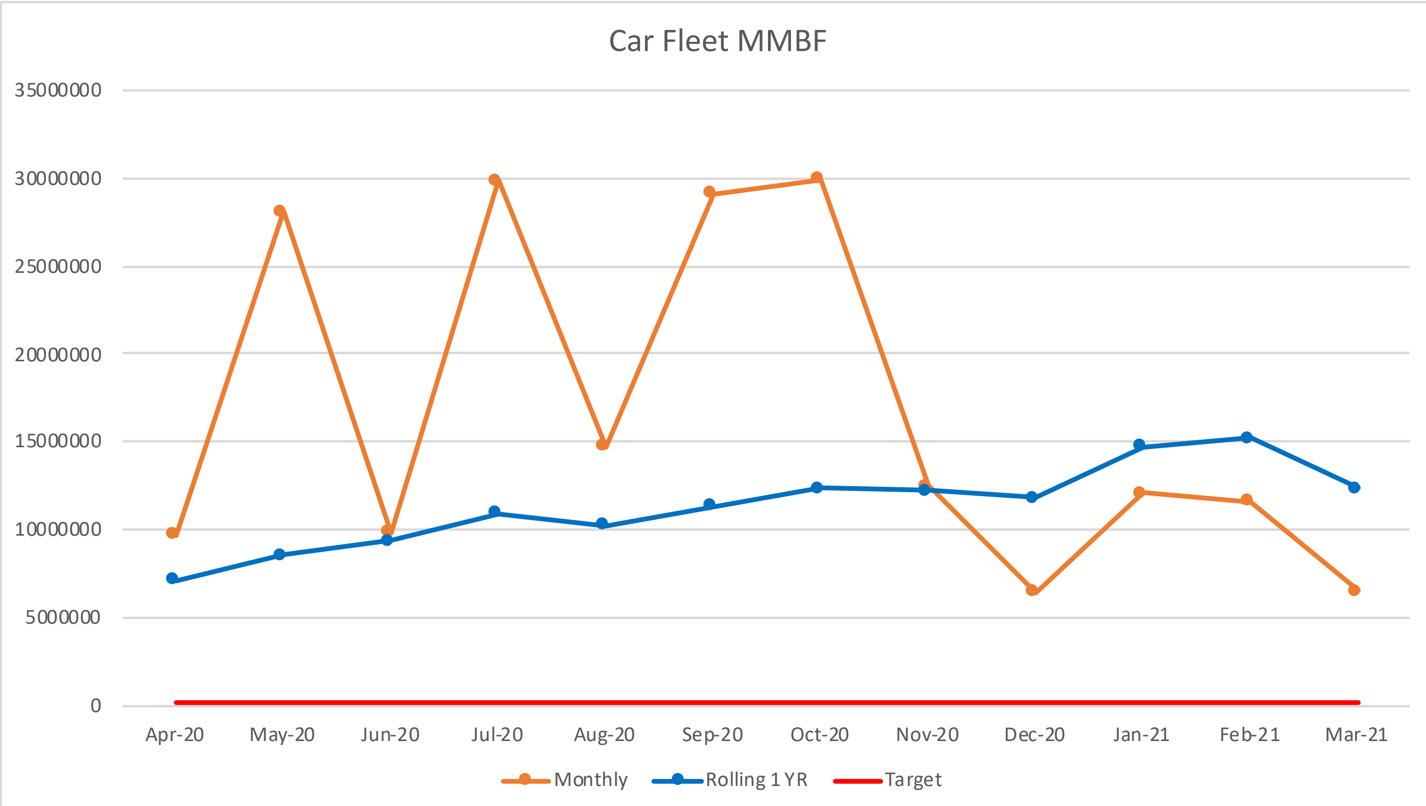
Figure 7.6 - MMBF - MP36

	Unit No.	MMBF
Top 20%	SCAX888	23999
	SCAX895	22716
Middle 60%	SCAX902	18887
	SCAX900	18384
	SCAX892	16990
	SCAX891	16618
	SCAX898	16055
	SCAX901	15863
Bottom 20%	SCAX897	12202
	SCAX899	11648



7.3.2 Passenger Coaches MMBF

Figure 7.7 - MMBF - Coaches



7.4 Future Maintenance and Operations Practices

Metrolink maintenance activities are constrained by the physical limitations and noise restrictions of the CMF and location of the EMF, impacting the efficiency and flexibility to inspect, service and maintain the rolling stock fleets. Incremental changes are recommended for implementation to enhance the productivity of the maintenance contractor and increase the availability and reliability of the fleet.

The below steps are recommended:

- Daily activities should be decentralized to outlying points on lines where daytime service is warranted or desired (reducing congestion at the CMF).
    - Less wear and tear on equipment for unnecessary travel.
    - Reduces fuel and other consumable consumption.
    - Implement fueling, DEF, lubing and other activities.
    - Cleaning and toilet dumping.
    - Noise impact reduction at the CMF.

- PM and shop activities concentrated at a central facility (CMF)
    - Reorganize CMF for more efficient maintenance and repair activities.
        - Shop Tracks
        - Locomotive Shop
        - Yard / Storage Tracks
        - Carwash
        - Materials Warehouse / Storage
    - Implement balanced maintenance workplans.

    - Heavy repairs
    - CB/LCM activities
  - Implement capital improvements.
    - Catwalks
    - Computerized Maintenance Management System
  - Skilled workforce concentration

- Consist-style Maintenance
  - Vehicles with the same inspection schedules allow for entire train inspections and minor maintenance activities to be performed more efficiently, also reducing congestion at the CMF.
  - Limits on the need for daily train make-up and streamlines activities at the CMF, EMF and outlying points.
  - More efficient train operations
    - Consists can be aligned for ridership by line segment.
    - Reduces train movements within yards and shops.
    - Reduced labor requirements.

- Construct satellite shops at select outlying points (EMF, OCMF, etc.) for frequent and less complex activities (e.g., 90-day or one-year inspections).

- Rebalance work activities - daytime vs nighttime service:
  - Servicing equipment during the daytime reduces equipment availability for revenue service.
  - Servicing equipment at night improves operational efficiency:
    - Reduced non-revenue train operations throughout the system.
    - Increased capacity for service enhancements.
  - Most daily servicing already occurs at outlying points, except fueling and DEF.

8 SCORE & NEW SERVICE INITIATIVES

Southern California Optimized Rail Expansion (SCORE) is Metrolink's $10 Billion Capital Improvement Program that is intended to upgrade the System in time for the 2028 Olympic and Paralympic Games being held in the Los Angeles Region. Segments of the plan include improvements to grade crossings, stations, the signal system, adding track segments and accelerating Metrolink's progress towards a zero emission future.

SCORE projects will be completed starting in 2023 with the full program completed by 2028 and will lead to improvements in emission reductions. Further improvements in environmental. See Section 10 for fleet-related requirements related to the SCORE Program.

WITH SCORE THE REGION GETS MORE:

- MORE SAFETY IMPROVEMENTS
- MORE PREAK AND OFF-PEAK RAIL SERVICE
- MORE ACCESS TO JOB CENTERS AND AFFORDABLE HOUSING
- MORE SEAMLESS CONNECTIONS TO OTHER RAIL PROVIDERS
- MORE JOBS AND ECONOMIC DEVELOPMENT
- MORE ACCESS TO DEALTHIER AIR FOR ALL

MORE SAFE, RELIABLE SERVICE

SYSTEM UPGRADES WILL ALLOW 35.5 MILLION NEW RAIL TRIPS WHEN RIDER DEMAND AND FUNDING IS AVAILABLE TO INCREASE SERVICE

MORE AIR QUALITY IMPROVEMENTS

3.4 BILLION VEHICLE MILES TRAVELED REMOVED DECREASING GREENHOUSE GASES BY 51.6 MILLION METRIC TONS

MORE SAFETY

CROSSING AND SIGNAL IMPROVEMENTS FOR THE ENTIRE SYSTEM

MORE CARS OFF THE ROAD

METROLINK REMOVES THE EQUIVALENT OF AT LEAST 2 LANES OF TRAFFIC ON ADJACENT FREEWAYS

MORE JOBS AND ECONOMIC DEVELOPMENT

1.4 MILLION JOBS AND $684 BILLION IN GROSS REGIONAL PRODUCT ADDED TO SOUTHERN CALIFORNIA'S ECONOMY

MORE QUIETZONE-READYCORRIDORS

TRAIN HORNS CAN BE REDUCED AS CROSSINGS ARE UPGRADED

MORE DEDICATED FREIGHT TRACKS

CARGO DELAYS REDUCED: SPEEDS INCREASED TO SUPPORT TRADE

MORE STREAMLINED OPERATIONS

ADDING TRACK REDUCES TRAIN DELAYS AND IDLING DUE TO CAPACITY LIMITATIONS

9 VEHICLE TECHNOLOGY ASSESSMENT

An assessment of various vehicle technologies was undertaken to identify and recommend feasible alternative propulsion technologies to reduce greenhouse gases and criteria pollutants while improving train performance. The assessment undertakes an analysis of eight different fleet technology scenarios to compare the costs and benefits associated with each technology type. The results of this analysis will facilitate the development of an in-depth Pilot Implementation Plan to provide real-world testing of different equipment with the aim of identifying preferred rolling stock, technology, supporting infrastructure, and timeline for when equipment procurements and maintenance updates need to occur.

9.1 State of Alternative Propulsion Technology

Various alternative propulsion technologies and vehicle types were identified to help inform fleet planning and recommendations for the Metrolink fleet. The sections that follow delve into the current state of development of these technologies in the context of both locomotive hauled coach and rail multiple unit passenger rail applications.

These technologies were divided into three main categories; low emissions which produce fewer emissions than OEM standards; zero emissions which produce no criteria pollutants and reduce Well-to-Wheels (WTW) greenhouse gases; and hybrids which combine various fuels and propulsion systems to produce fewer emissions. The WTW concept is characterized by the energy impact and emissions that occur throughout the life cycle for any fuel. For example, the primary energy change for electric vehicles occurs at the power plant (e.g. natural gas power station and the electricity is transmitted to the train, which leads to zero emissions during operation at the point-of-use). However, emissions are released in the extraction and transportation of the natural gas and its combustion in the power station. The various technologies under each of these categories are summarized in Figure 9.1.

Figure 9.1 - Alternative Propulsion Technologies

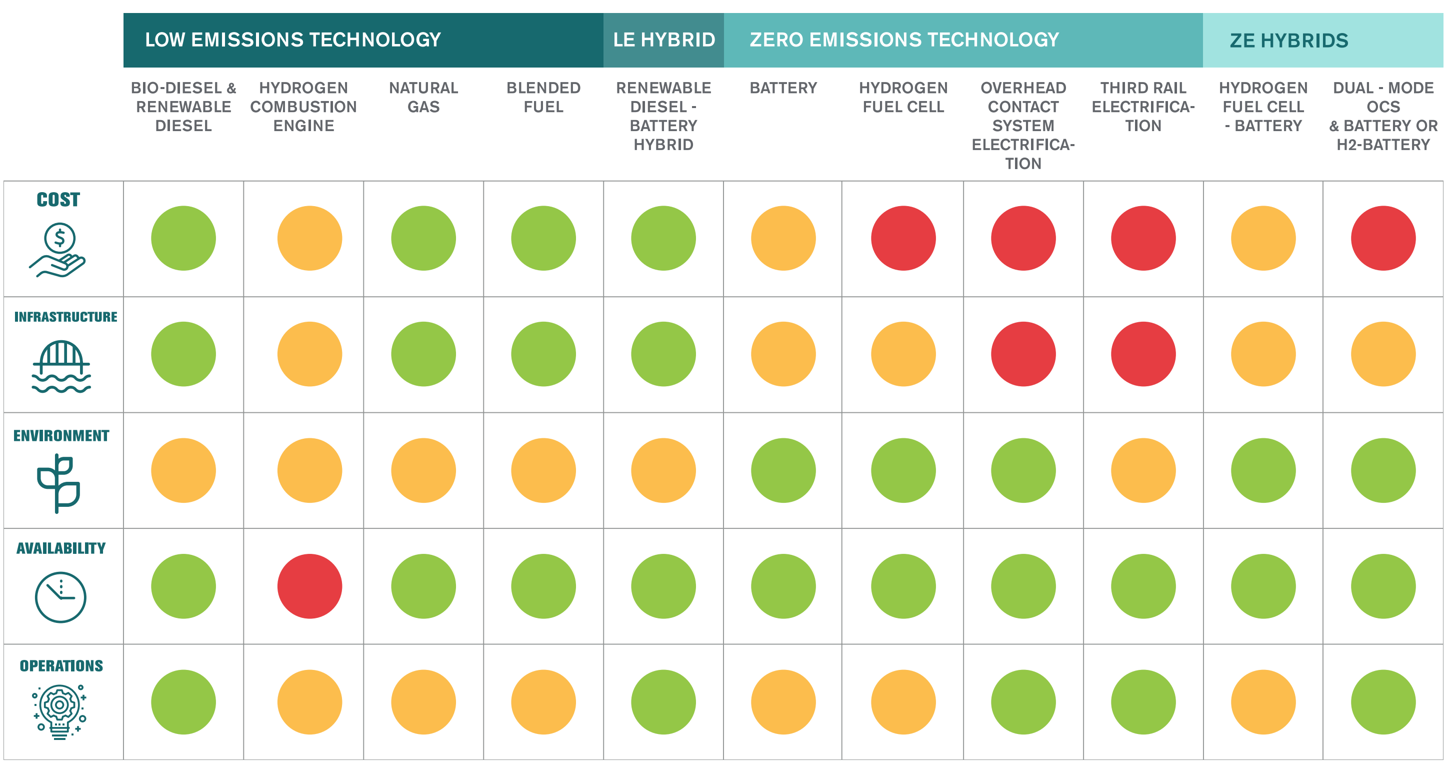
Low Emissions Technology	Zero Emissions Technology	Hybrid Technology
Biodiesel and Renewable Diesel	Continuous Overhead Contact System	Dual modes
Hydrogen Combustion Engine	Third Rail Electrification	Energy Storage
Natural Gas	Hydrogen Fuel Cell	
Blended Fuels	Battery	

The alternative propulsion options presented above provide a summary of the low and zero emission and hybrid technologies which are feasible for railway applications. These technologies are at various stages of development within the industry and in some cases require further advancements to be suitable for broader applications. A high-level evaluation of these low or zero emission technologies was completed as a part of SBCTA's ZEMU (Zero Emissions Multiple Units) Project to assess the suitability for the Redlands Passenger Rail Corridor. The outcome of this analysis demonstrated that the performance and benefit-cost ratio of some options did not meet SBCTA's goals. For this reason, many alternate propulsion options were screened out after SBCTA's first phase of technology evaluation process.

The results of previous studies, such as Metrolink's Fleet Modernization study, are being leveraged to inform the screening of infeasible technologies in Metrolink applications. Figure 9.2 presents a screening summary of these propulsion technologies. The scoring is based on a green-yellow-red scale, with green being the most feasible to red being the least feasible, in relation to the other options considered.

Low emission alternatives including hydrogen combustion, natural gas and blended fuels are less attractive in terms of emissions reduction and can present challenges for rail in terms of onboard energy storage. Overhead contact systems and third rail electrification are also not preferred given the integration issues with running a mixed fleet in the same corridor and exponentially high capital costs for implementation. However, there is less visual impact for third rail electrification when compared to OCS.

Figure 9.2 - Low and Zero Emissions Technologies Evaluation



9.2 Alternative Propulsion Challenges

As Metrolink moves forward to consider alternative fuel and propulsion technologies to achieve national and regional emissions goals and objectives, aspects such as energy, performance, range, refueling, required infrastructure improvements and maintenance can vary across the board. These aspects must be considered before any alternative technology can be recommended to identify the scope of improvements and infrastructure required for implementation as well as determine the compatibility with Metrolink as a system and as a national leader in achieving lower emissions. The following aspects were reviewed to help inform the compatibility with Metrolink and provide a framework to conduct a cost benefit analysis (CBA) of the most promising technology types:

- Current volumetric and gravimetric energy and power density of diverse options
- Well-to-wheel concept and implications
- Range and performance
- Refueling and recharging infrastructure
- Special handling, training, and maintenance
- Track, signal, and platform modifications needed

9.3 Propulsion and Vehicle Alternatives

In planning for Metrolink's future fleet outlook, the use of both alternative propulsion technologies and alternative vehicle types including different propulsion power train arrangements are being considered. The vehicle types were reviewed in a systemwide context as Metrolink looks ahead to operating a mixed fleet system:

- Locomotive hauled bi-level coaches: This configuration, utilizing high seating capacity bi-level passenger railcars, is suitable for non-electrified regional corridors where infrastructure constrains potential higher frequency of service.

- Locomotive hauled single level coaches: Like the bi-level LHC, single level coaches are common amongst regional and intercity services throughout North America and worldwide. The clear disadvantage that single level coaches have compared to bi-level is in the seating capacity per car, and therefore seating capacity relative to train length.

- Bi-level multiple units: Bi-level multiple units combine the advantages of high seat capacity relative to train length, with the efficiency, performance, and redundancy of an integrated and distributed power propulsion system. Bi-level multiple units are not uncommon in the worldwide rail industry; however the vast majority are equipped with an on-board electric propulsion system supported by continuous wayside power supply (OCS). With the existing examples of bi-level multiple units configured as multiple electric units, these are not directly compatible with Metrolink's system. It is anticipated that should Metrolink pursue a bi-level multiple unit fleet, the vehicle design would be adjusted to include a power car within the trainset that holds the power generation and energy storage equipment.

- Single level multiple units: Single level multiple units are used throughout the world for passenger rail services, particularly in regional and intercity services. Single level multiple units are commonly arranged in various propulsion configurations, include electric (requiring OCS) propulsion, diesel-electric, diesel-mechanical, diesel-hydraulic, and more recently battery-electric and hydrogen-hybrid electric.

The framework for the cost benefit analysis will be based on the existing LHC fleet and will explore and compare the costs and benefits from deploying single level multiple unit trains. The use of single level multiple unit trains in the cost benefit analysis has two potential benefits that require further exploration: firstly, limiting the length of the semi-permanently coupled trainsets reduces the impact of converting traditional individual locomotive or coach maintenance facilities to multiple unit facilities; and secondly, it allows a standardized fleet the flexibility to efficiently service both high and low demand routes.

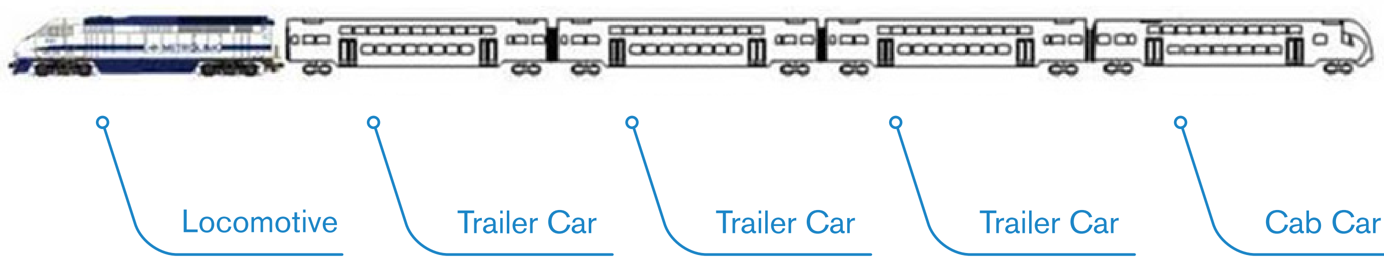
9.4 Cost Benefit Analysis

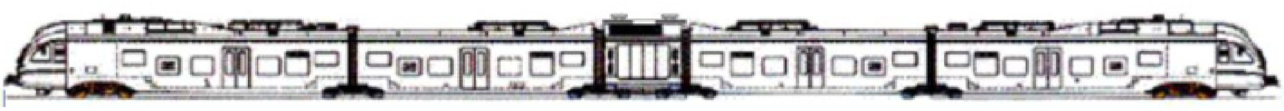
A high-level and systemwide assessment of the technology alternatives for Metrolink's future fleet planning efforts was conducted to provide order of magnitude cost estimates and benefits associated with the long-term implementation of alternative propulsion and zero emissions fleet technologies. This will provide guidance regarding potential long-term fleet goals that will be further assessed for implementation feasibility. To provide a true comparison of the technology impacts, the scenarios described below assume the current fleet will be replaced at the end of its service life such that capital costs relating to quantities of vehicles needing to be procured are a like for like representation:

1. Locomotive Hauled Coach / Diesel
2. Locomotive Hauled Coach / Diesel-Battery Hybrid
3. Locomotive Hauled Coach / Battery Only
4. Locomotive Hauled Coach / HFC-Battery Hybrid
5. Multiple Unit / Diesel
6. Multiple Unit / Diesel-Battery
7. Multiple Unit / Battery-Only
8. Multiple Unit / HFC-Battery Hybrid

Each scenario will assume a homogenized fleet of the consist type and propulsion technology listed, unless the range or performance of the technology may drive a train length limit, e.g., shorter train length on the AVL due to steep grades. For this level of analysis, a homogenized fleet is assumed to properly evaluate the performance of the technologies. It is understood that Metrolink may procure a mixed fleet and therefore further evaluation is recommended to assess mixed fleet scenarios to determine the appropriate combination of vehicle types and technologies to meet Metrolink's goals for their planned operations. The current assessment shall be a delta assessment of capital, operating and maintenance costs affected by the selection of propulsion technology or trainset type. For example, the delta does not include all the non-new technology costs (e.g., motors, running gear, brakes, etc.) where these are not a cost differentiator. The assessment provides "order of magnitude" level estimates of the following items for each scenario.

The locomotive hauled coach scenarios was comprised of a consist of 1 locomotive, 3 to 5 trailer coaches and 1 cab car. This is consistent with the consist evaluated within Metrolink's Locomotive Modernization Study such that data from that study are applied to the analysis.





The multiple unit scenarios will comprise a standardized consist of a 4 pasenger-car, 1 power car, articulated unit of a type consistent with SBCTA's ZEMU project such that the data from that project are applied to the analysis.

Figure 9.3 provides a summary of the major system characteristics for each scenario analyzed.

Figure 9.3 - Cost Benefit Analysis Scenario Overview

<table>
<tr><th>SCENARIO</th><th>1 LHC
LOCO
4-6 BI-LEVEL COACH
DIESEL</th><th>2 LHC
LOCO
4-6 BI-LEVEL COACH
DIESEL-BATTERY</th><th>3 LHC
LOCO
4-6 BI-LEVEL COACH
BATTERY ONLY</th><th>4 LHC
LOCO
4-6 BI-LEVEL COACH
HFC-BATTERY HYBRID</th></tr>
<tr><td>EQUIPMENT</td><td>500 miles of service between re-fueling
3.1 gal / mile avg. fuel consumption</td><td>580 miles of service between re-fueling
2.8 gal / mile avg. fuel consumption</td><td>100 miles of service between re-charging
34.5 kWh / mile avg. energy consumption</td><td>240 miles of service between re-fueling
2.8 kg / mile avg. energy consumption</td></tr>
<tr><td>OPERATIONS</td><td>58 locomotives & cab cars
222 coaches
46,000 gallons of diesel per day required</td><td>58 locomotives & cab cars
222 coaches
41,000 gallons of diesel per day required</td><td>115 locomotives
58 cab cars
222 coaches
527 MWh of electricity per day required</td><td>97 locomotives
58 cab cars
222 coaches
30,000 kg of hydrogen per day required</td></tr>
<tr><td>SERVICE DELIVERY</td><td>9.6 Daily Seat Miles
14,882 Daily Train Miles</td><td>9.6 Daily Seat Miles
14,882 Daily Train Miles</td><td>9.6 Daily Seat Miles
14,882 Daily Train Miles</td><td>9.6 Daily Seat Miles
14,882 Daily Train Miles</td></tr>
<tr><td>MAINTENANCE</td><td>No adjustments made as it is the benchmark case on existing technologies</td><td>Substantial increase in LCPM
1. Replacement (8yrs) of battery system
LPCM material costs reflect 30% downsized power unit</td><td>Substantial increase in LCPM
1. Replacement (5yrs) of battery system</td><td>Substantial increase in LCPM
1. Overhaul (7-10yers) and replacements (14-16yrs) of FC system
2. Replacement (8yrs) of battery system
3. Inspection & partial replacement of H2 tanks</td></tr>
<tr><td>INFRASTRUCTURE</td><td>No additional infastructure</td><td>1. Some upgrades of wayside power supply
2. Minor facility improvements</td><td>1. Charging via OCS at terminal/yards only
2. Upgrades to power supply
3. Significant facility improvements</td><td>1. Delivery or on-site production infrastructure
2. Significant facility improvements</td></tr>
<tr><td>COST ESTIMATE</td><td>Capital $1.5 billion
O&M $3.8 billion
TOTAL $5.3 billion</td><td>Capital $1.5 billion
O&M $3.7 billion
TOTAL $5.2 billion</td><td>Capital $2.6 billion
O&M $6.0 billion
TOTAL $8.6 billion</td><td>Capital $2.2 billion
O&M $5.3 billion
TOTAL $7.5 billion</td></tr>
</table>

Figure 9.3 - Cost Benefit Analysis Scenario Overview

SCENARIO	5 RMU 4-CAR SINGLE LEVEL COACH DIESEL	6 RMU 4-CAR SINGLE LEVEL COACH DIESEL-BATTERY	7 RMU 4-CAR SINGLE LEVEL COACH BATTERY ONLY	8 RMU 4-CAR SINGLE LEVEL COACH HFC-BATTERY HYBRID
EQUIPMENT	440 miles of service between re-fueling 1.6 gal / mile avg. fuel consumption	510 miles of service between re-fueling 1.4 gal / mile avg. fuel consumption	40 miles of service between re-charging 17.0 kWh / mile avg. energy consumption	350 miles of service between re-fueling 0.9 kg / mile avg. energy consumption
OPERATIONS	195 RMUs 69,000 gallons of diesel per day required	165 RMUs 59,000 gallons of diesel per day required	165 RMUs 717 MWh of electricity per day required	225 RMUs 39,000 kg of hydrogen per day required
SERVICE DELIVERY	9.6 Daily Seat Miles 42,241 Daily Train Miles	9.6 Daily Seat Miles 42,241 Daily Train Miles	9.6 Daily Seat Miles 42,241 Daily Train Miles	9.6 Daily Seat Miles 42,241 Daily Train Miles
MAINTENANCE	No adjustments made as it is the benchmark case on existing technologies	Substantial increase in LCPM 1. Replacement (8yrs) of battery system LPCM material costs reflect 30% downsized power unit	Substantial increase in LCPM 1. Replacement (8yrs) of battery system	Substantial increase in LCPM 1. Overhaul (7-10yers) and replacements (14-16yrs) of FC system 2. Replacement (8yrs) of battery system 3. Inspection & partial replacement of H2 tanks
INFRASTRUCTURE	1. Moderate facility upgrades	1. Moderate facility upgrades and minor facility improvements	1. Charging via OCS at terminal/yards + in-route changing at stations 2. Upgrades to power supply 3. Significant facility improvements	1. Delivery or on-site production infrastructure 2. Significant facility improvements
COST ESTIMATE	Capital $2.5 billion O&M $5.3 billion TOTAL $7.8 billion	Capital $2.3 billion O&M $4.7 billion TOTAL $7.0 billion	Capital $4.0 billion O&M $4.8 billion TOTAL $8.8 billion	Capital $3.4 billion O&M $6.3 billion TOTAL $9.7 billion

A mixed fleet of Locomotive Hauled Coaches and Rail Multiple Units will provide the most cost-efficient operation for Metrolink.

9.4.1 Results

The results of the initial eight cost analysis scenarios indicate that, irrespective of propulsion technology, the single level RMU is less expensive per operated mile than the bi-level locomotive hauled trainset, by a factor of at least two. Whereas the locomotive hauled consist is less expensive on a per seat mile basis, due to its higher passenger capacity. This supports a proposal that a mixed fleet of the two equipment types will provide the most cost-efficient operation for Metrolink.

The ridership predictions for SCORE Milestone 1B were analyzed to develop a fleet mix strategy based on operating the smaller, single-level MUs on less loaded equipment cycles, and retaining the locomotive hauled consists on the heavier loaded equipment cycles. As the RMUs were estimated to be typically at least half as expensive to operate, Milestone 1B equipment cycles that contained peak passenger loading predictions that could be accommodated by up to two multiple units were exchanged from locomotive hauled equipment. Some equipment cycles were exchanged with a single RMU, rather than two coupled together. This approach results in 18 of the 50 daily equipment cycles being operated by multiple units.

From this ridership-based fleet mix, Scenarios 9 through 12 were developed to analyze the impact and efficiencies of a mixed vehicle type fleet for the 4 propulsion technologies modeled. Table 9.1 provides the relative fleet quantities based on the same methodology as described for CBA Scenarios 1 through 8, where useful range limits the ability of a single locomotive or multiple unit to deliver a full equipment cycle then additional vehicles are assumed to be needed.

Table 9.1 - Mixed Fleet Scenarios - Vehicle Quantities

	Daily Need				Spares				Total Fleet		
Scenario	Logo	Coach	Cab Car	RMU	Logo	Coach	Cab Car	RMU	Logo	Coach	Cab Car
9 - Diesel	32	147	32	29	5	15	5	5	37	162	37
10 - Diesel Battery	32	147	32	29	5	15	5	5	37	162	37
11 - Battery	64	147	32	29	10	15	5	5	74	162	37
12 - H2 Battery	54	147	32	40	9	15	5	6	63	162	37

Most notably, where infrastructure or facilities costs vary between the respective locomotive hauled and multiple unit scenarios, the demands for both have been considered, for example both terminal and in-route battery charging are required for the battery mixed fleet scenario. Conversely, where efficiency is gained by employing MUs, for example in reduced energy consumption, the infrastructure cost estimates were adjusted to represent the reduced system demand.

9.4.2 Technology Cost Trends

Technology studies and research indicated significant decreases in the price of Lithium Ion Batteries, HFCs, and hydrogen from 2020-2030. Within these two technologies, the automotive industry leads in maturity with transit buses and rail vehicles slightly behind. It should be noted that the requirements for heavier vehicles like trains are different for lighter vehicles like buses and EVs. In comparison, the operating speeds, duty cycles, range, required power is more demanding for locomotives and multiple units and can vary widely. However, trends for the prices of batteries and fuel cells for rail vehicles can be estimated using available information on buses and EVs.

In considering mixed fleets, implementing the alternative scenarios could potentially result in cost savings when compared to the existing LHC fleet as shown in Table 9.2.

Table 9.2 - Mixed Fleet Cost Reductions Compared to Locomotive Hauled Coach Fleet

Diesel	Diesel-Battery Hybrid	Battery	H2-Battery Hybrid
7.7	8.1%	16.9%	8.9%

9.4.3 Sensitivity Analysis Results

Cost projections calculated for the CBA Scenarios were used to develop cost estimates for scenarios 1 through 12 for the 2030 equivalent estimations of technology costs. The cost model reflects these changes primarily through vehicle capital costs and lifecycle preventive maintenance costs, as well as energy consumption costs in the case of hydrogen.

Table 9.3 provides results of the cost model for scenarios 1 – 4 and 9 – 12 comparing the original 2020 technology cost basis, with the adjusted technology cost rates. The model shows a significant decrease in vehicle life cycle costs for both the battery and hydrogen-battery hybrid scenarios, as well as reduced energy consumption costs for hydrogen. The cost reductions resulting in hydrogen-hybrid scenarios being slightly lower or equivalent to the diesel baseline scenario, regardless of the fleet mix, whereas the battery scenarios remain approximately 15% to 25% more costly.

Table 9.3 - Cost Model Scenarios 1 - 4 and 9 - 12

Iteam	1 LHC Diesel	2 LHC Diesel	3 LHC Diesel	4 LHC Diesel	9 Mixed Diesel	10 Mixed Diesel Batt	11 Mixed Battery	12 Mixed H2 Batt
2020 ESTIMATED TECHNOLOGY COST BASIS								
Capital Costs	$1.49 B	$1.53 B	$2.68 B	$2.18 B	$1.45 B	$1.50 B	$2.77 B	$2.18 B
O&M Cost (30yrs)	$3.83 B	$3.71 B	$5.96 B	$5.35 B	$3.46 B	$3.32 B	$4.33 B	$4.68 B
TOTAL	**$5.23 B**	**$5.24 B**	**$8.55 B**	**$7.52 B**	**$4.91 B**	**$4.82 B**	**$7.10 B**	**$6.85 B**
2030 PREDICTED TECHNOLOGY COST BASIS								
Capital Costs	$1.49 B	$1.47 B	$2.12 B	$1.82 B	$1.45 B	$1.45 B	$2.43 B	$1.88 B
O&M Cost (30yrs)	$3.83 B	$3.60 B	$4.48 B	$3.42 B	$3.46 B	$3.22 B	$3.29 B	$2.98 B
TOTAL	**$5.32 B**	**$5.07 B**	**$6.59 B**	**$5.24 B**	**$4.91 B**	**$4.67 B**	**$5.72 B**	**$4.86 B**

The sensitivity analysis indicates the potential for these new technologies to become cost competitive with diesel propulsion technologies in the next decade if the cost trend predictions hold relatively true. It is typical of the rail industry to lag other industries in the rollout of new technologies and in realizing cost efficiencies, due to typically lower market volumes. This is represented in the analysis for both 2020 and 2030 basis costs, however the proportional cost reduction based on other market costs has been utilized. This remains a significant uncertainty, and thus the analysis indicating cost "parity" by 2030 is only indicative.

9.5 Assessment of Future Fleet Planning

The technology assessment identifies various options for implementing alternative propulsion technologies, primarily for the purpose of reducing or eliminating harmful emissions. The system cost benefit analysis illustrates and quantifies the main costs and impacts that Metrolink would face in operating such fleets, and the sensitivity analysis further investigates the predicted cost changes over time as the technologies mature and increase in volume across various markets.

In considering the assessment and Metrolink's planned service growth milestones, this section discusses potential implementation scenarios for planning purposes. In lieu of clear emission goals over time, this section describes a reasonable approach to transitioning to zero emission operation based on service needs and existing fleet conditions.

9.5.1 Fleet Mix and Line Preference

The technology assessment conducted indicates that equipment cycles that require equipment providing a passenger capacity that can be accommodated by two or fewer of the rail multiple units assessed, will result in significant cost savings for Metrolink without reducing service levels. As such an attractive fleet mix to optimize cost efficiency to meet expanded service goals through the 2020's involves a fleet consisting of approximately 65 to 85 percent locomotive hauled bi-level coach trainsets, and up to 15 to 35 percent single-level rail multiple units. Based on Metrolink's ridership forecasts, this would predominately utilize rail multiple units on the Antelope Valley Line, the Perris Valley Line and the Riverside Line while retaining locomotive hauled bi-level coaches on all other lines. There was an investigation into energy consumption and passenger capacity for each line. The Ventura County Line turned out to be too high in ridership capacity to be feasible for single and double MU consists to replace LHCs (3-4 MUs coupled together would be needed to accommodate the Ventura County Line peak capacity requirements).

9.5.2 Replacement of Current Equipment

It is anticipated that Metrolink would replace current equipment as it reaches the end of its useful life. The replacement of the existing fleet with zero emission vehicles is an option if short term goals include emissions reductions. Short term application of zero emissions trains may be best achieved through the procurement of ZEMUs as these are the only available products currently in the marketplace.

Further into the future, replacement of Metrolink's current vehicles with equivalent capacity zero or low emission propulsion is expected to be more viable. No examples of zero emission passenger locomotive products of the capability needed by Metrolink currently exist, however pilot projects being conducted in the North American freight rail industry, such as BNSF's battery locomotive and Canadian Pacific's recently announced plan to pilot a hydrogen powered mainline locomotive, may pave the way to encourage OEMs in the passenger locomotive space.

9.5.3 Modification of Existing Equipment

Modifying existing equipment to low or zero emissions propulsion systems may become viable as the F-125 locomotives begin to reach the middle of their expected useful life in the mid-to-late 2020's when due for an overhaul. At this point in time, replacement of the on-board diesel engine and generator sets, with hydrogen fuel cell or battery technologies could be a viable option for fleet of this size. The modular and expandable nature of both batteries, fuel cells and hydrogen tanks combined with the minimal moving or rotating parts (typically limited to cooling equipment or compressors), should enable a re-power modification without the major structural or modal complications that would typically be a factor in changing to a different diesel engine. Re-power of Metrolink's MP36 or F-59 locomotives would also be viable options around this timeframe, as well as these making good candidates for earlier pilot projects, as discussed in the fleet implementation strategy.

9.6 Recommendations

9.6.1 Propulsion Technology and Fleet Type

The high-level technology assessment and cost benefit analysis conducted indicate the following:

- Battery and hydrogen-battery hybrid propulsion technologies are technologically feasible zero emission solutions for Metrolink. However, these technologies have range deficiencies relative to Metrolink's current fleet that cause additional fleet quantity requirements and operational complexities that may not make them viable in the short term.

- Significant fueling, charging and facilities infrastructure would be required to support either technology.

- Hydrogen-battery hybrid propulsion is estimated to be the most economical zero emission alternative. However this is estimated to increase Metrolink's fleet related costs (including fuel) by approximately 40 percent relative to diesel-based fleets at the current cost of technology. With costs decreasing relative to diesel over time, it is estimated that it could reach parity in the early to mid-2030's based on cost trend predictions from the automotive, commercial and transit bus industries.

- Battery propulsion is the next most economical zero emission alternative. This is estimated to increase Metrolink's fleet related costs by approximately 60 percent relative to diesel-based fleets at the current cost of technology, with costs reducing relative to diesel over time. Significant advancements in capability and longevity are needed to reach cost parity with diesel. A significant risk lies in the implementation of needed charging infrastructure that should be studied further before investments are made.

- In the short- to medium-term, diesel-battery hybrid propulsion is expected to be an economical means to further reduce emissions beyond Tier 4 levels, particularly if renewable diesel is used which would reduce WTW GHG emissions.

Additionally, the analysis indicated that the most cost-efficient fleet type for Metrolink's future service forecasts is a mixed fleet formed by 65 to 85 percent high-capacity bi-level coaches, and 15 to 35 percent smaller, lighter, single-level rail multiple units. The single-level multiple units would primarily be utilized for operating the Antelope Valley, Perris Valley and Riverside Lines. This assertion is qualified by the need to further study right of way infrastructure and facilities implications as discussed in the next steps below.

The RMU strategy offers the best opportunities for transitioning to zero or low emission vehicles in the near term, pending the infrastructure facility impacts study, as the market for lower capacity multiple units is much more advanced in terms of offering viable, if not yet proven, zero emission products. This analysis indicates that a hydrogen-battery hybrid propulsion technology provides the best economic zero emission solution, combined with easier expansion potential, however Metrolink may wish to embark on a staged transition to this kind of sub-fleet such as first employing Tier 4 diesel, or Tier 4 diesel-battery hybrids as a first step. This would assist in managing the timeline for requisite fueling and facility upgrades that would be needed to support hydrogen propulsion.

Zero emissions timeline can be advanced to achieve Climate Action Plan moonshot goal of 2028 if all stars align for funding and technological advancement.

9.6.2 Implementation Strategy

Based on the technology assessment, the following implementation strategy is recommended for Metrolink.

9.6.2.1 Short- to Medium-Term (2021 through 2028)

- In addition to the proposed RMU pilot, Metrolink should investigate undertaking pilot projects to re-power existing locomotives with zero emission equipment, as both a demonstration of technology capability at a locomotive scale and passenger application, as well as gathering critical performance, reliability and cost data to better inform Metrolink's future fleet plans.

- Based on the indicative preferred fleet mix, pending the infrastructure facility impacts study, near term procurements could be focused on smaller, lighter single-level RMUs. Zero emission products are under development, however, to mitigate risk in such a large change of both vehicle and propulsion type an initial implementation plan may be to procure diesel or diesel battery hybrids.

- Action is needed to plan for the continued reliable operation of the MP36 fleet, Metrolink staff will be returning to the Board with a recommendation for MP36 overhaul in spring 2021.

- If RMU sub-fleet is not pursued, there is potential to re-power MP36 or recently retired F-59 locomotives with zero emission equipment to meet near term demand growth.
- Metrolink should take steps to engage the marketplace and other agencies and operators to understand the size of the potential market for new zero emission passenger locomotives, and/or zero emission high capacity bi-level RMUs. This will aid Metrolink in positioning itself to achieve its long-term fleet needs for high capacity zero emission equipment, potentially through joint agency procurements or other partnership programs.

9.6.2.2 Medium- to Long-Term (2028 through 2040)

- Metrolink should use its learning from pilot zero emission RMU operation, locomotive pilot projects or small fleet implementations and market engagement to develop a procurement strategy for a large-scale procurement of high capacity zero emission vehicles (locomotive hauled bi-level coach or bi-level RMUs) to support expanded service and replace aging locomotive hauled coach fleets.

- Additional procurements of single-level zero emission RMUs will be needed to support expanded service at the desired fleet mix ratio.

9.6.3 Areas of Additional Future Assessments

- It is recommended that Metrolink perform a study of full or partial electrification to quantify the anticipated costs of such a system. It is expected that the capital costs will be excessive compared to those scenarios studied here, however the whole of life system costs should be studied to put capital costs in perspective. Metrolink's significant longer-term service and frequency growth may justify investment in an electrified system.

- Detailed route modeling to confirm the preferred technology type and capability for each route of the high-level assessment holds true. Assess whether there is benefit to multiple / mixed propulsion technology types.
- Assessment of scope of modifications for infrastructure, maintenance facilities and yards for technology related upgrades.
- Assessment of scope of modifications for infrastructure, maintenance facilities and yards for RMU related upgrades.
- Assessment of hydrogen volume requirements and feasibility of fueling locations
- Assessment of other Metrolink infrastructure risks for hydrogen implementation, such as tunnel ventilation upgrades.
- If battery technology is to be pursued, detailed assessment of charging infrastructure needs, feasibility of locations for sub-stations and engagement with a utility grid provider to understand grid limitations and potential utility upgrade requirements.
- Investigation to clarify potential signaling / shunting upgrades for operation of RMU vehicles with lighter axle loads and less axle count.

PART 4

FUTURE FLEET AND FACILITIES

10 PLANNING FOR FUTURE FLEET AND FACILITY NEEDS

10.1 Fleet Requirements for Planned Service Requests and Funded Capital Projects

Future expansion of fleet and facilities is largely defined by the SCORE Program, the first phase of which is funded by $2 billion in grants with construction and a service phase-in expected to extend through 2028. To understand operational needs, the size of fleet, and nature of facilities modifications needed, a Cost Benefit and Operations Analysis (CBOA) was prepared. The CBOA helps SCRRA and its member agencies understand the levels of system-wide regional rail service enabled by the funded (and future unfunded) projects and the costs, benefits, and cost-effectiveness associated with those service increases. However, the CBOA does not commit SCRRA or its member agencies to run a predetermined level of service when that capacity is created.

The CBOA evaluated three incremental packages of infrastructure projects and analyzed the associated conceptual systemwide train schedules that provide a potential framework for maximum service frequencies and desirable service patterns. These scenarios constitute the “Milestones” analyzed in the CBOA with the results reported by line and at a system level. Analysis of the milestones captured results of progressive steps toward an ultimate build-out of the SCORE program.

Milestones in the CBOA are grouped around sets of track infrastructure improvements and conceptual train schedules, as well as assumptions related to service levels, train crews, equipment, maintenance facilities, and shared use agreements. Though milestones had to be associated with an analysis year for modeling purposes, they are not absolutely locked into a single year with respect to service deployment. Milestones represent a reasonable goal for potential service.

Table 10.1 - SCORE Milestone Timeframes

Milestone	Description	Potential Time Frame
1A	Partial SCORE Phase 1	2024-2026
1B	Full SCORE Phase 1	2027/2028
2	30 Minute Service on All Lines (i.e SCAG 2020 Regional Transportation Plan)	With new infrastructure, leading up to 2035

The conceptual train schedules for each of the three milestones included in this operational analysis were developed to meet or approach service patterns that complement SCRRA’s guiding principles for customer-friendly service:

Figure 10.1 - Guiding Principles for Customer-Friendly Service

- Regular - Service at regular intervals (e.g., every 30 minutes)
- Repeating - Service repeats at same time every hour (e.g., 8:10 a.m., 9:10 a.m.)
- Pulsed - Service schedule is synchronized to facilitate transfers
- Bidirectional - Service is balanced in both directions
- Reliable - Service schedule is consistently achievable at all stations

Milestone 1B represents the full implementation of Phase 1 of the SCORE program and requires 50 trainsets daily to operate all the planned service, not including spares (discussed later). This is 10 more than the 40 trainsets operated in 2019 and three to four more than the 46-47 daily sets the current fleet is sized to support.

Train consist lengths vary from 4- to 6-car consists on the routes based on passenger demand and equipment availability (see Section 3.2 for route information.) This scenario assumes fueling can be performed at the OCMF, Lancaster Layover Facility and, preferably, South Perris. If this does not come to fruition, additional equipment sets will be required for future service expansions beyond the counts above.

Milestone 1A represents a potential phasing in of improvements between the present and the full Phase 1.

As part of Phase 1, Los Angeles Union Station will undergo improvements to the track layout as part of the LinkUS project.

LINK US is a historic project that will impact the region by modifying the current stub-end station, currently serving all regional (Metrolink) and intercity (Amtrak) trains, requiring all trains to enter and exit LAUS through five station lead tracks – resulting in customer transfers, train idling and additional station dwell times. The project will meet the demands of the region by:

- Increasing the regional and intercity rail service capacity
- Improving schedule reliability via run-through tracks and elimination of the stub-end tracks
- Preserving freight operations
- Accommodating the planned high-speed rail service
- Increasing passenger / pedestrian capacity
- Installation of a new passenger concourse

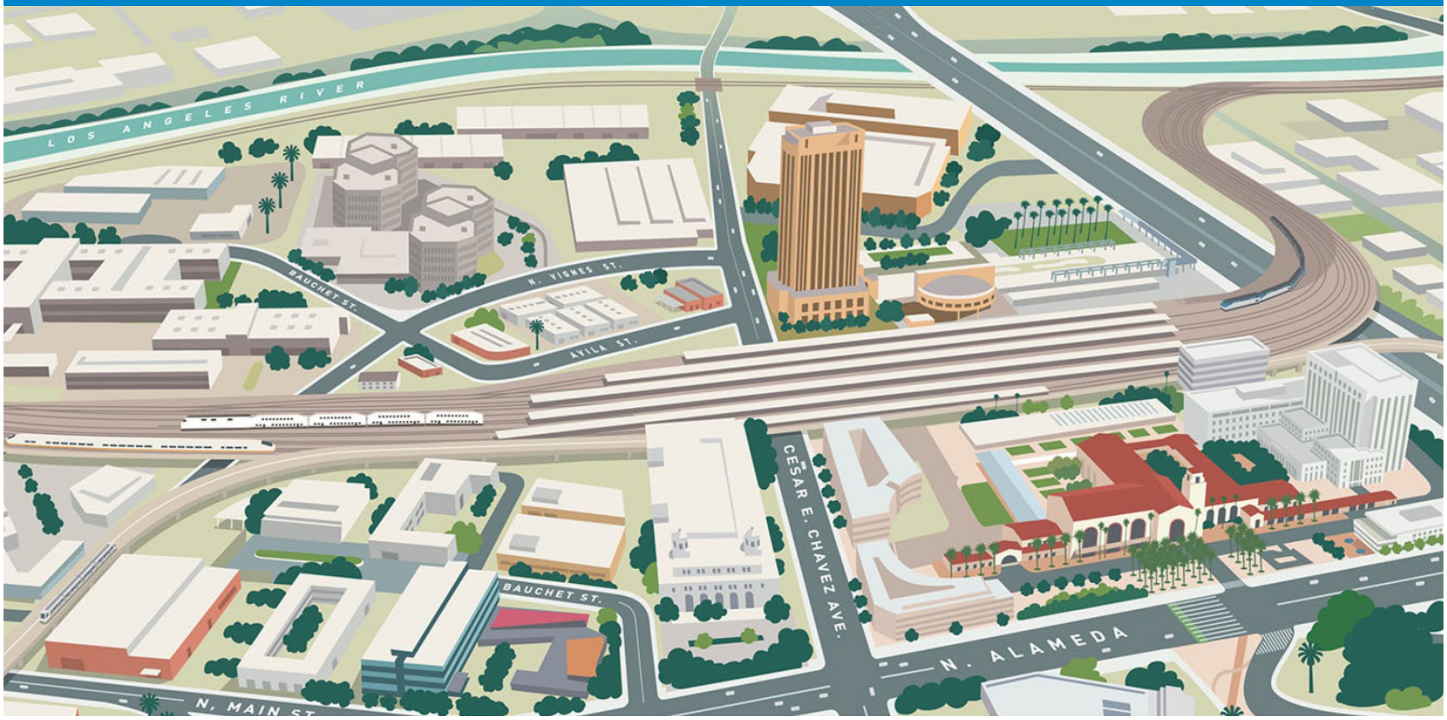
The Link US project is broken into Phases A and B. Phase A is fully funded and broken out into three sections, while Phase B is currently unfunded. Major project elements by Phase are shown in Figure 10.4. Run-through tracks as part of Phase A are illustrated in Figure 10.5. The project is currently in the environmental review phase.

Figure 10.12 - Link US Phases

Phase A - Funded			Phase B - Not Funded
SEGMENT 1 – THROAT AREA	SEGMENT 2 – COMMERCIAL & CENTER ST	SEGMENT 3 – VIADUCT & RUN-THROUGH	SEGMENT 4 – RAIL YARD / CONCOURSE AREA
1. Rail signal, communications and track work 2. Utility relocation	1. Property acquisition 2. Utility relocation 3. Street and ATP improvements	1. Viaduct structure over US-101(full width) and south of US-101 to 1st street 2. Two run-through tracks from Union Station Platform 4 to mainline tracks 3. signal and communication	1. Raising of the rail yard, including new platforms and tracks, new stairs, escalators and elevators, and new bridges over Cesar Chavez Avenue and Vignes Street. 2. Proposed modified expanded passageway, uncluding Rast and West Plazas 3. Add remaining run-through tracks and new lead track in the throat

Figure 10.13 - LAUS Run-Through Tracks Rendering

Preliminary Rendered Cocept of Two run-through track operation on Platform 4



Milestone 2 represents the full implementation of the SCORE program and requires as many as 92 trainsets daily to operate all the planned service, not including spares, by 2035. Estimates of the additional fleet required for service growth above Milestone 1B, but below Milestone 2, are shown in Table 10.2.

Milestone 1B, with completion of the Link US project, further integrates the Metrolink network while introducing new regional mobility options. The through-tracks planned as part of the Link US project would be able to provide one-seat rides[7] on combined routes, serving both suburb-to-downtown and suburb-to-suburb regional travelers through LA Union Station in Southern California.

As shown in Table 10.3 each milestone would enable systemwide increases in service, as indicated by the percentage change in weekday revenue trains and in revenue train miles. The increases in service are accompanied by forecasted gains in ridership with Milestone 2 estimated to result in a systemwide ridership increase of 166 percent over the 2019 baseline ridership (pre-COVID levels).

It should be noted that the forecasted ridership levels below flirt with the capacity limits of a 6-car consist of some peak trains. If ridership exceeds these forecasts Metrolink will need to consider running longer trains, which would require acquiring additional trailer cars. Additionally, these ridership levels reflect the market potential of reverse peak and off-peak services, which may require higher-capacity trainsets to effectively serve the growing customer base.

[7] With current stub-end tracks at LAUS, all trains passing through LAUS must stop and passengers must alight. With the provision of through-tracks, a stop at LAUS would be treated like a typical Metrolink stop and passengers would be able to continue on their journey on the same train.

Table 10.2 - Daily Revenue Service Equipment Increases between Milestones 1B and 2

Milestone	Weekday Trainsets (not including spares)
2019 Baseline (Observed)	40
Milestone 1A	44 (10% increase from Baseline)
Milestone 1B	50 (25% increase from Baseline) (3 of 50 can be potential RMU application)
1B + SB Line 30 min (Both Ways All Day)	+3*
1B + 91/PVL peak/reverse/off-peak 30 / 60 / 60-120 min 30 / 30 / 60-120 min	+4 +5
1B + OC Line Peak/reverse/off-peak 30 / 30 / 60-120 min	+1
1B + IEOC Peak/reverse/off-peak 60 / 60 / 120 min 30 / 60 / 60-120 min 30 / 30 / 60-120 min	+1 +4 +5
…	…
Milestone 2	92 (130% increase from Baseline)

* Potential deployment of rail multiple units (RMUs)

10.2 Rail Multiple Unit Viability

Metrolink also reviewed the viability of using RMUs in lieu of traditional locomotive hauled coach trainsets (see Section 9.4.) from a passenger-carrying perspective. Several candidates emerged for the use of this equipment including:

- One to three train cycles on the Antelope Valley Line to Santa Clarita
- One cycle between Moorpark and Los Angeles (VCOC)
- One to two cycles on the 91 / Perris Valley Line
- One cycle on the San Bernardino Line (if a five-car DMU is used).

There are certain considerations that need to be made with using this vehicle type, such as the need to rotate equipment between outlying yards and the CMF (or the designated RMU maintenance facility), passenger comfort and convenience (seating, restroom facilities), performance potential, station platform and vehicle interface, and compatibility with a line's signal system (ability to shunt).

Table 10.3 - CBOA Service and Ridership Statistics

Cost-Benefit & Operations Analysis: Systemwide Service & Ridership Statistics by Milestone

Milestone	Weekday Revenue Trains	Annualized Weekday Revenue Train Miles	Weekday Trainsets	Weekday Crews*	Weekday Ridership
2019 Baseline (Observed)	167	2,489,540	40	50	41,750
Milestone 1A	206 (23%)	3,204,151 (29%)	44 (10%)	75 (50%)	53,550 (30%)
Milestone 1B	224 (34%)	3,795,038 (52%)	50 (25%)	95 (79%)	73,030 (75%)
Milestone 2	454 (172%)	9,575,414 (285%)	92 (130%)	229 (258%)	109,200 (166%)

Notes: Percentages in table reflect comparison to 2019 Baseline.
* A crew includes one (1) engineer and one (1) conductor.

An RMU would need to be at least four cars in length to accommodate passenger loads (note exception on the San Bernardino Line). A five-car trainset would provide more versatility within the SCRRA fleet and provide options to implement Milestone 1B by replacing some of the locomotive hauled trainsets and /or allow for modification of the traditional trainset consist sizes.

RMUs can experience issues with shunting when operating on mixed corridors (where both light and heavy trains operate) due to the vehicles not being heavy enough to shunt and properly trip signals. RMUs were not cleared to operate in mixed corridors (where both light and heavy trains operate) initially due to the vehicles not being light enough to shunt and properly trip signals. For example, track circuit shunting is impaired by the presence of any sort of barrier between the rail and wheel. Rust, sand, crushed leaves, top-of-rail lubricants, etc., prevent low resistance electrical contact between the wheel and rail. This well-established phenomenon is somewhat remarkable in view of the very high contact pressure between the wheel and rail, where the contact patch between the wheel and rail is less than the size of a dime. An insulating film at the wheel-rail interface in combination with light axle loads can result in poor shunting performance. Additionally, wheel profile, railhead profile, track curvature, gauge, etc., each play a role in shunting performance. These factors are usually unknown or uncontrolled, but there are mitigation measures such as high-rail vehicles with brushes that can remove the debris.

Future study is needed to determine the compatibility of modern, lighter RMUs with Metrolink's aging signal system which was designed to detect heavy freight trains and not lighter passenger trains. Metrolink plans to conduct a focused study on this and other infrastructure factors to determine the level of investment needed to enable Metrolink's signal system to safely and reliably detect lighter and more fuel-efficient equipment such as RMUs. It is possible, perhaps even likely, that on some lines this level of investment may be so great as to make RMUs unviable in the short to medium term. Longer term, next-generation signal system upgrades may also help with this detection issue – but as those technologies are still in development the specifics are unknown.

Similarly, any deployment of new fleet types would need to involve an operating plan that addresses maintenance needs and other particularities to the new equipment.

10.2.1 Platform-Vehicle Interface

Metrolink serves 62 stations across seven lines and six counties – nearly a third of which are shared with other passenger rail systems such as Amtrak and COASTER. This, today, involves three different vehicle floor heights and two different platform heights. When RPRP Service begins in 2022, Metrolink and RPRP DMUs will share two stations on the corridor - introducing a third platform height to the system.

These three platform heights are:

- 8-inches as the Metrolink standard (Figure 10.13),
- 15-inches at the more recent Anaheim and Oceanside Stations (Figure 10.14);
- and 23.5-inches at RPR stations. The RPR stations where both Metrolink and RMUs will serve will have two separate platforms, at 8-inches and 23.5-inches, respectively.

Metrolink's existing Bombardier and Rotem-built passenger cars have a floor height of 25 inches Above Top Of Rail (ATOR), similar to the 24 inches ATOR of the new DMUs for RPRP. Coaster also uses the same type of Bombardier cars, as do most "young" commuter rail systems in North America. Amtrak, however, operates two different floor heights in the region – very low and high floor vehicles.

This diversity in vehicle floor and platform heights already creates a challenge for effectively serving our collective passengers – especially those unable to traverse steps.

Figure 10.2 - CPUC Side Clearance

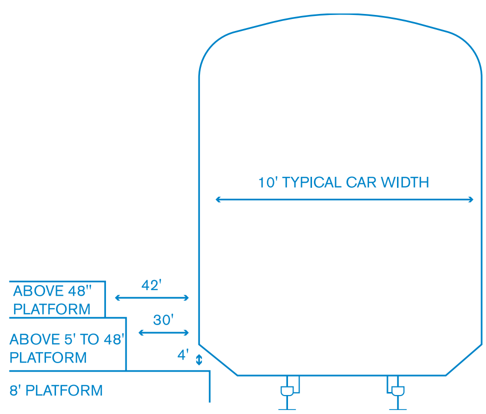
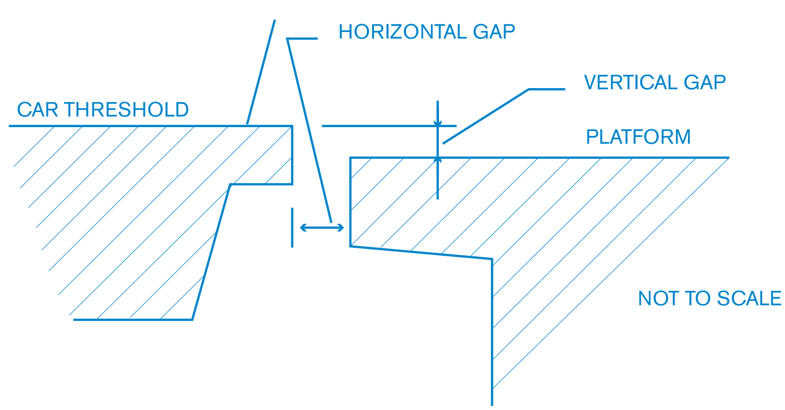


Figure 10.3 - ADA Level Boarding



At station platforms there are two competing requirements for the passenger-platform interface and maintaining freight traffic at Metrolink stations:

- California Public Utilities Commission requirements for side clearance, which specifies the minimum offset from the center line of the adjacent track to the track side structures. The platform is pushed away from the passenger vehicle envelope so that there is a safe passing clearance for wider freight vehicles. See Figure 10.2.

- Federal Transit Administration (FTA) and American with Disabilities Act (ADA) requirements for level boarding, which requires level boarding at new passenger rail stations to provide level-entry boarding to all accessible cars in each train using the station (all new cars are required to be accessible). Level boarding is defined as a door threshold to-platform interface that has a horizontal gap of less than three inches and a vertical height difference of no more than +5/8 inch. See Figure 10.3.
- For commuter, intercity, and high-speed rail platforms: level-entry boarding means a boarding platform design in which the horizontal gap between a car at rest and the platform is no more than 10 inches on tangent track and 13 inches on curves and the vertical height of the car floor is no more than 5.5 inches above the boarding platform. Where the horizontal gap is more than three inches and/or the vertical gap is more than 5/8 inch, measured when the vehicle is at rest, the horizontal and vertical gaps between the car floor and the boarding platform must be mitigated by a bridge plate, ramp, or other appropriate device consistent with 49 CFR 38.95(c) and 38.125(c).

Figure 10.4 - Metrolink 8" Platform

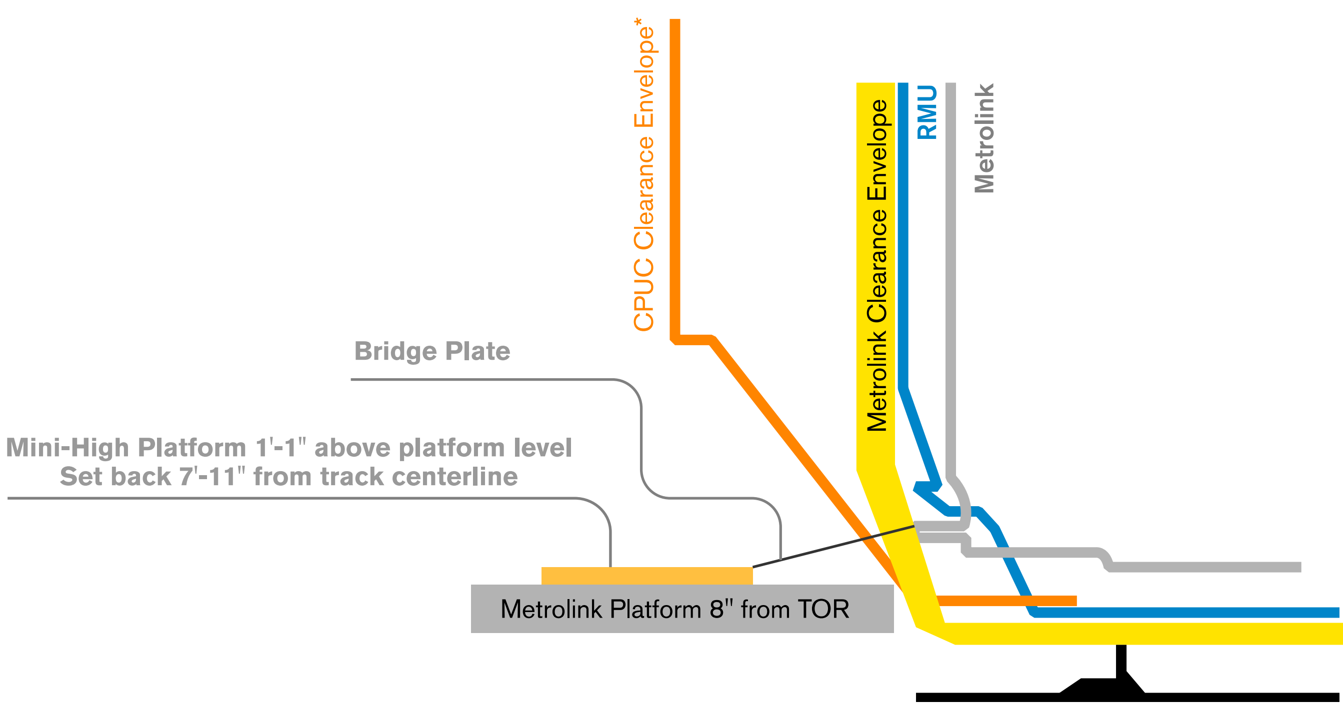
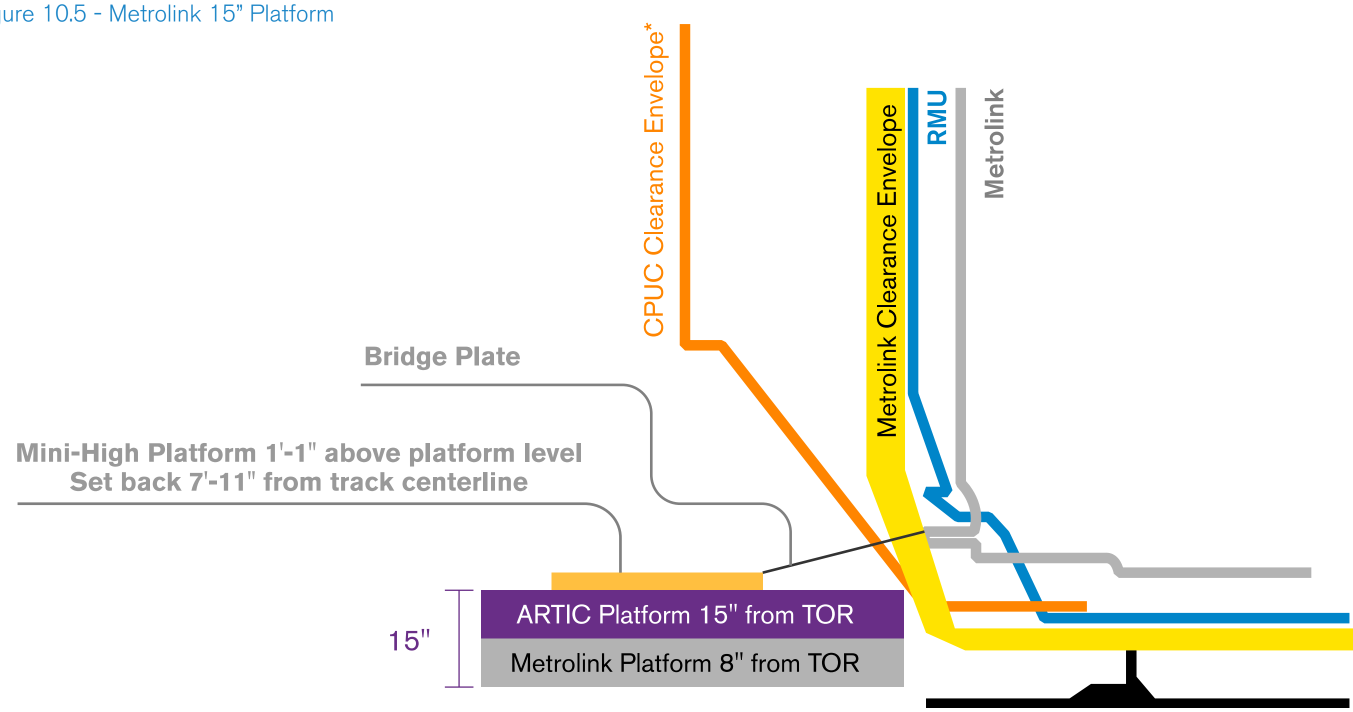


Figure 10.5 - Metrolink 15" Platform



True or near-true level boarding – where there are no steps or unnavigable gaps between the vehicle and platform edges – is desirable for both equity and operational effectiveness reasons.

Steps or unnavigable gaps represent a very literal barrier to passengers using wheeled methods of mobility such as a wheelchair or stroller. They can also represent barriers to the elderly or infirmed. The current mini-high and bridgeplate solution used by Metrolink and most younger commuter railroads in North America is an imperfect solution to deal with very real challenges that have held the industry back from achieving true level boarding. If a solution can be found to achieve true level boarding, even at a few stations, this would help unlock the promise of Metrolink for these riders.

The other principal benefit is operational and comes in two forms of time savings: the time it takes to deploy the bridgeplate and the extra time it takes passengers to navigate steps. Every time a conductor needs to deploy the bridgeplate for a passenger needing assistance can add one or more minutes to a station stop. If a train needs to "double-stop" to line up the right car with the mini-high platform, this can add an additional two or more minutes. The frequency of this has been increasing over the years, leading to increased delays in thelast decade. More generally, passengers take more time to traverse steps up from the platform into the car compared to level boarding. Individually this is a difference of seconds, but collectively this can add up, especially at more popular station stops. Implementing level boarding saves time in both ways and makes station stop times more consistent and less delay prone. Thus, level-boarding satisfies regulations and is a desirable operational practice.

Figure 10.6 - Platform and Vehicle Compatibility

Platform Height	RMU Threshold Strategy: 23.5" Fixed	RMU Threshold Strategy: 23.5"-15" Variable Step	Compatibility with Metrolink: Current Set-Up	Compatibility with Metrolink: With Tri-Rail Step Extension	Compatibility with Metrolink: Regulatory Compliance
23.5" Redlands Passenger	Level boarding	Level boarding at raised position	Incompatible (gap between platform and car due to lower vehicle step) But navigable with a bridgeplate	Conflict between lower step and platform edge	Requires CPUC waiver and/or FRA preemption
23.5" – 24" Tri-Rail Solution	Level boarding	Level boarding	Incompatible (gap between platform and car due to lower vehicle step) But navigable with a bridgeplate	Level boarding	Requires CPUC waiver and/or FRA preemption
15" Anaheim Regional Transportation Intermodal Center	Mini-high for ADA; step for others	Mini-high for ADA; step for others at raised position	Mini-high for ADA; step for others	Mini-high for ADA; step for others	Requires CPUC waiver and/or FRA preemption
8" Metrolink Standard	Incompatible	Mini-high for ADA; step for others at lowered position	Mini-high for ADA; step for others	Mini-high for ADA; step for others	Satisfies CPUC; may not satisfy ADA

Compatibility between RMUs and Metrolink LHCs and various platform heights are laid out in Figure 10.6. True level boarding, while desired, is not an entirely hard and fast rule. There are many potential solutions for achieving step-free access, including but not limited to the following:

- the use of mini highs with assistance from a boarding plate deployed by a train crewmember (the solution currently used at all existing Metrolink stations)
- constructing a platform that is lower on one end and higher on the other to accommodate the vertical gaps
- constructing separate platforms to accommodate the vertical gaps
- platform extenders that are triggered when a passenger vehicle is present and retracted when wider freight trains pass through
- step extenders built into the train that are static or automatically deploy to bridge the horizontal gap at platforms

10.2.1.1 Alternative Platform-Vehicle Interface Solutions for True- or Near-True-Level-Boarding

The Tri-Rail solution, illustrated in Figure 10.7, was developed to achieve near-true level-boarding at a new station with the same Bombardier and Rotem cars that Metrolink uses. This was achieved through a combination of adding a vehicle step extension and extending the platforms with a cantilevered edge to meet the threshold of the vehicle step. At existing stations that use 8" Platforms – like most Metrolink stations do – passengers will continue to use the traditional boarding method: steps for most passengers and a mini-high for those who need it.

To minimize costs, Tri-Rail developed specifications for a step-extender kit that was manufactured by a third-party parts manufacturer, and then this will be installed on its fleet by Tri-Rail maintenance team. Tri-Rail is building the matching platforms at the new Miami Central station created by Brightline. This station will not be shared with freight, and the specific platform dimensions chosen encroach slightly on common freight clearances.

Further investigation is needed to determine the engineering, legal, and financial viability of a solution like this in Metrolink's context. It might be possible to adjust a concept like this to work in a mixed passenger-freight context if the platform edge is pushed a few inches further back from the centerline and the vehicle step similarly further extended out.

A somewhat similar solution is in use today by the FrontRunner train in Utah. FrontRunner platforms for their Bombardier cars (same model as Metrolink) are built to 24" ATOR and set further back. FrontRunner cars lack the lower step of Metrolink and Tri-Rail cars and instead feature an extended upper step that reaches about a foot beyond Metrolink's, bridging the gap between vehicle and platform. The FrontRunner solution itself wouldn't work for Metrolink given the lack of a lower step to access 8" platforms, but it is a further example of the viability of mounting an extended step on the type of cars Metrolink operates.

Retractable steps built into vehicles is another alternative used to achieve level boarding in some places. An example are the vehicles used on Deutsche Bahn's (DB) subsidiary's DB Regio Southwestern (Süwex) regional express trains in Germany (see Figure 10.8.)

Figure 10.7 - Tri-Rail Platform

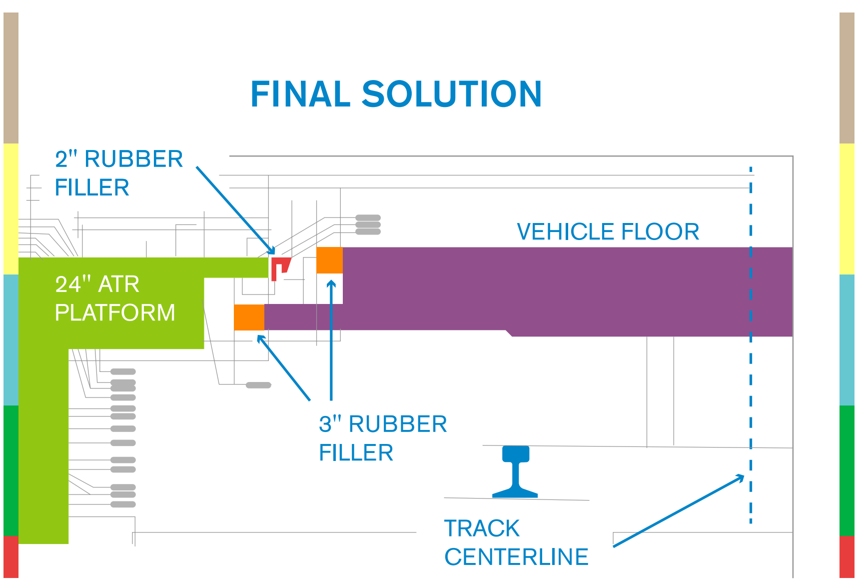


Figure 10.8 - Retractable Step

These vehicles use ultra-sonic sensors to detect platform gaps which trigger the use of retractable steps that take approximately 6 to 7 seconds to deploy or retract. These steps span up to 12", however for the application on SBL they may need to span upwards of 15". This is currently being investigated for potential use by the RMUs on the RPRP.

Station Modifications

Any solution to achieve level-boarding that requires a rebuild of all existing stations would be prohibitively expensive. New and modified vehicles must be compatible with Metrolink's many existing 8" and 15" station platforms. As an example, the Tri-Rail solution might work as its lower step allows backwards compatibility to low platforms, but the FrontRunner solution would not as it does not.

That said, true or near-true level boarding is desirable from an equity and operating efficiency perspective. If a solution can be cost-effectively applied to existing stations, then more passengers can benefit from level boarding. One way to quickly and affordably upgrade existing platforms is the use of "Harrington Humps." Harrington Humps are a relatively low-cost solution to achieving targeted platform height increases without rebuilding the platform and can be implemented on a temporary or permanent basis. They can be used for a portion of a platform (see Figure 10.16) to correspond to specific vehicle door locations or along the entire length of the platform.

Figure 10.9 - Harrington Hump

Vehicle Platform Interface Approach

New vehicles procured by Metrolink should share the 25" ATOR vehicle height as Metrolink's existing bilevel fleet, feature a lower step at the same dimensions, and employ the same access strategies as Metrolink's existing fleet (e.g., mini-high and bridge plate for passengers needing assistance). Before procuring new equipment, Metrolink should study to see if there is an opportunity to adopt a variant of the Tri-Rail solution and/or adjustable step solution to Metrolink's network and incorporate the resulting recommendation into such a procurement.

10.3 Fleet Requirements for Capital Maintenance Programs

Planning and coordination among SCRRA Equipment Staff, Operations, Procurement, the Equipment Maintainer, Facilities, Member Agencies and other Stakeholders will be required to ensure the fleet operating ratios are maintained during any planned capital maintenance programs – including LCM cycles to ensure continuity of operations is maintained. The planning activities should also take into account any unplanned out of service issues due to equipment failures, off-site transportation of the fleet for overhauls and delivery schedules and maximum lead times of materials, systems or components that may have an impact on the capital maintenance and overhaul program(s).

A review of the Capital Maintenance Program schedule and operational needs assessment should be performed as part of the project's due diligence – including scenarios wherein multiple Capital Maintenance Programs can be performed simultaneously or concurrently to achieve efficiencies.

10.4 Fleet Overhauls and Retirements

The timeline for vehicle retirements is largely determined by their age and condition, but also takes into consideration the needs of the service, the conditions of funding agreements, and possible timelines for replacement with other vehicles. Other items to consider include the transitional phase between replacements and retirements, the retainment of "hot spares" to provide coverage until new equipment has reached an acceptable level of reliability, and the ability to sell or dispose of retired equipment. The following sections should be viewed in conjunction with the procurements identified in Section 10.6.

10.4.1 Planned and Future Overhauls and Retirements

10.4.1.1 Locomotives

With the delivery of the F125 locomotive fleet, Metrolink will have a core fleet of Tier 4 locomotives that will be the backbone of the fleet for the next 20 years with retirement anticipated in 2042. With adequate life-cycle maintenance and overhaul, the F125 fleet may have their life extended another 10 or more years to 2052, regulations and their general condition permitting at that time.

The MP36PH fleet will be due for mid-life overhaul by 2025 at the latest. This presents a choice of completing the overhaul and attaining another 15 years of service, until 2040 as Tier 2 or Tier 4 locomotives, or retiring them and procuring 15 additional Tier 4 units to replace them. The latter course would result in no further locomotive retirements until 2042.

10.4.1.2 Passenger Railcars

The Guardian Fleet, Metrolink's newest cars, were delivered beginning in 2010 and are anticipated to be retired no sooner than 2039. With progressive maintenance and a second mid-life level overhaul to replace aging/obsolete systems and technology, it is possible to extend the service life of the stainless-steel car body to 45 years (retirement in 2055).

The Sentinel Generation 1 cars, a fleet of 88 cars, currently undergoing overhaul will have an extended useful life of approximately eight to ten years, resulting in their retirement 2029-2032, considering the overhaul project span of approximately two years. The Generation 2 car overhaul option execution would have a comparable eight-to-ten-year remaining life as well, however that car type represents a very small group of seven cars that would be retired in 2036. Finally, the Sentinel Generation 3 cars, a group of 137 cars currently in the queue for overhaul that will likely occur in 2022-2023, would be retired in 2035-2036.

Table 10.4 - Summary of Investment Needs and Major Activities for Rolling Stock

Year	Major Activity
2019 - 2023	Rail Car Restoration Program (15 Sentinel Generation 1 Cars from storage)
2021 - 2025	Retirement of 40 Locomotives begins – 1 x F40PH-2, 15 x F59PH, 7 x F59PHR, 14 x F59PHI, and 3 leased F59 locomotives (replaced by F125's)
2023	Initiate Condition Based/Lifecycle Maintenance Program
2025 - 2030	Overhaul or Replace 15 of the MP36PH-3C locomotive units (Overhaul would include upgrade to Tier 4 compliance)
2019 - 2023	Rehabilitation of 88 Bombardier Sentinel Generation 1 Cars
2020 - 2022	Retirement of 40 Locomotives completes (replaced by F125's)
2023 - 2025	Rehabilitation of 7 Bombardier Sentinel Generation 2 Cars
2025 - 2028	Rehabilitation of 26 Bombardier Sentinel Generation 3 Cars
2034 - 2038	Retire 88 Bombardier Sentinel Generation 1 Cars
2038 - 2040	Retire 7 Bombardier Sentinel Generation 2 Cars
2040 - 2043	Retire 137 Hyundai Rotem Guardian Cars
2040 - 2045	Retire 26 Bombardier Sentinel Generation 3 Cars
2042 or thereafter	Retire 15 MP36PH-3C Units and 40 F125 Units

10.4.2 Locomotive Fleet Modernization Study Findings

Metrolink has recently completed the Locomotive Fleet Modernization Study (Fleet Study) to determine the feasibility of and develop recommendations for the application of alternative propulsion technologies. One of the main considerations of the study is to satisfy the Governor's Executive Order N-19-19, as well as Executive Order N-79-20 to transition on and off-road vehicles to zero or near-zero emissions by the year 2035. The study also covered the potential conversion of the decommissioned F59PH/PHI legacy locomotive fleet to an alternative technology propulsion locomotive, and strategies include the potential for hybrid trainset configurations with the F-125 and MP36PH locomotives.

Ever tightening air quality rules and CARB proposals for implementing Tier 5 and potential zero emissions by 2035 are forcing all state rail operators to develop a longer-term strategy for their fleet. The propulsion technologies and trainset configurations evaluated as part of this Fleet Study included:

- Battery
- Hydrogen fuel cell with battery
- Hybrid systems (combinations of diesel, battery, hydrogen fuel cell and alternative fuels)
- Alternative fuels such as natural gas, renewable diesel and biodiesel
- Hybrid trainset (diesel locomotive coupled with a battery electric locomotive)
- Hybrid diesel powered and battery locomotive
- Dual mode (combinations of diesel, battery and overhead catenary)

The criteria used to evaluate the alternate propulsion concepts included:

- Commercially Available – Is the concept used in passenger rail transit revenue or other rail related operations?

- Industry Applications – Are there specific examples of the concept in operation (i.e., model number, railroad or agency)?
- Viability – Is the concept technically feasible? Are there technical weaknesses?

Additionally, each alternate technology was analyzed based on the following parameters and answered the following questions:

- Sustainability to Metrolink Operations – Can the concept be integrated into Metrolink's fleet of locomotives and passenger cars, or would the concept make the current fleet redundant or obsolete, and would the concept alter or limit current daily operations and maintenance activities?
- Greenhouse Gas – Will the concept meet Metrolink's goal of reducing greenhouse gas emissions?
- Technology Implementation – Will the technology be deployed somewhere in the world by the year 2025?
- Life Cycle Cost – What is the estimated initial capital investment, cost of operation and maintenance, training, and infrastructure changes required? Is any of these costs offset by the reduction in diesel fuel use, lower maintenance, LCFS credits, etc.?
- Reliability and Maintainability – How reliable is the concept expected to be in comparison with the existing fleet? What will change in terms of maintenance practices and maintenance intervals? How would the availability of the new technology have compared with the existing fleet?
- Operations and Maintenance Facilities Impact – What changes/upgrades to facilities will be required to operate and maintain the new technology?
- System Energy and Power Demands – How will the concept be compared with current energy usage and power requirements?
- Fuel Source Availability – Is the fuel commercially available and how can it be supplied to Metrolink?
- Scalability – Is the concept scalable to meet Metrolink's future needs?
- Life Span – What is the life span of the concept, how does it compare to the existing fleet?
- Regulatory Compliance – What rules and regulations will need to be met for the concept to operate in revenue service?
- Implementation Timeline – What is the estimated engineering/manufacturing schedule for delivery of the first unit?

The Fleet Study concluded that none of the options currently available are capable of meeting future Tier 5 Locomotive emissions standards while providing the capacity and power output sufficient for the demands of Metrolink service. In the interim, there are technologies that can be applied to reduce emissions through some of the strategies outlined in the report.

The most immediate strategy is the use of renewable diesel that will improve emissions significantly on the Tier 2 legacy fleet. The State of California is promoting use of renewable diesel fuel and given that a zero emissions vehicle is at least three years away from a prototype, Metrolink can reduce emissions in the interim by phasing in renewable diesel.

For the near term, in anticipation of upcoming new regulations from CARB, a hybrid trainset consisting of a Tier 4 locomotive in tandem (or on opposite ends of the consist) with a battery-electric locomotive is a potentially viable option. The battery powered locomotive could potentially provide hotel power while the train is parked for passenger boarding, eliminating noise and pollution impacts on train crews and adjacent passengers or communities. The engine in the diesel locomotive would be used to supplement power on the consist at higher speeds and when ascending grades or when the battery draw exceeds acceptable limits. This approach would result in a measurable reduction in exhaust emissions for a trainset, resulting in localized 'near zero' exhaust emissions when the diesel engine is not active. Diesel fuel savings is yet another benefit, as the prime mover diesel engine may need to be run for a very small percentage of the total route, depending on grade. Charging of the batteries would come from regenerative braking, and while in a consist diverting a small portion of the diesel's tractive or HEP horsepower through an inverter. However, to achieve a dramatic decrease in fuel consumption and exhaust emissions, the batteries can be depleted after a few trips and would be charged at its layover station.

The hybrid trainset also has redundant propulsion sources so there would always be a means to complete a route. Metrolink has several retired F59 hulks available, the primary costs are in reconfiguring the locomotives for onboard battery storage and operation. The Battery locomotives would be paired with an existing Tier 2 MP36 or F59PH-R locomotive fueled by renewable diesel. Unknowns would be battery life and replacement intervals, and the need for wayside charging. However, space restrictions limiting consist length on certain lines and in certain facilities may limit the applicability of a two-locomotive consist approach.

Other options described in the study are more developmental in nature and would require a large capital outlay for support facilities and/or vehicles that may not reflect the direction that the rail industry plans to go.

10.4.2.1 MP36 Locomotive Fleet Overhaul and Investment Strategy

The Fleet Analysis intends to provide Metrolink with an MP36 overhaul investment strategy. The Tier 2 MP36 fleet of 15 locomotives was deployed in 2008-2009 and is now approaching its mid-life and the RAMs metrics are trending down as expected for locomotives at this age and use. To stabilize and improve RAMs in line with industry standards, diesel locomotives commonly undergo mid-life overhaul by the 15th year (corresponding to a diesel locomotive average 30-year useful life). The mid-life overhaul is intended to restore the locomotive to a state of good repair and bring RAMs metrics to established industry standard levels. The overhaul may include the upgrade of the main and head-end power (HEP) engines to a higher emissions tier (e.g., Tier 4), removal of trucks, cooling systems, and other critical systems such as brake equipment for refurbishment, reliability and safety modifications and dealing with any obsolescence issues as well as addressing body damage and exterior repainting. Between January 1, 2017 and January 24, 2021, there have been 616 delays and 6,439 minutes of delay attributed to mechanical issues with the MP36 fleet. Over the coming years based on industry consensus around fleet reliability, without an overhaul program Metrolink can expect to see increased delays and terminations as well as increased materials expenditures to make unforeseen repairs.

The Fleet Study explores a range of options, including:

- Life extension overhaul (Tier 2) locally performed with the local equipment maintenance contractor
- Off-site overhaul to Tier 2+ with a special overhaul contractor
- Off-site overhaul and Tier 4 conversion with a specialty overhaul contractor
- Purchase of new commercially available Tier 4 locomotives.

A high-level benefit-cost analysis (BCA) was developed to provide insight into the MP36 overhaul investment options. The BCA factors in the capital costs, life-cycle maintenance costs, emissions/health benefits and grant funding scenarios.

To underscore the importance of mid-life overhaul planning and investment, most of Metrolink's legacy fleet of F59PH and PHI locomotives did not undergo the mid-life overhaul that would have occurred around 2007-2008. The locomotives continued to perform reliably in the years shortly after mid-life, but the oldest of the locomotives started experiencing an increasing number of breakdowns due to failures of key components such as crankshafts, turbochargers, HEP engines, and main engines. These failures led to impacts on service reliability.

Given the time required to identify and secure funding, and the duration to complete procurement activities and then execute the selected overhaul option, there is an immediate need to evaluate the alternatives and develop a plan for overhaul. With assistance from a consultant, Metrolink is working to identify available overhaul solutions and vendors, assess component/structural condition, develop cost estimates, schedules and life cycle costs. The detailed scope of this overhaul will be finalized as funding solidifies and as the project transitions into the procurement document development phase after the Fleet Study concludes.

Additionally, the project team continues identifying rolling stock procurement lessons learned and monitoring the California Air Resources Board (CARB) proposed concepts for in-use locomotive regulation which would require Metrolink to set aside funding on an annual basis for operating equipment that is not zero emissions. The greatest spending account contributions would be for Tier 3 and under. If approved as currently proposed, this CARB regulation would result in a significant impact on Metrolink's MP36 overhaul investment decision-making.

From October 2020 through January 2021, presentations about the condition of the MP36 fleet and need for overhaul planning were made to the Member Agency Advisory Committee (MAAC). Staff plan to return to the Board with overhaul recommendations in spring 2021. This, combined with the new F-125 fleet, indicates that Metrolink will continue to operate its locomotive-hauled fleet type for many years to come.

10.5 Vehicle Procurements

Vehicle procurements are timed to coincide with the necessary retirement of old and unreliable equipment (see Section 10.4), or with increased vehicle needs for passenger service. Procurements must also take into consideration the availability of funding. The Vehicle Technology Assessment included in Section 9 explores various alternative technologies to consider on Metrolink's path to reducing emissions even further as new equipment is needed to support service expansion. There are no ongoing passenger railcar procurements. The following sections identify future procurements.

10.5.1 Planned Procurements to Sustain Existing Service

None actively planned.

10.5.2 Planned Procurements for Service Increase or Expansion

To support the projected increases in vehicle needs per the SCORE Program and the CBOA, an additional 10 trainsets are required to operate the planned service, not including spares, over the 2019 daily need. This represents a total of 50 trainsets needed each day by FY2028. By FY2035, a total of 92 trainsets are needed for Milestone 2. Most of this can be absorbed by the current fleet if spare ratio goals are achieved, but some expansion would be needed.

To support the timeline of Milestone 1B constrained expansions, procurement of additional equipment should be started no later than 2021/2022, as vehicle specification preparation, solicitation, negotiation, manufacturing, testing and commissioning typically takes five to six years to complete (typically longer for new technology). That procurement strategy will need to make a determination on the potential to pursue RMU technology as part of the expansion plans.

10.6 Overhaul of Contingency Fleet for Service Increase or Expansion

Future service capacity increases or new service expansions will require additional rolling stock (locomotives, cab cars, coaches, RMUs, and associated spares & special equipment) and maintenance facility needs and/or improvements. Additionally, the contingency fleet will need to be retained in a useable state to prevent any significant deterioration from being out of use for periods of time, this may include the need to overhaul and maintain such things as safety critical systems/components as a minimum on a regular schedule with the in-service revenue vehicles for use in any service increases or expansions. Please refer to Section 4.2 for more information on the contingency fleet.

10.7 Procurement/Implementation Strategy Plan

10.7.1 Procurement Strategies

Best value procurement approach, performance-based specifications

- As there are agencies in the US interested in emissions control system retrofits for their locomotive fleets, there are potential opportunities to engage in cost sharing for engineering and development for common fleet types. The engineering costs for the development of an emissions control system for an agency which has a small number of locomotives to be considered for upgrade might not be viable. Economies of scale are a major factor for the engineering and production of these types of specialized, and potentially locomotive model customized systems. If the interest from other agencies in emissions control systems is gauged to be high, and collaboration between agencies can be coordinated, major cost savings can be realized. Additionally, with multiple agencies' influence during procurement, emissions system providers will have more incentive to offer better pricing and timetables for engineering, pilot programs, and production.

Potential Challenges and Opportunities

- After-market emissions control systems that are currently developed are specific to one type of locomotive, a F59PH passenger locomotive equipped with a blended aftertreatment system. As these current systems have only been developed for one specific locomotive model, a period of design and engineering will be required for other locomotive models. However, as the base design fundamentals remain the same for these types of systems across all locomotive platforms, the engineering development period would be significantly less than the first system designed for the F59PH locomotive. With the design of a new system for a new locomotive type, a pilot program would be recommended prior to activating a production line for an entire locomotive fleet. Development of a blended aftertreatment system on other passenger locomotive types and models can allow operators to extend the life of their current fleet through upgraded power electronics systems working in conjunction with emissions control systems. These upgrades and retrofits offer opportunities for emissions reductions and additional increases in maintenance and operational efficiency as these systems are designed to offer features which were not available to mechanical and operating personnel from the locomotive OEM.

Current Markets

- The North Carolina Department of Transportation – Rail Division has been developing and testing blended aftertreatment systems for locomotives since 2016. The first production system is scheduled to enter service in second quarter of 2021. This system will undergo emissions testing to validate its operation of the various individual emissions components to Tier 3 or Tier 4 levels and confirm its tier level certification
- Other agencies throughout North America have expressed interest in emissions reduction technologies like blended aftertreatment systems as an option to reduce locomotive emissions while more advanced zero emissions technologies are developed. This may provide opportunities for collaboration with other agencies on development and pilot programs for emissions control systems. The use of aftertreatment systems is an economical short-term solution for emissions reduction on passenger locomotives as a bridge to zero emissions goals.

10.7.1.1 Joint Procurement and Piggybacking

Joint procurement with other agencies looking to procure similar vehicles using zero or near-zero emission propulsion technologies should be considered by Metrolink, especially if this approach would improve pricing and administrative efficiencies. The joint procurement usually is conducted by a lead agency on behalf of another agency, or as it has been done successfully on several procurements, on behalf of several regional or State agencies.

The Uniform Guidance (2 C.F.R. Section 200.318(e) states the following: “To foster greater economy and efficiency, and in accordance with efforts to promote cost-effective use of shared services across the Federal government, the non-Federal entity is encouraged to enter into state and local intergovernmental agreements or inter-entity agreements where appropriate for procurement or use of common or shared goods and services."

In a Joint Procurement two or more grantees issue a single solicitation document and enter into a single contract with a vendor or vendors for rolling stock in a fixed quantity. A joint procurement does not permit non-parties to participate in the contract except through the assignment of options. Joint Procurements must be tailored to the specific quantities that participants anticipate needing, the maximum quantity available under the contract should bare a reasonable relationship to the recipients' number of peak service vehicles.

The parties of a joint procurement can share responsibilities for different portions of the process, e.g., one recipient may prepare the technical specification, and another is responsible for the solicitation process. FTA Circular 4220.1F states the following: "Participation in a joint procurement, however, does not relieve any participating recipient from the requirements and responsibilities it would have if it were procuring the property or services itself, and does not relinquish responsibility for the actions of other participants merely because the primary administrative responsibility for a particular action resides in an entity other than in itself. All elements of the procurement should be subject to the review and approval of all participants. Each participant should have the right to take part in the evaluation and selection process."

Recipients of a Joint Procurement need to consider the following questions before undertaking a joint procurement:

1. Do parties want the same item(s)?
2. Can the parties commit to specific quantities?
3. Does the solicitation meet all FTA requirements?
4. How will the responsibilities for the procurement be allocated?

Even though a joint procurement would result on a single contract award, parties in a joint procurement may award individual contracts for their particular needs as long as those contracts reflect the terms and conditions in the joint procurement competitive solicitation and the proposal that was submitted by the winning contractor. One approach that can be implemented, consists of having the lead agency to award the basic contract with pricing, specifications, terms and conditions, etc., and then to have the participating agencies issue individual purchase orders against the basic contract as funding becomes available to the agencies during the life of the contract; this practice is also known as "piggybacking". The purchase orders would reflect the basic contract unit prices and reference the basic contract for other terms and conditions.

An agency that has obtained the rights for piggybacking must determine the following:

1. Whether the contract price or prices established under the original agreement are still fair and reasonable.
2. That the original contract provisions comply with all applicable Federal requirements.

3. Ensure the quantities the assigning recipient acquired, together with the quantities the acquiring recipient seeks, do not exceed the amounts available under the assigning recipient's contract.
4. Ensure the contract complies with FTA's Buy America requirements for the assigned quantities.

10.7.1.2 State Cooperative Purchasing Contracts

Under Section 3019 of the FAST Act, grantees may purchase rolling stock and related equipment from a State cooperative procurement contract. A "cooperative procurement contract" means a contract entered between a State government or eligible nonprofit entities and one or more vendors under which the vendors agree to provide an option to purchase rolling stock and related equipment to multiple participants. The contract term for a cooperative procurement contract may be for an initial term of not more than two years and may include three optional extensions of one year each. Under prior law, FTA referred to these types of State contracts as "State purchasing schedules" and, as such, were only available to recipients within that State. Under the FAST Act, a grantee may purchase rolling stock and related equipment from any State's cooperative procurement contract or schedule. State cooperative purchasing contracts or state schedules are subject to federal requirements, including, but not limited to, full and open competition, no geographic preferences, Buy America, and must include all FTA required clauses and certifications with its purchase orders issued under the State contract. Pursuant to Section 3019 of the FAST Act, recipients may purchase from another State's schedule.

10.7.1.3 Other General Strategies to Improve the Procurement Process

Procurement of rail vehicles is a complex process, some of the issues that must be avoided at all costs include contractor default, delivery delays, and poor quality and reliability performance.

The planned introduction of new technologies by Metrolink can further complicate the process. For this reason, it is important to set procurement strategies that would result in successful and efficient rail vehicle procurements, especially when these procurements involve risks which include the use of relatively new technologies still in a developing stage, limited availability of components, and unknown factors such as reliability performance, and other maintenance and operating factors. In addition to the practices mentioned early, including Joint Procurements, Piggybacking, and State Cooperating Purchasing contracts, other procurement strategies that are recommended for Metrolink to follow, include:

Use Performance-Based Technical Specifications

- Developing specifications based on the outcome required rather than specifying detailed designs or specific equipment or brands, will allow the carbuilder to offer the best package to the agency based on their experience and established relationship with system suppliers, effectively reducing costs and eliminating risks including poor systems integration, quality and performance.

Use common or Industry mutually agreed Standards

- The selection of standards, especially for the procurement of new technology, will be a challenge as most of these standards are still in the developing stage or keep changing, trying to keep up with the advances of technology. It is recommended to obtain a consensus from the Industry and understand which the best standards are to apply. In some cases, these standards may have been initially developed for use on different industries, but their applicability can be extended to the Rail Vehicle Industry.

Share the risk

- Especially when using new technologies, it is recommended to allow the car builder to propose their own milestone-based schedule. Metrolink and the selected car builder must work together, in a partnership atmosphere, to structure contract terms that would allow the car builder to implement their preferred production approach and eliminate the risk of delivery delays, cash flow issues, and imposed contract penalties.

Balance difficult contract terms and conditions

- When necessary, it is recommended to adapt terms and conditions to reflect current production, testing, and commissioning practices of new technologies, to minimize the potential of contractor defaults, delay deliveries, and/or extremely high prices.

Strong relationship with Carbuilders

- Especially when introducing new technologies, it is key that transit agencies know and understand the technical and financial capabilities of Car builders and their suppliers, as well as the new technology to be introduced and its latest trends. Informal gatherings, visits to the Car builder or suppliers' facilities, their strengths and weaknesses, and in-depth knowledge of their experience and success story, are aspects that are highly recommended for a transit agency to engage on prior to starting the solicitation process. Likewise, it is important that Car builders and suppliers understand the agency's operating needs, service conditions, and political environment.

Best Value Procurement

- When procuring new technologies, as important as it is the cost to procure the technology, it is also important to evaluate the cost of ownership, e.g., cost to maintain, overhaul, replace. The cost of ownership must be part of the evaluation and negotiation process. It is important for the transit agency to clearly state its evaluation priorities and methodology to minimize the risk of complicated selection and negotiation processes.

10.7.1.4 Potential Funding Mechanisms

Federal Agencies

- Exploring grants and other development funding opportunities offered by federal agencies like the Environmental Protection Agency or Department of Energy. These types of opportunities are typically geared towards empowering public agencies and state government entities to develop and test alternative propulsion and emissions technologies for on and off-road vehicles. By establishing a collaborative partnership group with state transportation agencies, both in California and other states which are interested in pursuing emissions reduction and zero emissions technology, federal agencies may be more inclined to push research and development funding towards these types of groups. Collaborative partnerships of state and public agencies to focus efforts on shared development has the potential to offer more pathways to additional research funding opportunities. More discussions with the various public agencies to gauge interest in near-zero and zero emissions technology development, as well as discussions with federal agencies on funding programs that are under development which fit into the overall timeline of zero emissions locomotive implementation.

Research Institutions

- Utilizing research institutions (public universities) to develop and test small scale technology improvements as a mechanism to incrementally progress alternative propulsion technology and supporting infrastructure. Engineering and research programs within public universities are an underutilized arena for rail technology application development but can offer a significant amount of flexibility with their access to various research funding sources. These programs can be utilized for testing and development of small-scale applications for proof of concept and scalability testing. Collaborative efforts between State government agencies and research institutions in other states have proven to be highly successful with emissions and rail technology infrastructure development programs. These programs have also shown that engaging more with the research institutions and increasing the level of involvement and interest among the university community in transportation technology advances is well received by political influencers.

Leasing established test vehicles from Independent Companies

- Opportunities for leasing locomotives already equipped with emissions reduction or alternative propulsion technology is also an option that can prove to be financially beneficial and potentially reduce development time. Currently there are small independent companies developing and improving battery operated locomotive applications. The challenges these companies face is the lack of capital for continuous system improvements and a dedicated test environment. Utilizing these already established test vehicles and the expertise of these companies could potentially allow opportunities to further understand development vectors, provide an initial platform for proof-of-concept testing, and advance the timeline for implementation of battery locomotives. Other state agencies have developed emissions reduction systems for locomotives in an effort to achieve Tier 3 or Tier 4 emissions levels. Opportunities for leasing a unit from other state agencies for a demonstration of an emissions reduction locomotive can be explored as an economical short term bridge technology solution that can be implemented until zero emissions technology matures and locomotives become available to allow for a complete fleet replacement.

10.7.1.5 Collaboration with the FRA

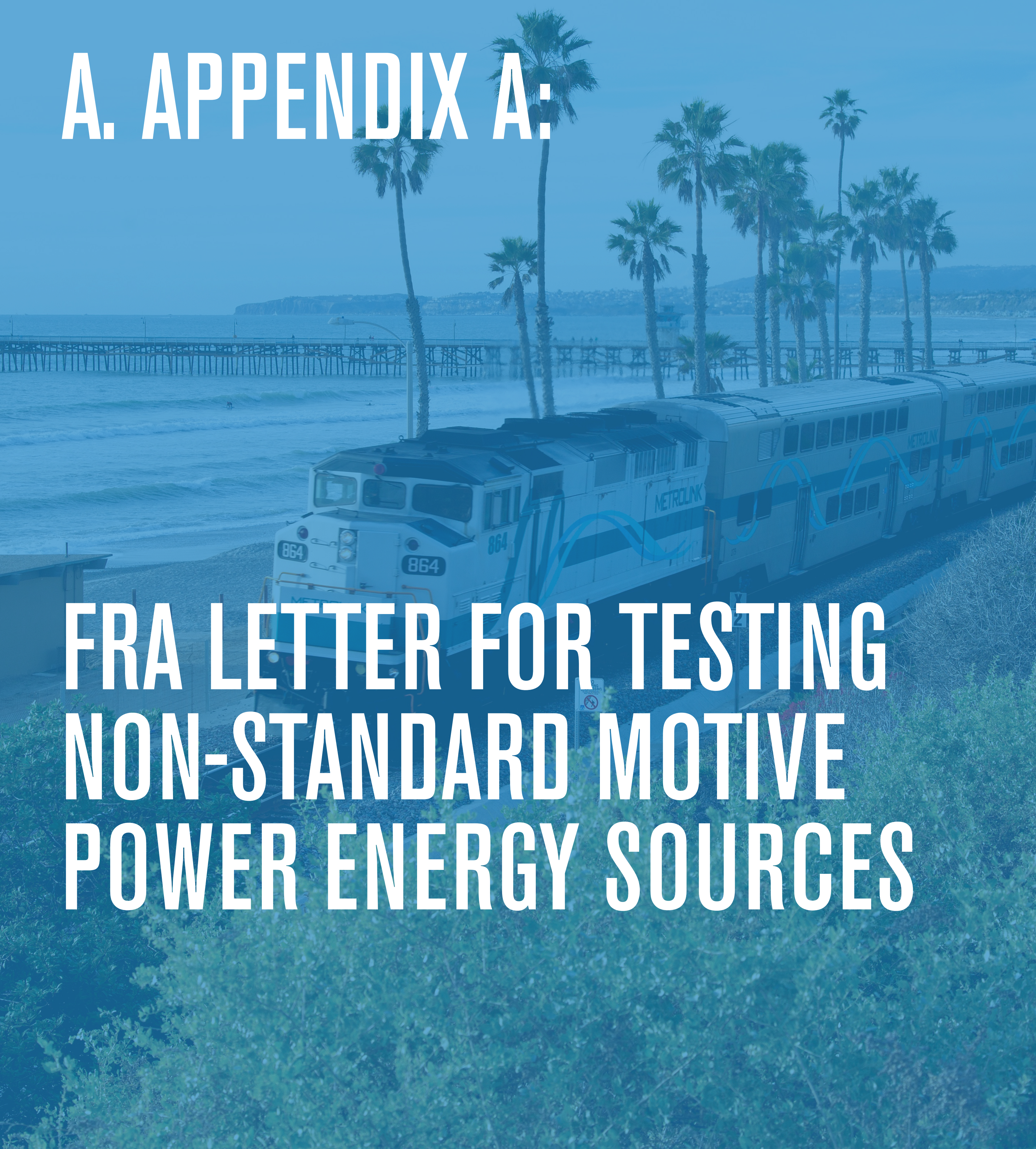
The FRA has general statutory authority and responsibility for the safety of locomotives and self-propelled passenger vehicles regardless of the motive power source employed. In general, FRA is interested in the following aspects:

1. Equipment Safety Standards – crashworthiness, fuel tank design, fire safety, fueling, etc.
2. General Safety Considerations – emergency preparedness, training (employee/first responder), risk/hazard analysis, etc.
3. Continued Research & Development to further understanding of the technology

FRA Guidance for Projects Considering Alternative Fuels

The FRA has a statutory responsibility to ensure that locomotives are safe and in proper condition or the intended service. The lack of explicit regulatory requirements does not alleviate a railroad/supplier from the underlying safety statutes. In 2013, FRA sent a letter to AAR, ASLRRA, and APTA to clarify FRA's position on the testing and use of natural gas as a fuel, refer to Appendix A. Although the letter focuses on natural gas, the guidance applies to all non-standard motive power energy sources. Railroads and project sponsors considering alternative energy vehicles should consult with FRA early to understand the potential regulatory requirements.

A. APPENDIX A:



FRA LETTER FOR TESTING NON-STANDARD MOTIVE POWER ENERGY SOURCES

U.S. Department
of Transportation

Federal Railroad
Administration

1200 New Jersey Avenue, SE
Washington, DC 20590

AUG 26 2013

Mr. Robert Fronczak
Association of American Railroads
425 Third Street SW
Washington, DC 20024

Mr. Thomas Streicher
American Short Line and Regional Railroad Association
50 F Street NW
Suite 7020
Washington, DC 20001

Mr. Lou Sanders
American Public Transportation Association
1666 K Street NW
Suite 1100
Washington, DC 20006

Dear Messrs. Fronczak, Streicher, and Sanders:

Recently, a number of railroads, vendors, and other interested parties have requested meetings with Federal Railroad Administration (FRA) staff to discuss potential plans and testing programs related to the use of natural gas (either compressed natural gas (CNG) or liquid natural gas (LNG)) as an alternative fuel source by the railroad industry. FRA is supportive of all efforts to use more efficient, less polluting, and domestically produced fuel in rail operations. However, in order to ensure proper consideration of each party's request, provide adequate time to meet with each party, and arrive at productive outcomes from such meetings, FRA has developed a set of meeting preparation guidelines that each party should follow. Providing the requested information prior to the meeting will help all parties achieve positive results from such efforts.

A number of stakeholders have inquired about FRA's approval of a test program for CNG and LNG use. In accordance with Federal regulations, FRA has authority over vehicles that serve as locomotive tenders. As such, any vehicle that carries natural gas or any other material being used to fuel attending locomotives is subject to FRA's statutory authority under 49 U.S.C. Chapter 207, Locomotives (formerly known as the Locomotive Inspection Act (LIA)), as well as other regulations applicable to locomotives and locomotive tenders.

The regulations permit the use of a locomotive or tender only if the equipment is "in proper condition and safe to operate without unnecessary danger of personal injury."

Accordingly, railroads and vendors must ensure that locomotives and the equipment serving as locomotive tenders are safe prior to initiating tests. Therefore, FRA's rail safety regulations must be considered in evaluating the safety of the equipment and its proposed operation, and in determining compliance with the LIA. In addition, although the Hazardous Materials Regulations are not directly applicable to a locomotive or tender and its operations, the safety rationale underlying those regulations must also be considered.

Prior to initiating the testing of new dual-fuel locomotives or tender vehicles, railroads and vendors must conduct a comprehensive safety analysis that must be provided to FRA for approval. This analysis must identify the risks of the operation and any measures designed to mitigate those risks.

Enclosure 1 to this letter lists the information that must be provided to FRA before a face-to-face meeting is conducted. Enclosure 2 to this letter lists the information and documents that must be provided to FRA if a railroad or vendor seeks approval of a proposed test plan. Please disseminate these enclosures and other preparatory materials to your members and other interested parties.

Thank you for your cooperation in this important effort. If you or your members have any questions, please contact Mr. Karl Alexy, Staff Director, Hazardous Materials Division, at (202) 493-6245 or Karl.Alexy@dot.gov.

Sincerely,

Robert C. Lauby

Robert C. Lauby
Acting Associate Administrator for Railroad Safety/Chief Safety Officer

Enclosures

Enclosure 1: Information to be submitted to FRA prior to a meeting on the use of compressed natural gas (CNG) or liquid natural gas (LNG) in railroad service

A railroad or industry vendor meeting with the Federal Railroad Administration (FRA) to present its plan for testing equipment modified for CNG or LNG use as fuel must provide the following items, at a minimum, at least 2 weeks prior to the meeting.

1. Statement of the objective of the meeting and the benefit to the vendor from such a meeting (what is the expected outcome of the meeting?).
2. Clear description of the system to be tested, summary of the overall test plan, goals to be achieved in the test, and the principal elements that will be evaluated.
3. List of the project team members and their respective duties. Include specific statements on whether the team includes representatives from labor unions. If not, please explain why.
4. Details of the project plan for the tests. This should include, but not be limited to, the following items:
   a. Test plan.
   b. Schedule and milestones.
   c. Location of tests.
   d. Coordination with other stakeholders (vendors, subcontractors, emergency response institutions, etc.).
   e. Alternative approaches, if any.
   f. Physical layout, operational descriptions, flow diagrams, etc.
   g. Equipment design information (marked as confidential, proprietary, not for distribution).
5. Evaluations of personnel and public safety issues during both the test phase and the operational phase.
6. Types of data that will be collected, including an explanation of why and how these may be used in the design of the commercial operations.
7. Issues that can be resolved by the railroad or vendor, and those which are external (and uncontrollable).
8. List of all regulations directly or indirectly applicable, indicating how compliance with the regulations will be achieved. Prepare a list of items for which a waiver from the requirements of the Federal regulations will be required for the purpose of testing.
9. Request for waiver from the requirements of the applicable Federal regulations for execution of the test plan, if compliance is not achievable.
10. List of potential benefits from the proposed plan to the industry and the public.

11. Set of specific questions that require a response from FRA.

Note: If the information is considered proprietary or confidential, then confidential treatment must be requested and justified, in accordance with Title 49 Code of Federal Regulations Section 209.11, *Request for confidential treatment*. Further information on confidential treatment of submittals is available upon request.

<u>Enclosure 2:</u> Information to be submitted for FRA approval of a plan to test the use of compressed natural gas (CNG) or liquid natural gas (LNG) in railroad service

A railroad or industry vendor requesting approval to test equipment modified for CNG or LNG use as a fuel in the rail industry must provide the following information and data to the Federal Railroad Administration (FRA).

1. All items identified in Enclosure 1 when a meeting with FRA is requested.
2. Detailed structural analysis documentation and any relevant test data to support the safe operation and crashworthiness of the equipment and fuel storage elements (note: additional analysis or validation tests may be required by FRA).
3. Procedures for equipment maintenance and testing.
4. Risk analyses addressing, at a minimum, the following items, where applicable:
    a. Fueling operations.
    b. Leak detection and response.
    c. Locomotive and tender separation (protection of crew).
    d. Survivability of tender, appurtenances, and connections in rail environment.
        - Crashworthiness (in such scenarios as derailment, collision, sideswipe, etc.)
        - Fatigue life
        - Excessive in-train forces
        - Fuel tank penetration protection
5. Details of communication plans with employees, first responders, and public organizations.
6. Other relevant data or information that will expedite processing an approval of the proposed test plan and application for a waiver.

Note: If the information is considered proprietary or confidential, then confidential treatment must be requested and justified, in accordance with Title 49 Code of Federal Regulations Section 209.11, *Request for confidential treatment*. Further information on confidential treatment of submittals is available upon request.